

Forecasting the future

Changing climate, changing behaviour

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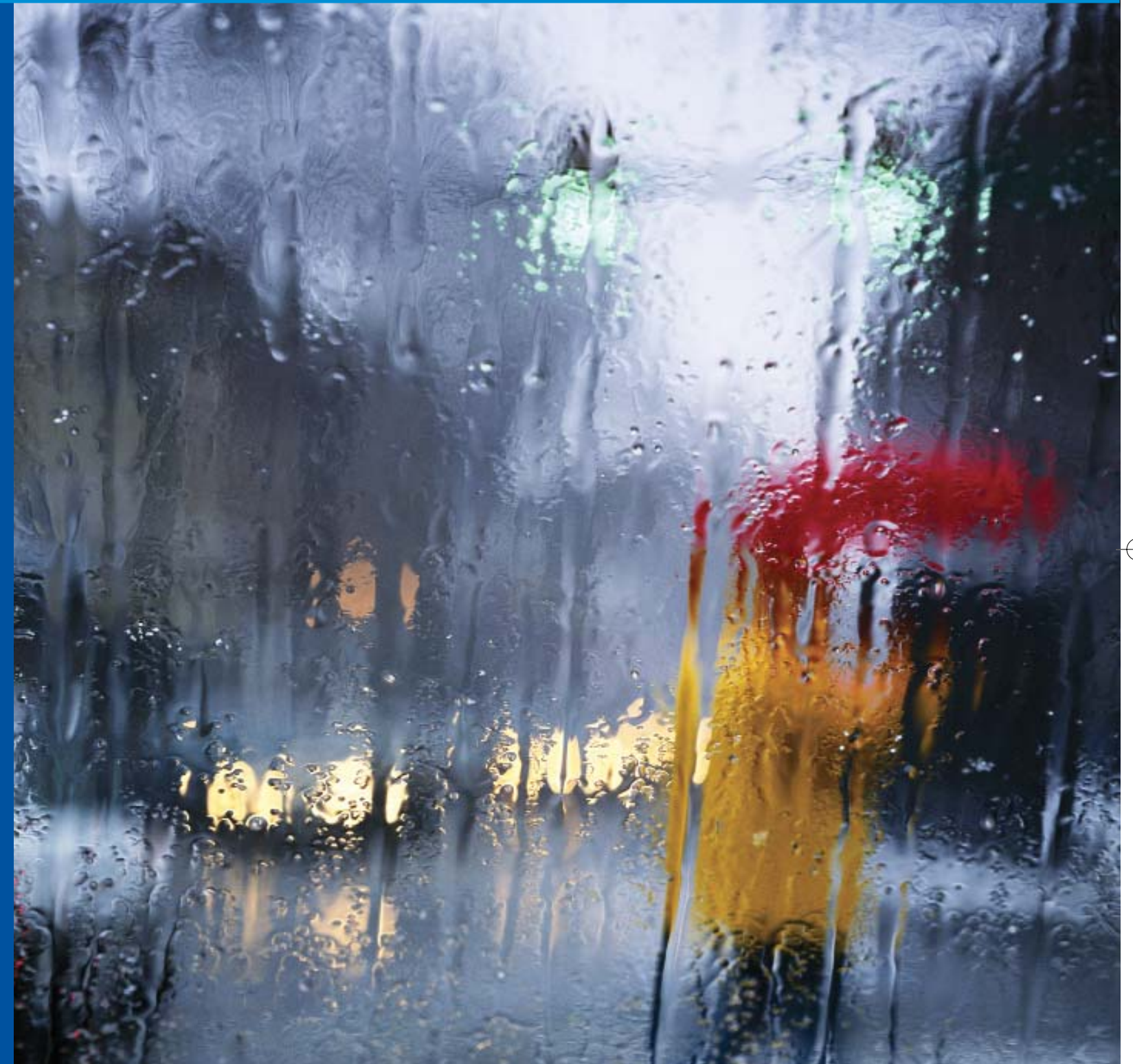
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Energy Saving Trust

Foreword



Philip Sellwood

Climate change is happening now. The Earth's temperature has risen significantly in the last century and we have experienced eight of the hottest summers in the last decade. Technological advances have meant that our homes are consuming more and more energy and more and more oil is being consumed by our cars. The by-products, carbon dioxide in particular, are not only damaging our environment, warming the planet and changing weather patterns but will also damage our health and more importantly the health of our children and grandchildren.

The Government has set itself tough targets to be met by 2010 to reduce carbon dioxide emissions. However, few people realise that 26 per cent of the UK's total carbon emissions come from motor vehicles and 28 per cent come from our homes so ultimately it is down to everyone - you and me - to help make a difference. Now is the time to act, the time to make a contribution, the time to make a change.

Start with a few simple steps such as switching your TV and video off standby, upgrading to high efficiency appliances, using your car less and insulating your home sufficiently. Filling cavity walls, for example, is one the most cost-effective ways you can help save energy, money and the environment. Also did you know that new, Energy Efficiency Recommended fridges can be around 33 per cent more efficient than their inefficient counterparts? So when you are buying new appliances look out for the blue and orange Energy Efficiency Recommended logo. For more tips go to page seven.

The Energy Saving Trust (EST) was set up by the UK Government after the 1992 Earth Summit in Rio de Janeiro to help reduce the UK's carbon dioxide emissions and is now one of the UK's leading organisations addressing the damaging affects of climate change.

Our aim is to cut carbon dioxide emissions by promoting the sustainable and efficient use of energy in all that we do. We offer grants, impartial advice and information to help you save energy, both on the road and in your home. Over the following pages and you will find a wealth of useful tips to get you started. Or speak to us by either dropping into one of our 52 nationwide Energy Efficiency Advice Centres or calling 0845 727 7200 to find out more.

I hope you enjoy the next few pages and that we can inspire you to act - now!

Philip Sellwood
Chief Executive, Energy Saving Trust.

Introduction

"Everybody talks about the weather but nobody does anything about it." Mark Twain.

A hundred years ago, it was calculated that doubling the carbon dioxide levels from the industrial revolution would raise the Earth's temperature by four to six degrees Celsius. Today those figures are becoming startlingly true - the Earth is now dangerously overheating because of our greenhouse gas emissions.

2003 was the third warmest year ever recorded, the ten warmest years ever recorded worldwide have all occurred in the past 14 years, the 1990s were the warmest decade in the past 1,000 years. And the heating is accelerating.

Carbon dioxide (CO₂), methane (CH₄), and various other gases are wrapping the world in an invisible bubble, which is trapping excess heat on Earth instead of letting it escape into space. This is known as the Greenhouse Effect, without which the global average temperature would be approximately -18°C instead of +15°C. What the world is facing now is that man's activities are adding to the natural Greenhouse Effect at a level that is unprecedented in human history.

CO₂ is the chief culprit in this story, mostly from burning fossil fuels, oil and gas. Every year the levels of CO₂ in the atmosphere climb higher and are expected to double pre-industrial levels this century. This could spell significant climate change.

The trouble with such a huge, global problem, is that people can feel helpless. But if there was a change in public attitude we could make a significant difference, because just over a quarter of all CO₂ pollution comes from homes, in the energy used for heating, light and household appliances. Domestic lighting alone in the UK is creating approximately seven million tonnes of CO₂ from power stations, per year or approximately five per cent of the UK total. If every standby button on TV sets and videos in the UK were switched off we would save the power equivalent to about half the annual output of a typical power station.

If every home had a solar photovoltaic panel on its roof the electricity generated would be equivalent to eight 700MW power stations. Approximately another quarter of all CO₂ pollution comes from using cars and trucks.

Thanks to our dependence on fossil fuel energy, the planet is overheating. Glaciers are disappearing, sea levels are rising and the climate is changing. In the UK, our winters are growing milder, summers warmer and flooding is steadily worsening as rainfall and increased amount of building on flood plains all play their part. Climate change will bring some benefits, but the problems potentially outweigh any advantages. The climate change we expect in the next 30-40 years will be due to past greenhouse gas emissions, but climate change later this century will be determined by the emissions we allow now. We need to adapt our way of life so that we can prepare for the changes that are already in the climate system, as well as limiting our future greenhouse gas emissions.

But Mark Twain wasn't quite right - we can do something about the climate. To raise awareness of the link between domestic energy use and climate change, Energy Saving Trust (EST) has teamed up with the UK Climate Impacts Programme (UKCIP) to produce this report. It looks at the changing climate in the UK now and over the next 100 years, the impact our actions can make now and for the future and what people can do to reduce this impact.

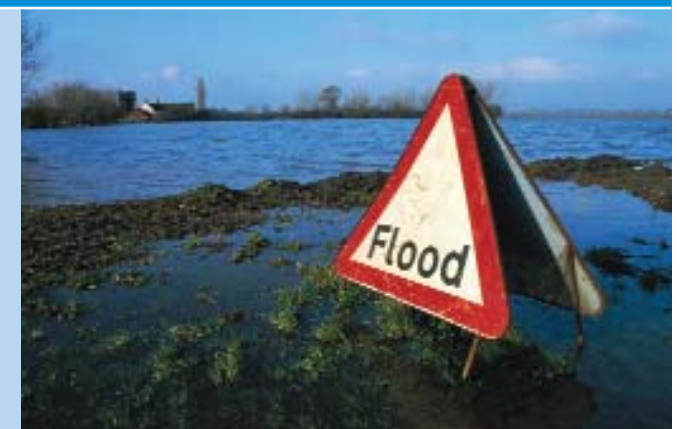
EST hopes that by highlighting this ever-growing problem it will spur people to take action, no matter how big or small, because we're running out of time and no matter what governments do, it is up to individuals to make a difference - each and every one of us.

Under the Kyoto Protocol and European Union agreements, by 2008-2012 the UK must reduce its baseline emissions of six major greenhouse gases by 12.5 per cent from a target set in 1990. The UK Government has also set a target to reduce carbon dioxide emissions to 20 per cent beneath that baseline.

Background

The Energy Saving Trust (EST) was set up by the Government after the 1992 Earth Summit in Rio de Janeiro and is one of the UK's leading organisations addressing the damaging causes of climate change. It aims to cut carbon dioxide emissions by promoting the sustainable and efficient use of energy in homes and cars. EST is a non-profit organisation funded by government and the private sector.

UK Climate Impacts Programme (UKCIP) was set up in 1997 and is funded by Department for Environment, Food and Rural Affairs (DEFRA). UKCIP helps organisations assess how they might be affected by climate change, so they can prepare for its impacts. UKCIP co-ordinated studies on climate change impacts for all areas of the UK and into aspects of the built and natural environment. UKCIP has data and information that can help organisations plan for and respond to climate change.



2050: a fictional vision of the future

By the 2050s, the UK could have a climate more like what we currently expect to see in parts of Southern Europe.

Water will remain a big issue. Water efficiency measures will help, but drier summers will mean water supplies in the South and East of England will need to be piped in from other regions. New water storage built closer to population centres might also be in place. In the driest years, water for agricultural and industrial use may also be restricted. Garden lawns will be made up from new seed mixes better able to withstand the drier summers and wetter winters, or gardeners may have to switch to something entirely different. Gardeners are likely to have to become adept at greywater recycling and rainwater storage as a way to keep their plants irrigated during dry summers. The changing weather patterns could exacerbate subsidence problems in clay soil areas, including the Thames Valley, Bristol and Birmingham, costing some £600 million per year in claims.

Buildings might suffer if wind speeds increase, with perhaps one million properties damaged by the worst storms. Flooding is a potential problem as winter rains grow heavier and sea levels rise. Flood and sea defences will need to protect over two million houses and the 40 per cent of industry that lie near to coasts or river estuaries: that is equivalent to £200 billion of assets. In particular, investment will be needed to protect London and other key places from flooding as well as vulnerable installations such as nuclear power stations, even after they have closed down. Within 50 years from now, significant parts of East Anglia will have to be heavily defended against rising seas, including ports like Felixstowe. Some land could be returned to the sea, called managed retreat, as has already happened at Paull Holme Strays.

Home insurance costs could go through the roof, or perhaps be withdrawn altogether in some places, with annual insurance claims reaching the £800 million mark. Insurers could suffer massively with increased claims for flooding, storm damage and weather disasters worldwide, sending the insurance industry into turmoil.

There are mixed blessings for public health. Milder winters should reduce the number of cold-related deaths, but any serious summer heatwaves could see an increase in heat-related deaths. The heat will also require more careful food handling to avoid rises in food poisoning. Unless we clean up our car exhaust emissions, air pollution will cause bigger health problems in the warmer, sunnier conditions. We will also have to remember to apply plenty of sunscreen throughout the summer to minimise the risk of sunburn and skin cancer.

Heatwaves could create huge demand for air conditioning. Natural ventilation and shading should help minimise this, but power generators will need to plan carefully for changing seasonal demands.

Without action to make the transport infrastructure more climate robust, it could grind to a halt as rails buckle and foundations subside in hot summer while rain and flooding lead to landslides.

UK tourism may win as more people shun unbearable summer heat on the Mediterranean for sunshine in the UK, but the ski industry in Scotland will have long since diversified into other forms of tourism as snowfall becomes increasingly rare.

The countryside could be painted with new colours as exotic crops more often grown in Southern Europe will spread northwards, such as maize and sunflowers. The long hot summers will have the potential to boost the British wine industry. The milder winters however could encourage pests, diseases and weeds - including new alien invaders which can survive when there are no longer any winter frosts - so farmers will need to be vigilant, introducing new control methods.

Warmer seas around the UK may attract increasing numbers of exotic fish, such as mullet and tuna, at the expense of colder-water fish such as cod.

Snapshot of life in 2050

Organisations like EST, UKCIP and others are working together to help ensure that we are prepared for the climate change we can't avoid, and are taking action to stop making climate change even worse. But what might happen if nothing was done to address climate change? Nothing to reduce damaging emissions, nothing to prepare? This is an account of the climate we will avoid by taking action now.

It's another blistering hot day in August. The heatwave has cooked up a thick brown smog, not helped by moorland fires raging out of control and the dust blown from the dry arable fields. Sleeping is difficult in the hot, sticky nights. Using the air conditioning pushes up summer fuel bills - although winter heating bills aren't so high these days - so it is cheaper to leave windows open and sleep under nets to keep the mosquitoes out. Due to the warmer climate all food has to be kept in the fridge otherwise it goes off very quickly and it's surprisingly easy to pick up food poisoning. No-one leaves food lying around anyway, the increased number of household pests such as mice are now active all year round as there are fewer cold snaps to control their numbers. Visits from the pest exterminators might become more commonplace.

Buildings insurance premiums have seen a hike to pay for the storm, flood and subsidence damage, although if you live in a flood-zone you're lucky to get any cover at all. Water is a more precious commodity, with no more power showers and restrictions on car washing and garden watering. At least it will be a good year for homegrown Sussex baked beans and Kent olive oil. Traditional cod and chips is now a special treat, but North Sea tuna is surprisingly plentiful even if the potato harvest is vulnerable to dry summers.

Those warmer seas mean that a hot holiday on the South Coast is now as good as the Costa Brava used to be last century - but the cost of property on the Coast has tripled in value as a result!

On the way in	
1. Creepy crawlies Bloodsucking ticks, scorpions and poisonous spiders all might become a feature of life in a hotter UK	6. Wisteria Scale We could see a bout of new garden pests such as the Wisteria scale, which could threaten Wisteria plants
2. Hayfever Hayfever could be experienced for months on end as trees and grasses flower far beyond their previous seasons	7. Termites These six legged pests are spreading north through Europe and are already in France, and could reach the UK
3. Clogged waterways Once winter frosts disappear, we could see the spread of Water Hyacinth a vigorous alien weed, which could clog our waterways	8. Vineyards The North East of Scotland could become warm and dry enough to make a decent white wine
4. Pest control We will need to take action to control infestations of flea, wasp, mice and rat populations, which thrive in the mild winters and hot summers	9. Diseases Mosquitoes carrying diseases such as Dengue fever and West Nile virus have already invaded the US because of rising temperatures. They could become a regular feature in the UK in the future
5. Sharks Different types of sharks could be spotted off the coast of Scotland and stingrays along the south coast of England in the warmer waters	10. Cleaner air If we tackle those exhaust emissions we will all be able to breathe more easily



On the way out	
1. Scotland's ski resorts With increasingly mild temperatures and much less snow, Scotland's ski industry has already had to diversify into other activities like mountain biking and paragliding	6. The village green Traditional greens could become difficult to maintain, as soaring temperatures, drought and water restrictions turn them brown, prompting a move to new grass seed mixes
2. Golf courses Golf courses could become very expensive to maintain in the long, hot summers with drought and tough water restrictions affecting the quality of grass, and waterlogged conditions in winter	7. Sunbathing Days spent lying in the sun on a beach could become a thing of the past as holiday makers are more cautious of the summer sun
3. The Snowdon Lily The rare Snowdon lily and many other British alpine plants could become extinct, as their mountain homes grow too hot and they face competition from other species	8. Daffodils Warmer winter temperatures will put our daffs and crocuses at risk, while other climate change impacts will affect snowdrops, rhododendrons and primula
4. Cod Warm waters further threaten our already dwindling numbers of cod, with cod and chips potentially relegated to a thing of the past	9. Golden beaches A trip to the seaside could be a thing of the past, as some sandy beaches are submerged under the rising seas. 70 per cent of the world's sandy shores have already been in retreat over the last century
5. The Dormouse The Dormouse could disappear as warmer summers and milder winters threaten its habitat	10. Christmas trees Spruce tree plantations could die, as they no longer have sufficient cold spells in the winter to allow them to grow the following season



An alternative future

It's a great temptation to throw up your hands up in defeat and say, "it's inevitable." But it doesn't have to be that way.

Picture this scene in the year 2050. It's a cold and dark winter's morning. You get up and switch on the light, powered by energy stored from solar electric cells and the mini-wind turbine on the roof. The central heating comes on, using an energy efficient 'A' rated condensing boiler and heat pump, which turns waste heat into electrical power.

The house soon becomes warm and snug, thanks also to the triple glazed windows fitted with special heat-insulating glass, draught-proof automatic doors, and thick insulation in the walls and roof.

The tiny amount of heat which leaks out into the outside world will be picked up on a satellite in space, monitoring any waste heat from homes, offices and factories. If you leak too much heat it sends a message to the local energy office and they'll send you a bill for harming the environment.

A computer chip in your kettle will buzz a warning if you overflow it and waste electricity. You sit down to watch the morning news on a low energy flat-screen TV screen. You jump in your electric car powered by a fuel cell that runs on methanol, a renewable fuel made from crops. And as for the car itself, it's made of Soya oil! The oil is converted into a strong plastic that never rusts, and when the car is scrapped it can be recycled like compost!

Public transport provides a cheap and easy alternative to the car. A bus or tram gets you to the local station to take a train for the rest of your journey. Mind you, this isn't the clanking train of olden days - the engine is driven by powerful magnets which levitate the train above the track and shoot it along at some 300 mph at a fraction of the cost of electric or diesel engines, which were a waste of energy.

The highest property prices these days are for homes away from rivers and coasts at risk of flooding, and that are equipped with latest features, like shading and natural ventilation, to prevent overheating in the summer.

This picture of an energy efficient future may sound like a fantasy, but it's all possible with today's technology if only we invested in the technology now.

Climate change: the human factor



The climate changes for all sorts of reasons. Ocean currents shift, volcanoes shower the world in ash. The sun's energy also slightly changes and for the past century it has been unusually active and affected our climate. But for the past 50 years or so, global temperature rises have been largely due to our own CO₂ pollution.

The two gases that are the biggest contributors to man-made climate change are carbon dioxide and methane. Carbon dioxide remains the chief culprit, and at present about seven billion tonnes of carbon are emitted globally into the atmosphere each year, mostly through the combustion of coal, oil and gas for energy. The majority of scientists, involved in the Intergovernmental Panel on Climate Change, agree that the human impact on climate is substantial.

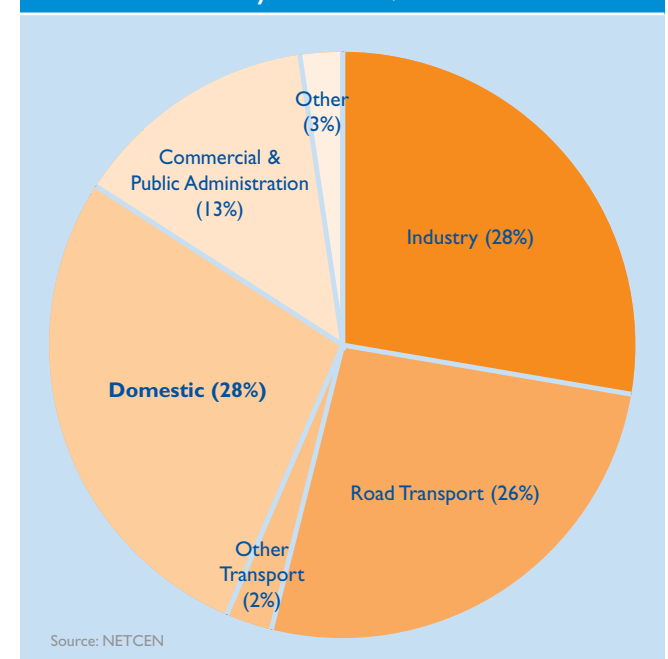
For centuries there was little change in the concentrations of this gas until the dawn of the industrial age, when the concentrations shot up. Today it is at the highest level for the past 440,000 years. There is now so much carbon dioxide in the air that for the past 200 years plants have been growing fewer pores in their leaves to soak up the abundant gas.

In the UK, 28 per cent of all carbon dioxide emissions released into the atmosphere come from the energy that is used to run our homes.

Every household in the UK creates around six tonnes of carbon dioxide every year - approximately the weight of an African bull elephant and enough to fill six hot air balloons ten metres in diameter.

In fact, the average home is responsible for more harmful carbon dioxide emissions than the average car produces every year. The average household could save around £200 a year by taking energy efficiency measures. This is equivalent to a saving of around two tonnes of CO₂ per year. Space and water heating account for more than 80 per cent of energy consumption in the domestic sector - the amount of heat lost in homes annually through roofs and walls is enough to heat around three million homes for a year, or equivalent to about £1 billion a year.

CO₂ emissions by end user, 2002



Climate change: the UK picture

What you can do: top ten tips for cutting carbon

1. Buy energy efficient appliances

When replacing appliances, consider their energy efficiency rating. Look for the Energy Efficiency Recommended Logo as a guide to help you choose the most suitable product

2. Choose a high efficiency condensing boiler

If your boiler needs to be replaced, then make sure you replace it with a high-efficiency condensing boiler - from April 2005 this will be law. This could save you around a third on your bills - that's over ten per cent more than replacing with a conventional boiler

3. Consider installing cavity wall insulation

If your home is suitable, about three hours of a professional's time will save you money in the long run

4. Get some lofty ideas

Insulating your loft to a depth of at least 25cm is a great way of cutting down heat loss and you can do it yourself

5. Double glazing

This is another great way of cutting down heat loss and it will also stop rattles, draughts and reduce noise pollution

6. Hot water tank insulation

By fitting a jacket on your tank you can reduce heat loss by around 75 per cent

7. Use energy efficient light bulbs

They last up to 12 times longer and use a fraction of the electricity guzzled by ordinary bulbs

8. Turn down the thermostat by one degree

It could cut your heating bills by up to ten per cent

9. Use your car less

Try walking or cycling to the shops occasionally, it's better for you and the environment

10. Think solar

Solar PV panels generate electricity for your home and you could qualify for a grant to contribute to the cost

Energy boosters

- If every household in the UK installed cavity wall insulation (where possible), it would save £670 million a year and nine million tonnes of carbon dioxide annually
- If all homes installed loft insulation up to 25cm thickness, the savings would pay the energy bills of 635,000 families for a year
- If all gas central heating systems used a condensing boiler, it would cut CO₂ emissions by 17.5 million tonnes, saving £1.3 billion on energy bills every year
- Each year, video recorders and televisions consume around £150 million worth of electricity while on standby mode
- If everyone boiled only the water they needed, instead of filling the kettle, it would save enough electricity in a year to run more than three quarters of the street lighting in the entire country
- If every household changed just two ordinary light bulbs for energy efficient ones, enough electricity would be saved each year to power all the street lighting in the UK
- Lowering home heating by just one degree typically saves up to ten per cent of heating costs. If all UK households did this, enough energy would be saved each year to heat nearly 2.8 million homes

Fiscal incentives

Energy efficiency in the home is the key to reducing our impact on the environment. To help households take on board more energy efficiency measures in order to reduce their CO₂ emissions, the EST has called on the Government to introduce a range of fiscal commitments to make this easier and more affordable for households.

In the Energy White Paper, released by the Government in 2002, they made a strong commitment to energy efficiency, describing it as the cheapest, cleanest and safest means of meeting policy objectives. To help achieve this, as part of the Energy Efficiency Commitment (EEC), energy suppliers offer consumers financial reductions on energy efficiency measures such as insulation, condensing boilers, low energy light bulbs and A-rated appliances.

Incentives we have proposed to the Government include:

- An environmental tax or inefficiency charge on the least efficient products
- A proposal to the Chancellor that he should give a rebate on stamp duty to homemovers who install insulation and efficient heating systems when they move to a new home.
- Lowering Council Tax bands for energy efficient homes to give people a financial incentive

We believe these measures would have a positive effect on trade and industry as well as consumers. There are still a lot of smaller things individuals can do to help make a positive difference to the environment. Make sure you turn off your lights when you leave a room, draw your curtains at night and only boil the amount of water you need to make a cup of tea.

The climate in the UK is going through significant changes. Gone are the days of ice skating on the Thames as in Dickens' time - now it seems almost every month's climate is different from average and weather records are regularly being broken.

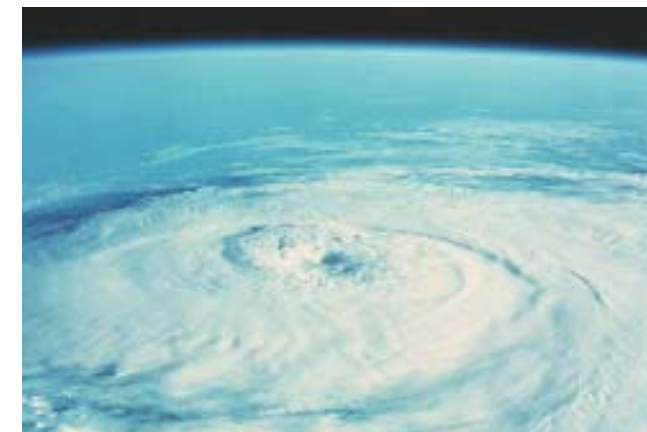
We have the longest weather records in the world, dating back to 1659, and these reveal that the temperature in Central England has increased by 0.7°C since that time. Of that, a rise of 0.5°C occurred in the 20th century. Globally, average temperatures have increased by 0.6°C since 1860.

The warming has become even faster since the 1970s, and the 1990s were the warmest decade on record. Already this decade looks set to become even hotter, and it was no coincidence that the UK's previously highest temperature record was broken in 2003.

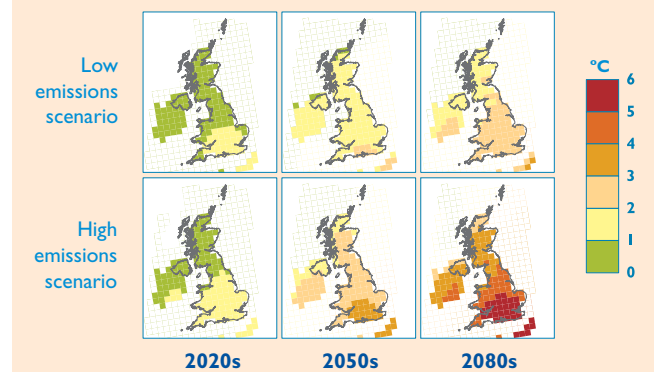
The climate is changing in other ways. Over the past 40 years, the UK's winters have grown wetter, with heavier bursts of rain. The summers are growing drier and hotter - one of the starkest changes over the last 200 years is that July has grown remorselessly drier. Summer heatwaves are more frequent and more intense. Slowly but surely, much of the UK is experiencing extreme climates more associated with our European neighbours.

Climate change is already hitting home, quite literally. Many gardeners, even in Scotland, are finding their lawns need mowing in winter and snowdrops are blooming before Christmas, as winters grow milder, with fewer frosts, cold snaps and snowfalls. Spring is arriving earlier and autumn later - the growing season for plants in the UK has expanded by about a month since 1900. French champagne houses are even buying up vineyards in the south of England where the conditions are now ideal for developing sparkling wine.

But flooding is a looming threat over much of the country. Severe storms and rising seas - some 10cm higher than the sea level in 1900 are slowly eating away our coastlines. As rainfall comes down in deluges, rivers are breaking their banks more often, with flashfloods becoming a more common occurrence.



UKCIP annual temperature scenarios



By the end of this century, the average yearly temperature of the UK could be between 1°C and 4.5°C hotter than today, depending on how high greenhouse gas levels rise. The land will heat up faster than the sea, and the South East more than the North West. Summer and autumn will generally heat up more than winter and spring, and as the nights turn hotter and stickier - the sort of temperatures we currently get at 7pm could be experienced at 11pm by the end of the century.

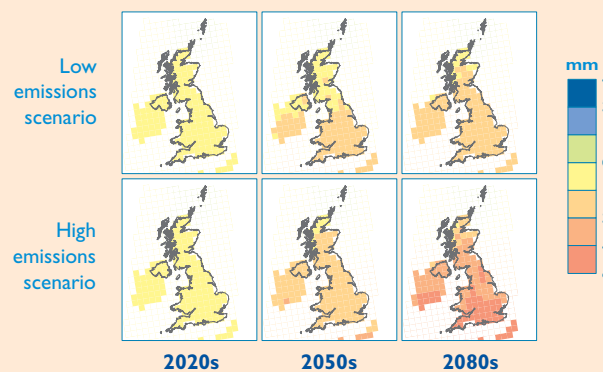
There is potential for a huge increase in the growing season, as much as an extra 100 days a year, and southern England may even get some years when plants grow all year round. Summers are already growing more extreme with more heatwaves that last longer and are hotter. Just think back to the scorching heatwave of August 2003 when highest temperature records were smashed throughout the country, from the Orkneys to Kent.

By the end of the century, we could be facing far worse heatwaves reaching up to the mid 40°C in some places, more like the heat in 2003 that killed thousands of people across the rest of Europe. Temperatures as high as this have probably not been experienced since the last great warm period over 100,000 years ago, at the same time that hippos roamed England. As the summers become hotter and drier, drought could become a major threat. Anyone who lived through the long, hot summer of 1976 will remember the drought that reached crisis proportions: water rationing, building subsidence, withered crops, diseased trees, wildfires and deaths from the heat. Such could be the face of summers to come if we don't learn to adapt and take steps to prevent further climate change.

Climate change: the UK picture

The UK picture

UKCIP annual precipitation scenarios



In the hot summer of 2003, all snow completely disappeared from Scotland, only the fourth time this has happened in recorded history.

Across the UK, snow has dwindled over the past 20 years and in the future could become so rare that many regions could have long runs of snowless winters.

The yearly pattern of rainfall is less clear. In recent times it has been a rollercoaster ride, with 2000 the third wettest year in England and Wales since records began in 1766, while 2003 was unusually dry.

But the seasonal rainfall trends look much clearer - winters have never been so wet compared to summers, and the rain in winter is also falling in longer, heavier bouts lasting five days or more.

The outlook is for continued wetter winters, with an increase in rain of more than 30 per cent in the worst case scenarios by the 2080's. Such a dramatic increase is greater than what we would expect from natural variability in climate.

By the summers of the 2080s, almost the whole of the UK is potentially heading for drier conditions, with rainfall reductions down 50 per cent on current levels in the worst cases.

Eastern and southern regions can expect the biggest changes in rainfall, North West Scotland will see the least. The bad news for farmers is that some of them could see less rain in springtime.

Sea levels

It takes centuries for the oceans to warm up as air temperatures rise, but once it starts, the heating becomes virtually unstoppable. Like water in a saucepan rising up as it's heated, warmer oceans lead to rising sea levels. Added to that, the mass of water melting off glaciers on mountains and Antarctic is sending world sea levels rising even higher.

Globally, sea levels could rise by 69cm by the 2080s and will continue rising for several centuries and probably more. With much of the UK's coastlines and estuaries lying at or even below sea level, new or improved sea defences will be needed to tackle the risk of flooding.

The UK also suffers another problem with the sea. The UK landmass is still recovering from the last ice age, when the vast mass of ice over Scotland pushed the North down and the South up, like a big seesaw. The ice disappeared, but as a result the North is still slowly rising up while the South is still sinking, which means sea levels in the South East are rising even faster. This means that sea level rise for London could be as much as 86cm by the 2080s, but 60cm for South East Scotland.

Cloud cover

The weather may become sunnier, a trend already happening. The good news for UK tourism is that summer sunshine could rise, up to 25 per cent in the south but this could lead to higher levels of skin cancer and heat exhaustion, although winters would be slightly cloudier. There may be less fog but the increased sunshine and heat would lead to poorer air quality unless pollution levels were reduced.

Wind speeds

It's difficult to predict how wind will change, but more frequent and intense winter storms may be expected. Southern and central UK in particular may expect stormier and windier conditions in winter.

Soil moisture

The ground is expected to become increasingly dry in summer and autumn, making it particularly difficult for crops. The hardest summer droughts could hit South East England. Even the long, hard rains forecast for winter will not be enough to balance the increasingly hot and dry summer droughts.

Scotland

Scotland is set to grow warmer by between 1°C to 3.5°C this century, with relatively more warming in summer than the winter.

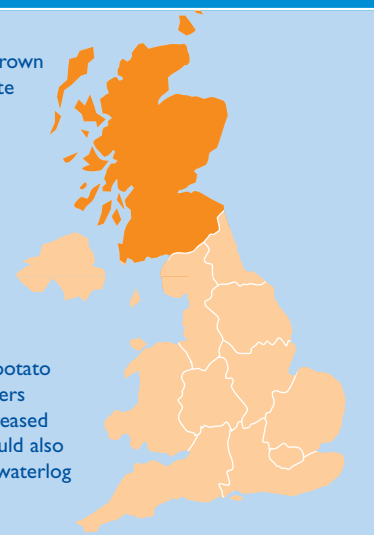
That could profoundly change some of Scotland's most distinctive landscapes and natural history. Mountain birds like ptarmigan, dotterel and Snow bunting, and alpine plants such as subarctic willows, could come under threat of extinction from rising temperatures. Heather moors and forests will be threatened by wildfires, as springs grow drier, although trees are likely to grow faster in the warmer weather.

Huge changes are underway in Scottish waters, where exotic creatures such as the sunfish from the Mediterranean are already appearing. In the future, tuna could end up taking over from cod as the main fishing catch in the UK.

Scotland can expect to see its first home-grown wine within the next 50 years, as the climate grows warm enough around the drier east coast and Borders.

The lack of snow could wipe out the ski industry within 20 years, perhaps offset by more tourists encouraged to come in the warmer weather. With milder winters, fewer cold-related deaths might be anticipated.

But the multi-million pound Scottish seed potato industry could face ruin from warmer winters allowing in aphids carrying viruses. The increased rainfalls expected in autumn and winter could also trigger landslides on roads and railways and waterlog crops such as potatoes.



North East

The balmy weather of the Cornish Riviera could reach Durham by the 2050s, lowering heating bills in winter and encouraging tourism, although condensation, damp and mould could increase as winter rains grow heavier.

The growing season for plants is lengthening as spring arrives earlier, and records dating back to 1850 show that garden snowdrops in Northumberland are now flowering about three weeks earlier.

By the 2080s, the growing season could extend by up to 100 days, allowing new crops to be grown, arable farming in some upland areas and vineyards to be commercially viable.

But the cold-loving alpine plants of Teeside are at grave risk, such as the rare Lady's Slipper orchid.

Forestry should also thrive in the warmer climate, although waterlogged ground and stormier weather will fell many more trees.

Wildlife is also changing, and since the 1970s, the Comma butterfly has expanded its range northwards into the North East.

River flooding and waterlogged land is expected to worsen as winters turn wetter with heavier downbursts of rain, but extensive irrigation may be needed in summer droughts.

Between 1900 and 2000 the North Shields tide gauge recorded a sea level rise of approximately 20cm, and as the seas grow higher, coastal erosion will worsen. Already beaches such as at Alnmouth, Northumberland, are disappearing.

North West

The North West may have the least severe climate changes in England. But here too, the balmy weather could reach Manchester by the 2020s.

Warming is already underway as shown by the lack of winter ice on the surface of Lake Windermere. Until the mid-1980s, the lake partially froze on average ten days a year, but no ice has appeared on the lake since 1989. Two rare cold-loving Arctic fish, the vendace and shelly, of the Lake District are also disappearing.

Winter rains could increase, especially intense downpours leading to river flooding, which has struck the region several times over the past 20 years.

Summer rain shortages will not be so extreme as most other parts of the UK, although the drought of 1995/6 saw reservoirs drained to record low levels and the

introduction of drought orders. Such events are likely to become more frequent over the coming decades.

Most of the North West's coast is low-lying, and much is highly populated on the coastal floodplain, along with industry, fishing ports, seaports, seaside resorts and important feeding areas for bird life. Sea level rises, of up to 69cm by 2080 will result in a greatly increased flood risk unless sea defences are upgraded. Multi-million pound sea defences are being planned at Blackpool, for example. The threat of tidal surges reaching danger levels could treble over the next 50 years, and could be made worse by higher waves whipped up by stronger winds.



The UK picture

Yorkshire & Humber

Over the last 20 years, serious droughts and floods have affected Yorkshire and Humberside, and the pattern is set to continue. Temperature rises of between 1.5° and 4°C are expected by the 2080s, with the greatest rises in the summer months.

The warming trend is already encouraging changes in wildlife, with the Speckled Wood butterfly currently pushing northwards and an increased invasion of bracken being forecast. Heathlands and moorlands will grow dry in the summer and risk wildfires, with places such as the North Yorkshire Moors potentially closing more often to the public.

Milder winters could pose serious problems for Yorkshires rhubarb industry area as the crop needs cold winter spells to succeed.

Summer rains could decrease by up to half, putting huge demand on water supplies. And rainfall could increase by up to a third in the winter, putting cities such as Leeds, Sheffield and Bradford with their antiquated Victorian drains, under severe risk of flooding and sewer overflows. The threats of drought and flooding could also put York Minster and its cathedral, as well as other important heritage sites at risk.

The Humber estuary, may experience sea level rises of up to six mm per year, leading to increased risk of tidal flooding in the floodplains and disruption to shipping, with the port of Immingham on the Humber potentially experiencing extremely high seas up to 20 times more often by the 2080s.



Wales

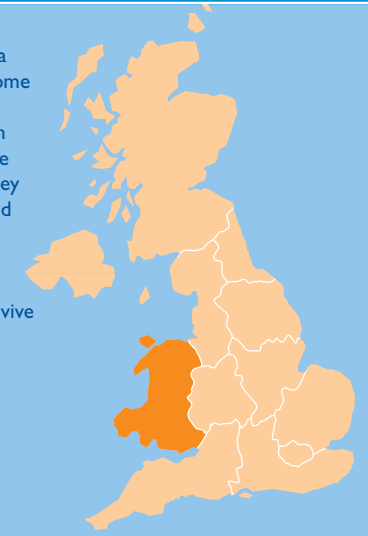
Wales is one of the wettest areas of the UK, and heavier winter rains could cause flooding of low-lying inland areas. Population and tourism are concentrated on the coast, and a significant amount of the Welsh coastline is less than a metre above sea level, making it vulnerable to increasing sea levels and a possible increase in the number of storms.

In summer, shortages of rainfall bring the threat of drought. There may be difficulty providing adequate water supplies for some parts of Wales even by 2025. Over half the water currently abstracted in Wales is transported to the English Midlands and Merseyside.

The mountains of Wales could see unprecedented changes as a result of rising temperatures with far less snow, fewer alpine plants, and footpath erosion from heavy rains.

The higher temperatures could encourage a move from livestock to arable farming in some parts of Wales, and a change in the crops grown, although irrigation may be needed in dry summers. But farmers need to be aware that pests could be more troublesome if they survive milder winters, and heat stress could affect livestock in summer.

Forests could be damaged by more storms and pests such as the spruce aphid may survive better over warmer winters.



East Midlands

Climate predictions estimate temperature rises of up to 4°C by the 2080s, with the summers growing drier and winters wetter.

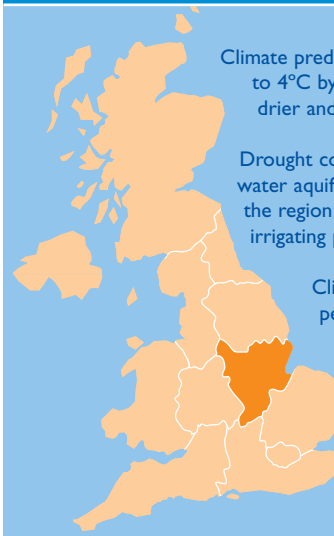
Drought could become chronic with underground water aquifers and rivers already fully stretched in the region to meet current demands, especially for irrigating potatoes, salad crops and sugar beet.

Climate change raises fears of new crop pests such as the Colorado Beetle, but the countryside could see new crops such as sunflowers, grain maize and Navy beans (used for baked beans). Other crops such as Vining peas may become less viable and livestock could also suffer stress in the heat.

Possibly the biggest threat is flooding. Sea level rises of between 20-80cm are expected on the East Midlands coast by the middle of the century, possibly accompanied by storm surges and bigger waves which could lead to flooding and increased erosion of cliffs and sea walls. Unless coastal flood defences are greatly improved.

There is potential for river flooding on a scale similar to the disastrous Northampton floods of Easter 1998, which led to insurance claims for several hundred millions pounds of damage.

All these flooding problems mean the insurance industry could refuse buildings insurance or raise premiums in some places, with serious consequences for property values and development in the region.



Climate change may have a greater impact in East Anglia than any other part of the UK. With a substantial amount of the region below sea level, it faces a huge flooding threat from rising sea levels.

The region is also sinking as the land adjusts to the end of the last ice age. Sea level rises of up to 82cm are possible in the next 100 years and with the possibility of bigger and more frequent storms, the threat of floods loom large.

A worst case scenario is another storm surge like that of 1953, when East Anglia and the Thames estuary were flooded and over 300 people killed.

Unless significant improvements are made to flood defences, vulnerable land may have to be sacrificed to the sea and allowed to flood as natural marshland.

There is also a growing risk of flooding from rivers, as winter rainfalls grow heavier and more intense.

At the other extreme, East Anglia is the driest region of the UK with most of the best agricultural land.

Drier summers could turn the land into a dustbowl unless more irrigation is used, putting huge pressure on scarce water supplies that will compete with the needs of a booming population. Recent proposals for a desalination plant on the Thames Estuary highlight the importance of preparing for future water shortages.



West Midlands

The Midlands conurbation could sweat in hot, sticky nights during summers thanks to the urban heat island effect. Rainfall in the summer has been decreasing since the 1880s and is expected to continue to fall, while winter rainfall increases over the past 200 years could carry on rising, with heavier downpours.

Although the summer skies may turn sunnier, the poor air quality from road and industrial pollution could grow much worse and spread far into the countryside.

The West Midlands is at the heart of the national transport systems. Higher winter rainfall could increase the risk of flooding on railways and on poorly drained roads and runways, with the risk of landslides in cuttings.

Hot summers can melt tarmac roads and runways and buckle rails. Higher summer temperatures could increase accident risk as driver concentration is reduced.

Parts of the West Midlands are among the driest in England, so for the farming community, a reduction in summer rainfall could mean that water for spraying, irrigation and livestock is restricted during drier summers.

In summer, increased demand for irrigation because of drier soils could rise by almost a quarter by the 2020s.



London

Heat could reach crisis proportions in London. The urban landscape absorbs so much solar energy it creates its own 'urban heat island', several degrees warmer on summer nights than the surrounding land. By the end of the century, summers could be as hot as those of present day New York, creating unbearable conditions on streets, underground trains and in buildings without any air conditioning.

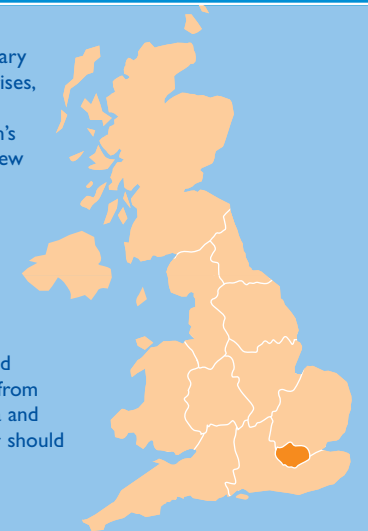
The death rate could soar in severe heatwaves increasing the demand for air conditioning.

London is also one of the driest capital cities in the world, with a rainfall similar to Barcelona and available water per head of population equivalent to Israel. Drier summers will make huge demands on water and lead to subsidence of buildings on clay soils as they dry out.

Its position on the edge of the Thames estuary makes London highly exposed to sea-level rises, with some £100 billion worth of land and property at risk, nearly a tenth of the nation's assets. By 2050 the city could need major new flood defences.

Intense rainfalls also pose another great threat - recent summer flash floods overpowered the sewer, drain and underground train systems.

Smog could grow unbearable as the heat and increasing sunlight cook up more pollution from road traffic, leading to an increase in asthma and heart attacks, but deaths from cold weather should tail off in the milder winters.



The UK picture

Summary

South West

By the 2050s, Cornwall could start to resemble today's south of France. Sub-tropical palm trees could grow in baking hot summers and winters will have almost non-existent frost or snow.

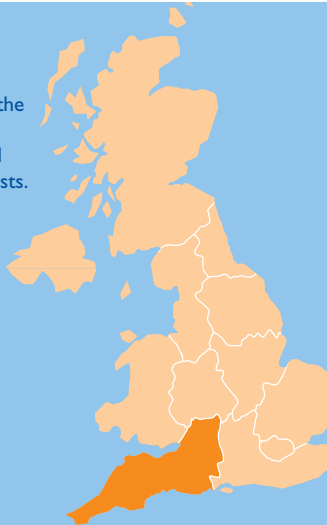
The warming waters have been bringing exotic sea creatures from the Mediterranean and beyond for the past 20 years, such as sunfish, torpedo rays, squid, sardines, and even certain African species such as the sail-finned dory.

The hot summers could rejuvenate West Country resorts - although the intense sunshine risks increasing incidences of skin cancer and cataracts.

The countryside could be carpeted in continental crops such as sunflowers and sweetcorn, but summer droughts remain a possibility.

Intense bursts of rain in summer and winter threaten flashfloods, as well as landslides and river flooding over wide urban areas. Adding the danger of flooding to the possible greater numbers of storms and rising sea levels could cause considerable risks to buildings and forests.

Protecting or relocating threatened coastal lands could be costly, leaving the option of abandoning some of it to the sea. But retreat in some locations, such as the Isles of Scilly, is not possible without damaging the entire island's economy.



South East

The South East may warm up more rapidly than anywhere else in the UK and feel more like the Continent, with blistering hot summers, possibly over 4.5°C higher by the 2080s.

Chronic summer droughts could become normal as some 20-50 per cent less rain falls in summer pushing up the demands for farm irrigation and exacerbated by a rapidly growing urban population. Hot, dry winds could add to the drought, whipping up wildfires and dust bowls, while clay soils shrink and subside buildings, roads and railways.

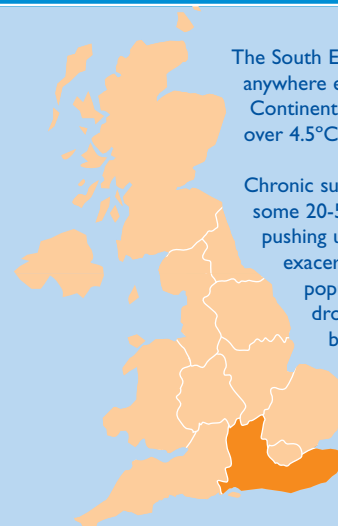
The summers may be too hot and dry for oak and beech woodlands, and water meadows and heaths could turn

into tinderboxes. But much of the countryside could look like present day France, with sunflowers and soya and cattle grazing outdoors all year round. However, the warmer winters could challenge farmers by changing the timing and outbreaks of pests and diseases.

There will be fewer cold-related deaths in the milder climate, but there may be far more heat and smog-related illnesses in the heat of summer.

The possibility of stormier winters may mean further devastation similar to the 1987 storm, which caused £1.2 billion damage.

The region could also see the highest rises in sea levels of the UK because of its geology and climate. Coupled with storm surges, they could erode beaches, cliffs and low-lying land.



Northern Ireland

Farming is Northern Ireland's most important industry, and rising temperatures may encourage a more mixed agriculture including spring-sown cereals. But milder winters may lead to more pesticide use to combat fungal diseases, vigorous weeds and pests such as slugs and aphids.

Farm land in western parts may become so wet and waterlogged in winter that traditional grassland farming becomes more marginal, perhaps leading to a move towards forestry.

In the south of the country, introduced tree species, like the sycamore, are likely to flourish in a milder, less extreme environment, than natives such as oak or ash.

Heavier rainfalls could set off more frequent severe flooding, especially in vulnerable areas of Belfast and Londonderry and parts of the western region.

However, the rains will help feed the vitally important boglands of Northern Ireland, some of the finest peatbogs in the world, and a major carbon 'sink' for keeping carbon dioxide locked away out of the atmosphere.

The humidity in the air could increase and bring more damp, mould and condensation problems for housing.

These damp conditions may encourage the spread of many infectious diseases.



The scenarios

Climate experts have painted a picture of future climate in the UK for this century based on four climate change scenarios, using the Met Office's Hadley Centre supercomputer.

They range from a 'low emissions' world - which might happen if we made big cuts in our energy use right now up to a high emissions world where energy use shoots up dramatically with potentially dire consequences.

The scenarios show that even if the world managed to control carbon dioxide pollution and it actually fell below today's levels - the Low Emissions scenario - the amount of global warming for the next 100 years would be startling: about four times greater than during the 20th Century.

Worse still, if the carbon dioxide emissions grow to above four times today's level - the High Emissions scenario - then future warming rate would be higher still - about twice as large again.

The sobering fact is that carbon dioxide stays in the atmosphere for about 100 years after it's been pumped out of our cars and power stations. Even if by some miracle we drastically slashed carbon dioxide pollution by some 70 per cent overnight, the world would carry on heating up for several more decades - and the seas would rise for several more centuries.

So we need to take urgent action now in order to make any difference for the future. There's no time to lose.

Conclusions

We depend on fossil fuels because they've given us so many addictive things - warm homes, bright lights, refrigerated food, computers, TVs, videos, DVDs and all the rest of modern domestic bliss.

But it can't go on like this any longer.

The reason is simple - the gases released from power stations, boilers in our homes, cars and much more are pushing the world's climate towards crisis point. We're now entering a new, highly uncertain future with difficult times ahead.

The UK is heading for such serious sea and river flooding that we may have to abandon large tracts of land and defend other parts with expensive defences.

Droughts could grow more severe with huge consequences for finding enough water.

Weather disasters are going to become more frequent so that insurance may become expensive or unavailable for some parts of the UK.

We must wean ourselves off fossil fuels. And quite apart from saving the climate and the world, there are other huge benefits to cutting down our energy demands - it saves money, helps secure our energy supplies in a very uncertain world and saves the huge mess left over from coal, oil and gas production.

We've got to cut down our energy for the sake of our future.