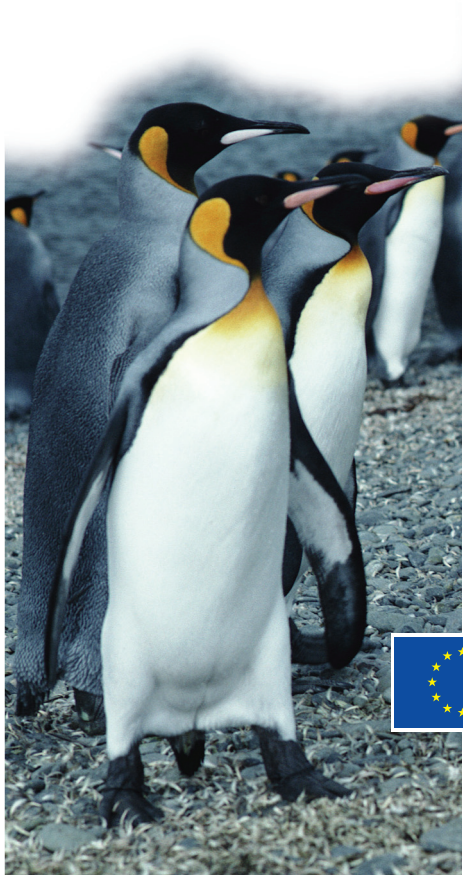
Climate change — what is it all about?

An introduction for young people



European Commission

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European Commission
Directorate-General for the Environment

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Contents

Climate change — what is it all about?

Climate change is happening, and its impact on all of us is growing. Have you noticed storms and floods becoming more frequent around your area, or on television? Does it seem to be warmer in the winter, with less snow and more rain? Do you feel that spring is coming a little earlier each year, with flowers blooming or birds arriving before you expect them?

These are all signs of accelerating climate change — or global warming, as it is sometimes known.

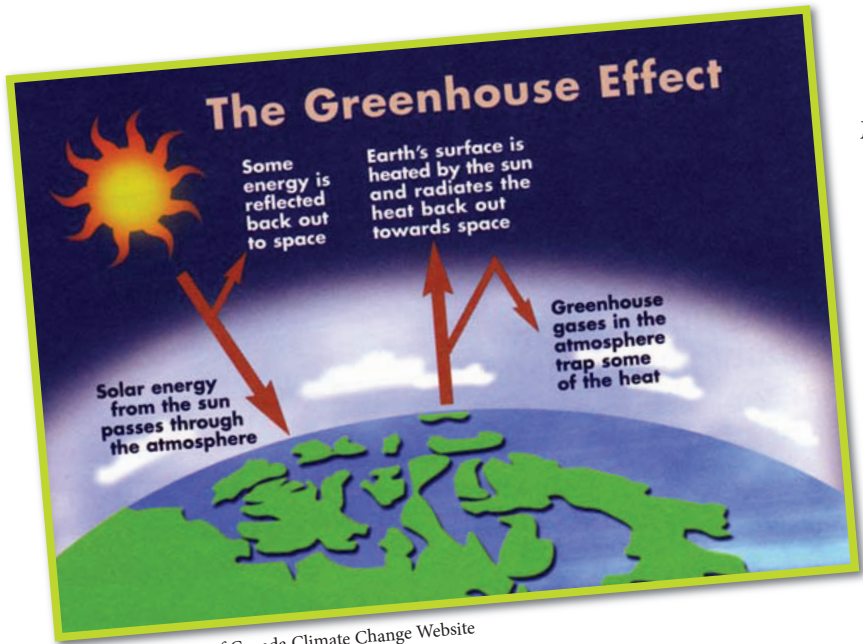
If we don't take action to stop it, it is going to damage the world we live in, and alter the ways of life we now take for granted.

What causes climate change?

The climate is changing because of the way people live these days, especially in richer, economically developed countries — and that includes the European Union. The power plants that create energy to provide us with electricity and to heat our homes, the cars and planes that we use, the factories that produce the goods we buy, agriculture to grow our food — all these play a part in changing the climate.

The greenhouse effect

Our atmosphere acts as a transparent, protective covering around the Earth. It lets in sunlight and retains heat. Without it, the sun's heat would immediately rebound off the Earth's surface and go back into space. In that case, it would be some 30° Celsius colder on Earth — everything would freeze. The atmosphere therefore acts a bit like the glass walls of a greenhouse. This is why people talk about the 'greenhouse effect'. Responsible for this effect are the 'greenhouse gases' in the atmosphere, which trap heat.



Source: Government of Canada Climate Change Website

Most of the greenhouse gases occur naturally. However, since the industrial revolution in the 18th century, human society too has been producing greenhouse gases — in ever-increasing amounts. As a result, their concentrations in the atmosphere are now higher than at any time in the past 420 000 years. They make the greenhouse effect stronger. This means rising temperatures on Earth — climate change.

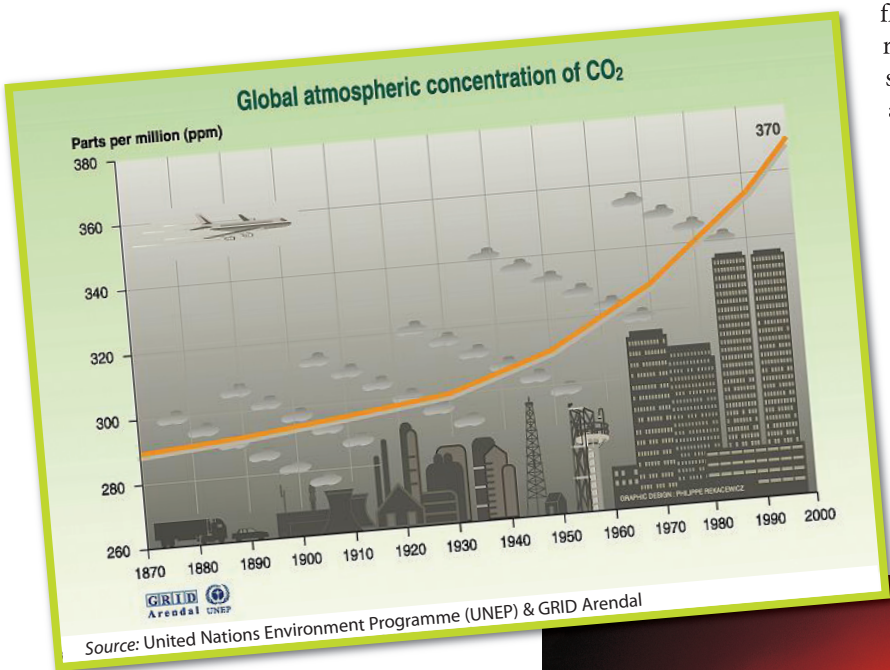
The greenhouse gases we produce

The principal greenhouse gas generated by human activities is carbon dioxide. It accounts for some 75 % of all the 'greenhouse gas emissions' in the world. This term describes all the releases of greenhouse gases into the atmosphere as part of the smoke, the steam and the fumes from exhaust pipes, chimneys, fires and other sources.

Carbon dioxide is mainly released when fossil fuels, such as coal, oil and natural gas, are burnt. And fossil fuels are still the most used energy source. We burn them to produce electricity and heat, and we use them as fuel for our cars, ships and planes.

Most of us know carbon dioxide (CO_2) from soda drinks — the bubbles in carbonated drinks and beer are actually CO_2 bubbles. It also plays an important role in breathing: we take in oxygen and breathe out carbon dioxide, while trees and plants absorb CO_2 to produce oxygen. This is why the world's forests are so important. They help soak up some of the excess CO_2 that we are producing. However, deforestation — the logging, clearing and burning of forests — is taking place on every continent.

Other greenhouse gases released by human activities are methane and nitrous oxide. They are part of the invisible fumes from waste landfills, cattle breeding, rice cultivation and certain agricultural fertilisation methods. We also artificially manufacture some greenhouse gases, the so-called fluorinated gases. They are used in refrigeration and air conditioning systems, but find their way into the atmosphere due to leakages and if the appliances are not properly treated when they become waste.



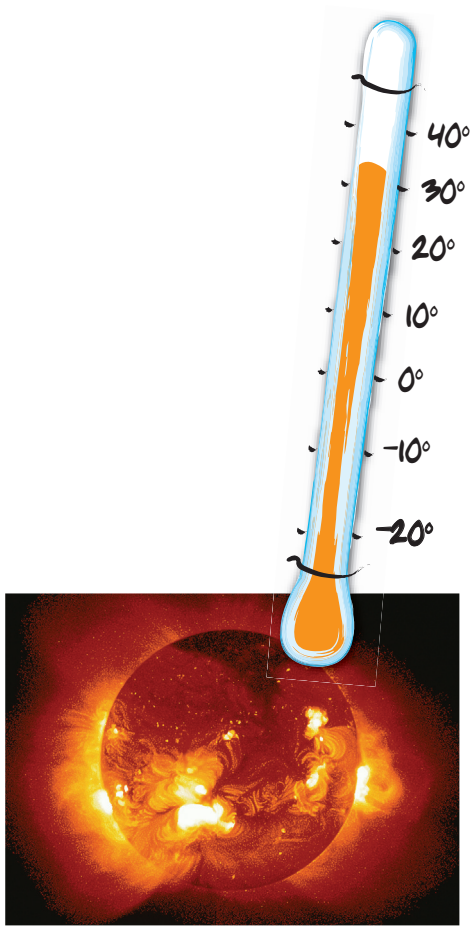
Source: United Nations Environment Programme (UNEP) & GRID Arendal

Evidence of climate change

Climate change has already begun. Over the last century, the average global temperature has increased by 0.6° Celsius, while the average temperature in Europe has increased by almost 1° Celsius.

Globally, the five hottest years 'on record' (since around 1860 when we designed instruments that can measure temperatures fairly accurately) have been, in this order:

1. 1998
2. 2002
3. 2003
4. 2004
5. 2001



The warming trend is due to the growing amount of greenhouse gases released by human activities. Climate experts project that this trend will accelerate, with the average global temperature increasing by between 1.4° and 5.8° Celsius by 2100, and temperatures in Europe by between 2° and 6.3° Celsius.

These temperature increases may not seem much. But one need only remember that during the last Ice Age, which ended 11 500 years ago, the average global temperature was just 5° Celsius lower than today. Yet polar ice covered much of Europe. A few degrees make a lot of difference for our climate.

The current change in climate is already having an impact in Europe and around the globe (see next page). In the longer term, it could even trigger catastrophic events, such as rapidly rising sea levels and floods, big storms, and food and water shortages in some parts of the world. Climate change will affect all countries, but developing countries are the most vulnerable. They often depend on climate-sensitive activities such as agriculture and do not have much money to adapt to the consequences of climate change.

Climate change and its effects

- The polar ice caps are melting. The area of sea covered by the Arctic ice at the North Pole has shrunk by 10 % in recent decades, and the thickness of the ice above the water by about 40 %. On the other side of the world, the ice sheet above the Antarctic continent has become unstable.

- Glaciers are retreating. It is likely that 75 % of the glaciers in the Swiss Alps will disappear by 2050. Managers of the Andermatt ski resort in Switzerland are now planning to cover the Gurschen glacier, a popular skiing area, with a huge insulating plastic sheet during the summer to stop it from melting and sliding.

- As the ice caps melt, sea levels rise. They have already gone up by 10–25 centimetres over the last century (depending on the measurement) and are projected to rise further by up to 88 centimetres by 2100. This would flood low-lying islands and coastal areas, such as the Maldives, the Nile Delta in Egypt, and Bangladesh. In Europe, some 70 million coastal dwellers would be at risk. Even further away from the coast, sea water would penetrate and contaminate agricultural soil and freshwater supplies.

- If the huge Greenland ice sheet melts, which might happen over the next few centuries, sea levels could rise by as much as seven metres.

- Climate change causes extreme weather events, such as storms, floods, droughts and heat waves. In the last decade, there were three times more weather-related natural catastrophes — mostly floods and windstorms — in the world than in the 1960s. These disasters not only create a lot of damage, they also drive up insurance costs.

- Water is already scarce in many regions of the world. Almost a fifth of the world population, 1.2 billion people, do not have access to clean drinking water. If global temperatures increase by 2.5° Celsius above pre-industrial levels, an additional 2.4 to 3.1 billion people worldwide are likely to suffer from water scarcity.

- A 2.5° Celsius temperature rise would also leave 50 million people at risk of hunger, in addition to the 850 million people suffering from chronic hunger today. In Europe, the growing season lengthened by ten days between 1962 and 1995. While this has been beneficial for agriculture in northern Europe, even there yields will start declining once temperatures rise beyond 2° Celsius above pre-industrial levels.

- Tropical diseases like malaria might spread because the area where the climate conditions are suitable for the malaria-carrying mosquito will expand. A 2° Celsius temperature increase could put 210 million more people at risk.

>>>

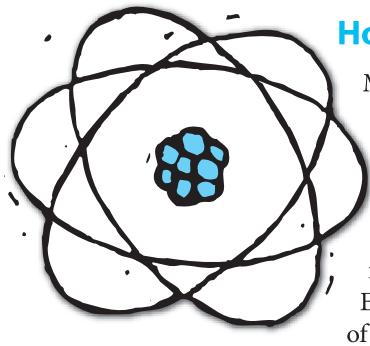
- From around 2070 onwards, Europe could experience a heatwave like in 2003 every second year. The scorching summer of 2003 contributed to the premature deaths of 20 000 Europeans, set off large-scale forest fires in southern Europe and caused agricultural losses of more than EUR 10 billion.

- Many animals and plants will not be able to cope with changed temperatures, or to move to regions where the climate is suitable for them. One alarming study finds that climate change could lead to the extinction of a third of the Earth's species by 2050. Cold weather mammals and birds like polar bears, seals, walruses and penguins are especially vulnerable. In the Amazon forest, scientists have noted that bigger, faster-growing trees that absorb more CO_2 are flourishing at the expense of others.

- In the long term, widespread climate change could trigger regional conflicts, famines and movements of refugees as food, water and energy resources become scarce.

- Another worst-case scenario would be the shutdown of the Gulf Stream that carries warm water northwards in the Atlantic — a storyline used in the 2003 movie *The Day After Tomorrow*. While this is unlikely to happen during this century, scientists agree that it would annul the warming trend in northern Europe and result in much colder weather there ([1]).

([1]) This and many more interesting facts and figures are from the European Environment Agency report 'Impacts of Europe's changing climate', August 2004, available at: http://reports.eea.eu.int/climate_report_2_2004/en, and the European Commission's background paper 'Winning the battle against climate change', February 2005, to be found at: http://www.europa.eu.int/comm/environment/climat/pdf/staff_work_paper_sec_2005_180_3.pdf



How climate scientists work

Modern climate science is all about studying the past and accurately observing and interpreting what is happening now.

Scientists use a surprising array of sources to find out about past conditions. For example, they drill through the top of the ice caps at the poles down to the bedrock and extract ice cylinders known as ice cores. In the Antarctic, a team of European researchers recently removed ice cores from a depth of more than 3 km, which have not been touched by light or air in more than 900 000 years (1)!

The physical properties of the ice and the air contained in small bubbles tell the researchers what the climate and atmosphere were like at that time. Other sources that provide clues about the past are the rings in trees and corals from ancient times, stalagmites, and old pollen, seeds and leaves.

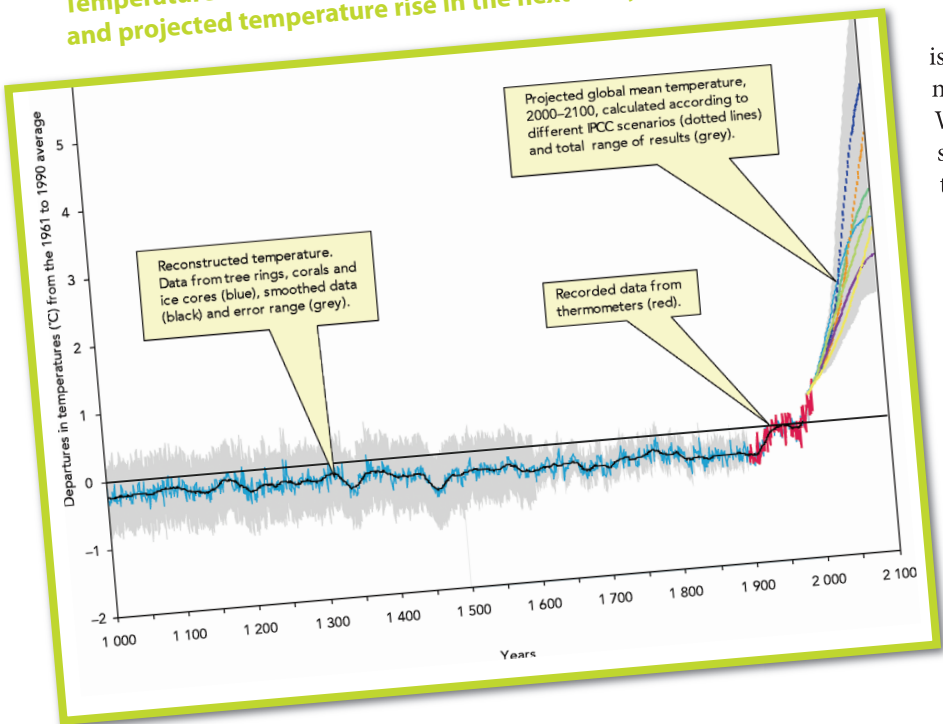
Based on these studies, we know that ice ages have alternated with warmer periods, and that temperatures on Earth have moved up and down between about 9° and 22° Celsius (current average global temperature is 15° Celsius). These fluctuations were due to natural causes, such as variations in the Earth's orbit around the sun and in the Earth's axis, changes in the sun's activity and volcanic eruptions.

For the past 8 000 years, the climate has been fairly stable, with small changes of less than 1° Celsius per century. These stable conditions have enabled society and ecosystems as we know them today to develop. But now things are hotting up fast. Natural causes alone cannot account for such rapid warming, which is unprecedented for at least 1 000 — some studies say 2 000 — years.

Much of the information that scientists have discovered is used to predict future climate and the effects of climate change. This

(1) For more information about this European project called EPICA, go to http://www.esf.org/esf_article.php?activity=1&article=85&domain=3

Temperature over the last 1 000 years (northen hemisphere) and projected temperature rise in the next 100 years



Source: European Environment Agency

is done through computer modelling and simulations. We are not talking about simple PCs — the computers that are used to look 100, 200 or 300 years into the future are complex systems that take in many variables. For example scientists still do not know exactly *how* sensitive our climate is to the rising greenhouse gas concentrations, that is which concentrations trigger which temperature changes. This also depends on other factors like air pollution and cloud formation. So, the scientists run simulations based on different presumptions.

They must also make many other presumptions, for example how much fossil fuel we will burn in the future, how many people will live on Earth, and how economies will develop. This is why all projections of future climate developments operate within ranges.

In 1988, the United Nations set up the Intergovernmental Panel on Climate Change (IPCC), which brings together thousands of scientists from around the world. Their task is to assess existing research and knowledge about climate change and its effects, and to report on it. So far, the IPCC has published three reports — in 1990, 1995 and 2001. From all the available evidence, the IPCC has concluded that greenhouse gas concentrations in the atmosphere have increased mainly as a result of human activities. It is also the IPCC's assessment that temperatures will rise by between 1.4° and 5.8° Celsius by 2100 (see p. 7).

What needs to be done to curb climate change?

Quite simply: we need to reduce emissions of greenhouse gases into the atmosphere. Some greenhouse gases are long-lived, which means that they stick around in the atmosphere for decades or even longer. Even if we take firm action now, temperatures will continue to rise for a while. However, if we do not take any action, temperatures will increase even more, and at some point the climate could spiral out of control.

Reducing our greenhouse gas emissions will require investments and changes to how we produce and use energy. Recent studies find that the price of doing nothing would be much higher because of the damage and suffering that unconstrained climate change would cause.

What governments are doing

In the 1980s, evidence of climate change was mounting. Governments realised how big a threat climate change was and that they had to do something about it. They also realised that they had to work together to have a chance of success. Climate change is a global issue because all countries contribute, in varying degrees, to greenhouse gas emissions, and all countries are affected by it. So no country can solve the problem on its own.

The UN Framework Convention on Climate Change

In 1992, governments agreed the United Nations Framework Convention on Climate Change (UNFCCC). So far, this international agreement has been formally accepted by 189 countries — almost all the countries in the world. The ultimate objective of this Convention is:

> *the stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic [human-induced] interference with the climate system. Such a level should be achieved within a timeframe sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and*

to enable economic development to proceed in a sustainable manner.

Under the Convention, the 189 governments monitor and report the greenhouse gases they produce, develop climate change strategies, and help the poorer among them address climate change. They meet once a year to discuss things and decide what to do next. The Convention was designed as an umbrella under which more action would be agreed in the future.

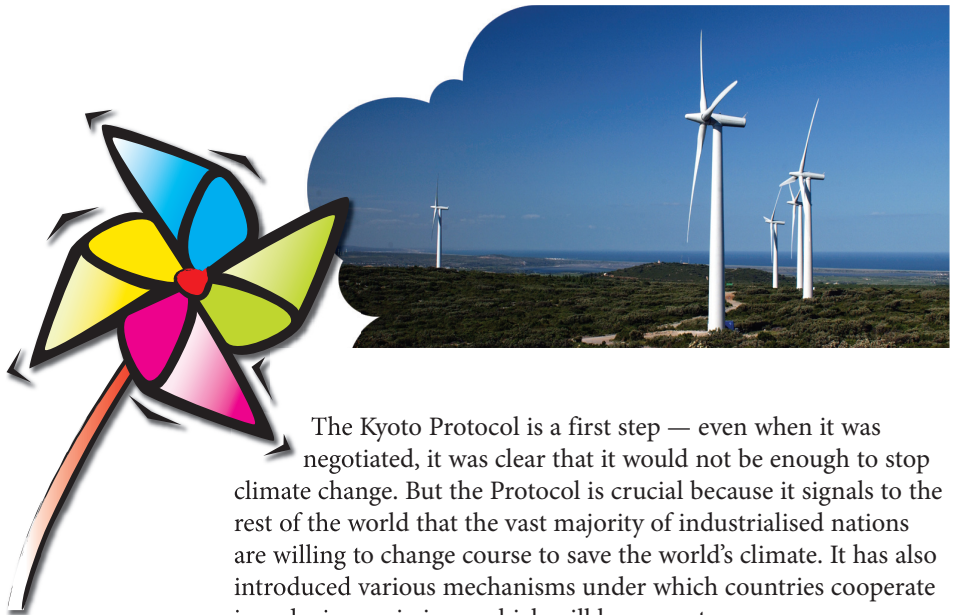
The Kyoto Protocol

In 1997, in the Japanese city of Kyoto, the governments took the next step and agreed the important Kyoto Protocol. This treaty commits the industrialised countries among them to reduce or limit their greenhouse gas emissions and reach certain emission targets by 2012. For each country, there is a target.

The Kyoto Protocol focuses on industrialised countries because they are responsible for most of the past and current greenhouse gas emissions and have the knowledge and money to reduce them. For example, the amount of greenhouse gases produced in the EU is 11 tonnes per citizen every year, while developing countries produce only around 1 tonne per citizen each year.

The Kyoto Protocol came into legal force on 16 February 2005. So far, 150 governments, including all 25 EU countries, have formally adopted it (1). Thirty-six are industrialised countries and have Kyoto targets, most of which require greenhouse gas reductions of 5 to 8 % from 1990 levels by 2012. Only the US and Australia have decided not to participate in the Kyoto Protocol although they had initially planned to do so.

(1) The status of the number of ratifications is as of 29 April 2005.



The Kyoto Protocol is a first step — even when it was negotiated, it was clear that it would not be enough to stop climate change. But the Protocol is crucial because it signals to the rest of the world that the vast majority of industrialised nations are willing to change course to save the world's climate. It has also introduced various mechanisms under which countries cooperate in reducing emissions, which will lower costs.

What the EU is doing

The European Union is at the forefront of the global fight against climate change. It is convinced that as a major economic power it has a duty to lead by example.

During the negotiations of the Kyoto Protocol, the 15 countries that made up the EU at the time (marked in yellow, see box next page) took on a particularly ambitious target: to reduce their collective greenhouse gas emissions by 8 % below 1990 levels until 2012. They then decided how much each of them should do for this collective target to be reached, taking into account the economic situation and industrial structure of each country. Most have to reduce their emissions, but some are allowed to increase them up to a certain limit, while others must keep their emissions at the same levels as in 1990.

The ten countries that joined the EU on 1 May 2004 (marked in blue) have individual targets under the Protocol with the exception of Cyprus and Malta, which have no targets.

Kyoto Targets in the EU

EU Member States sharing an 8 % reduction target under the Kyoto Protocol	
Austria	–13 %
Belgium	–7.5 %
Denmark	–21 %
Finland	0 %
France	0 %
Germany	–21 %
Greece	+25 %
Ireland	+13 %
Italy	–6.5 %
Luxembourg	–28 %
Netherlands	–6 %
Portugal	+27 %
Spain	+15 %
Sweden	+4 %
United Kingdom	–12.5 %

EU Member States with individual targets under the Kyoto Protocol	
Czech Republic	–8 %
Estonia	–8 %
Hungary	–6 %
Latvia	–8 %
Lithuania	–8 %
Poland	–6 %
Slovak Republic	–8 %
Slovenia	–8 %

In March 2000, the EU launched the European Climate Change Programme (ECCP). Together with representatives from industry, environmental associations and other interested groups, the EU has identified 42 measures that will help its member states reduce their greenhouse gas emissions in a cost-effective way. All these measures have already become law or are in the process of being adopted.

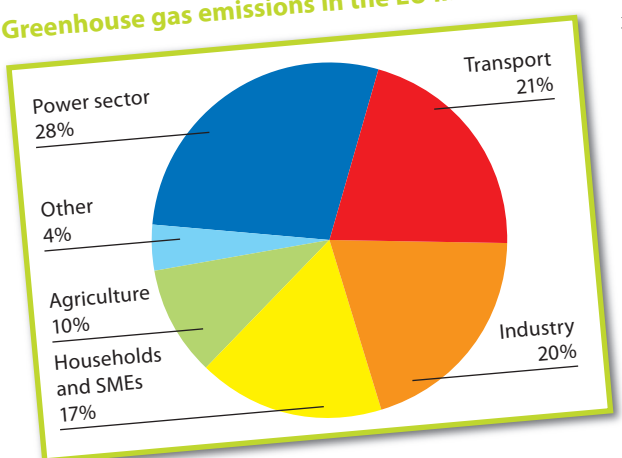
A cornerstone of EU climate change policies is the EU's emissions trading scheme launched on 1 January 2005. EU governments have set limits to how much CO_2 some 12 000 power plants and energy-intensive factories are allowed to emit per year. These plants account for almost half of the EU's CO_2 emissions. Those plants that emit less CO_2 than they are allowed to can sell the unused emission quotas to other factories that are not doing that well. This provides for a financial incentive to reduce emissions. The system also makes sure that there are buyers for the emission allowances. Companies that exceed their emission limits and do not cover them with emission rights bought from others will have to pay hefty penalties. The emissions trading scheme will make

sure that emissions are cut where it is cheapest, and lower the overall costs of reducing emissions.

Other ECCP measures are, for example, aimed at improving the fuel-efficiency of cars and the energy efficiency of buildings (better insulation can reduce heating cost by 90 %!); increasing the use of renewable energy sources, such as wind, the sun, tidal power, biomass (organic material such as wood, mill residues, plants, animal droppings, etc.) and geothermal power (heat from hot springs and volcanoes); advancing combined heat and power generation because this requires less energy; controlling the fluorinated greenhouse gases used in air conditioning; reducing methane emissions from landfills; raising awareness; and strengthening research and the development and use of climate-friendly technologies.

Many climate-friendly technologies already exist and only need to be further improved to be widely used. For example, it is possible to capture some of the carbon released when fossil fuels are burnt and then bury it in old mines or former oil fields. This technology is called 'carbon capture and storage' and reduces CO_2 emissions into the atmosphere. Another promising technology, which, however, requires considerably more research, is the production of hydrogen from renewable energies and its use in 'fuel cells'. The fuel cell converts the hydrogen with oxygen into water, and in the process it produces electricity.

Greenhouse gas emissions in the EU in 2001



Source: European Environment Agency

The EU is on course to reach its Kyoto targets for 2012 if all the measures planned by the EU and its member states are implemented. By 2002, the most recent year for which data were available when this booklet was written, the former 15 EU countries had reduced their greenhouse gas emissions by 2.9 % compared to 1990 levels (their Kyoto target is 8 %). Together, the 25 EU countries had reduced their emissions by 9 %.

What businesses are doing

Companies are playing an important role in the fight against climate change. They are coming to understand that by cutting their greenhouse gas emissions they not only protect the climate, but can also save money, earn good publicity, and gain an advantage over their competitors.

For example, a big multinational company manufacturing a wide range of products in different regions of the world has, since 1990, saved EUR 1.5 billion by reducing energy consumption and installing new climate-friendly technologies in its factories. In addition, it saves EUR 7 to 11 million annually through the use of renewable energy. With these measures, it has reduced its greenhouse gas emissions by 67 % since 1990 (1).

The associations of European, Japanese and Korean car manufacturers have voluntarily committed themselves to reducing the average CO_2 emissions of new passenger cars sold in Europe by roughly a quarter from 1995 levels by 2008 (European carmakers) or 2009 (Japanese and Korean carmakers).

The development of climate-friendly technologies also creates new jobs and opens up new markets. Thanks to support schemes for wind power in several EU countries, European companies now supply 90 % of the booming global market for wind power equipment. In Germany, introducing wind power has generated work for 40 000 people.

If European companies are quick in developing new climate-friendly technologies, they will have a competitive advantage when global demand for such technologies rises.

(1) See 'Less is more: 14 pioneers in reducing greenhouse gas emissions' by the Climate Group, a coalition of organisations committed to reducing their greenhouse gas emissions. Document available at http://www.theclimategroup.org/tcg_lessmore.pdf

What *you* can do

Climate change is a global problem, and yet each of us has the power to make a difference. Even small changes in our behaviour can help prevent greenhouse emissions without affecting our quality of life. In fact, they can save us money.

- Recycle things. Recycling 1 kg of old aluminium cans consumes ten times less energy than producing them from scratch, and factories use far less energy to make paper from old newspapers than from wood pulp.
- When you make a hot drink, just boil the amount of water you need.
- Save hot water by taking a shower rather than a bath — it requires four times less energy.
- Don't forget to switch off the lights when you don't need them. Households are responsible for 30 % of the electricity consumption in the EU, so if we all save electricity, it will make a big difference.
- If you buy new light bulbs, try energy-savings ones — they last longer and use five times less electricity than conventional bulbs.
- Don't leave your TV, stereo and computer on standby – this is the mode when a little light is still on. On average, a TV set uses 45 % of its energy in standby mode. If all Europeans avoided the standby mode, they would save enough electricity to power a country the size of Belgium.
- Also, don't leave you mobile phone charger plugged in when you are not charging your phone. If you do, 95 % of the electricity is wasted – only 5 % is used to actually charge your phone.
- If you or your parents buy a new electrical appliance, for example a fridge or a washing machine, make sure that it is graded 'A' under the European energy-efficiency label, which every appliance must carry. 'A' certifies that it is very efficient in energy use.
- Look for goods with the European eco-label, symbolised by a little flower (see top left corner of this box), in shops and supermarkets. This means they have been manufactured under strict environmental standards.
- Don't overheat your home. Reducing the temperature by just 1° Celsius can cut up to 7 % off your family's energy bill.
- When you air your room, leave the window wide open for a few minutes and then close it again, rather than letting the heat escape over a long period.
- Private cars are responsible for 10 % of the EU's CO_2 emissions. Public transport, cycling and walking are cheaper and healthier alternatives.
- If your parents are about to buy a new car, ask them to buy a small and fuel-efficient model. Under European legislation, car manufacturers must display information about how much CO_2 their cars emit.
- Flying is the world's fastest-growing source of CO_2 emissions. For distances of a few hundred kilometres, use alternatives such as trains and buses.
- Plant a tree at school, in your garden or neighbourhood. Five trees typically soak up around 1 tonne of CO_2 throughout their lifetime.

Looking to the future

The European Union is convinced that we can cut our greenhouse gas output and go on improving people's standards and quality of life at the same time. The two are not incompatible. But it will mean making adjustments to the way we live and how we produce and use energy.

European leaders have agreed that global temperatures should not be allowed to rise by more than 2° Celsius above pre-industrial levels — because if they did, there would be a much greater risk of diminished food and water supplies and environmental disasters in the world. To reach the 2° goal, far-reaching action will be needed after 2012, the year by which the Kyoto Protocol targets are to be met.

It may be necessary that industrialised countries reduce their greenhouse gas emissions, from 1990 levels, by around 15–30 % by 2020, and by 60–80 % by 2050. But it is also important that developing countries that are doing well economically participate in a future agreement because their emissions are rising fast.

International discussions about the future climate change regime are starting now. The European Commission has already published a paper outlining some basic elements that the new regime should include, such as broad participation by all countries that emit a lot of greenhouse gases, and a determined push for new climate-friendly technologies.

Climate change won't disappear immediately, but the sooner we all become aware of it and take action against it, the better we will be able to take control of our destiny, live comfortably, and protect all the beauty and diversity of our planet for the future.

Useful websites on climate change:

European Commission, Directorate-General for the Environment
http://www.europa.eu.int/comm/environment/climat/home_en.htm

European Environment Agency
http://themes.eea.eu.int/Environmental_issues/climate

United Nations Framework Convention on Climate Change and Kyoto Protocol
http://unfccc.int/2860.php

Intergovernmental Panel on Climate Change
http://www.ipcc.ch/

United Nations Environment Programme
http://www.unep.org/themes/climatechange/

The Climate Group
http://www.theclimategroup.org

WWF
http://panda.org/about_wwf/what_we_do/climate_change/index.cfm

Greenpeace
http://www.greenpeace.net/climate.htm

Copies of this publication can be ordered or downloaded via the following link:
http://europa.eu.int/comm/environment/pubs/home.htm

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