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Climate and Energy

Information booklet

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Introduction

Welcome to World Wide Views on Climate and Energy.

We have invited you to take part in World Wide Views on Climate and Energy because political leaders need to learn about your views on what should be done about climate change. We look forward to hearing your opinion and making your views known to decision makers and to the public.

Climate change has impacts for almost all people around the world. We are already experiencing climate change in all continents, and changes in weather that could be a result of climate change. Our children and grandchildren may live to experience more dramatic consequences. Politicians may determine the future of the planet, but you, as a citizen, and your children, will have to live with the consequences. Therefore, your opinion is important.

At the World Wide Views meeting you will share your views with fellow citizens. This booklet provides basic information about the science of climate change and different points of view on how to deal with it. The booklet will serve as common ground for the discussions at the World Wide Views consultation. It focuses on issues which countries will negotiate at a major climate conference in Paris in December, 2015. Science informs us. It does not tell us what to do. The choice is ours. Have your say.

How to read the document

This paper has five parts. We have tried to use simple language; however, the issues are complicated.

The **first** part is a general introduction to climate change, its consequences and the need to shift to a low carbon economy. It explains the current and future impacts, causes, and risks. What is climate change? Is it caused by humans? What is the greenhouse effect? What is known about the impacts of climate change in different parts of the world? Are there risks of climate change getting out of control?

The **second** part is about tools to tackle climate change. Here we look at the cost of cutting carbon emissions. Some steps seem like common sense, because they save energy and cut air pollution, too. But tackling climate change may make energy more expensive. Would you be willing to pay that price?

The **third** part is about the role of the United Nations, and of the climate negotiations. What is on the table at the UN climate conference in Paris at the end of this year? Countries have been talking about climate change for more than 20 years. What difference can Paris make? One question is whether all countries should agree a global target to slash greenhouse gas emissions. Would this help, and can they agree to this?

The **fourth** part is about how to make sure that each country does its fair share. Some rich countries have contributed more to the problem of climate change, by burning fossil fuels for centuries. But now some developing countries are developing rapidly, so how should efforts to limit climate change be distributed in a fair manner? Should rich countries pay the rest of the world to develop cleaner energy? If so, how much should they pay, and who should receive the money?

The **fifth** part is about how to make sure that countries keep their promises and encourage them to give new ones. Should countries be allowed to inspect each other's climate action? Should anyone inspect them?

Scientific knowledge

Scientists all over the world have worked for many years to explore all aspects of climate change, and to figure out how much of the change observed is caused by human activity.

Scientists also work hard to make clear what we actually know, and what we do not know, so we can all make informed decisions about what to do next.

The Intergovernmental Panel on Climate Change, IPCC, is the authoritative source for such knowledge. It was formed by decision of the UN General Assembly in 1989 to provide scientific advice for decision-makers. The IPCC regularly examines and assesses the scientific contributions of thousands of scientists. Its main conclusions are approved by scientists and government representatives. Membership of the IPCC is open to all countries which are also members of the World Meteorological Organisation and the UN Environment Programme.

According to the IPCC, the world is definitely warming up. It is extremely likely (at least 95 percent probability) that human-made greenhouse gas emissions caused most of the global warming since 1950, the IPCC says. Future climate change can be described only within a range of uncertainty, however.

The 195 countries which are party to the UN Climate Convention say that they want to limit global average warming to less than 2 degrees Celsius. To achieve this, the IPCC tells us that the world must reverse by 2020 a trend of growing greenhouse gas emissions.

This paper largely builds on the latest assessment report from the panel, published in 2013 and 2014. The wording and simplifications, however, are solely our own responsibility.

How this document was produced

The information booklet has been written by journalist and analyst Gerard Wynn in close cooperation with the Danish Board of Technology, which coordinates World Wide Views on Climate and Energy in collaboration with Missions Publiques and the French National Commission for Public Debate. A Scientific Advisory Board has been established to review whether the information given in this booklet is accurate, sufficient, and balanced, considering the questions that you are invited to deliberate on.

To test if the information was relevant, well balanced, and easy for lay people to understand, four focus group interviews were carried out in Japan, The United States of America, France and Uganda.

Copenhagen, May 2015

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Glossary of words

Adaptation – action to prepare for climate change, such as strengthening flood defences

Carbon dioxide– the greenhouse gas most responsible for climate change, and is produced from burning fossil fuels

Climate change – refers to the impacts we will see as the world warms up, such as more droughts and floods

Fossil fuels – include coal, oil and natural gas, which we burn to generate energy for transport, heating and electricity; burning them emits the greenhouse gas carbon dioxide

Global warming – global average surface temperatures have risen by nearly 0.9 degrees Celsius in the past 150 years

Greenhouse gas – block heat from the Earth radiating back into space, and so are warming up the planet

IPCC – the Intergovernmental Panel on Climate Change, a United Nations panel which produces a major assessment of climate change every six years or so, written by hundreds of climate scientists

Kyoto Protocol – agreed in 1997, and the first climate agreement which set targets for countries to cut greenhouse gas emissions

Loss and damage – damage caused by climate change, for example as a result of droughts, floods and sea level rise

Mitigation– action which cuts greenhouse emissions, and so reduces the risks from climate change

COP – Conference of the Parties (COP) to the UN's Convention on Climate Change, an annual meeting where senior country representatives and leaders take decisions on climate action

COP21 – the 21st Conference of the Parties (COP), in Paris later this year

Paris agreement – a major new agreement on climate change, which countries are expected to reach in Paris at the end of 2015

Renewable energy – energy derived from sources which cannot run out, such as wind, solar, geothermal and hydro power, which are also often very low or zero carbon emitting

UNFCCC – the United Nations Framework Convention on Climate Change (UNFCCC), which countries agreed in 1992

1. Importance of tackling climate change

What is the greenhouse effect?

Every day, sunlight passes through the Earth's atmosphere, and warms up the surface of our planet. As the planet's surface warms, it creates heat. Some of this heat is radiated back, through the atmosphere, into outer space. Not all of this radiated heat escapes into space, however. Greenhouse gases in the atmosphere absorb some of it, stopping it from escaping.

In the past century and a half, levels of greenhouse gases in the atmosphere have risen dramatically, by more than two fifths. Our planet is now absorbing more energy from the sun than is escaping back into space. As a result, the Earth is warming up.

The main greenhouse gas emitted by human beings is carbon dioxide (CO₂). People release carbon dioxide into the atmosphere when they burn fossil fuels such as coal, oil and gas. We burn these fossil fuels to produce energy, for example to generate electricity, and for transport and heat. Carbon dioxide is also released into the atmosphere when we burn trees, for example to clear land for farming.

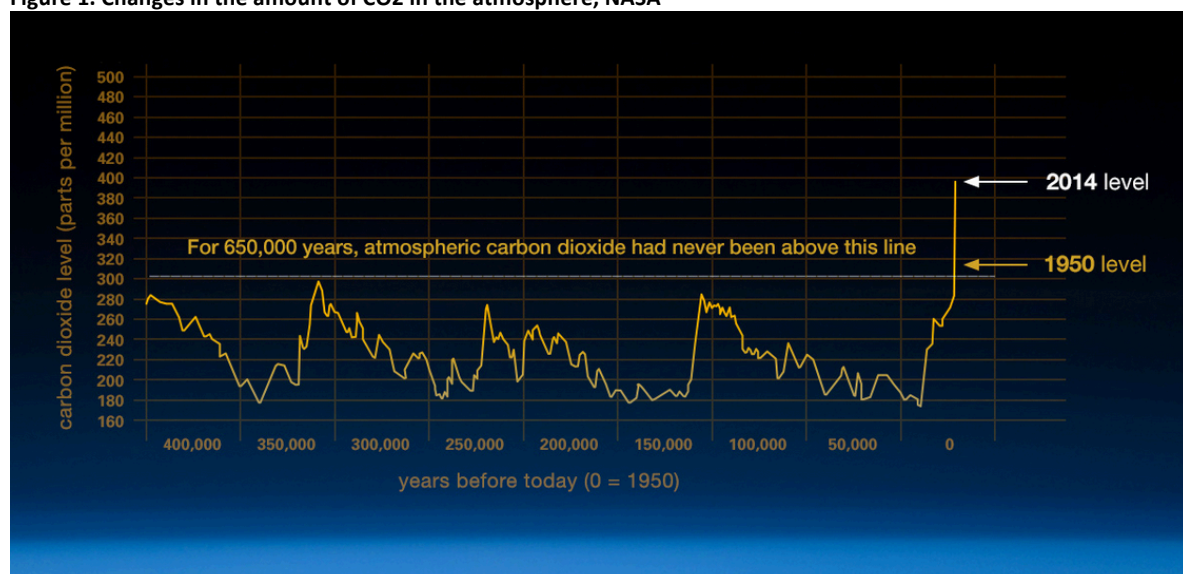
Other important greenhouse gases include nitrogen oxides from the production and use of artificial fertilisers in farming. Methane is a powerful greenhouse gas, which is emitted from rotting waste and farm animals. It is also the main ingredient of natural gas, and so may be emitted by the oil and gas industry. Finally, other strong greenhouse gases, called fluorinated gases, are used in fridges and air conditioners.

Greenhouse gases are also produced naturally. For example, carbon dioxide is emitted from the soil, volcanoes and wild fires. But scientists are in no doubt that it is human activities that are responsible for rising carbon dioxide levels in the atmosphere now.

Why is the greenhouse effect a growing problem?

Since the eighteenth century, richer countries have grown their economies by generating energy from burning fossil fuels, to power engines and machines. As a result of this industrialisation, the human race has emitted nearly 2,000 billion tonnes of carbon dioxide in the past few centuries.¹ These carbon emissions are still rising almost every year.² Our annual carbon dioxide emissions are now at an all-time record level of nearly 40 billion tonnes per year. Carbon dioxide is at its highest level in the atmosphere for at least the past 650,000 years (see Figure 1)³.

Figure 1. Changes in the amount of CO₂ in the atmosphere, NASA⁴

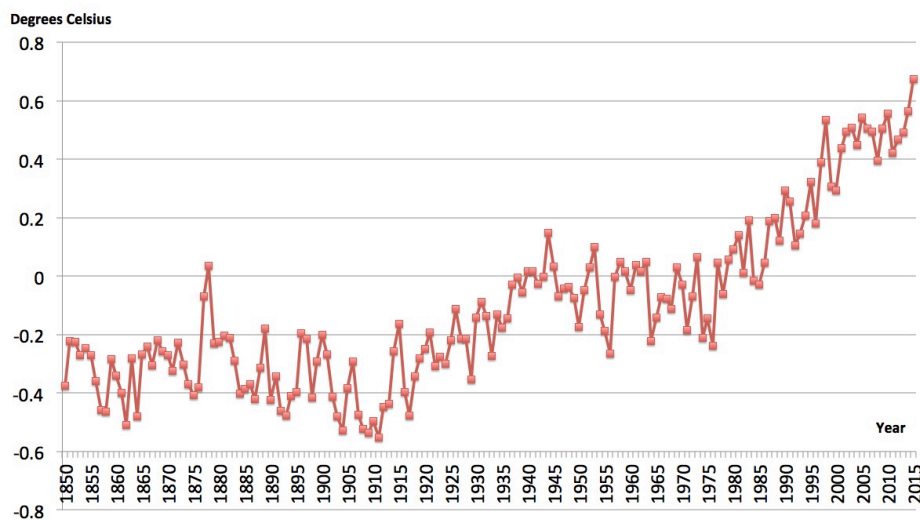


Because of these rapidly growing greenhouse gases, the world is warming up (see Figure 2). Scientists say that 2014 was the hottest year since modern records began, around 1850. Fourteen of the 15 hottest years have been in the 21st century.

Since 1850, global average surface temperatures have risen by nearly 1 degree Celsius (°C). That does not sound like a lot, but the Earth's history shows that small differences in average temperature are very important. For example, 4°C was the difference between the last ice age and the present day. Global sea levels are now about 100 metres higher than in the last ice age.⁵

It is extremely likely that the warming we have seen in the past few decades was mostly caused by human greenhouse gas emissions, according to the Intergovernmental Panel on Climate Change (IPCC).⁶ The IPCC is a UN body which advises governments about the science of climate change. The IPCC was established in 1988. It publishes a major assessment of climate change every six years or so. Its last review, published in 2013 and 2014, was written by more than 800 climate scientists.⁷

Figure 2. Global average surface temperature, 1850 to Feb. 2015, degrees Celsius (difference compared with 1961-1990)⁸



What is climate change?

Global warming will change the climate in different ways. See Box 1 for some changes that are happening in different parts of the world, which scientists say may be due to human interference with the climate. Box 1 also lists some of the changes that scientists expect this century, unless there is determined effort to cut greenhouse gas emissions.

One change will be more extreme weather. As global temperature rises, extreme heat waves and droughts will become more frequent.⁹This is already happening, scientists say. Also, a warmer atmosphere can hold more water vapour, which will lead to more frequent, very heavy rainfall events. This may lead to more flooding.¹⁰

Another change is sea level rise. As the world gets warmer, ice will start to melt. That includes both ice sheets and glaciers, which are attached to the land, and sea ice, which floats on the sea. Melting of ice sheets and glaciers will cause sea levels to rise. Glaciers around the world are already shrinking. The ice sheet on top of Greenland is now melting much more rapidly than 10 years ago.¹¹Scientists say that sea levels are now rising by about 3 centimetres every decade, which is twice the rate of the last century. Sea levels could rise by up to 1 metre this century, if emissions keep rising.¹²

As for sea ice, in the Arctic, this shrank to a record low in the summer of 2012. That has made it more difficult for Inuit people to hunt and travel.¹³But melting sea ice does not increase sea level rise. Meanwhile, in Antarctica, sea ice extent is actually increasing. That has led some people to doubt that there is a big problem.

Climate scientists say that Antarctic sea ice is increasing because vast ice sheets, some which are underwater, are melting more quickly, making the sea colder.¹⁴

START BOX

Box 1. Examples of climate impacts by region

Here are just a few examples of changes that are already happening around the world, which scientists say may be due to human greenhouse gas emissions. Also listed are further impacts expected later this century, if people fail to cut greenhouse gas emissions urgently.¹⁵

Africa: Already happening: less water in West African rivers; decline in coral reefs in tropical waters; decline in fruit production in the Sahel; spread of malaria in Kenyan highlands; lower production of fish in the Great Lakes. **Expected this century:** failed crops as a result of heat and drought stress.

Europe: Already happening: retreat of glaciers; earlier spring; increased colonisation of alien plant species; northward shift of fish and seabirds; **Expected this century:** more river flooding; reduced water availability in southern Europe; health impacts from more frequent extreme heat waves.

Asia: Already happening: shrinking glaciers; less water availability in northern China; northward movement of many plant and animal species. **Expected this century:** increased river and coastal flooding; increased drought-related food shortages and malnutrition.

Australasia: Already happening: southward movement of marine species near Australia; increased coral bleaching in the Great Barrier Reef. **Expected this century:** increased flood frequency; risks to low-lying coastal infrastructure from sea level rise in Australia and New Zealand.

North America: Already happening: shrinking glaciers; more frequent wildfires; increases in tree death from drought; northward shift of Atlantic fish species. **Expected this century:** more heat-related deaths; more frequent extreme rainfall and cyclones; more severe wildfires.

Central and South America: Already happening: increased forest fire in the Amazon; water shortages for farmers in Bolivia; higher agricultural yields in southern South America. **Expected this century:** deteriorating water availability; more floods and landslides; lower food production.

Polar regions: Already happening: melting of permafrost and Arctic sea ice; increased shrub cover in Arctic tundra; increased coastal erosion across the Arctic; declines in Southern Ocean seals and seabirds. **Expected this century:** more damage to infrastructure as a result of melting ice.

Small islands: Already happening: declining fisheries as a result of coral reef bleaching; invasion of seawater into groundwater supplies. **Expected this century:** low-lying coastal areas threatened by sea level rise and extreme storms, leading to a loss of livelihoods and coastal settlements.

END BOX

Can we be so sure about climate change?

A small minority of scientists, sometimes called “sceptics”, say that the climate change problem may not be as big as feared. Some of them doubt that human climate change is real at all. They have some arguments, a few of which we describe here.

ARGUMENT 1: “Climate change is a hoax.”

The U.S. Republican senator, James Inhofe, famously described climate change as a political hoax, meant to increase the power of central government over citizens. He argues that climate change is a theory, which central government is trying to use to increase taxes.

However, the theory of the greenhouse effect is well understood. Scientists first proposed it more than a century ago. And in the 1940s, they demonstrated how atmospheric carbon dioxide absorbs heat. Scientists are almost sure that the world is warming because of greenhouse gas emissions.

ARGUMENT 2: "Warming has slowed down recently, showing that the whole problem was exaggerated."

Some sceptics point out that global temperatures have risen much more slowly since around 1998, which was a very hot year, compared with the 1980s and early 1990s. They say that in the past 15 years or so, people have emitted hundreds of billions of tonnes of carbon dioxide into the atmosphere, but the temperature has hardly risen at all.

Scientists are not completely sure why warming has slowed down. Recent studies suggest that the oceans may be responsible.¹⁶ It may be that ocean cycles have transferred some heat from the Earth's surface into the deep oceans. The deep oceans can hold much more heat than the air, and they have continued to warm up.¹⁷ Last year, 2014, was still the warmest year on record.

ARGUMENT 3: "Global warming is a natural cycle which we don't fully understand."

Some sceptics point out that lots of natural factors impact the climate. The sun has cycles of activity which can change the temperature. Volcanoes cause cooling, by spewing soot and dust into the atmosphere, which darken the Earth's surface. Ocean currents transfer heat. The world's climate is a complicated system, and some sceptics say that it may be too early to be sure that greenhouse gases are responsible for global warming. After all, there are all these other factors to consider, too.

It is true that natural factors influence the climate. And these natural effects do make it more difficult for scientists to understand the exact impact of greenhouse gases on the Earth's climate. But climate scientists say that greenhouse gases explain most of the recent rise in temperatures.

ARGUMENT 4: "Warming we are seeing now is not unusual; look at the Middle Ages"

Scientists can estimate the Earth's climate from many centuries ago. For example, they can use tree rings from very old trees to work out how quickly they grew. They can also use information locked up in polar ice, to estimate the temperature in the distant past. Such information suggests that about 800-1000 years ago, there were periods when some regions of the world were nearly as warm as today. Scientists are unsure what caused that "Medieval Warm Period". However, they find no link with warming today, which is global, not regional.

Can climate change be beneficial?

Limited climate change may have some benefits at higher latitudes. In northern countries, for example, warming could extend the crop-growing season, while milder winters will reduce cold-weather deaths. In addition, some crops will grow faster as carbon dioxide levels rise. That is because carbon dioxide is a vital ingredient in the process of photosynthesis, which plants use to grow.

But the message is a little more complicated. While plants do need carbon dioxide, scientists have found that such faster growth is not all good. While yields may go up, these crops may have less nutritional value. Scientists have found they have less protein, and lower levels of important nutrients.¹⁸

In addition, benefits in northern countries must be weighed against damage to health and crops, in the same countries, for example as a result of more floods, droughts and heat waves. Meanwhile, in tropical countries,

people are poorer and may be less able to cope with climate change that is already happening. The overall effect of climate change will be increasingly negative this century.¹⁹

How will climate change affect our way of life?

Without cuts in greenhouse gas emissions, scientists expect climate change to damage infrastructure, food and water supplies and human health. For example, cities are vulnerable to damage from storm surges and sea level rise. Most large cities are near the coast and below 10 metres altitude.²⁰ Regarding impacts on food supplies, recent experience shows that there is a link between extreme heat waves and global malnutrition. For example, a Russian heat wave in 2010 destroyed the country's wheat crop, prompting it to ban grain exports. As a result, world food prices rose, pushing 44 million people below the poverty line across 28 countries.²¹ Climate change had increased the chance of the Russian heat wave.²²

By threatening the most basic human needs, including food, water and shelter, climate change may have bigger social effects, for example triggering mass migration, unrest and conflict. Some researchers have made a link between climate change, drier weather in the eastern Mediterranean and war in Syria (see Box 2).

START BOX

Box 2. Did climate change contribute to the Syrian conflict?

Syria experienced its worst recorded drought from 2006 to 2011.²³ In 2008 alone, rainfall in eastern Syria was 70% below the annual average, devastating the wheat crop and contributing to the migration of up to 1 million people to nearby cities.²⁴ This migration led to unemployment, hunger and unrest, and contributed to the start of civil war in 2011.²⁵

A recent study used climate observations and models to calculate that human greenhouse gas emissions had contributed to a new, drying trend in the eastern Mediterranean. Climate change had made the Syrian drought two to three times more likely, the authors estimated. "We conclude that human influences on the climate system are implicated in the current Syrian conflict," they said.²⁶

END BOX

Can we simply adapt to climate change?

As people emit more greenhouse gases, the climate will change, as we have seen. To some extent, we can prepare for these changes. That is called adaptation. For example, we can prepare for storm surges by building stronger sea defences. And we can prepare for more extreme heat waves, by planting drought-resistant crops. We can also plan better disaster responses. We can prepare for heavy rain and floods, for example, with better weather forecasts and warning systems. Many of these steps make sense even without climate change. They help countries deal with natural disasters. And many will boost economic development and livelihoods, by improving education, healthcare and infrastructure.

Some people say that adaptation will be enough to fight climate change. They suggest that if we prepare well enough, we do not have to worry so much about cutting carbon emissions. They suggest that adaptation might be a cheaper option, at least for now. Such people may consider that in the meantime, we could try and find cheaper ways to cut carbon emissions, as technology improves. Cutting carbon emissions is called mitigation.

However, we have to cut greenhouse gas emissions urgently, if we want to avoid more dangerous effects, scientists say. Climate change is expected to get more dangerous above around 1-3°C warming. It will then become more difficult or expensive to adapt to. Here are some examples of climate change that will get worse

in coming decades, if we do not cut greenhouse gas emissions urgently. These changes may be difficult to adapt to:

Summer heat: The human body struggles to cool down, once air temperatures rise above about 35°C, in humid conditions. As a result, it is very difficult for people to work outside at all, during extreme heat waves. As these become more frequent, outdoor workers and businesses, such as farms and construction, will suffer.²⁷

Coral reefs: Warm-water corals would be severely damaged by bleaching (meaning that they turn white and die) above 2°C warming. The loss of coral reefs would make coastal communities more vulnerable to extreme weather and sea level rise, because reefs protect coastlines from big waves. The death of reefs would also deprive fishermen and tourism operators of their livelihoods.

Melting sea ice and permafrost: Permafrost is a thick layer of soil which stays frozen all year in Arctic regions. It supports polar infrastructure, including roads and buildings. As a result of melting permafrost and sea ice, some Alaskan villages have now become uninhabitable. For such people, the only adaptation is relocation, and that is already happening.²⁸

What has the United Nations done to tackle climate change?

Countries agreed in 1992 to do their best to avoid dangerous climate change. That agreement was called the United Nations Framework Convention on Climate Change (UNFCCC). Almost every country on Earth signed it, including all major economies and polluters.²⁹ Since 1992, countries have tried to take decisions on climate action.

In 1997, most countries agreed to the Kyoto Protocol. Kyoto only limited the greenhouse gas emissions of industrialised nations, from 2008-2012.³⁰ It excluded big emerging economies like China. The United States did not ratify it. And the targets were too easy for many former communist countries, like Russia. As a result, Kyoto did not limit the emissions of the world's top four polluters: China, the United States, India and Russia. Supporters of Kyoto say that it was a first blueprint for global climate action. They say that it was not perfect, but that it showed how the world could take decisions on difficult matters, like designing a system for nations to report their emissions, or establishing a global carbon market.

Since Kyoto, there have been other agreements. In 2010, countries made new targets for climate action in 2020.³¹ And all countries have agreed to try and launch a new agreement, in Paris at the end of 2015. A Paris agreement would set targets for climate action after 2020, either in 2025 or 2030.

In the UN climate talks so far, countries have spent a lot of time arguing about who should do most to tackle the problem. All UN decisions have to be reached by consensus, which has slowed down progress. Critics say that the talks have achieved too little, and that there must be a better way to deal with this problem, if climate change is a priority at all. They say that while countries have been talking about climate change, greenhouse gas emissions have risen fast. Cumulatively, from 1992 to 2013, countries have emitted about 600 billion tonnes of carbon dioxide from burning fossil fuels.³²

Supporters of the talks say that these have maintained a global focus on a serious, long-term problem, in a world where politicians are easily distracted by short-term issues, like the economy or war. Supporters say that the UN process has at least forced countries to do something. For example, the European Union has agreed on a series of domestic emissions cuts, driven by the United Nations agenda. And it appears that countries are poised this year to agree on global action in Paris, so now may not be the time to give up.

How urgently do we need to tackle climate change?

There is no quick fix. The deep oceans are still absorbing heat trapped by the greenhouse gases that we have already emitted. In addition, much of the carbon dioxide that we emit today will still be in the atmosphere

1,000 years from now.³³ Because of these two facts, we are storing up a problem which we cannot fix simply by stopping emissions. Even if we stop all emissions tomorrow, the world will take thousands of years to cool down again.³⁴ The longer it takes for the world to start cutting emissions, the more difficult it will be to tackle the problem.

All countries have agreed that they should take urgent action to limit warming to no more than 2°C.³⁵ Warming of 2°C is seen as one possible danger limit (see Box 3). So far, global average temperatures have risen by about 0.9°C, above pre-industrial levels.³⁶ Even if we stop emissions tomorrow, the world will warm by about another 0.6°C, scientists say, as seas continue to warm up.³⁷ Present trends in greenhouse gas emissions put us on course for warming of about 3-4°C this century.

If we want to limit warming to 2°C, scientists have calculated that the world can only emit about another 1,000 billion tonnes of carbon dioxide (CO₂). At present, we are emitting nearly 40 billion tonnes of CO₂ every year. At this rate, we have less than 30 years to go, if the world wants to have at least a two thirds chance of meeting the 2°C target. As a result, scientists calculate that annual emissions must stop rising by 2020, at the very latest. They must then fall twice as fast, every year, as they did during the worst year of the recent global financial crisis. That would require determined effort. In the longer term, global greenhouse gas emissions would have to halve by 2050, from present levels, and fall to around zero, or below, by 2100.

START BOX

Box 3. Is global warming above 2°C dangerous?

Climate scientists are sure that the world is warming up. And they are almost sure that it is caused by human greenhouse gas emissions. But how we define “dangerous climate change” partly depends on our personal viewpoint.

Some people might say that climate change is already dangerous. As we have seen, some Arctic communities are already affected by melting sea ice. And even if we stopped emitting greenhouse gases tomorrow, some very low-lying islands may be affected by sea level rise in coming decades. Scientists say that the last warm period, before the most recent ice age, was less than 2 degrees warmer than pre-industrial levels, but sea levels were still 6 to 7 metres higher than today.³⁸ Such sea level rise would take centuries, but fundamentally threaten many coastal cities.

Other people may define climate change as “dangerous” only when there is much clearer evidence that it is killing people, or causing large costs. Such definite proof may be hard. It is difficult to say with absolute certainty that climate change was responsible for one particular catastrophe, for example. Scientists can only say that climate change made it more likely.

Climate change will not suddenly become more serious above a particular level of warming. As a result, a single warming limit such as 2°C is rather arbitrary. Following are some changes that people may define as dangerous, as the planet warms up:

- **Food availability:** Warming of 2°C will increase harvest failures, especially in tropical countries. Warming of 4°C “would pose large risks to food security globally”.³⁹
- **Sea level rise:** If warming is maintained at 1-4°C above pre-industrial levels, the Greenland ice sheet will melt entirely over the course of many centuries, causing sea levels to rise by 7 metres.⁴⁰
- **Mass extinctions:** Warming above 3°C will cause extensive extinctions of wildlife species.

END BOX

Who should be most responsible for tackling climate change?

Global responsibility: Some people say that it is up to the United Nations to deal with climate change, with all countries working together. Greenhouse gases mix in the atmosphere, causing a problem with global impacts. Countries will not take ambitious action on their own, because they would have to share the benefits with countries which had done nothing. National governments often say, “What is the point of our limiting emissions, when others who emit more than us do nothing?” Countries will only act ambitiously if they act together. Experts compare this situation with farmers who share a piece of land which is over-grazed. If just one farmer removed his/her sheep, then others may just add more sheep of their own. The only way to tackle the over-grazing is if all the farmers work together.

One advantage of a global agreement is that it will involve even the smallest countries, some of which may be most vulnerable, such as small islands. The UN system gives each country on Earth one vote, regardless of size. Global UN action can also send a clear message, to the world’s people, investors and businesses, that every country means business. That may galvanize action. But some people say that they do not want another layer of government, such as in the United Nations, creating new rules and red tape. They may also point out that trying to get action by all countries on Earth is just too difficult. They may say, “Why not just leave the problem to a small group of the world’s most powerful countries, who are responsible for the vast majority of global emissions?” Other people may say that leaving the climate change problem to the United Nations is just a way of avoiding our own personal and national responsibilities.

National responsibility: National governments have huge powers to cut carbon emissions. They set the national laws, standards and guidelines which drive decisions by local governments, businesses and citizens. For example, they will decide whether or not to subsidise fossil fuels, and whether to protect national forests. Governments can help prepare a country for climate change, because they have tax revenues. National governments also have the resources to help other nations which are less well off. For example, Germany is helping the Philippines prepare for sea level rise.

Some people would say that it is up to governments to tackle climate change. They say that it has nothing to do with citizens and businesses, whose daily choices and behaviour are fixed by national rules and laws. Others might point out that their governments have no interest in climate change, for example because they are distracted by other, short term issues. They may say, therefore, that it is for all of us to do something, or else for the United Nations, or civil society groups, to take a lead.

Local government responsibility: Cities are responsible for 70 per cent of global greenhouse gas emissions, and so have a big opportunity to reduce these.⁴¹ And as home to more than half of the world’s people, and its most valuable assets, they have a big responsibility to protect these from climate change.⁴² In addition, local governments, including cities, have sharp, local powers to control local greenhouse gases. They will decide, for example, on how to deal with local municipal waste, whether to dump this in a hole in the ground, leave it to rot, or to promote recycling.

Some people might say that local governments, therefore, should take the lead, because they have these local powers and responsibilities. Others might say that local governments are politically vulnerable to powerful companies and investors, and therefore need guidance, and should not be given too much responsibility. In addition, while local governments may make decisions, they may have little money. Cities will need government support, to build low-carbon infrastructure.

Business responsibility: Some businesses emit as many greenhouse gases as small countries. For example, a big utility may burn fossil fuels to generate electricity, and emit tens of millions of tonnes of carbon dioxide every year. Businesses make choices which influence these emissions. For example, they may decide whether to invest in fossil fuels, or renewable energy. Burning fossil fuels emits carbon emissions. Wind and solar power have no emissions.

Some people would say that it is up to companies to stop emitting. They may say that companies should stop building runways, for example, or burn less coal in power plants. They may say that it is the responsibility of carmakers to design more efficient cars. Others may say that companies only do what consumers want. They may say that if people want to fly, then you cannot blame the companies which build or operate planes. Or they may say that it is up to governments to set standards, for example on fuel economy. There are already lots of business groups which already set voluntary targets for their members to cut carbon emissions. For example, the insurance industry committed to double its green investments to \$84 billion by the end of 2015, at a Climate Summit at the General Assembly of the United Nations in New York last year.⁴³

Citizen and civil society responsibility: The personal choices of citizens in rich countries have a big impact on global carbon emissions. These choices include what kind of car and appliances to buy, whether these are more efficient or not. Other choices may include where to go on holiday, and whether to recycle. Our behaviour also has an impact, such as whether or not to turn off light bulbs in empty rooms.

However, people may be limited in their choices. Governments may set the standards that determine the choices for the goods we buy. If governments cannot be bothered to help, is it the job of civil society to educate citizens, about climate change and about how they can make a difference? Civil society groups sometimes criticise big companies and governments for not doing enough. Should they criticise citizens too? Some people have argued, however, that environmental groups may exaggerate the problem, to get attention and drive up their membership.⁴⁴ Meanwhile, citizens in poorer countries may emit almost zero greenhouse gases. The emissions in these countries may instead be made by a rich elite, or by industry.

2. Tools to tackle climate change

Does it make economic sense to cut greenhouse gas emissions?

Economists find it very difficult to measure the cost of damage from climate change, because future impacts are uncertain and may be very large. It is very difficult to put a cost on climate change beyond 2°C warming, because it may cause huge human impacts, including: crop failures; mass migration; and rapid sea level rise.⁴⁵ Economists are not used to measuring the costs of such effects.

It is more straightforward to measure the cost of avoiding climate change, through cuts in greenhouse gases. Responding to climate change will require big investments in low-carbon infrastructure, in energy, transport and buildings. Examples of energy investment will include wind and solar power; in transport, mass transit systems which substitute for cars; and in buildings, better insulation and more efficient appliances.

Some low-carbon equipment can be more expensive. For example, solar power is still often more expensive than burning coal, to generate electricity. And building a metro or rapid bus system may at first be more expensive than building roads. More efficient appliances may be more expensive than regular ones, until they start paying for themselves in energy savings. And there may be a social cost from cutting carbon emissions. For example, high-carbon industries such as coal mining, may lose out, and will have to be compensated.

So, cutting emissions will cost more money at first. But experts say that they do not expect such costs to have a big impact on economic growth.⁴⁶ In addition, cutting emissions may even appear as good value for money, once the benefits, as well as the costs, are considered. These benefits include:⁴⁷

- Avoided climate change;
- Cleaner air, and so fewer deaths from strokes, and lung and heart disease, as a result of burning less coal;
- Tax savings, from reducing fossil fuel subsidies;
- Energy savings, as a result of investing in efficiency;
- Better energy security, from relying less on imported fossil fuels.

Is a carbon tax a good way to cut emissions?

Coal is the most carbon-emitting form of energy. Burning natural gas emits carbon dioxide, but only about half as much as burning coal. Some forms of renewable energy and nuclear power have zero emissions (see Table 1 below).

Table 1. Carbon emissions per unit of power generation, by fuel source, U.S. averages ⁴⁸

Fuel source	Carbon dioxide emissions per megawatt hour	
	Tonnes	Pounds
Coal	1.02	2,249
Natural gas	0.51	1,135
Wind and solar power	0.00	0
Nuclear power	0.00	0

One way to cut emissions is to make burning fossil fuels more expensive. At the moment, most countries do not charge for emissions. Governments treat them as if they do no harm. Emissions are free, and as a result, no one is paying for the damage that climate change will cause.

A carbon tax is a charge made per tonne of carbon dioxide. For example, the owner of a coal-fired power plant may be forced to pay a certain amount per tonne of carbon dioxide, as a result of burning coal. The tax will favour renewable energy and nuclear power, because they do not emit carbon dioxide, and so will pay nothing.

A good thing about a carbon tax is that it can apply to the whole energy sector, or even the whole economy. That means that it can be very big effective, making a big difference to increase the cost of fossil fuels, and so cut carbon emissions. Several countries apply a tax per tonne of carbon dioxide. Tax rates vary widely, from \$2 per tonne in Japan, to nearly \$170 in Sweden.⁴⁹ Another good thing about a carbon tax is that it raises money which governments can use to fight climate change. For example, in the United Nations climate negotiations, there never seems to be enough money to help least developed countries cut carbon emissions and adapt to climate change. A carbon tax could be a really good way to raise such climate aid. For example, at present jet fuel is not taxed. Such a tax could raise a lot of climate finance.

The problem with carbon taxes is that no one likes taxes. People may not vote for a government which says that it wants to introduce a carbon tax, even if it is good for the climate. Some economists say that governments should give all the revenues from a carbon tax directly back to citizens, to make such a tax more popular. But governments often like to use tax revenues as they please. Another problem with a carbon tax is that it increases the cost of energy. That is because energy producers pass on the extra cost to consumers. More expensive energy can help increase efficiency; people will be more careful not to waste it. But it may also hurt poorer people, who may already be struggling to pay their energy bills. So if governments introduce a carbon tax, they will have to make sure that energy stays affordable.

Some countries have introduced emissions trading schemes. These work like a carbon tax, putting a price on carbon emissions. These schemes force polluting companies to buy emissions permits. One advantage of emissions trading is that it does not sound like a tax, and so citizens may resist it less. But they are complicated to set up. And they will still raise energy prices, just like a carbon tax.

How can we increase investment in low-carbon energy?

Carbon taxes and emissions trading schemes work by making fossil fuel energy more expensive. Another way to cut emissions is to make low-carbon energy cheaper.

Until now, many forms of low-carbon energy were more expensive than fossil fuels. To make them cheaper to produce, some countries give them a subsidy. Supporters say that they deserve these subsidies, because they

provide benefits which are not normally included in the price of energy. In the case of wind and solar power, those benefits include: lower carbon emissions; less air pollution; less water consumption; and fewer fossil fuel imports. Some forms of low-carbon power are controversial, however. Nuclear power produces radioactive waste. Burning wood (called biomass) does emit some carbon dioxide, and may also compete for land with food crops. And some critics say that wind and solar electricity are less reliable than fossil fuels, because they depend on the variable power of the wind and sun. Evidence from Germany and the United States, however, so far suggests that renewables do not threaten the reliability of supply.

Other people are worried that subsidies for renewable energy are too expensive, and have pushed up the cost of energy, just like carbon taxes. For example, Germany has long been the world leader in generating solar photovoltaic (PV) power. In 2014 alone, the country spent more than 9 billion Euros (\$10 billion) subsidising solar power.⁵⁰ These subsidies are mostly paid for through residential electricity bills. The subsidies accounted for 21 percent of German domestic electricity prices in 2014.⁵¹ Germany has the second highest electricity prices in Europe, after Denmark, which also subsidises renewable energy.⁵²

By raising energy prices, schemes such as carbon taxes and emissions trading schemes may also increase costs for industry. That may make them less competitive, compared with rival companies in countries which do not limit carbon emissions. If one country imposes very high carbon taxes, this may simply result in factories moving to other countries which do not have carbon controls, and emitting greenhouse gases there instead.

Over the past decade, however the cost of renewable energy has fallen rapidly. For example, since 2008, U.S. wind power costs have fallen by more than a third.⁵³ Since 2008, in Germany, the full cost of installing solar panels has fallen by two-thirds.⁵⁴ In India, Deutsche Bank analysts calculate that solar power without subsidies is now competitive with power plants burning imported coal.⁵⁵ Most developed countries still subsidise wind and solar power, but these subsidies have fallen, often by more than half. Even wind and solar power industries say that they will not need subsidies after around 2020.

How can we cut carbon emissions more cheaply?

It makes sense for governments to try and cut carbon emissions as cheaply as possible. There are several ways to do this. These options may not cut carbon emissions as quickly, however, as national support for renewable energy or a carbon tax.

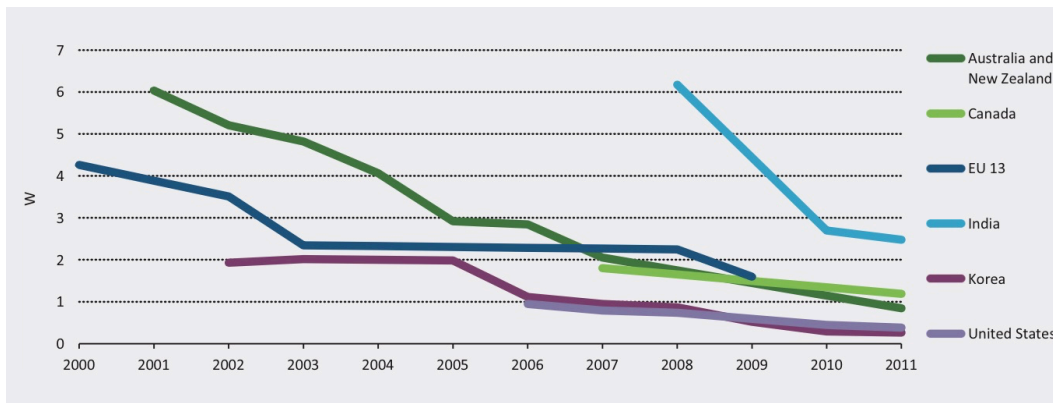
1. Eliminate subsidies for consuming fossil fuels. Some countries have a lot of fossil fuels. These countries may sell energy to their own people more cheaply than it costs to produce, because they want to help consumers. Governments may do this to spread the country's resource wealth, or to make themselves popular.⁵⁶ Fossil fuel subsidies create problems, however. They lead to waste, carbon emissions and local air pollution, because energy is cheaper than it actually costs to make. The subsidies may benefit rich people most, because they consume most energy. The total value of all fossil fuel subsidies worldwide in 2013 was \$548 billion.⁵⁷

Several countries have recently cut these subsidies, including India, Indonesia, Malaysia and Morocco.⁵⁸ Cutting fossil fuel subsidies saves governments money, at the national level. So it is a very cheap way to reduce carbon emissions. However, cutting subsidies will also increase the cost of energy for citizens. That may hurt the very poorest people who struggle most to pay their bills. It is important, therefore, that governments use some of the money they save to compensate poor people, and ensure that energy is still affordable.

2. Invest in efficiency. Most growth in carbon emissions this century will come from developing countries. They need more energy to grow their economies, and many of them depend on coal. An important way to cut carbon emissions, therefore, will be to invest in energy efficiency, in transport, industry and buildings. Because improving efficiency saves money, it can be a very cheap way to cut carbon emissions. It also can boost economic competitiveness, and reduce fossil fuel imports.

One difficulty with trying to improve energy efficiency is that businesses and people may not be aware of exactly how much energy they use, or how much they could save by buying more efficient products. Governments can help, by setting standards for more efficient cars, light bulbs and appliances. One example is to reduce the energy consumption of appliances left on standby. These appliances still consume energy, and because many are left on standby their whole life, this adds up to a lot of energy. Standby energy accounts for about 10 percent of global household electricity use.⁵⁹ Some countries have introduced standards to require televisions on standby to consume less than 1 watt of electrical power per hour (Figure 3).

Figure 3. Average standby power consumption of new televisions, watts per hour, 2000-2011



3. Investing in research and development (R&D). Investing in R&D is another way to support low-carbon energy. For example, if governments pay for research which boosts the power of solar panels, or increases the efficiency of electric vehicle batteries, these become cheaper. In theory, this has the same effect as subsidies or a carbon tax, without raising the cost of energy. But R&D may not be as effective in driving rapid, mass demand, as German solar subsidies have done, for example.

4. Investing in infrastructure. Another way to cut carbon emissions is to invest in large-scale, low-carbon infrastructure projects. These may include a metro, which gives people an alternative to driving their cars. Another example is a district heating scheme, which traps heat normally wasted by power plants, and distributes it to heat homes. Such projects save money in the long run. A metro system will reduce air pollution; give poor people cheaper access to city centre jobs; and reduce energy bills from burning less gasoline. The trouble is that these projects are often very expensive to start with. That will require some kind of government help.

What global, national and local solutions are there for climate change?

Climate change can be tackled at different levels, from the city or town, to the national government, or a global scheme.

Global solutions. Some approaches for cutting greenhouse gas emissions can only be delivered globally, through schemes which involve lots of countries. For example, the Kyoto Protocol required industrialised nations to cut carbon emissions. But it allowed them to do this by paying developing countries to cut emissions on their behalf. The idea was that it may be cheaper to build a wind farm in China than in Denmark, for example. Under this scheme, rich countries paid for low-carbon projects in developing countries, and earned credits in return. That created a global market in carbon offsets. In some ways, this scheme was very successful. Since 2007, it has supported 7,800 projects in 107 developing countries, cutting emissions by an estimated 1.5 billion tonnes of carbon dioxide.⁶⁰ At its height, the scheme was worth more than \$7 billion per year.⁶¹ However, it was complicated to administer. In addition, it provided lucrative profits for European carbon brokers and investors. Not all of the money went to developing countries. And in developing countries, it was

most effective in cutting emissions from big, industrial projects, such as chemical factories. It did less to help individuals, households or cities change the way they consume or produce energy.

National solutions. Governments can steer national direction through targets and policies, such as national limits on greenhouse gas emissions. They can favour particular types of energy, through subsidies either for fossil fuels or renewable energy. In that way, they can steer investment decisions, and mobilise billions of dollars of private capital. In addition, national governments can set standards which influence how consumers behave and what products they buy. National planning rules can decide how cities grow. However, governments can only pull levers, through such rules and policies. They cannot decide what actually happens, at the local level, because that depends on investors, who provide much of the money, and on citizens, businesses and cities. In addition, some governments simply may not care about climate change, and in the absence of their political will, other solutions are needed.

Local solutions. City mayors and local governments may control local infrastructure, and may have local funds. For example, planning officials may be able to guide the growth of their city, and decide whether that will be compact growth, which protects green spaces and connects communities, or sprawling growth, which ends up forcing people to drive long distances, and creates communities separated from each other and from jobs and services. One problem is that climate change may be rarely near the top of a local government's priorities. They may face daily problems, such as wrestling with law-and-order, delivery of basic public services, improving housing, dealing with chronic congestion, and paying municipal workers. They may need national policies to guide them.

How can civil society be more involved in combating climate change?

Decisions on climate policy are often made by governments, influenced by powerful groups, such as business lobbies, environmental organisations and development agencies. Other groups of people and initiatives may seem neglected.

Women are especially vulnerable to climate change including extreme weather, in countries where they have less independent income, or fewer land rights. When floods or heat waves strike, or food prices suddenly rise, they may have fewer resources to protect themselves. In addition, in very poor countries, women may be responsible for providing water and food for their families. When these are in short supply, for example during drought, women may be forced to travel farther, and spend more time working for less return. Women are aware of the solutions they need, and could be more at the forefront of decisions on climate change.⁶²

Indigenous peoples may similarly face the direct consequences of climate change, because they depend closely on the environment and its resources for their livelihoods. Climate change may worsen the difficulties they already face, such as poor representation, uncertain rights over their land and unemployment. One example of a vulnerable, indigenous group is the 160,000 people of the Inuit, living in the Arctic. They depend on hunting for food and for their cultural identity, but may find that traditional resources are increasingly unavailable, as Arctic sea ice melts.

Tropical forests are especially important in the fight against climate change. Deforestation is a big source of carbon emissions. More frequent, severe droughts will kill trees. But planting trees can help offset emissions elsewhere, because they absorb the greenhouse gas carbon dioxide. Conservation of forests is an important way to tackle climate change, but must be done in a way which protects indigenous peoples. In the past, some tropical countries have handed licenses for logging or mining companies to exploit forests, ignoring the indigenous people who live in them. Some development groups have said they must now be careful not to ignore or remove indigenous people, under plans to protect more forests.

Education programmes can have an enormous impact on climate change, by influencing the way citizens behave and the goods they buy. To change their behaviour, people may need information. For example,

consumers may be unable to calculate the differences between high and low-carbon products, when they go shopping. Carbon labelling would help here. Or citizens may be unaware of their impact on climate change through the way they behave. People with cars, for example, will benefit from information about how to drive efficiently. And people may not think to turn off appliances on standby, unless governments make them aware of the energy they could save. Such education programmes can help people feel less powerless in the face of a global issue as big as climate change.

UN agencies have responsibility for protecting human welfare and rights. Climate change may make their job more difficult, and so they may benefit from more direct involvement in decisions. For example, the UN High Commission for Refugees tackles refugee problems. Climate change may cause more crop failures, which lead to the mass movement of peoples. The United Nations this year is crafting new Sustainable Development Goals (SDGs), to reduce poverty and boost access to food and water, which may be made more difficult without urgent action to fight climate change. The Convention on Biological Diversity seeks to protect biological diversity. Wildlife is expected to suffer severely above around 3°C warming.

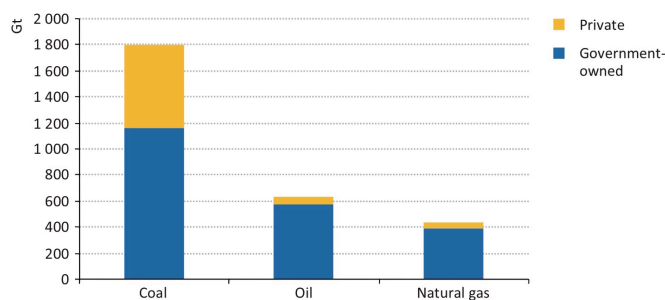
Should the world stop exploring for fossil fuels?

Energy companies produce fossil fuels from underground reserves. Their businesses partly depend on the size of these reserves. They spend time and money exploring for new finds. But do we really need any more?

Proven reserves are those fossil fuels that energy companies are sure they can exploit, based on their initial investigations. Energy experts tell us that there are far more fossil fuels in these reserves than we can safely burn. If all existing proven reserves were burned, these would emit about 2,860 billion tonnes of carbon dioxide (see Figure 4).⁶³ But the human race can only emit about another 1,000 billion tonnes of carbon dioxide, in total, to limit global average warming to 2°C.⁶⁴ In other words, about two thirds of proven fossil fuels reserves would have to stay in the ground to meet this target. That calculation is based on an assumption that people want at least a two-thirds chance of staying below 2°C warming. But people may not be so worried. For example, they may only insist on a one third chance of meeting this limit. In that case, people can emit about another 1,400 billion tonnes of carbon dioxide. But that would still require people to leave fossil fuels in the ground.

If we can only burn about a third to a half of the fossil fuels we already know about, some experts and campaigners say that energy companies should stop exploring for more. They are exploring in the deep oceans, in the Arctic and in shale oil and gas deposits, for example. Some energy companies say that the world will continue to need fossil fuels for many decades to come, so that a growing, and increasingly prosperous world population can meet its demands for energy. For example, Royal Dutch Shell says that all of its proven reserves will be needed, and says that concerns spread by some campaigners were “alarmist”.⁶⁵

Figure 4. Potential CO2 emissions in proven fossil fuel reserves, billion tonnes (Gt), by fuel type



3. UN negotiations and national commitments

What is the UN process of climate negotiations?

In 1992, almost every country in the world signed the United Nations Framework Convention on Climate Change (UNFCCC). Since then, countries have met every year, to discuss action on climate change. Those meetings include a major conference at the end of each year, attended by national ministers and leaders. It is at this annual Conference of the Parties (COP) that countries take decisions, by consensus.

Over the years, different countries have committed to the UN climate negotiations to varying degrees. In 1997 most countries supported the Kyoto Protocol. But the Protocol only required emissions cuts by industrialised nations.⁶⁶ And the United States never ratified the Protocol. Many more countries signed up to climate action under the Copenhagen Accord, in 2009.⁶⁷ But some countries still did not pledge any climate action then, including many oil producing nations.

What is a Paris agreement about?

Now, all countries have committed to launch a new climate agreement in Paris at the end of 2015. A Paris agreement would set climate action beyond 2020, either for 2025 or 2030. The Paris conference may launch the first climate agreement where every country in the world commits to take action, in line with its capability.

All countries have agreed to submit new pledges for climate action in advance of the Paris conference, and by October 2015 at the latest. The aim of submitting targets early was to make sure that all countries were well prepared; to increase trust among nations; and to encourage outsiders including sub-national groups to participate.

What should each country offer?

There are advantages from making a positive contribution to a climate agreement. For example, poorer countries which develop clear plans for how they need to adapt to climate change are more likely to get UN funds to make those plans happen. And if developed countries agree to make funds available, then developing countries are more likely to cut their emissions, and help safeguard the world's climate. Ultimately, if every country participates, that will result in a more ambitious agreement. If some countries hold back, it is more likely that others will hold back, too.

Some people and countries may say that they are too poor to participate. But countries will only have to offer what they feel comfortable with, under a Paris agreement. Countries will not be told what to do. Having said that, the richer a country is, the more that will be expected of it.

Developed countries are expected to pledge new, more ambitious national targets to cut greenhouse gas emissions. Emerging economies may pledge a year when their emissions will at least stop rising. The poorest, least developed economies may offer particular policies, such as support for renewable energy; measures to protect forests; or to phase out fossil fuel subsidies. They may need financial support to achieve these measures.

Some oil producing nations will worry that a global climate agreement will reduce demand for and the price of fossil fuels. That may impact the wealth of such countries. For example, in the past, Saudi Arabia has asked for financial assistance, in return for its participation. However, Saudi Arabia has one of the highest per capita incomes in the world, and so other countries may be less willing to support it.

Some countries may be unwilling to participate simply because they have other, very serious priorities right now, such as civil war. Or they may be unwilling to participate because they feel that richer countries are not doing their bit. Some countries may be sceptical about participating in a UN climate agreement, which they

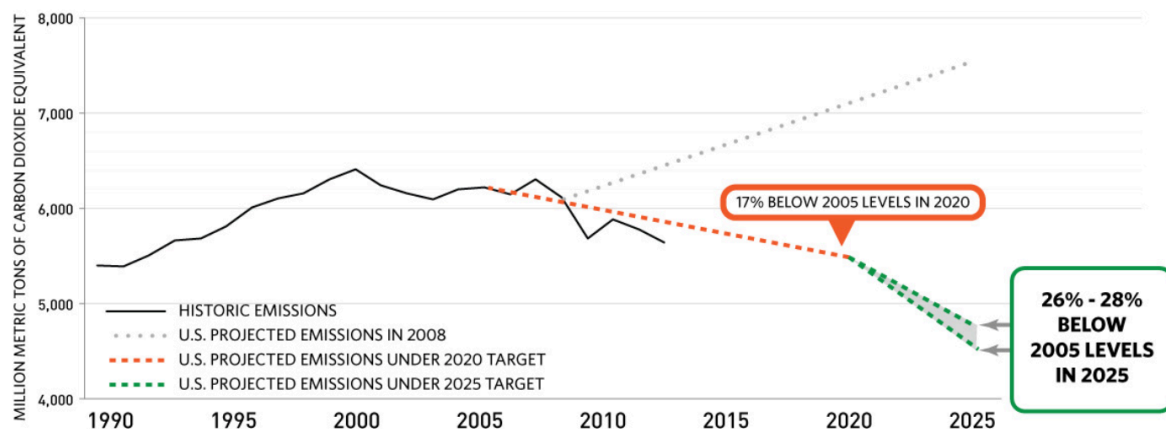
fear will infringe their national sovereignty. But a Paris agreement would be based on voluntary contributions, provided by national governments, with rules only for monitoring and reporting emissions, to increase transparency and trust.

What have countries offered so far?

As of April 2015, several major economies had made formal offers for climate action, under a Paris agreement, or had hinted at what they will offer. These pledges include:⁶⁸

- The European Union will reduce its greenhouse gas emissions by 40 percent by 2030, compared with 1990 levels. That compares with an existing pledge to cut emissions by 20 percent by 2020.
- The United States will cut its greenhouse gas emissions by up to 28 percent by 2025, compared with 2005 levels. That compares with its existing target, to cut emissions by 17 percent by 2020. The new target would require the United States to double the rate of annual emissions cuts (see Figure 5).
- Russia has pledged to cut its emissions by up to 30 percent by 2030, compared with 1990 levels. That is only a slight increase compared with its existing pledge, to cut emissions by up to 25 percent by 2020.
- China said that its greenhouse gas emissions would stop rising by 2030, at the latest.⁶⁹ But its emissions already fell last year.⁷⁰ China also said that it intended to increase the share of non-fossil fuels in its energy mix, to 20 percent by 2030, from less than 10 percent now. That would require China to build more low-carbon power than it has in equivalent coal-fired power plants today.

Figure 5. U.S. greenhouse gas emissions targets in 2020 and 2025, million tonnes of CO₂ equivalent⁷¹



Could a Paris agreement include a long-term emissions goal?

Under the UN negotiations, countries have already committed to limit warming to no more than 2°C. But they have not agreed on how to meet that goal. For example, they have never agreed on a long-term global emissions target. Perhaps as a result, the world is far behind meeting this 2°C target.⁷²

One way to steer the world back on track would be for countries to agree a long-term, global goal for greenhouse gas emissions. For the first time, a Paris agreement could introduce a global goal for zero emissions in 2100, or to halve global emissions by 2050. Such goals would be roughly consistent with limiting global average warming to no more than 2°C.

However, previously some countries have resisted such long-term emissions goals. Oil exporting nations are worried about the impact on demand for their fossil fuel exports. In addition, some large, rapidly growing, emerging economies have also rejected a long-term global goal. That is because they are trying to reduce poverty and meet the energy needs of their people. They are worried that a long-term emissions goal would hurt them most, because it is their emissions that are growing fastest. Poor people in these big emerging

economies want better lifestyles. To sign up to such a goal, these developing countries may need a stronger commitment from developed countries, to very ambitious cuts in greenhouse gases. They may also demand more climate aid from developed countries, to help them cut emissions and prepare for climate change which is already unavoidable.

Alternatively, the world could simply decide that the 2°C target is unattainable, and miss this target. Such an approach would be expected to lead to higher costs of adaptation.

4. Fairness and distribution of efforts

As we have seen, a global shift to a low-carbon economy will save money in the long run, but could cost more at first. The issue of fairness is very real in climate negotiations. Who will meet these higher costs?

How can we compare the contributions of different countries to climate change?

There are different ways we could compare responsibilities.⁷³

1. We could compare historical emissions. Some countries started emitting a lot of carbon dioxide, from burning fossil fuels, about 200 years ago.⁷⁴ There are two arguments for focusing on these historical emissions. First, it is this cumulative carbon dioxide which is causing climate change now. Second, these industrialised nations have grown rich from burning fossil fuels, and may therefore have the most resources, to lead now. On the hand, the human race has only known that climate change was a serious threat since the 1980s. The emissions of some industrialised nations were already falling by then. The European Union says that its emissions stopped rising in 1979.⁷⁵
2. Instead, we could compare current emissions, and those expected this century. The reason global annual emissions are now rising is because of the rapid growth of emerging economies, especially in Asia, the Middle East and in Central and South America. Almost all growth in emissions this century will come from developing countries.⁷⁶ The global climate at the end of this century will therefore depend most on what they do to slow growth in their emissions.
3. Perhaps we should not compare national emissions at all, but instead look at emissions per person (also called “per capita”). After all, it is per capita emissions which measure our personal, individual contributions. People living in rich industrialised countries, such as the United States, are still the biggest per capita emitters. Perhaps it is therefore up to them to do much more than people in China, who individually emit far less.
4. Perhaps we should not even be comparing emissions, but wealth, instead. After all, richer people will be able to cope better with climate change, and can better shoulder the global cost of cutting emissions. Perhaps they should take the lead.

Depending on how we measure responsibility for climate change, we come up with completely different answers. If we measure responsibility by per capita emissions, the United States is one of the most responsible nations (see Figure 6). If we compare total national emissions, China is number one (see Figure 7).

Countries have already agreed that in Paris they should only commit to climate action that they feel comfortable with. This may lead to weaker targets. But the alternative is that countries try to agree a formula for deciding who does most. Experts say that countries may never agree such a formula, because it would be so controversial. For now, richer, industrialised nations accept that they should do more, but the question is, how much more?

Figure 6. Per capita and total emissions, by region, in 2011⁷⁷

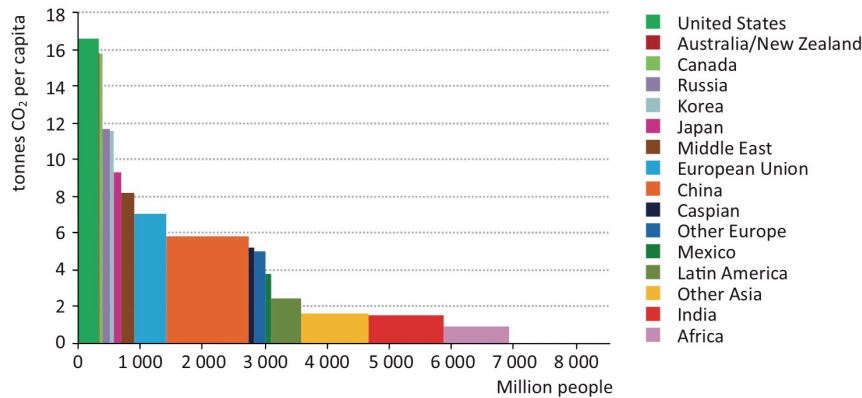
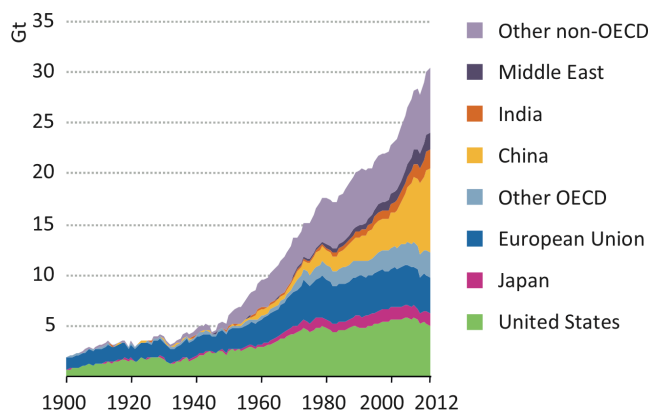


Figure 7. Annual energy-related carbon emissions by country, 1900-2012⁷⁸



How can developed countries help poorer nations cut carbon emissions?

Climate scientists have calculated that global emissions must stop rising by around 2020 at the latest, and then fall rapidly, if the world decides it wants to stay below 2°C warming. This will require developing countries to cut their expected emissions most, because they are growing fastest. But it does not seem fair to put all the responsibility on them, because they do not yet enjoy the lifestyles of richer people in industrialised nations. One way to solve this dilemma is for developed countries to pay developing countries for some of these emissions cuts.

In 2009, developed countries pledged to provide \$100 billion every year by 2020, to help developing countries fight climate change.⁷⁹ The money would come both from governments and the private sector. But the developed countries did not say anything about whether these funds would continue after 2020. And it was unclear why they chose a number of \$100 billion. Box 4 below tries to answer the question whether \$100 billion is enough.

In Paris, countries are meant to agree climate action beyond 2020. Developing countries may expect developed countries to extend or increase their \$100 billion offer. For their part, developed countries may say that they are still cutting spending, after the global financial crisis.

START BOX

Box 4. Is \$100 billion enough for developing countries to fight climate change?

Fighting climate change involves both cutting emissions (which is called mitigation), and preparing for climate change (called adaptation).

Regarding mitigation, both developed and developing countries will have to invest in low-carbon development, to keep the world on a safer climate track. Developed countries would have to invest an extra \$590 billion per year or so, and developing countries an extra \$760 billion or so. Developed countries may have to transfer “hundreds of billions of dollars” every year by 2050, to help developing countries achieve their larger emissions cuts.⁸⁰

Regarding adaptation to more droughts, floods and sea level rise, this will cost developing countries around \$70-100 billion per year, in coming decades.⁸¹

Together, these estimates suggest that climate aid of \$100 billion annually would be very helpful for developing countries, but would fall a long way short of meeting the full extra investment that they will need to make, to fight climate change.

END BOX

What roles do the public and private sector play in climate finance?

The world will need both public and private money to help finance a shift towards a low-carbon economy. Private investors, including pension funds and banks will be critical for implementing an agreement. For example, building a global low-carbon economy will require a six-fold increase in investment in clean energy and energy efficiency, to \$2.3 trillion per year by 2035, from around \$390 billion now.⁸² Private investors will need to supply much of this cash.

Governments can influence how the private sector spends its money, in two ways. First, investors need to be confident that they can make a profit, for example from investing in wind and solar power. This is where government policy comes in. Governments can create subsidies to support low-carbon energy, for example. Such subsidies will increase private investor profits, and encourage them to spend their money.

Second, governments can use public money directly to support low-carbon investment, for example through grants and loans. By lending or giving money to low-carbon projects in developing countries, governments will reduce the risk for private investors, who will then also invest. This “leverage effect” can be quite big. Experts calculate that for every dollar that rich countries give to development banks, such as the African Development Bank, developing countries can raise a total of \$16 public and private investment.⁸³ That is because development banks can use the money to make loans, which then encourage lending from private banks.

Some developing countries insist that climate aid targets, as agreed in UN negotiations, should consist mostly or entirely of public money. That is because it is difficult to guarantee that the private sector will deliver: investors will only invest if they feel the rewards are right for them, they cannot be forced. By contrast, governments can commit to spend public money. Some developing countries may suspect that developed countries highlight the role of the private sector so that they can avoid spending their own money. Developing countries may suspect that they will never see the money which developed countries pledge from the private sector. In addition, private investors will always be attracted to the most profitable projects. That may exclude climate adaptation projects, for example, or certain high-risk, developing countries.

Developed countries say that in the aftermath of the global financial crisis, public money is scarce, and that they are still implementing austerity programmes. They may ask, how can they increase overseas aid when they are cutting spending at home? They may argue that in this case, the private sector can fill the gap.

Why does the UNFCCC distinguish between developed and developing countries? Are these groups fair?

The 1992 UN Framework Convention on Climate Change (UNFCCC) divided the responsibility for fighting climate change broadly between two groups of countries.⁸⁴ The Convention referred to these as “developed” and “developing” countries. It listed the countries that it counted as “developed” in an annex. The Convention

stressed that developed countries should take the lead. UN climate decisions still distinguish between these two groups.⁸⁵

Developing countries often say that developed countries have not shown enough leadership. Meanwhile, developed countries say that the world has changed since 1992, and that some “developing countries” are now as wealthy as they are, or more so. They reject the idea that the roles and definitions of developed and developing countries should be fixed for all time.

Box 5 lists the countries which the UNFCCC defined as “developed”.

Box 6 lists some countries now classed by the World Bank as the wealthiest, “high-income” group, which are still classed as “developing countries” by the UNFCCC.

START BOX

Box 5. Nations classed as “developed countries”, under the UNFCCC in 1992

Following are “developed countries”, as listed under Annex 2 of the UNFCCC.

The European Union (not all members)	Australia	Canada
Iceland	Japan	Liechtenstein
New Zealand	Norway	Switzerland
United States of America		

END BOX

START BOX

Box 6. Nations classed as “high income economies” by the World Bank in 2015⁸⁶

Following is a list of some “high-income economies”, as defined by the World Bank in 2015, which are classed as “developing” by the UNFCCC.

Bahrain	Kuwait	Saudi Arabia
Chile	Oman	Singapore
Israel	Puerto Rico	United Arab Emirates
Republic of Korea	Qatar	Uruguay

END BOX

What is the solution for defining richer and poorer countries? There are several options. One formal approach would be to create a third group of wealthier, developing countries, under the UNFCCC. Another formal approach may be to create a new procedure for countries to graduate from “developing” to “developed” status. Perhaps not surprisingly, there appears little or no appetite for these steps from developing countries.

An alternative, less formal approach may be simply to refer less often to the distinction between developed and developing countries, in UN decisions, and instead ask all countries to do what they can, according to their ability.

What is the role of the Green Climate Fund?

Countries set up the Green Climate Fund in 2009, to transfer public funds for tackling climate change from developed to developing countries.⁸⁷ A “significant portion” of the \$100 billion that developed countries have committed in 2020, as discussed above, will be channelled through the Green Climate Fund.

The purpose of the fund is to help developing countries both cut carbon emissions and to prepare for climate change. Projects could include the protection of forests; support for low-carbon energy; and funds to strengthen coastal defences.

The Green Climate Fund is an official body of the UNFCCC, which guides its rules and operations. While the purpose of the Green Climate Fund is to help developing countries, some developing countries are also contributing funds. So far, as of April 2015, some 33 countries had pledged \$10.2 billion to the Fund. Of these countries, eight are developing countries, which have pledged \$123.6 million.⁸⁸ These developing countries are: Chile, Colombia, Indonesia, Mexico, Mongolia, Panama, Peru and the Republic of Korea.

While developing countries are showing that they are willing to contribute, they are also demanding that the developed world does more. For example, developed countries never explained how they would reach a target of \$100 billion climate aid in 2020. At the moment, the Green Climate Fund is far short of this total. If rich countries do not offer more funds soon, it may be that developing countries will also stop contributing.

Can developed countries meet the full cost of fighting climate change for developing countries?

The UNFCCC agreement in 1992 stated that developed countries should take the lead, and provide financial resources to help developing countries meet the “agreed full incremental costs” of cutting emissions and adapting to climate change.

This is a controversial aspect of the UN negotiations. Developing countries say that developed countries now have to do more, to show that they are taking their responsibilities seriously. Developed countries, meanwhile, accept that the world’s poorest countries need help. The question is how far they will also help big emerging economies, like China, Brazil, India, Mexico and South Africa. Even between these developing countries there are big differences in wealth; for example, Mexico has three times the per capita income of India.⁸⁹

The fact that some developing countries, including Mexico, have contributed to the Green Climate Fund suggests that they are now keen to contribute as well as receive funds for climate action. Some developing countries are considering submitting two climate action pledges, at the Paris conference, one for action they can fund themselves, and the other describing what they can do with financial support.

Should local governments and cities benefit from the Green Climate Fund?

Any sub-national organisation based in a developing country can apply to the Green Climate Fund, including local governments and cities, and civil society groups.⁹⁰ The Fund has already approved several organisations, including one in Senegal, which helps protect coastlines, and a foundation in Peru, which manages protected areas such as forests.

By allowing cities and local organisations to apply, the Green Climate Fund may encourage more engagement from civil society in the UN climate process. That is because the more ambitious the UN negotiations, perhaps the more money there will be in the Green Climate Fund. More local participation may be a good thing for climate action. For example, cities may be more motivated to show how that can drive cuts in carbon emissions, for example by installing roof-top solar panels. That may allow their national governments to offer more ambitious targets.

However, there may be less rigorous procedures for controlling how local authorities spend their money, compared with national governments. There could be a greater need to check that these climate funds are spent wisely.

How can the world pay for losses and damage from unavoidable climate change?

Scientists expect that climate change will lead to more frequent extreme droughts, heat waves and floods. This extreme weather will cause costs, called “loss and damage”. These costs are in addition to the costs of adaptation. Adaptation is about trying to avoid such “loss and damage”, through better preparation for climate change.

We already know the kinds of costs that we can expect from severe weather. Table 2 below shows that four out of the five most expensive natural catastrophes in 2014 were the kinds of extreme weather events – floods, drought and severe storms – that we might expect as a result of climate change. Of course, it is not possible to say that climate change caused a particular drought or flood, but it is possible to calculate that climate change made one event more likely. The total cost of these four big, extreme weather events last year was \$23 billion, as Table 2 shows.

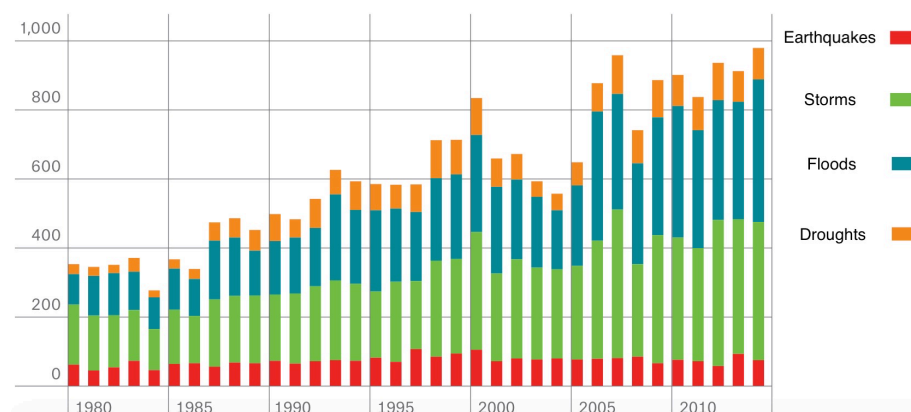
Table 2. The five largest natural catastrophes in 2014.⁹¹

Date	Country/Region	Event	Fatalities	Overall losses US\$ m	Insured losses US\$ m
11-13.10.2014	India	Cyclone Hudhud	84	7,000	530
7-16.2.2014	Japan	Winter damage	37	5,900	3,100
3-15.9.2014	India, Pakistan	Floods	665	5,100	330
3.8.2014	China	Earthquake	617	5,000	-
2014	Brazil	Drought	-	5,000	-

Source: Munich Re

The insurer Munich Re shows that the number of extreme weather events is growing, year on year (see Figure 8).⁹² This may be partly because of better monitoring of such events.

Figure 8. Number of natural catastrophes, 1980-2014



The subject of “loss and damage” is very new in the UN climate negotiations. Countries are still undecided how to deal with it. Naturally, the world’s most vulnerable countries, such as those with long, low-lying coastlines, would like to have a dedicated UN fund to help them deal with these costs. However, it may be that developed countries will be careful not to accept legal liability, in case that opens the door to expensive lawsuits. They may be cautious about supporting a formal, compensation regime. They may also be wary of an international

court to settle climate damages, for the same reason. Developed countries may prefer that existing, adaptation funds are used.

In the absence of a dedicated UN fund or a climate court to settle loss and damage claims, governments, businesses and individuals can take out insurance, to cover them for these losses. At present, such insurance only covers a very small part of total losses. In 2014, private insurance covered less than \$4 billion of the total \$23 billion damage caused by the four biggest extreme weather catastrophes (see Table 2 above). Without such insurance, governments and ultimately taxpayers will end up paying the bill. One way to help cover the cost of climate change may be to encourage and support more countries, businesses and individuals to take out insurance.

5. Making and keeping climate promises

Countries can pledge climate action, but it is another matter whether they keep their promises. There are different ways to do this.

What are the options for increasing ambition over time?

In the past, countries have made pledges for climate action over different timescales. For example, under the Copenhagen Accord, in 2009, countries made a one-off pledge for climate action in 2020, but nothing beyond. They agreed a \$100 billion fund, but for the year 2020 only; in theory, this aid could fall to zero in 2021.

Countries are now negotiating an entirely new agreement for climate action beyond 2020, for the Paris conference. Under these new negotiations, countries have a completely clean slate. That may let them off the hook, if they adopt weaker rules or targets than they committed to previously.

An alternative approach is to try and make an agreement stand the test of time. Such an approach has the support of environmental groups, and the United States. They favour a Paris agreement which commits countries to make new and more ambitious pledges every five years. Such an agreement could, in theory, continue until a long-term goal was met, to avoid dangerous climate change. Under such an approach, countries would not re-negotiate the rules every few years, but simply update their targets. That may stop them watering down previous commitments.

However, the world has tried such an approach before, under the Kyoto Protocol. Kyoto committed rich nations to cut emissions from 2008-2012, and it referred to “subsequent commitment periods”. In the end, the United States never ratified Kyoto, while Japan and Russia dropped out before the second round. It may be difficult for countries to support a long-term agreement in Paris, and then stick to it for many decades.

How important is a review of climate action?

At UN climate conferences, countries have repeatedly said that they are not doing enough to avoid dangerous climate change. Scientists have agreed that countries are falling short of more ambitious targets. At present, there is no process for calculating the size of the gap, between action pledged and required. At present, countries simply agree year after year that they must try harder.

Assuming that countries are right, that they are falling short, the question is, how can they be encouraged to take firmer action? One way may be to introduce a formal review, of past climate action, or future climate pledges. A review may encourage countries to take the process more seriously. That is because of the risk that the review will show that they are not doing enough, and embarrass them.

Ahead of the Paris conference, countries have for the first time asked the United Nations to compile a report, measuring the “aggregate effect” of all their pledges. The United Nations will work out what the pledges mean,

collectively, for global greenhouse gas emissions after 2020. The United Nations will report these findings back to countries, in Paris.

However, the UN report will simply count up the emissions implied by the pledges. It will not say how far short they are of meeting the 2°C warming target. Some countries rejected that idea. And the United Nations will certainly not judge the ambition of individual pledges. Some countries feel that it is not the business of the United Nations to tell them what to do. They may be concerned that such a review would infringe their national sovereignty. Countries which put more focus on political freedoms and representation seem less concerned about such infringements.

Nevertheless, even without a formal review, there are plenty of external experts who will be able to analyse the pledges. They will consider the UN report, and calculate how far the pledges in Paris fall short of avoiding dangerous climate change. Perhaps their work will be enough to get the world's attention.

What is the advantage of monitoring climate action?

Past multilateral agreements have shown how international monitoring can build trust. For example, the Nuclear Non-Proliferation Treaty (NPT) was a milestone in cooperation to reduce stockpiles of nuclear weapons. During the height of the Cold War, both the United States and former Soviet Union signed the treaty.⁹³ The treaty created an atmosphere of increasing trust, by allowing each country to inspect each other's stockpiles.

Under a Paris agreement, richer countries may want to inspect low-carbon projects which they have funded in developing countries, to check that their money was spent wisely. This is a touchy subject. Developing countries may feel that it is excessive interference. One way around the problem may be also to allow developing countries to inspect developed country budgets. They could check whether the climate aid is new, or simply funds shifted from a different part of a country's overseas aid.

Such mutual monitoring is politically controversial, and requires a lot of trust. But the Nuclear Non-Proliferation Treaty showed that countries can achieve cooperation, once they have built up trust.

How important is it to make national climate action legally binding?

All countries have agreed to make pledges for climate action beyond 2020, either for 2025 or 2030, under a Paris agreement. But we will have to wait until Paris for a decision on whether or not countries make these pledges legally binding. There are two options.

- 1. Make the pledges legally binding, under domestic or international law.**

Under the Kyoto Protocol, rich countries agreed emissions targets which were binding under international law. The United States rejected Kyoto because developing countries did not have legally binding targets. To get U.S. backing, a Paris agreement would almost certainly have to make climate action legally binding on all countries, or on none.

The advantage of making targets legally binding under international law is that the agreement could then apply some kind of punishment on countries which did not fulfil their pledges. That punishment could for example ban them from trading low-carbon products, like solar panels. Punishment could force countries to meet their targets, but also make them weaker in the first place. Another problem with internationally legally binding targets is that some countries may have to get parliamentary approval. At present, there seems little chance for the U.S. Congress to approve a binding Paris climate agreement.

Many countries take national laws very seriously, and at least as seriously as international law. This option may be a good alternative. It may encourage more ambitious participation, without the threats of sanctions. But domestic parliaments would still have to approve such targets.

2. **Make the pledges voluntary.**

Making pledges voluntary would probably avoid the need for domestic, parliamentary approval of a Paris agreement. That may make it easier for countries such as the United States to participate fully. The disadvantage is that countries may take the targets less seriously. If pledges were voluntary, it may be even more important for countries to agree detailed rules which make them keep their promises.

Should all countries report their emissions regularly?

At present, developed countries already have to measure their greenhouse gas emissions every year, and report these to the United Nations. That was required of them, under the 1992 UNFCCC. The United Nations reviews these reports for their accuracy, including making visits to the host country.

Developing countries, by contrast, only have to publish details of their emissions once every four years, and those reports do not have to be up to date. As a result, many developing countries last reported their annual emissions in 2005. Countries will have to decide in Paris whether developing countries will also have to report their emissions annually, under a new agreement.

Reporting emissions is a great way for countries to identify where they can make cuts, including the easiest and cheapest emissions cuts. Once they measure their emissions, they will know where their emissions are rising fastest, and why. In addition, requiring all countries to report and publish their annual emissions will make it much easier for other countries, the United Nations and citizens to check that countries, and the whole world, are taking action. At present, the latest available data for global greenhouse gas emissions is in 2010.⁹⁴

But it is an expensive and technical business, to measure emissions every year. Countries will have to understand the differences between various greenhouse gases, and have systems to measure and report these. Certainly, poorer countries would need financial and technical help to do this.

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