



# ENVIRONMENTAL TIPPING POINTS

**1** THE MELTING OF SUMMERTIME SEA ICE IN THE ARCTIC, WHICH WILL AMPLIFY GLOBAL WARMING

**2** A DECLINE IN SIZE OF GREENLAND'S ICE SHEET

**3** THE WEST ANTARCTIC ICE SHEET  
SLIPPING INTO THE OCEAN

**4** THE DRYING UP AND WITHERING  
OF BOREAL FORESTS

**5** A DECREASE IN THE AMAZON  
RAINFOREST'S RAINFALL

**6** AN INCREASE IN THE EL NIÑO EFFECT, CAUSING  
DROUGHT IN SOUTHEAST ASIA

**7** A STRENGTHENING IN INDIA'S MONSOONS, AS  
WARMER AIR CARRIES MORE WATER

**8** ANY SHIFT IN THE WEST AFRICAN MONSOON  
WILL IRREVERSIBLY DAMAGE THE SAHARA DESERT

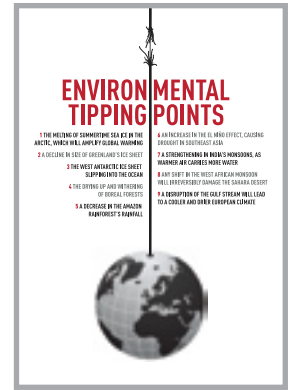
**9** A DISRUPTION OF THE GULF STREAM WILL LEAD  
TO A COOLER AND DRIER EUROPEAN CLIMATE



# TIPPING POINTS

All development is ultimately about expanding human potential and enlarging human freedom. It is about people developing the capabilities that empower them to make choices and to lead lives that they value. Climate change threatens to erode human freedoms and limit choice. It calls into question the Enlightenment principle that human progress will make the future look better than the past.

The early warning signs are already visible. Today, we are witnessing at first hand what could be the onset of major human development reversal in our lifetime. Across developing countries, millions of the world's poorest people are already being forced to cope with the impacts of climate change. These impacts do not register as apocalyptic events in the full glare of world media attention. They go unnoticed in financial markets and in the measurement of world Gross Domestic Product. But increased exposure to drought, to more intense storms, to floods and environmental stress is holding back the efforts of the world's poor to build a better life for themselves and their children.



## UNDP Human Development Report, 2008

Scientists studying climate change and its myriad effects have identified 9 'tipping points' - 9 different scenarios brought about by climate change that could each result in a long-term ecological catastrophe. These tipping points are not apocalyptic scenarios: rather, they are situations that, if they are allowed to develop, will bring about irreversible damage.

### 1. Arctic Sea Ice

When sea ice melts the ocean surface grows much darker. Darker surfaces absorb more radiation, therefore amplifying global warming even further. Arctic sea ice has been in steady decline for a number of years, especially during the warmer summer months. The disappearance of summertime sea ice could spell disaster.

### 2. Greenland Ice Sheet

Total melting of the ice sheet may occur within 300 years, but the 'tipping point' could come much earlier: scientists believe that, at current rates, enough of the ice sheet will have melted within 50 years to cause irreversible change.

### 3. West Antarctic Ice Sheet

Data suggests that, as temperatures rise, this ice sheet is slipping into the ocean. A worst-case scenario shows the entire ice sheet being gone within 300 years, resulting in a sea level rise of up to 5 metres.

### 4. Boreal Forests

The vast boreal forests that cover much of the Earth's northern latitudes store carbon, filter water and are vital components to the habitats of several rare plant and animal species. As temperatures rise, the forests may dry up and die out, taking these species and carbon sinks with them. A rise of 3° Celsius will destroy boreal forest ecosystems within 50 years.

### 5. Amazon Rainforest

As temperatures rise and deforestation continues unabated, rainfall in the Amazon is likely to decrease by up to one-third. This would extend the dry season and exacerbate the Amazon's rate of decline. Warming of under 3° Celsius would be enough to wreak irreversible damage.

## 6. El Niño

El Niño is southern Pacific water current which allows the Pacific Ocean to release heat. Climate change is likely to increase the El Niño effect, causing drought in Southeast Asia.

## 7. Indian Summer Monsoon

Greenhouse gases tend to strengthen the monsoons, since warmer air can carry more water. However, aerosol pollution has the opposite effect, increasing sunlight reflection and therefore weakening the monsoon. Either scenario would be disastrous to India's farming; stronger monsoons will result in floods, weaker ones in drought.

## 8. West African Monsoon

Although scientists agree that the West African Monsoon will be affected by climate change, there is considerable disagreement over what the effect will be. Some believe that there will be increased rainfall over the Sahara, turning the arid desert greener; others argue that the opposite is likely to happen, with further droughts likely.

## 9. Gulf Stream

Melting glaciers and ice sheets will increase the inflow of water into the Atlantic, disrupting the Gulf Stream (a vital water current which carries warm water from the Mexican Gulf across the Atlantic and onto European shores, considerably warming up Europe's climate). A disruption of the Gulf Stream would lead to a cooler and drier European climate.

## HUMAN DEVELOPMENT TIPPING POINTS

The 2007/8 UNDP Human Development Report identifies 5 'transmission mechanisms' which link climate change to human development. According to the UNDP, if climate change continues unabated, it will negatively impact human development through the manifestation of these 5 mechanisms. And, as the UNDP points out, *'In contrast to economic shocks that affect growth or inflation, many of the human development impacts – lost opportunities for health and education, diminished productive potential, loss of vital ecological systems, for example – are likely to prove irreversible.'*

### AGRICULTURAL PRODUCTION AND FOOD SECURITY

Climate change will affect rainfall, temperature and water availability for agriculture in vulnerable areas. For example, drought-affected areas in sub-Saharan Africa could expand by 60-90 million hectares, with dry land zones suffering losses of US\$26 billion by 2060. Other developing regions - including Latin America and South Asia – will also experience losses in agricultural production, undermining efforts to cut rural poverty. The additional number affected by malnutrition could rise to 600 million by 2080.

### WATER STRESS AND WATER INSECURITY

Changed run-off patterns and glacial melt will add to ecological stress, compromising flows of water for irrigation and human settlements in the process. An additional 1.8 billion people could be living in a water scarce environment by 2080. Central Asia, Northern China and the northern part of South Asia face immense vulnerabilities associated with the retreat of glaciers – at a rate of 10-15 metres a year in the Himalayas. Seven of Asia's great river systems will experience an increase in flows over the short term, followed by a decline as glaciers melt. The Andean region also faces imminent water security threats with the collapse of tropical glaciers. Several countries in already highly water-stressed regions such as the Middle East could experience deep losses in water availability.

## RISING SEA LEVELS AND EXPOSURE TO CLIMATE DISASTERS

Sea levels could rise rapidly with accelerated ice sheet disintegration. Global temperature increases of 3-4°C could result in 330 million people being permanently or temporarily displaced through flooding. Over 70 million people in Bangladesh, 6 million in Lower Egypt and 22 million in Viet Nam could be affected. Small island states in the Caribbean and Pacific could suffer catastrophic damage. Warming seas will also fuel more intense tropical storms. With over 344 million people currently exposed to tropical cyclones, more intensive storms could have devastating consequences for a large group of countries. The 1 billion people currently living in urban slums on fragile hillsides or flood-prone river banks face acute vulnerabilities.

## ECOSYSTEMS AND BIODIVERSITY

Climate change is already transforming ecological systems. Around one-half of the world's coral reef systems have suffered 'bleaching' as a result of warming seas. Increasing acidity in the oceans is another long-term threat to marine ecosystems. Ice-based ecologies have also suffered devastating climate change impacts, especially in the Arctic region. While some animal and plant species will adapt, for many species the pace of climate change is too rapid: climate systems are moving more rapidly than they can follow. With 3°C of warming, 20-30 percent of land species could face extinction.

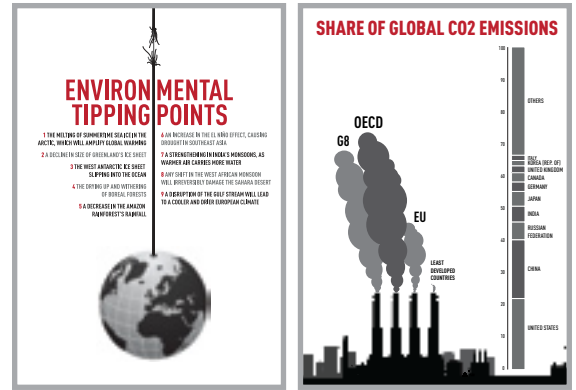
## HUMAN HEALTH

Rich countries are already preparing public health systems to deal with future climate shocks, such as the 2003 European heatwave and more extreme summer and winter conditions. However, the greatest health impacts will be felt in developing countries because of high levels of poverty and the limited capacity of public health systems to respond. Major killer diseases could expand their coverage. For example, an additional 220-400 million people could be exposed to malaria – a disease that already claims around 1 million lives annually. Dengue fever is already in evidence at higher levels of elevation than has previously been the case, especially in Latin America and parts of East Asia. Climate change could further expand the reach of the disease.

UNDP Human Development Report (2008)

# THE KYOTO PROTOCOL AND CO<sub>2</sub> EMISSIONS

- The primary human source of carbon dioxide (CO<sub>2</sub>) in the atmosphere is from the burning of fossil fuels for energy production and transport
- Another leading cause of CO<sub>2</sub> is deforestation, which is responsible for more greenhouse gas emissions than all the world's cars, trucks, planes and boats combined
- In order to stop global warming, dramatic cuts in all CO<sub>2</sub> emissions must be achieved – at least 25%- 40% below the 1990 levels by 2020, and at least 80%-95% below the 1990 levels by 2050.



## WHAT ARE FOSSIL FUELS?

Oil, coal and natural gas are called fossil fuels because they are formed from the remains of plants and animals that lived millions of years ago. All fossil fuels are made up of hydrocarbons and release carbon dioxide when burned.

Currently, fossil fuels are the primary source for almost 80% of the industrial world's energy. They are non-renewable resources that will eventually run out. If we want to avoid dangerous climate change, we need to switch to renewable energy sources as soon as possible, rather than waiting for the oil wells to run dry.

## WHO DOES THE MOST BURNING?

Industrialised nations have large economies that have burned fossil fuels for a long time and for this reason are responsible for most of the human-caused carbon dioxide in the atmosphere - however, all nations are responsible to one degree or another.

Among the world's top economies, the US remains a top polluter. With less than 5% of the world's population, the US is responsible for almost a quarter of global emissions of carbon dioxide.

But to look at carbon dioxide emissions only by country is not enough. Ultimately, CO<sub>2</sub> emissions come from people. For example, someone driving a gas-guzzling 4x4 SUV is burning more fossil fuels than someone with a smaller, more efficient vehicle. Someone eating a diet heavy in meat will create more CO<sub>2</sub> emissions than someone eating less meat. As individuals, we all have a responsibility to protect the climate by making informed daily choices, pushing corporations to create market solutions and demanding that governments protect our shared environment.

## DEFORESTATION AND CO<sub>2</sub> EMISSIONS

Most CO<sub>2</sub> emissions from deforestation stem from the destruction of tropical forests. While some forests are logged, many are simply burned to make room for industrial agriculture like cattle ranching and palm oil plantations – two leading causes of tropical deforestation. This burning emits massive amounts of CO<sub>2</sub> into the atmosphere.

Logging can also raise the risk of fire by drying out and heating up forests through the removal of trees that create shade and store moisture. In addition, logging activities – from the deliberate burning of leftover “slash,”

to accidental sparks from machinery – increase unnatural fires and CO<sub>2</sub> emissions.

As global warming leads to hotter, drier summers, northern forests like the Canadian Boreal may experience bigger, more frequent fires. The Boreal, which locks up billions of tonnes of carbon, is the single largest storehouse of carbon on land. If the Boreal burns, global warming could increase, raising the likelihood of more fires. This vicious cycle of CO<sub>2</sub> emissions from forest fires and global warming has been called a ticking ‘carbon bomb’.

## LIST OF COUNTRIES (REGIONS) BY CO<sub>2</sub> EMISSIONS (2004 DATA)

RANK		METRIC TONNES	%
1	United States	6049435	22
2	China and Taiwan	5010170	18
3	European Union	4001222	15
4	Russia	1524993	6
5	India	1342962	5
6	Japan	1257963	5
7	Germany	860522	3
8	Canada	639403	2
9	UK	587261	2
10	South Korea	465643	2
61	Ireland	42353	0.2
	<b>WORLD TOTAL</b>	<b>27245758</b>	

## THE KYOTO PROTOCOL

The Kyoto Protocol is an international agreement that set targets for industrialised countries to cut their greenhouse gas emissions. Targeted gases include carbon dioxide, methane, hydrofluorocarbons, perfluorocarbons and hexafluoride. These gases are considered at least partly responsible for global warming - the rise in global temperature which may have catastrophic consequences for life on Earth. The protocol was agreed in 1997, based upon principles set out in a framework convention signed in 1992.

Under Kyoto, industrialised countries committed themselves to cut their combined emissions to 5% below the 1990 levels by 2008-2012 and each country that signed the protocol agreed to its own specific target. EU countries are expected to cut their present emissions by 8% and Japan by 5%. Some countries with low emissions were permitted to increase them. Russia initially wavered over signing the protocol amid speculation that it was jockeying for more favourable terms. But the country’s cabinet agreed to back Kyoto in September 2004. The Kyoto Protocol became a legally binding treaty on 16 February 2005. It could only come into force after two conditions had been fulfilled:

- It had been ratified by at least 55 countries
- It had been ratified by nations accounting for at least 55% of emissions from what the Treaty calls “Annex 1” countries – 38 industrialised countries were given targets for reducing emissions, plus Belarus, Turkey and now Kazakhstan.

The first target was met in 2002 but following the decision of the United States and Australia not to ratify (Australia has now signed the protocol), Russia’s position became crucial for the fulfilment of the second

condition. It finally did ratify on 18 November 2004 and the Kyoto Protocol came into force 90 days later, on 16 February 2005.

Between 1990 and 2000 industrialised countries cut their overall emissions by some 3% largely because of a sharp decrease in emissions from the collapsing economies of the former Soviet countries, which masked an 8% rise among rich countries. The UN says industrialised countries are now well off target for the end of the decade and predicts emissions of about 10% above the 1990 levels by 2010. The treaty suffered a massive blow in 2001 when the US, responsible for about quarter of the world's emissions, pulled out.

The agreement acknowledges that developing countries contribute least to climate change but will likely suffer the most from its effects, yet most developing countries have signed the agreement. They do not have to commit to specific targets, but do have to report their emissions levels and develop national climate change mitigation programmes. China and India, potential major polluters with huge populations and growing economies, have both ratified the Kyoto protocol.

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## FURTHER INFORMATION

As you might expect, there is a wealth of information about climate change available on the internet. A quick search of news sites such as the [BBC](#) or [New York Times](#) will throw up literally hundreds of articles on the subject. Environmental group websites all have their own pages dedicated to climate change and carbon dioxide emissions – Greenpeace International's [portal](#) is quite exhaustive without being confusing.

<http://news.bbc.co.uk>

<http://www.nytimes.com/>

<http://www.greenpeace.org/international/campaigns/climate-change/science>

The UN Statistical Division website can be daunting, but [this page](#) on CO<sub>2</sub> emissions worldwide is straightforward and includes world maps to simply things even further.

[http://unstats.un.org/unsd/environment/air\\_co2\\_emissions.htm](http://unstats.un.org/unsd/environment/air_co2_emissions.htm)