NATURE’S BOTTOM LINE
CLIMATE PROTECTION AND THE CARBON LOGIC

A crucial component is missing from the international plan to combat climate change - the bottom line. How much warming can our planet tolerate before its ecological systems begin to break down? What are Nature’s ecological limits and how can we stay within them?

GREENPEACE

The 1997-1998 El Nino event with its fires, floods and outbreaks of disease and pestilence, offers a glimpse of the future in a 'warmed' world and illustrates vividly the disastrous consequences that even minor fluctuations in the climate system can bring.

Scientists warn that the rates of climate change are likely to exceed any in the last 10,000 years, making it impossible for many ecosystems to adapt and survive.

In the northern polar regions, for example, predicted changes could mean vegetation having to migrate at the rate of one metre an hour to stay within the same growing conditions, tantamount to asking trees to get up and walk. Failure to adapt will increase the vulnerability of ecosystems and some will not survive.

Seemingly small and insignificant changes can begin a chain reaction that impacts on ecological, social and economic systems.

In Alaska, climate change has altered conditions for beetle brood development, reducing the amount of deaths in winter and allowing beetles to reach sexual maturity in one year instead of two, resulting in the worst spruce bark beetle outbreak in Alaskan history. Since 1989, 25 million trees have died and 1.2 million acres of forest have become infested.

Flooding along the River Maas in the Netherlands

WHAT ARE THE LIMITS?

In 1990 the United Nations Advisory Group on Greenhouse Gases specified the following limits for rates and magnitude of temperature and sea-level rise in order to protect both ecosystems and human systems:

Global mean temperature:
- **Maximum rate of 0.1 degree C per decade**
- **Maximum increase of 1.0 degrees C**

They found that temperature increases beyond 1.0 degree C "may elicit rapid, unpredictable and non-linear responses that could lead to extensive ecosystem damage"

Sea level rise:
- **Maximum rate of rise 20mm per decade**
- **Maximum 20cm increase above 1990 levels**

A 20mm limit on sea level rise would "permit the vast majority of vulnerable ecosystems, such as natural wetlands and coral reefs to adapt. Beyond this rate of rise damage to ecosystems will rise rapidly".

THE CLIMATE CONVENTION

United Nations Framework Convention on Climate Change, the international community's response to the problem, states as its ultimate objective: "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner."

International efforts fall short of this agreed objective because they do not address the environmental imperative. Until they do, the Climate Convention is doomed to fail.

CO_2 CONCENTRATIONS

The rate and magnitude of global temperature increase are primarily governed by the amount of CO_2 or its equivalent concentrated in the atmosphere. The pre-industrial atmospheric load, which is thought to have prevailed for several thousand years, has increased by 30% over the last 200 years.

If we continue to burn fossil fuels at current rates CO_2 concentrations will double by the year 2060. According to the Intergovernmental Panel on Climate Change (IPCC), a doubling of CO_2 in the atmosphere could cause temperatures to rise between 1.5 and 4.5 degrees C, depending on how easily CO_2 in the atmosphere causes global climate to change (climate sensitivity). If the earth's climate is less sensitive to CO_2 (or its equivalent in other gases) the increase will be at the bottom of this range. If it is more sensitive it will be at the top.

Although the 'best guess' used by most governments is 2.5 degrees C, the IPCC have noted that the actual pattern of temperature change best fits an assumption of 3.5 degrees C.

To stay within the ecological limits defined here, taking a climate sensitivity of 3.5 degrees C as a prudent and precautionary approach, levels of CO_2 in the atmosphere have to be stabilised at or below 350 parts per million volume (ppmv). This means bringing them down below current levels.

The time lag between CO_2 being emitted and temperature and sea level rising means that the 'global warming' we are witnessing today is less than half of what we can eventually expect to see as a result of emissions over the last 200 years.

Once CO_2 is stabilised it could still take several decades or even a century before atmospheric temperature stabilises and we may find that the earth is already committed to a rise of at least 1 degree C.

Delaying action will mean future cuts will have to be much faster and larger than they would otherwise have been.

CARBON BUDGET

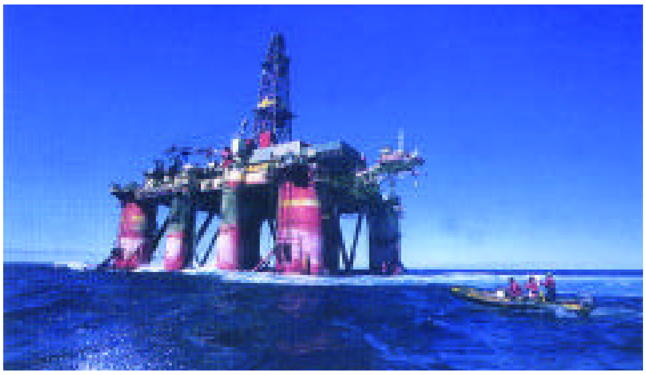
Given the knowledge that keeping the long-term temperature increase below 1.0 degrees C requires stabilisation of atmospheric CO_2 at 350 ppmv it is possible to calculate a carbon budget giving the total amount of fossil fuels that can be burnt.

Assuming a climate sensitivity of 3.5 degrees C, and making the optimistic assumption that destruction of the world's forests is halted (see Box), the total amount of carbon that can be released from the burning of fossil fuels is 225 billion tonnes. Current reserves total more than four times this amount.

Figure 1: Carbon Budget

Climate Sensitivity (°C at equilibrium for doubling of CO_2)	Carbon Budget for 1°C climate target	Carbon Budget for 2°C climate target
1.5	480	935
2.0	360	720
2.5	295	585
3.0	255	480
3.5	**225**	410
4.0	200	360
4.5	185	325

The figures in this table all assume action on de-forestation. Even taking the most optimistic assumption of climate sensitivity and the higher 2 °C limit, it is clear that fossil fuel reserves are far in excess of what we can afford to burn.

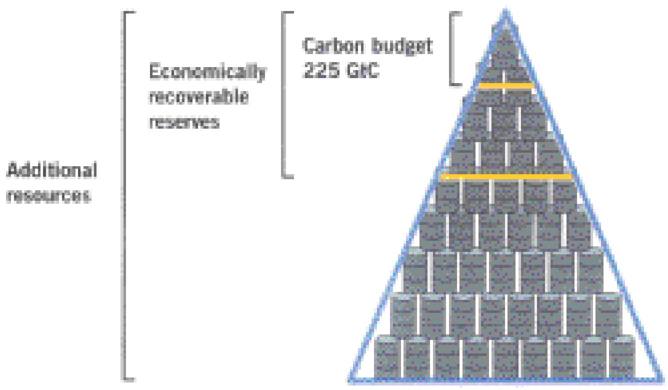


Exploring for new oil in the Atlantic Frontier only adds to 'unusable'reserves.

Figures for reserves of fossil fuels range between 829 and 1501 billion tonnes of carbon depending on the source of the estimate. Beyond these reserves the resource base in total is estimated at 4116 to 4678 billion tonnes of carbon.

Logically, to stay within the defined ecological limits, 75 per cent of the known economically recove rable reserves can never be used as fuel. Considered in terms of the total fossil fuel resource, 95 per cent can never be used as fuel.

Fossil fuel reserves and resources versus carbon budget



RESERVES AND RESOURCES

Economically recoverable reserves are those defined as fossil fuels recoverable with known technology and within a price range close to the present.

Additional resources are estimates based on geological information, of all the existing fossil fuel sources which, theoretically, might one day be recoverable. They include current reserves.

Exploration for and development of fossil fuels can be thought of as converting resources to reserves. Technological progress has made it possible to extract fossil fuels previously considered only as resources, for example, deep-sea oil, which is now being commercially extracted.

DEFORESTATION

Forests absorb CO_2, acting as a 'sink'. If they are destroyed they become a 'source' releasing CO_2 back into the atmosphere. The more action taken to limit deforestation the greater the 'carbon budget' can be for fossil fuel use.

- If deforestation continues at the present rate the budget is 145 billion tonnes of carbon.
- With action to halt the destruction of forests, stabilising them at current levels and major regeneration in the next century the carbon budget is 225 billion tonnes.
- Given action to halt forest destruction and afforestation to lock up an extra 40 billion tonnes of carbon, the budget is 270 billion tonnes.

Throughout this analysis Greenpeace has assumed the second, extremely optimistic, scenario which allows a carbon budget of 225 billion tonnes of carbon.

Climate change itself could also impact on forests causing them to turn from 'sinks' to 'sources'. In 1997-98 forest fires in Indonesia, caused by a combination of drought and logging, added as much CO_2 to the atmosphere as all the coal, oil and gas burned in Europe in one year.

PHASING OUT FOSSIL FUELS

The Carbon Logic dictates that:

• The amount of carbon burnt in the form of fossil fuels must be restricted to 225 billion tonnes if CO_2 concentrations are to be stabilised at the required level. (see Figure two).

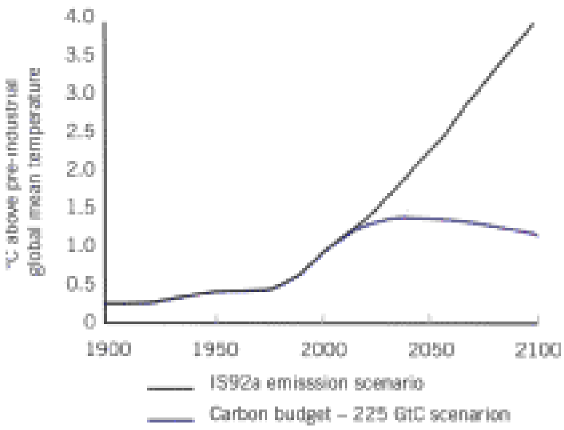


Figure2: Temperature increase over time for 225 GtC carbon budgetand the IPCC 'business-as-usual'scenario

• Given the current rate of fossil fuel use this budget will be exhausted in 40 years. If energy demand continues to grow at the present rate of 2% per year this budget will last for less than 30 years. The time-scale dictates that the phase out of fossil fuels begin immediately.

This means that 'conventional' wisdom, which has been current since the seventies must be stood on its head. Oil will not 'run out', it must be shut down.

Fossil fuel reserves must be left in the ground and the race to open up new reserves halted. Instead we need to make, in the words of the Governments Advisory Committee on Business and the Environment, "a transition to a low-carbon economy" – and phase out fossil fuels.

A fossil fuel phase out will require new politics and new policies but also offers new opportunities. As a first step the UK government should:

• Halt the development of new oilfields.

• Start the shift to a genuinely sane energy path using renewables and energy efficiency

• Redirect existing fossil fuel and nuclear subsidies to renewable energy technologies and energy efficiency

Greenpeace ship at Tuno Knob windfarm, Denmark

A much fuller account and technical description is given in the report *Fossil Fuels and Climate Protection: the Carbon Logic* which is available from Greenpeace.

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