CSE STATEMENT

MAKING THE KYOTO PROTOCOL WORK

Ecological and economic effectiveness, and equity in the climate regime

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- To combat global warming, countries will have to produce fewer emissions than the world's sinks absorb.

- Governments must ensure greenhouse gas concentrations do not build up beyond an acceptable level, after which they begin to decline.

- The longer the dominance of the carbon-energy economy, the more problems it creates.

- Clean coal has good short term but bad long term implications.

- Zero-carbon energy transition is not only the best but also possibly the only option to combat climate change in this century.

- A market-based Clean Development Mechanism, seeking least-cost options, could actually end up as an obstacle for a zero-carbon energy transition.

- As long as the world remains within a carbon-based energy economy, equitable sharing of atmospheric space becomes a critical issue.

- Equity demands convergence, where all nations agree to reach the same level of per capita emissions.

- Research investments made in the next few decades will shape the technology options available to the world even after 2020.

- With appropriate 'technology push and policy pull', renewables could contribute as much as 37-39 per cent of the global primary energy supply by 2050, and net carbon emissions could be below 1990 levels by as much as 15 per cent.

Making the Kyoto Protocol work

Ecological and economic effectiveness, and equity in the climate regime

INTRODUCTION

Climate change is one of the biggest challenges facing humankind. Unfortunately, economic concerns, rather than ecological and social justice concerns, are currently the driving force behind the Kyoto Protocol of the UN Framework Convention on Climate Change (FCCC). **The protocol is a disaster built entirely on short-term perspectives, rather than the long-term action needed to prevent global warming.** But both governments and non-governmental organisations (NGOs) are so keen to have the protocol ratified that they are willing to overlook the fact that it has very serious shortcomings in its design.

What is largely missing, both in the global debate and in the official negotiations, is a vision for a climate framework to address the 'ultimate objective' of FCCC — to avert the threat of climate change, and to get the entire world to cooperate with confidence in each other. **By itself, the protocol will do nothing to solve the climate change problem.** The direct greenhouse gas (GHG) impact of the mandated reductions during the first budget period will amount to an almost negligible effect — atmospheric carbon dioxide levels will come down by only about one-third of one per cent relative to where they would be in 2010 without a Kyoto Protocol.[1]

The focus of the negotiations so far, particularly the focus of the US and its umbrella group, has been to take on the least cost options, by buying 'emission credits' from developing countries. Calls for ecological effectiveness, and equity in the management of the Earth's atmosphere, a global common, have been ignored by the umbrella group which focuses on pushing through the Kyoto mechanisms.

Great divide

The world is divided into three key climate camps today. The first consists of nations that want to take serious action on global warming. This camp includes nations of the Alliance of Small Island States (AOSIS), who are afraid that they will affected if sea level rises, and some European nations who have a strong pro-environment public opinion and Green Parties in their parliaments. For this group, the Kyoto Protocol must lead to ***ecologically effective*** action.

The second camp consists of nations who believe that emissions reduction will come at a high cost and are searching for as low cost solutions as possible. For this group, led by the US, which has to reduce the highest quantity of emissions, the Kyoto Protocol must lead to ***economically effective*** action.

The third camp consists of poor nations who want appropriate 'environmental space' for their future economic growth, given the fact that development within a carbon energy economy is closely related to carbon emissions. This group, led by India, China and other poor nations, want the Kyoto Protocol to undertake ***equitous and socially just*** actions.

For a protocol built on true international cooperation, all three aspects will have to be considered. If a protocol that has high economic costs is not acceptable to the umbrella group, one that does not take on equity concerns and is ecologically ineffective is not acceptable to developing countries. Countries will have an equal opportunity at development only if all countries have equitable entitlements to the atmosphere, because of the unbreakable link between carbon dioxide emissions and the economy so long as we are on a carbon path. Otherwise, the climate regime does not amount to good governance of the Earth's natural resources – it amounts to an autocracy of the rich.

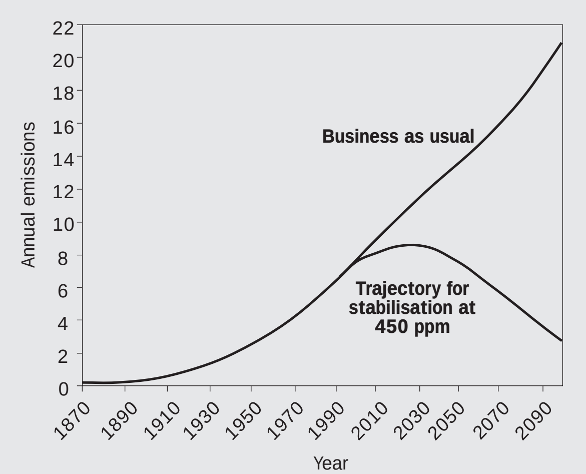
ECOLOGICALLY EFFECTIVE ACTION

In order to combat global warming, governments of the world must ensure that GHG concentrations do not build up beyond an acceptable level, after which they begin to decline. According to the Intergovernmental Panel on Climate Change (IPCC) studies, if GHG concentrations stabilise at 450 parts per million (ppm) by the end of the 21st century, global average temperature will increase by 0.7°C, accompanied by a sea level rise of 10-65 cm. Though this temperature rise exceeds natural variability, it would allow many – though not all – ecosystems to adapt. It can thus be tentatively taken as an upper limit on the tolerable rate of climate change.

To stabilise at 450 ppm, cumulative GHG emissions have to be limited to about 600-800 billion tonnes of carbon equivalent (gtC) between now and the end of the 21st century. By this time annual emissions should diminish to less than 3 gtC per year. But under a business as usual scenario, cumulative emissions between now and 2100 will be about twice as high, at 1500 gtC, with annual emissions reaching 20 gtC per year and accelerating upward (*see Graphs 1 and 2*). The world could expect a warming of 1.4 to 2.9°C and a sea level rise of 19 to 86 cm by 2100 under this scenario (*see Table 1*). This will adversely affect natural habitats, agricultural systems and human health, and have severe implications for coastal and island ecosystems and their human communities.

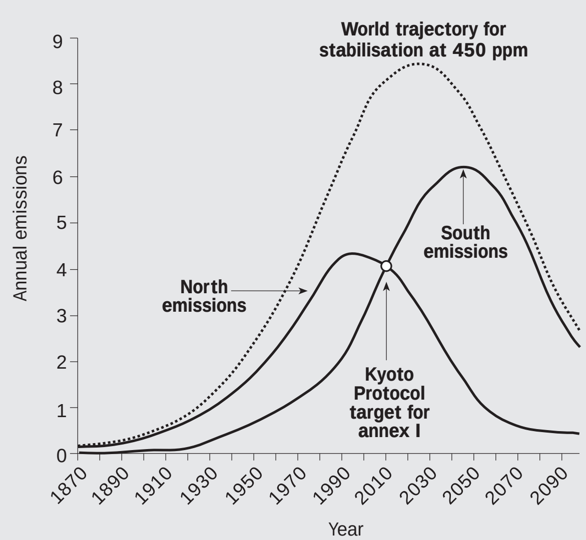
The 450 ppm stabilisation trajectory, despite being a dramatic deviation from business as usual, is itself not without considerable risks. Not only would it commit the world to a non-trivial degree of climate change, it could subject the global climate system to a radical shock due to non-linear mechanisms that are incompletely accounted for in existing climate models. Evidence from prehistoric climatic records is increasingly supporting the view that the climate system can change rapidly with dramatic ecological impacts.

Graph 1: Trajectory of global carbon emissions from fossil fuel combustion for the 450 ppm stabilisation scenario – 1860-2100 (billion tonnes of carbon)



Source: Sivan Kartha *et al* 1998, "Meaningful Participation" for the North and South, Paper presented at SEI/CSE Workshop on Towards Equity and Sustainability in the Kyoto Protocol, Buenos Aires, November 8, *mimeo*

Graph 2: Trajectory of North and South carbon emissions for the 450 ppm stabilisation scenario (billion tonnes of carbon)



Source: Sivan Kartha *et al* 1998, "Meaningful Participation" for the North and South, Paper presented at SEI/CSE Workshop on Towards Equity and Sustainability in the Kyoto Protocol, Buenos Aires, November 8, *mimeo*

Table 1: Environmental impacts of different atmospheric levels of greenhouse gases

Implications and impacts	Atmospheric levels by 2100	
	Business as usual scenario	**450 ppm tolerable scenario (Carbon dioxide equivalent)**
Carbon budget between now and 2100	1,500 gtC	600 – 800 gtC
Annual emissions in 2100	20 gtC and rising	less than 3 gtC
Global average temperature rise	1.4° – 2.9°C	0.7°C
Sea level rise	19 – 86 cm	10 – 65 cm
Impact on ecosystems	Severe implications for coastal communities, natural habitats, agriculture and human health	Many, but not all, ecosystems may be able to adapt unless there are radical shocks due to uncontrollable positive feedbacks

Source: Sivan Kartha *et al* 1998, "Meaningful Participation" for the North and South, Paper presented at SEI/CSE Workshop on Towards Equity and Sustainability in the Kyoto Protocol, Buenos Aires, November 8, *mimeo*

Relatively small human-induced changes could thus be amplified by positive feedback that operates within larger systems that cannot be controlled by human beings.[2]

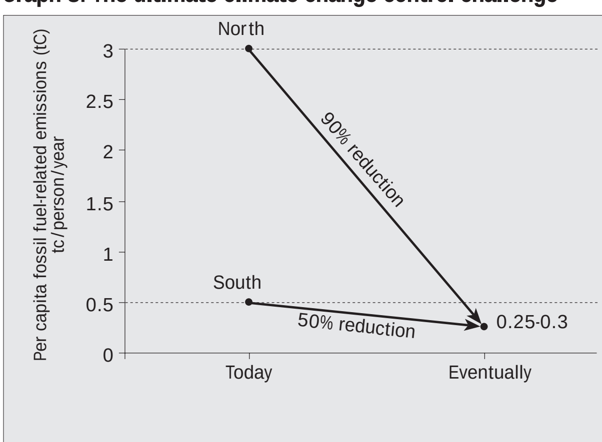
Already, the current global concentration of carbon dioxide alone (ignoring other GHGS) is around 360 ppm. Nobody has as yet talked about stabilising atmospheric concentrations at this level in the next century or thereafter. Nor has anyone talked about stabilising at 750 ppm even though business as usual scenarios show concentrations rising well above 750 ppm. Most of the discussion has been between 450 ppm and 650 ppm.[3] The EU has only accepted the 550 ppm carbon dioxide stabilisation scenario.[4]

Can concentrations be kept at safe levels?

In terms of per capita emissions, not interfering with the world's climate poses an extremely daunting challenge. It means that both the North and South will have to reduce per capita emissions substantially (*see Graph 3*). The North must reduce its current carbon emissions of about 3 tonnes per capita from fossil fuel sources to about one-tenth. The South must eventually reduce its own current per capita carbon emissions of about 0.5 tonnes per capita by half even as its population and economies motorise and industrialise in the years to come.[5]

This task will be impossible, unless nations not only change their current carbon-intensive energy path by undertaking energy efficiency measures, but the world moves towards a zero-carbon energy-based economy as fast as possible. Several studies show that a rapid shift towards a **zero-carbon energy transition is not only the best but also possibly the only option to combat climate change in the next century itself**. Though the goals of moving to a zero carbon economy and energy efficiency are not mutually exclusive, a focus on energy efficiency measures could pose a serious risk to a zero-carbon energy transition. Such a focus could 'lock in' fossil fuels for a much longer time than desired, and 'lock out' renewable energy sources. Many studies show that governments must take a

Graph 3: The ultimate climate change control challenge



If climate change is to be averted, all nations have to reduce their per capita carbon emissions quite substantially

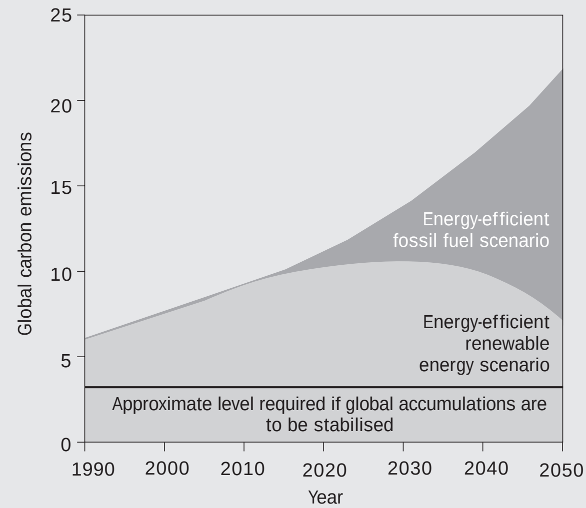
Source: Sivan Kartha *et al* 1998, "Meaningful Participation" for the North and South, Paper presented at SEI/CSE Workshop on Towards Equity and Sustainability in the Kyoto Protocol, Buenos Aires, November 8, *mimeo* proactive role in promoting the transition here and now. Though a zero-emissions future looks more promising today than ever before, the transition will not take place by itself.

A major study conducted by the International Institute for Applied Systems Analysis (IIASA) based in Austria and the World Energy Conference (WEC), entitled *Global Energy Perspectives,* also points to the importance of renewables.[6] With appropriate 'technology push and policy pull', renewables could contribute as much as 37-39 per cent of the global primary energy supply by 2050, and net carbon emissions could be below 1990 emissions by as much as 15 per cent. Both in case of the Organisation for Economic Cooperation and Development (OECD) and developing countries, gross carbon emissions remain at the lower end of 2050 projections only where governments take a proactive position to push for non-polluting renewable energy sources and for energy efficiency.

In such a scenario, OECD countries will be able to cut their 1990 carbon emissions by about 75 per cent and developing countries will be able to stay within 2.5 times of their 1990 carbon emissions. The world as a whole will be able to return to the gross carbon emissions of 1990. Any deviation from this path would mean that even by 2050, the world will not be able to reduce its gross carbon emissions below the 1990 levels, which in itself are 2-3 times higher than those considered to be environmentally sustainable (*see Graph 4*).

On the other hand, if the world waits for a large part of its oil and coal resources to be exhausted before this shift to renewables occurs, which will not be before the 22nd century, the certainty of serious climate change occurring becomes inordinately high, almost definite.

Graph 4: Global carbon emissions under an energy-efficient fossil fuel scenario (gtC per year)



Energy-efficiency in a fossil fuel based carbon economy cannot avert climate change

Source: Dennis Anderson 1996, Energy and Environment: Technical and Economic Possibilities, *Finance and Development*, June, pp 10-13

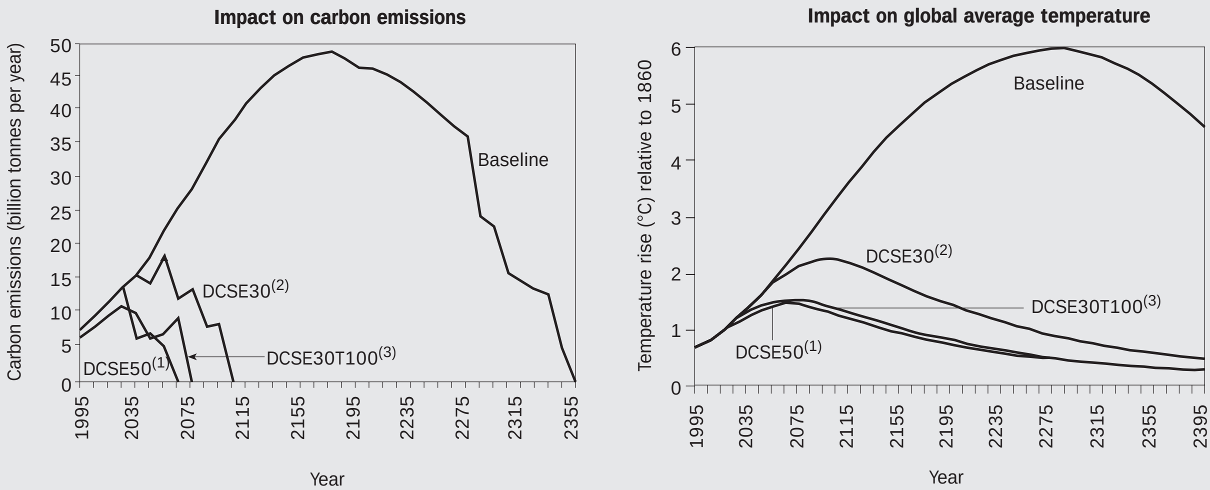
Promise of renewable technology

A study conducted by Ujjayant Chakravarty and others at the University of Hawaii has tried to measure the impact of solar energy penetration on future carbon emissions. The study shows that in the baseline scenario, in which global carbon emissions grow for nearly 180 years and reach a peak of 49 gtC in 2175, average global temperatures rise to a maximum of 6°C (relative to 1860). But in the most optimistic solar energy penetration scenario, under which the prices of solar energy systems fall by 50 per cent per decade, global carbon emissions will peak at only about 13 gtC in 2035. Global average temperature will rise by 1.5°C and begin to decline after 2055, making global warming a problem that can be dealt with within the first half of the next century (*see Graph 5 and Table 2*). Solar energy would have become competitive enough to replace fossil fuels in every economic sector by 2065.

Even a relatively pessimistic scenario in which solar energy costs decline by 30 per cent per decade makes a salutary difference. If this 30 per cent decline is accompanied by a carbon tax on fossil fuels of about US $100 per tonne (raising coal prices by about US $ 70/tonne or 300 per cent, and oil prices by about US $8 per barrel), the effects are the same as the earlier scenario, with a 50 per cent decrease in solar energy prices every decade.[7]

On the other hand, moving towards clean coal technology has a limited impact. The model assumes that a new coal combustion technology will become available by 2020 which removes 50 per cent of the carbon dioxide emitted by coal. In this case, peak temperatures rise by about 4°C. Prior to 2045, clean coal technology does help to control temperatures and delay global

Graph 5: Scenario showing impact of solar energy penetration



Rapid solar energy penetration can make global warming a problem that can be solved within the first few decades of the 21st century

Notes: (1) DCSE50 Scenario: Solar energy costs drop by 50% per decade (2) DCSE30 Scenario: Solar energy costs drop by 30% per decade (3) DCSE30T100 Scenario: Solar energy costs drop by 30% per decade plus there is a US $100/tonne carbon tax

Source: Ujjayant Chakravarty *et al*, Extraction of Multiple Energy Resources and Global Warming, University of Hawaii, *mimeo*

warming even more than the most optimistic solar energy penetration scenario of 50 per cent rate of solar cost reduction per decade. But once oil and natural gas run out, the global energy economy will become totally dependent on clean coal and temperatures begin to rise rapidly. Clean coal therefore has good short term, but bad long term, implications (*see Graph 6*).[8]

Obstacles for renewable technologies

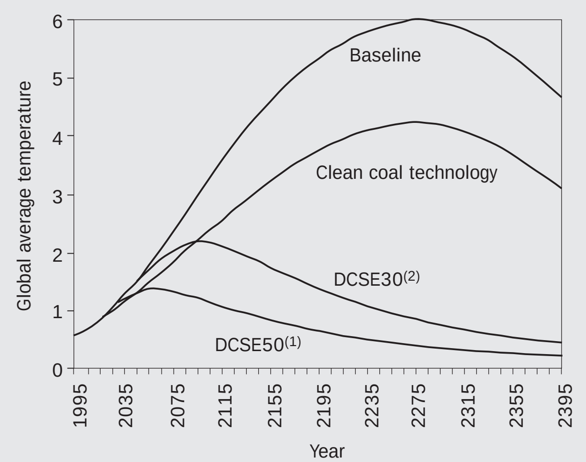
New renewable technologies are growing faster than any method of electricity generation.[9] Despite these developments, renewables are still unable to penetrate the market partly because of existing government policies. The biggest obstacles in the way of renewable technologies today are low fossil fuel prices

Table 2: Impact of solar energy penetration on climate change

Scenario	Peak annual emissions		Peak global average temperature rise relative to 1860		Comments
	Year	Amount (billion tonnes of carbon)	Year	Amount	
Baseline scenario	2175	49	2275	6°C	Solar energy takes over all economic sectors only when all fossil fuels are exhausted
50 per cent reduction/decade in the cost of solar energy	2035	13	2055	1.5°C	Solar energy takes over all economic sectors in 2065
30 per cent reduction/decade in cost of solar energy	2055	18	2095	2.2°C	Solar energy takes over all economic sectors in 2105

Source: Ujjayant Chakravarty *et al*, Extraction of Multiple Energy Resources and Global Warming, University of Hawaii, *mimeo*

Graph 6: Impact of clean coal technology on future global average temperatures (degrees Centigrade)



Clean coal technologies slow down global warming only in the short-term but do not prevent global warming in the long-term

Notes: (1) DCSE50 Scenario: Solar energy costs drop by 50% per decade
(2) DCSE30 Scenario: Solar energy costs drop by 30% per decade

Source: Ujjayant Chakravarty *et al*, Extraction of Multiple Energy Resources and Global Warming, University of Hawaii, *mimeo*

and fossil fuel subsidies in many countries; declining public sector research and development, and plummeting private sector research and development as the deregulation of energy markets increasingly focuses on short term returns.[10] For instance, despite major technological innovations and cost reductions, these technologies are failing to penetrate the US market significantly. They are faced with a 'moving target' - no matter how cheap they get, fossil fuel energy is cheaper and they have to compete not only with the cost of existing fossil fuel systems, but also with the falling costs of increasingly efficient fossil fuel systems in the future.

As fossil fuel prices are not going to change dramatically in the years to come, rapid expansion in the use of zero-carbon technologies will come only with a proactive official policy aimed at increasing research investment, and encouraging mass production to bring their costs further down. Governments of the world have to play a key role in 'reinventing the energy system' in the 21st century, just as they have played a key role in determining the modern energy supply structure ever since the 19th century. But government research and development investment in renewable energy in recent years has been extremely poor and has been falling. In 1995, it was a mere US $878 million in all industrialised countries put together, less than 10 per cent of the total reported government expenditure on energy research and development (*see Table 3*).[11] During the 1980s there was a dramatic fall in official support for renewable energy research though there has been a slight increase in the 1990s (*see Graph 7*).

The IIASA/WEC study warns that capital turnover rates (the time it takes to recover investment) of energy supply technologies, and particularly of infrastructures, are five decades or longer. So research investments made in the next few decades will shape the technology options available to the world even after 2020. The more the world gets locked into fossil fuel-based systems, especially efficient and low-cost fossil fuel systems, the longer it will take to get out of them. Opportunities for increasing research and development investment are not small. A carbon tax of US $5 per tonne of carbon will increase the price of oil by just US $0.65 per barrel but it will generate US $10-15 billion in the US alone, which could be used to fund research in solar energy.

Economically effective action

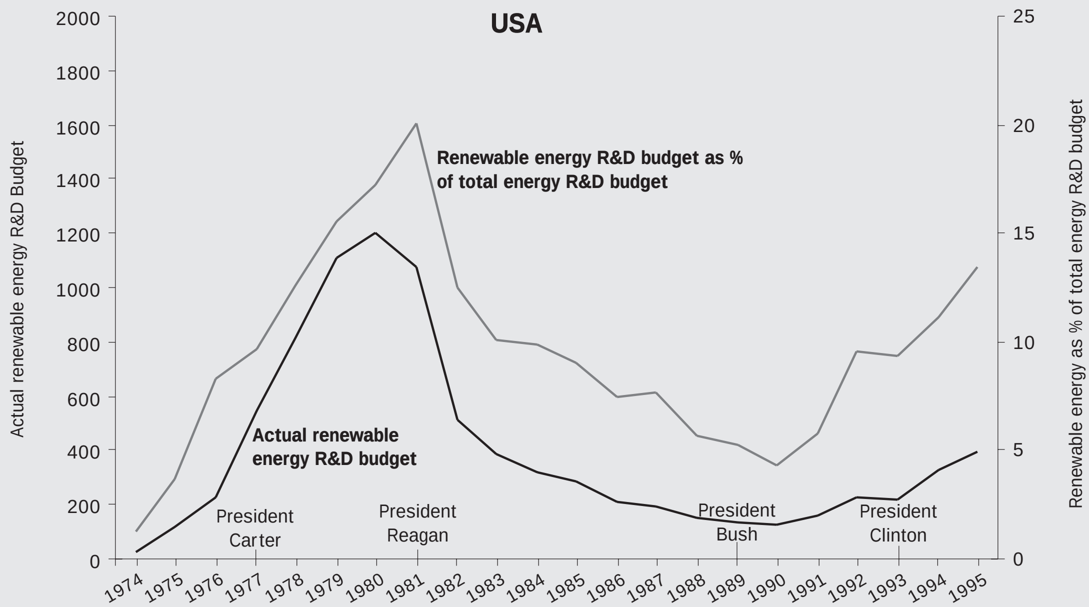
The Royal Institute of International Affairs (RIIA), London, estimates that the total emissions of OECD countries are projected to exceed their targets by 580-1160 million tonnes of carbon (mtC) in 2010.[12] If all reductions come only from domestic action, the cost could be as high as US $120 billion a year, according to a study conducted

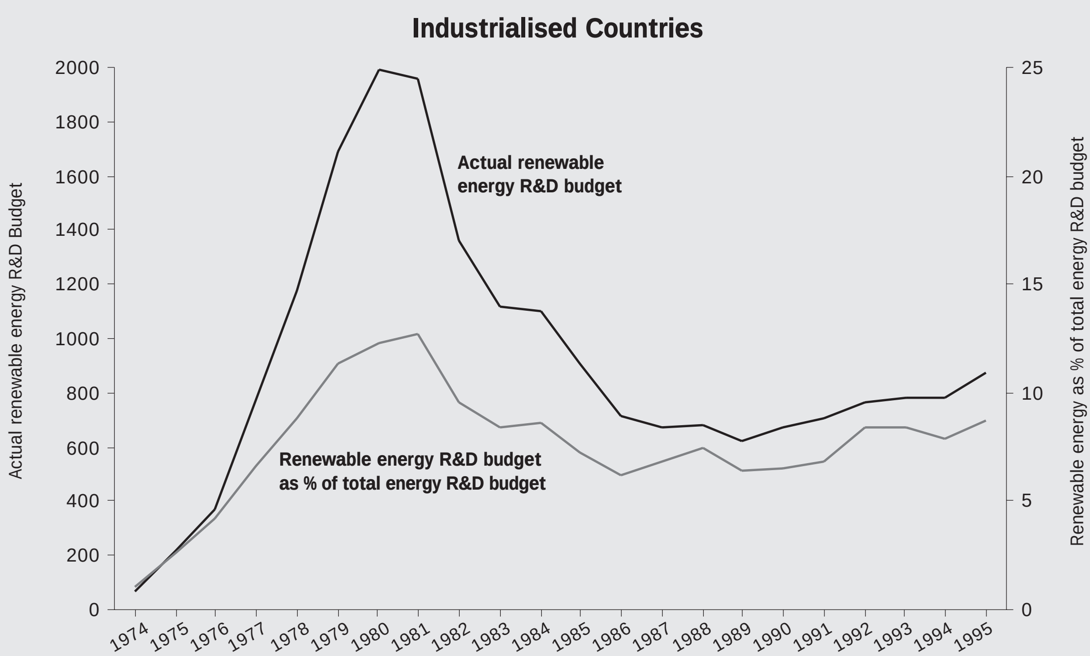
Table 3: Top 5 government research and development budgets for renewable energy

By actual amount (US $ million)		Percentage of total energy research & Development budget	
USA	393.00	Spain	46.10
Japan	139.42	Denmark	39.25
Germany	96.21	New Zealand	39.16
Spain	65.61	Germany	26.89
Switzerland	45.01	Switzerland	24.60

Source: Anon 1998, IEA Energy Technology R&D Statistics 1974–1995, OECD, Paris

Graph 7: Government budgets for research and development of renewable technologies in the US and Industrialised countries – 1974-95 (US $ million, at 1995 rates)



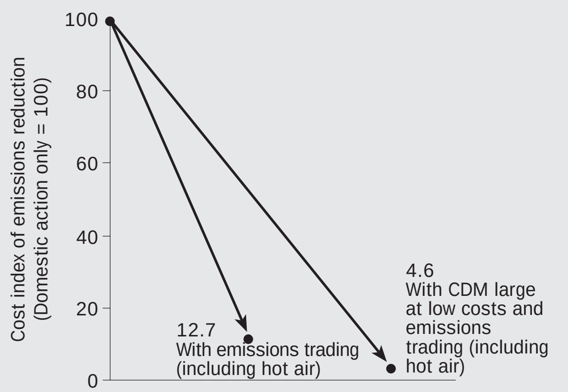


Government investments in renewable energy R&D were far less in the 1990s then in the late 1970s

Source: Anon 1997, IEA Energy Technology R&D Statistics 1974-1995, OECD/IEA, Paris, pp 3-5

at the Massachusetts Institute of Technology (MIT), though experts criticise the study for taking very high emission growth rate figures, and disregarding 'no-regret options'. As the Kyoto Protocol expects annex I countries to meet the stipulated targets as an average of a five year period from 2008 to 2012, the total cost, according to the MIT study, could be as much as US $600 billion. However, with trading between annex B countries, this figure could drop by as much as 87 per cent. If there is also large use of CDM at low costs, reduction

Graph 8: Cost reduction using different flexibility mechanisms



Source: Christiaan Vrolijk 1999, The potential size of the CDM, in *Global Greenhouse Emissions Trader*, UNCTAD, Geneva, Issue 6, February, pp 2-4

costs drop by about 95 per cent (see *Graph 8*).

But a market-based Clean Development Mechanism (CDM) that seeks least-cost options could actually end up becoming an obstacle for a zero-carbon energy transition, rather than a solution to the global warming problem. This is because any strategy that seeks to obtain least cost carbon emission reduction options will inevitably focus on improving energy efficiency in the carbon energy sector. So CDM may end up 'subsidising' fossil fuel technology, and as a result, lock the world into fossil fuel for many years to come. Unless the mechanisms of the Kyoto Protocol are carefully designed, they will result in enormous build-up of GHGs, especially when we take into account the huge energy investments that will be made by developing countries in the next 3-4 decades. If these investments lock developing countries into a carbon energy economy like industrialised countries, it will be very difficult for them to get out of it fast.

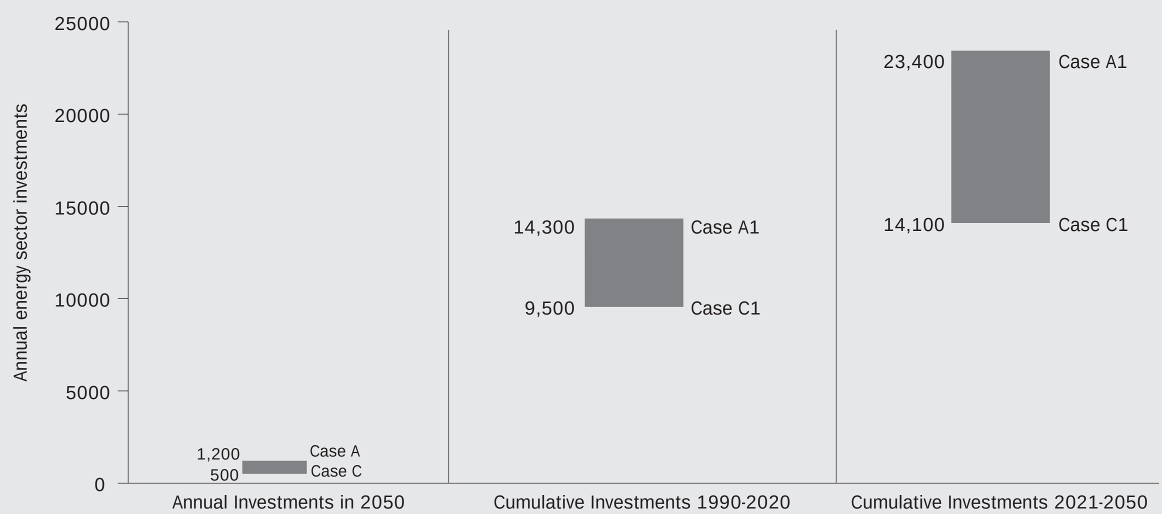
If 'ecological effectiveness' is the objective of the Kyoto Protocol, however, and all CDM projects are restricted to zero-carbon energy technologies, emissions reduction costs would indeed be higher than the least cost options that the US is looking for. Instead of US $14-23 tonnes of carbon (tC), as indicated by Janet Yellen, chairperson of the White House council of economic advisors, costs would be about US $17-32 per tC in the case of wind farms, and about US $64-82/tC in the case of solar thermal power plants — about 2-4 times higher. But this is an upfront cost for a technology whose costs are coming down rapidly, which means that future emissions reduction costs through the renewables route would be lower. Several studies also show that renewables have not only reached a stage where they can take off with government support, in the long run they could also lead to much lower energy investments compared to a fossil fuel scenario. Authors of the IIASA/WEC study agree that if energy investments are made carefully, then both annual and cumulative energy sector investments will be lowest in the case of renewables and energy efficiency scenarios (*see Graph 9*). And according to the Stockholm Environment Institute (SEI), the combination of zero-carbon energy sources and highly efficient technologies will be a critical element of adhering to a low-carbon trajectory. Failing to develop advanced energy producing and energy-using technologies would cause the ultimate costs of GHG mitigation to be dramatically higher than otherwise.

With proper policies, developing countries can take a lead in creating a global market for zero-carbon energy technologies because they have two distinct advantages. They have more solar energy than most Western countries; and they provide a huge niche market in hundreds of thousands of their villages that are not yet touched by the carbon grid. There are more than 2 billion people today who have no access to electricity.

The South, therefore, has to bear the extra cost of taking a different path and has to 'get it right the first time'. This raises several critical issues. Production of energy is based on long-lived capital which, once built, commits a society to a lifetime's worth of emissions. A power plant built today will still be emitting 30 years from now, by which time global carbon emissions would have to be reduced by 25 per cent from the business as usual scenario. The South is witnessing rapid economic growth and its major energy investment decisions in the immediate decades ahead will significantly contribute to the majority of global emissions in the subsequent decades. There is very little that can be done to change the fossil fuel-based path for the next 20 years. But if efforts to make renewables begin to compete by 2020 are not made now, then the world will stay committed to a carbon based energy economy well into the next century.

A slower rate of reduction today will mean either

Graph 9: Projected energy sector investments worldwide – 1990-2050 (US $ million)



Investment projections for the energy sector in and by 2050 are the lowest in Case C scenarios, in which use of renewables and energy efficiency are emphasized by governments

Source: Nebojsa Nakicenovic *et al* (ed) 1998, *Global Energy Perspectives,* Cambridge University Press, Cambridge

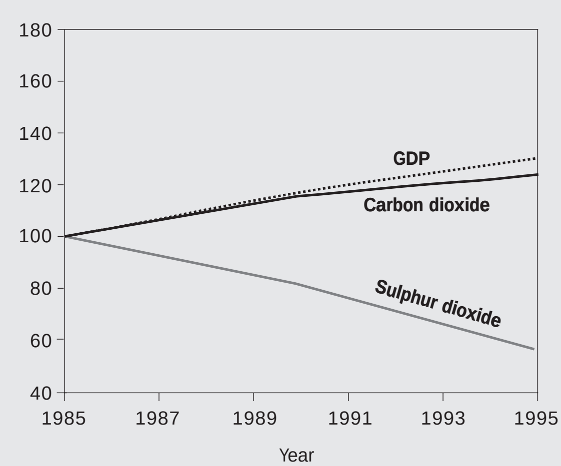
fast rates of reduction later or a high risk of climate change. This would mean passing on a very heavy burden to future generations.[13]

ACTION FOR EQUITY AND GLOBAL SOLIDARITY

As long as the world remains bound to a carbon based energy system, it cannot delink its economy substantially from carbon dioxide emissions. Per capita carbon dioxide emissions are closely related to a country's level of economic development and standard of living. Industrialised countries have been able to delink sulphur dioxide emissions from GDP growth, but have failed to do the same with carbon dioxide emissions (*see Graph 10*). In order to meet its Kyoto commitments, the Netherlands, for example, is depending heavily on emissions credits from developing countries.

Equitable sharing of 'atmospheric space' then becomes a critical issue, especially for developing countries who need the maximum space for their future economic growth. The enormous inequity in carbon dioxide emissions, as it currently stands, is best represented by the comparison between US per capita emissions and those of South Asian nations, which are amongst the world's poorest nations. In 1996, one US citizen emitted as much as 17 Maldivians, 19 Indians, 30 Pakistanis, 49 Sri Lankans, 107 Bangladeshis, 134 Bhutanese, and 269 Nepalis (*see Table 4*). Though the gap is narrowing, this extraordinary inequity makes it very difficult for political leaders,

Graph 10: Growth in GDP versus growth in sulphur dioxide and carbon dioxide emissions in the Netherlands



The Netherlands has been able to delink its economy from sulphur dioxide emissions but has failed to do the same with carbon dioxide emissions. This is true for all industrialised countries

Source: Anon 1998, National Environmental Policy Plan 3, VROM, The Hague

Table 4: Comparision of per capita emissions of USA and South Asia

Country	Per capita emissions (tC)		No. of citizens equivalent to one US citizen	
	1990	1996	1990	1996
USA	5.18	5.37	1	1
Bangladesh	0.04	0.05	130	107
Bhutan	0.02	0.04	259	134
India	0.22	0.29	24	19
Maldives	0.19	0.31	27	17
Nepal	0.01	0.02	518	269
Pakistan	0.16	0.18	32	30
Sri Lanka	0.06	0.11	86	49

Note: tC: tonnes of carbon

Source: Gregg Marland *et al* 1999, *National carbon dioxide Emissions from Fossil Fuel Burning, Cement Manufacture and Gas Flaring*, Oak Ridge Laboratory, USA

especially in nations with an electoral democracy, to agree to a common action plan unless there is a clear recognition of the need for equity in sharing available atmospheric space. Without sharing equitably, global solidarity will not be possible.

Although the importance of equity has been stressed in several governmental and non-governmental fora, including the European Parliament and the heads of the Non-Aligned Nations, very few studies have been undertaken both to conceptualise and operationalise the implications of equity. The concept of equal per capita emissions entitlements was incorporated in the Buenos Aires work plan at CoP-4 at the insistence of G77 and China. A few studies have tried to elaborate this concept. Two basic approaches have been adopted — one includes historical emissions, and the other builds a system of entitlements on current and future emissions. The concept of equal per capita emissions entitlements using current and future emissions entitlements has been elaborated by the New Delhi-based Centre for Science and Environment (CSE) using four approaches

Sinks approach

Under this approach, the emissions absorbed annually by the global atmospheric sinks, especially global commons like the oceans, could be distributed equally among all people of the world, providing each person with an equal entitlement.

In order to avoid global warming, the world will have to produce fewer emissions than the world's sinks absorb. According to IPCC, 1990 emissions must come down by over 60 per cent if atmospheric concentrations of GHGS are to be stabilised. The average annual production of carbon dioxide between 1980 and 1989 has been estimated at 7.1 gtC. The average annual absorption by all the sinks for these years was 3.8 gtC.[14]

There are mainly two types of sinks for carbon dioxide – oceanic, and terrestrial, or land-based. Terrestrial sinks are national property, but oceanic sinks, which absorb to the order of 2 gtC per year, belong to humankind and are common global property (*see Table 5*). As the 1990 world population was 5.3 billion, this gives a per capita sink availability of 0.38 tC, which can be considered to be each person's entitlement.

But this entitlement is so low that while some countries will reach their limits very fast, there are many developing countries that have already crossed the limit. India's carbon dioxide emissions in 1990 from burning of fossil fuels, gas flaring and cement production, for instance, was 0.22 tC. India should then be entitled to increase emissions up to 0.38 tC and, in the meantime, trade unused emissions, or bank them for future use. Major developing countries which were emitting less than this level in 1990 included all the seven countries of South Asia, African countries like Tanzania, Ghana, Kenya and Nigeria, Asian countries like the Philippines and Indonesia, and South American countries like Peru and Brazil. But several countries like Egypt and China had already crossed this level.

Industrialised countries, way above this per capita

Table 5: Size of carbon dioxide sinks (billion tonnes of carbon)

Type of sink	Amount absorbed every year
Oceanic sinks	2.0
Sinks provided by Northern Hemisphere forests	0.5
Other terrestrial sinks (Carbon dioxide fertilisation, nitrogen fertilisation, climatic effects, etc)	1.3
Total sinks	3.8

Source: Anon 1996, *Climate Change 1995: The Science of Climate, Contribution of Working Group I to the Second Assessment Report of the IPCC*, Cambridge University Press, Cambridge, p 79 level, will find it almost impossible to come down as long as they remain within a carbon based energy economy. Their emissions will keep contributing to the build-up of carbon dioxide levels in the atmosphere.

Budget approach

Recognising that the build up of GHG emissions in the atmosphere is inevitable in the decades ahead, the second approach first fixes the future atmospheric concentration limits for different GHGs which cannot be exceeded by a certain date. These concentrations will have to be fixed at levels that do not threaten to seriously destabilise the global climate. These concentrations and dates then provide humanity with a global emissions budget over a specified time period, to be distributed among all nations in the form of equal per capita entitlements. This approach demands that the targeted atmospheric concentration be subject to periodic scientific reviews, and changed appropriately. Therefore, per capita entitlements based on this approach, too, would be subject to review. If a country does not use its budget during a particular year, it would have the right to trade its unused budget.

IPCC has estimated the total amount of carbon dioxide emissions that can be emitted in a 110-year period from 1991 to 2100 to reach specified atmospheric concentrations. If the world were to aim for a maximum atmospheric concentration of 450 ppm of carbon dioxide by 2100, then it can emit an average of 5.73 to 5.91 gtC every year, which would have provided in 1990 a per capita entitlement of 1.08-1.12 tC. For a 550 ppm, the 1990 per capita entitlement would be 1.49-1.53 tC (*see Table 6*).

Moving entitlements approach

Under this approach, nations agree on a moving per capita emissions entitlement which could, to begin with, be anything like 2.0 tC or even 2.5 tC. This entitlement would be subject to periodic reviews, allowing reductions based on the latest scientific information on the seriousness of the threat of global warming.

The approach may appear ad hoc, but there is already a lot of 'pragmatic adhocism' in the climate negotiations. The amount that industrialised countries are going to emit by 2008-2010 as specified in the Kyoto Protocol, for instance, is pegged to their emissions in 1990. The choice of the base year 1990 is as ad hoc as anything can be. But it has been accepted because industrialised countries have to show that they are reducing their emissions relative to some year. As long as they reduce emissions, it does not matter which year is chosen as the baseline. Some countries in economic transition, in fact, have been given the option to choose their own baseline year. The choice of the amount by which each industrialised country is going to reduce its emissions relative to 1990 emissions was also voluntary and ad hoc. Once again, the targets have been chosen simply in the interest of moving ahead.

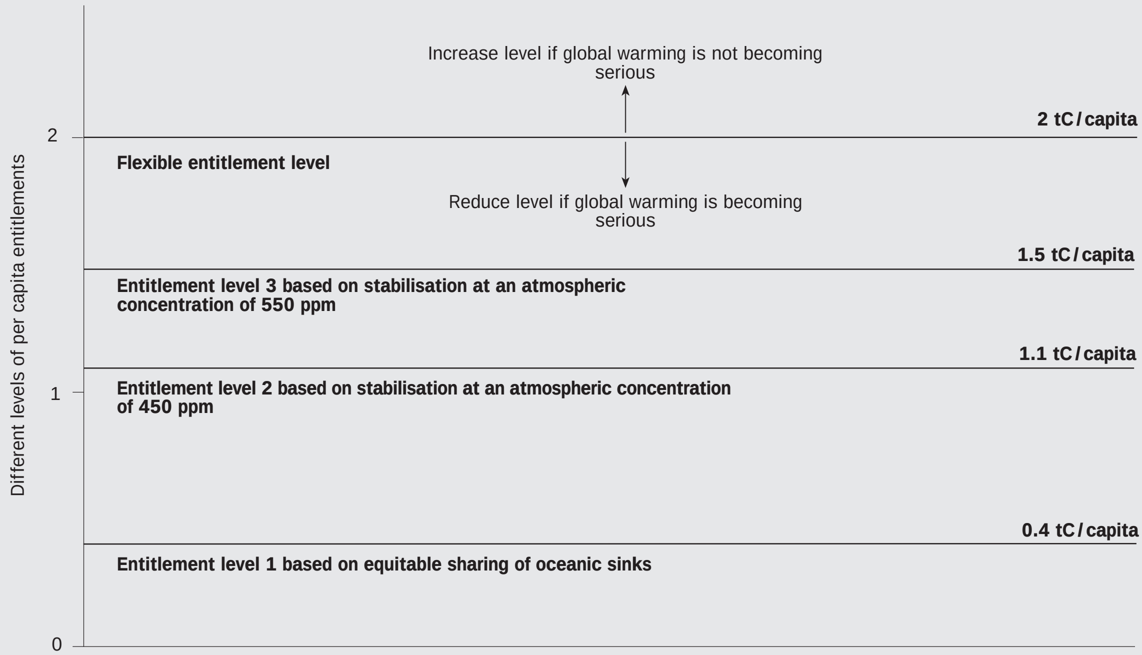
An ad hoc entitlement amount can similarly be chosen to get the principle of equity and convergence

Table 6: Carbon dioxide emissions budgets for different atmospheric concentrations

Atmospheric concentration of carbon dioxide (parts per million)	Emissions budget over the period 1991-2100 (billion tonnes of carbon)	Average annual budget over the period 1991-2100 (billion tonnes of carbon)
350	300–430	2.73–3.91
450	630–650	5.73–5.91
550	870–890	7.91–8.09
650	1030–1190	10.27–10.82
750	1200–1300	10.91–11.82

Source: Anon 1995, *Climate Change 1994: Radiative Forcing of Climate Change and an Evaluation of the IPCC IS 92 Emissions Scenarios*, Cambridge University Press, Cambridge, p 22

Graph 11: Levels of three different approaches to per capita equitable entitlements



Investment projections for the energy sector in and by 2050 are the lowest in Case C scenarios, in which use of renewables and energy efficiency are emphasized by governments

Source: Nebojsa Nakicenovic *et al* (ed) 1998, *Global Energy Perspectives,* Cambridge University Press, Cambridge

enshrined within FCCC, and get North-South cooperation moving through emissions trading (*see Graph 11*).

Convergence

Equity demands the principle of convergence, where all nations agree to reach the same level of per capita emissions entitlements, be accepted along with the principle of equitable entitlements. Nations with higher emissions than their per capita entitlements will slowly reduce their emissions to reach their level of entitlement, while those with emissions below their entitlement can reach up to that level.

ECOLOGICAL AND ECONOMIC EFFECTIVENESS, WITH EQUITY

The three objectives of economic effectiveness, ecological effectiveness and equity and global solidarity can be put together to develop an action plan to keep climate change at tolerable levels. Equal per capita emissions entitlements offer the most just, effective and 'meaningful' way of getting developing countries to engage with the climate change problem. These entitlements have the added advantage of providing developing countries with an incentive to keep their emissions growth path as low as possible, so that they have unused emissions to trade for financial gain.

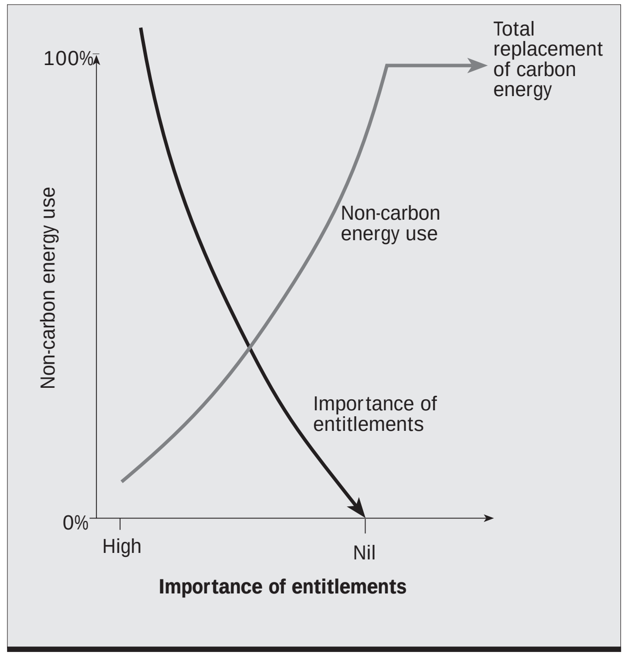
But emissions trading should be restricted only to projects that promote the zero-carbon energy system, and should not be allowed for projects that promote the carbon energy system. If CDM is used to influence emissions in projects where added costs are only in the range of 2-10 per cent of the projects costs, then a CDM project worth US $10 billion can influence energy projects worth as much as US $100-500 billion.[15] But then literally all these energy projects will further lock the developing world into the carbon energy sector. By subsidising carbon energy sources, it will, in all probability, lock out renewables for an inordinately long time. It is indeed ridiculous to subsidise the carbon energy system in order to prevent climate change.

As industrialised countries are already locked into a carbon system, they should invest in energy efficiency measures. But since the resources available through emissions trade are going to be limited, they should be used in a catalytic manner for the first commitment period to help the cost of renewables to drop to a level where they can compete with carbon-based energy technologies on their own. *Once this happens, the fossil fuel era and the climate change problem comes to an end*. It is also important to note that developing countries will undertake more energy efficiency measures as their economies grow, energy markets liberalise and competition increases. Worldwide statistics already show that developing countries are culling back on energy subsidies, and energy efficiency in several developing countries is already improving rapidly.

Once the pro-renewables strategy is accepted, the purpose of per capita emissions entitlements also gets redefined. Its key purpose then is not to create a framework which forces all countries to converge to a sustainable level of emissions but to create a framework for engaging poor nations such that the world can kick-start a movement towards a zero-carbon energy transition. Once the world seriously starts moving towards such a transition, the entitlements framework becomes increasingly redundant (*see Graph 12*).

The longer the dominance of the carbon energy economy gets prolonged, the more problems it will create. Poor nations will demand adequate 'environmental space' for their growth whereas industrialised countries will find it extremely difficult to reach the low levels of per capita emissions that are needed to restrain climate change. It is impossible as of now to foresee how a country like the US can reduce its per capita carbon dioxide emissions from 5.37 tC to 0.38 tC or even 1.00 tC, without a major move towards zero-carbon energy systems. However, it is clear that such a **move** will require farsighted political leadership, not one that falls prey to the dinosaur-age oil and automobile industries.

Graph 12: Reducing importance of entitlements in a non-carbon energy transition



What developing countries should not accept is a principle of emissions trading built solely on the argument that they provide a lucrative opportunity to reduce emissions cheaply. Emissions trading cannot simply be carried out to achieve economic efficiency. It must be undertaken in an environment that also promotes ecological efficiency and social justice and global solidarity. The purpose of equity and an equal per capita entitlements principle is not to force industrialised countries to drastically curtail their economy. It is to create a framework for global cooperation so that the world can move as fast as possible towards a world economy that can keep on growing by using renewable energy. A three-pronged combination of emissions trading, equitable entitlements, and promotion of renewables thus constitutes a truly 'meaningful' plan of action.

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