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Climate Change Mitigation and Sustainable Development

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By

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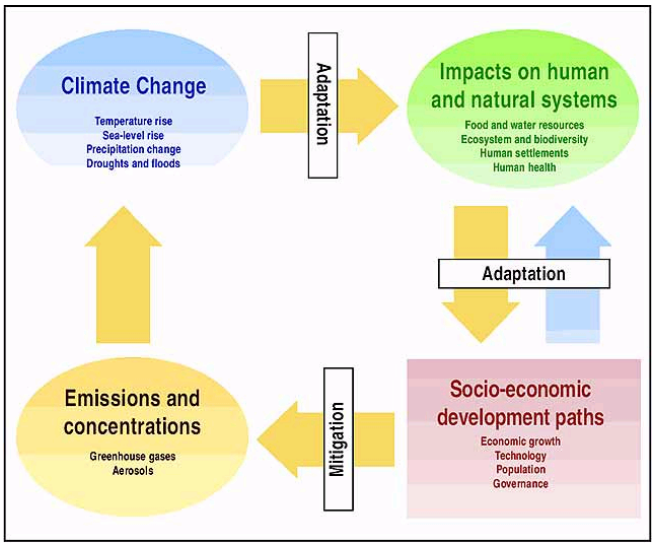
Climate change mitigation and sustainable development

Climate change and sustainable development

Sustainable development needs to be understood in its many dimensions. There is the temporal aspect – development today cannot be at the expense of development tomorrow. Sustainability also needs to be envisaged in its composite whole, as a dynamic system of interdependent forces – economic, social, and environmental (TERI and AEI 2002). Climate change can be seen as a part of the larger challenge of sustainable development through a two-fold link.

1. The impacts of climate change can severely hamper development efforts in key sectors, e.g. increased threat of natural disasters and growing water stress will have to be factored into plans for public health infrastructure.
2. Development choices will themselves influence the capacity to mitigate and adapt to climate change, e.g. policies for forest conservation and sustainable energy will, if correctly targeted and implemented, enhance the resilience of communities and thereby reduce the vulnerability of their livelihoods to climate change.

Figure 1 Climate change: an integrated framework



Source IPCC (2001)

Figure 1 shows how alternative development pathways can give rise to different levels of greenhouse gas emissions leading to climate change impacts on natural and human systems. It also identifies mitigation and adaptation as the two response strategies to the problem of climate change: by curtailing GHG emissions, the magnitude of temperature rise

can be abated; additionally, by increasing community coping capacities and reducing their vulnerability one can adapt to climate change impacts that are already occurring. The IPCC Third Assessment Report emphasises that as a result of the linkages described above, climate change mitigation and adaptation policies can be more effective when consistently embedded within broader strategies designed to make national and regional development paths more sustainable.

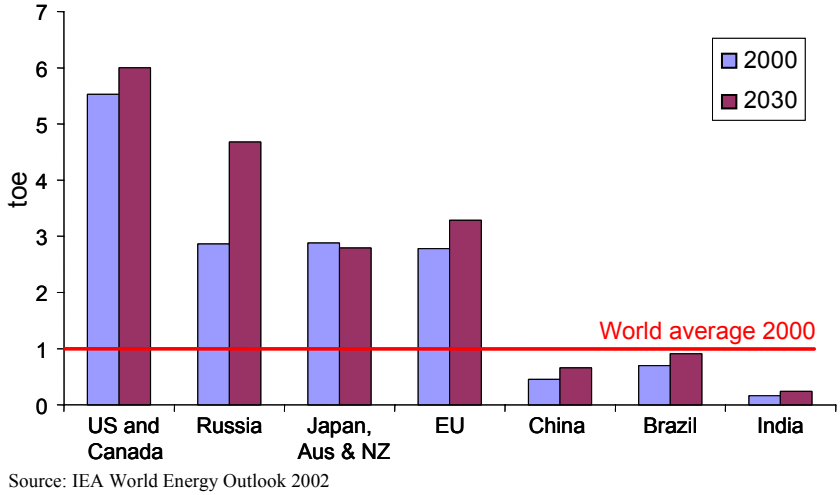
In this context, this paper briefly examines the equity and political dimensions of mitigation, and moves to the real opportunities and challenges that need to be addressed for achieving climate abatement including an assessment of belied hopes in the past and introducing the new processes that have been initiated in 2005. It further outlines the achievements that different countries have highlighted in their efforts to respond to this problem, and from there examines the issues that may need to be dealt with in different time frames.

Mitigation and development

Equity aspects

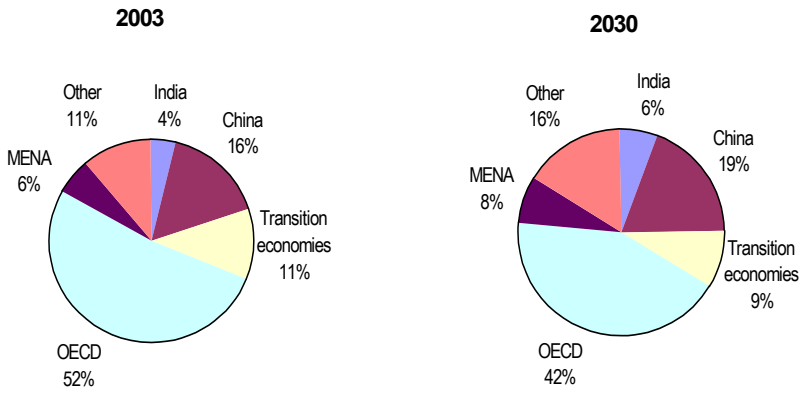
Equity issues have been at the heart of climate change negotiations especially so in the context of mitigation. The cost/burden associated with mitigation measures, the ostensible greater scope for low-cost emission reductions in developing countries, the historically low contribution of developing countries to the creation of the greenhouse problem are the issues related to this aspect. Figure 2 displays per capita final energy consumption estimates for a range of developed and developing countries. Even with projected economic growth over the next 25 years, per capita energy consumption (and hence per capita carbon dioxide emissions) in India, China, and Brazil will continue to be a fraction of that in developed countries. Figure 3 shows the corresponding share of different countries/regional groups in global energy-related carbon dioxide emissions.

Figure 2 Per capita final energy consumption



Source: IEA World Energy Outlook 2002

Figure 3 Global energy-related CO_2 emissions

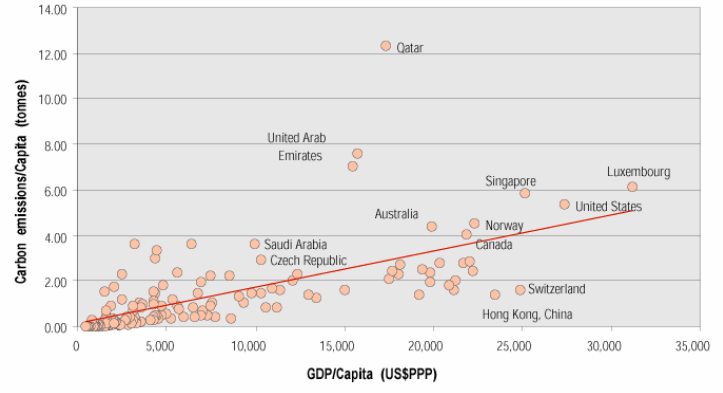


Source International Energy Agency

In accordance with the principles of "common but differentiated responsibilities" and "respective capabilities", the UNFCCC (United Nations Framework Convention on Climate Change) states that, owing to their historical contributions to the accumulated stock of GHGs, and their greater financial and technical capacities, "developed country Parties should take the lead in combating climate change". The participation of developing countries is contingent on the provision of incremental costs. Further, it emphasizes that “all countries, especially developing countries, need access to resources required to achieve sustainable social and economic development and that in order for developing countries to progress toward that goal, their energy consumption will need to grow taking into account possibilities for achieving greater energy efficiency and for controlling greenhouse gas emissions in general, including through the application of new technologies on terms which make such an application economically and socially beneficial”.

This is juxtaposed against the observation that carbon emissions are closely correlated to income levels–both across time and across nations (Figure 4), which implies that mitigation of carbon emissions may have strong distributional effects.

Figure 4 Per capita carbon emissions and income



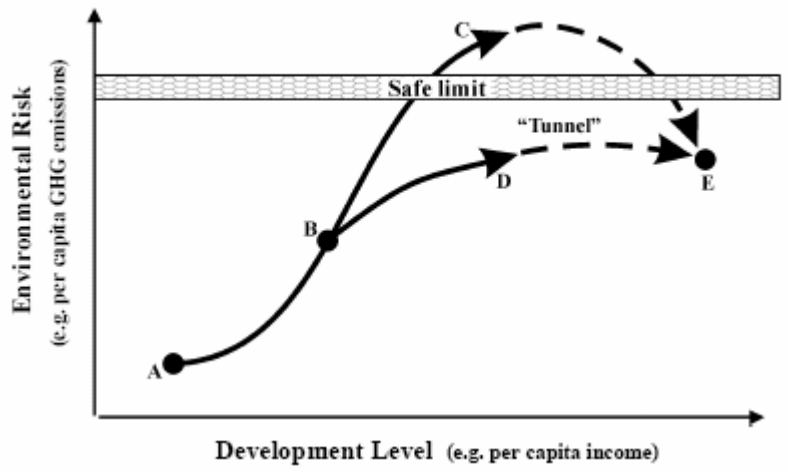
Source IPCC (2001)

Thus the challenge of climate change mitigation from an equity perspective is to ensure that mitigation policies do not exacerbate existing inequities within and across nations. Considerations of the historical contributions to the accumulation of GHGs in conjunction with considerations of intra-generational and inter-generational distribution of the benefits and burdens of mitigation policies are crucial in this respect (IPCC 2001). Just as the impacts of climate change will fall disproportionately on different regions and communities, similarly the costs of the economic impacts of climate policies are distributed unevenly as well. The Report pointed out that mitigation policies that lead to higher energy prices impose higher burdens on the poor since they tend to spend a larger share of their income on energy. Such distributional consequences can be avoided if mitigation policies include provisions that reduce costs on the lowest-income groups.

At the same time, Figure 4 holds out a way ahead if we consider the large differences in per capita emissions of countries and regions at the same level of affluence (e.g. Hong Kong, Switzerland, Singapore, Japan, and the USA). This suggests the possibility of technological leap-frogging, i.e. the lowering of emissions through technological development and capacity building, without impacting income levels.

Various studies using cross-country data have also revealed the existence of an environmental Kuznets curve (EKC) or inverted-U shaped relationship between GHG emissions and per capita income (Figure 5). In other words, as a country proceeds on the path of economic development, carbon emissions must first rise and then begin to decline. However, the adoption of appropriate mitigation measures that are consistent with the country's sustainable development priorities (i.e. through better environmental policies, internationalization of externalities, and removal of subsidies) could be viewed as a sustainable development "tunnel" through the EKC (Munasinghe 2000).

Figure 5 Environmental risk versus development level

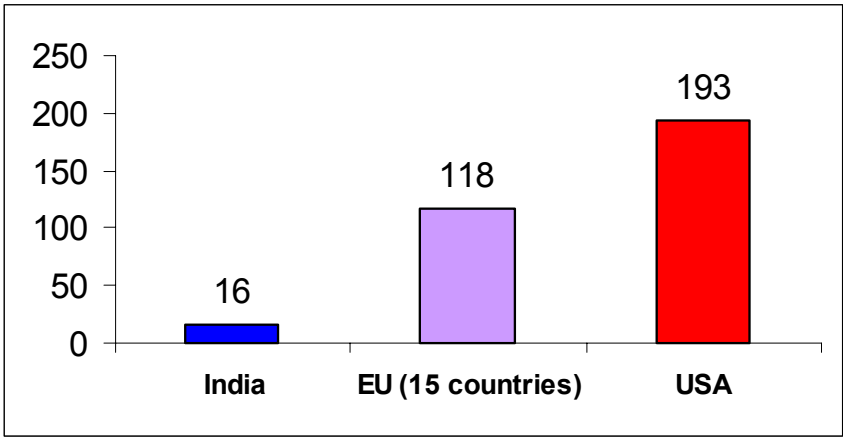


Source Munasinghe (2000)

Sustainable lifestyles

Apart from the ethical dimension of equity, sustainable production and consumption patterns necessarily will have to underline mitigation efforts. Agenda 21 noted that "the major cause of the continued deterioration of the global environment is an unsustainable pattern of consumption and production". Unsustainable patterns of resource use may often stem from user behaviour and lifestyles. The Worldwatch Institute (2004) reported that around 1.7 billion people worldwide have entered the "consumer class", adopting the diets, transportation systems, and lifestyles that were limited to the rich nations of Europe, North America, and Japan during most of the last century. Private consumption expenditures have increased fourfold since 1960, topping more than $20 trillion in 2000. The 12% of the world's people living in North America and Western Europe account for 60% of this consumption, while the one-third living in South Asia and sub-Saharan Africa account for only 3.2%. Figure 6 illustrates these international disparities by comparing transportation-related emissions across countries.

Figure 6 Estimated CO_2 emissions from passenger transport (gm/passenger-km)



Source TERI analysis (various data sources)

Agenda 21 advocated the use of technologies that would reduce the amount of energy and resources used per unit output, and called for widespread use of capture, recycling, and use of factory wastes. Significant changes in energy demand can be influenced by the mix of personal activities and locations, besides energy prices and incomes. The moot question is how to influence personal activities and choices to a more sustainable pattern, and the willingness of individuals and governments to exercise preferences to a more sustainable consumptive pattern.

Millennium Development Goal 7: Ensure Environmental Sustainability

Most countries have committed to the principles of sustainable development and to incorporating them into their national policies and strategies. They have also agreed to the implementation of relevant international accords. But good intentions have not translated into sufficient progress on the ground to reverse the loss of our environmental capital. Even regions that have made significant progress towards achieving other Millennium Development Goals, such as parts of Asia, tend to have a much poorer record on environmental issues.

Per capita carbon dioxide emissions, the main source of the "greenhouse effect" causing climate change, have increased in developing countries and remained stable in the group of industrialized countries (known as "Annex I Parties") that have ratified the Kyoto Protocol. At the world level, per capita emissions have slightly decreased, mainly as the result of a decline in industrial production in the economies in transition in the 1990s.

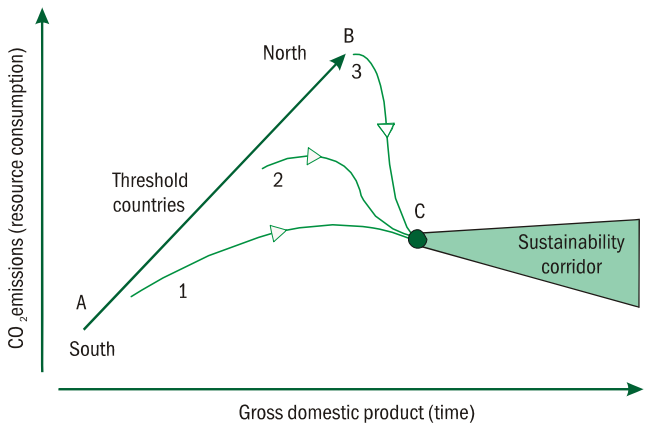
Progress in energy efficiency and access to clean technology and fuels is ongoing. But the transfer of these new technologies to the developing countries, where energy needs are skyrocketing, is not proceeding at a fast enough pace. Rational consumption patterns among the richest countries could also help to ensure environmental sustainability. In contrast, nearly half the world's population depend on solid fuels, including wood, dung, crop residues and coal, to meet their most basic energy needs. Indoor air pollution from cooking with such fuels is responsible for more than 1.6 million deaths annually, mostly among women and children.

Source: Progress towards the Millennium Development Goals, 1990-2005
http://unstats.un.org/unsd/mi/mi_coverfinal.htm

Contraction and convergence: Is there a political consensus?

Short-term efforts to mitigate GHG emissions have to dovetail towards the achievement of the ultimate objective of the UNFCCC of "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." In the long-term, stabilization of greenhouse gas concentrations requires *convergence* of countries' emissions in an equitable manner (Figure 7). Developed countries would have to redirect their lifestyles towards a more sustainable path, whereas developing countries could adopt 'leapfrogging' as a development strategy, i.e. employ sustainable and better technologies early in the development process.

Figure 7 Sustainability corridor



Source TERI (1997)

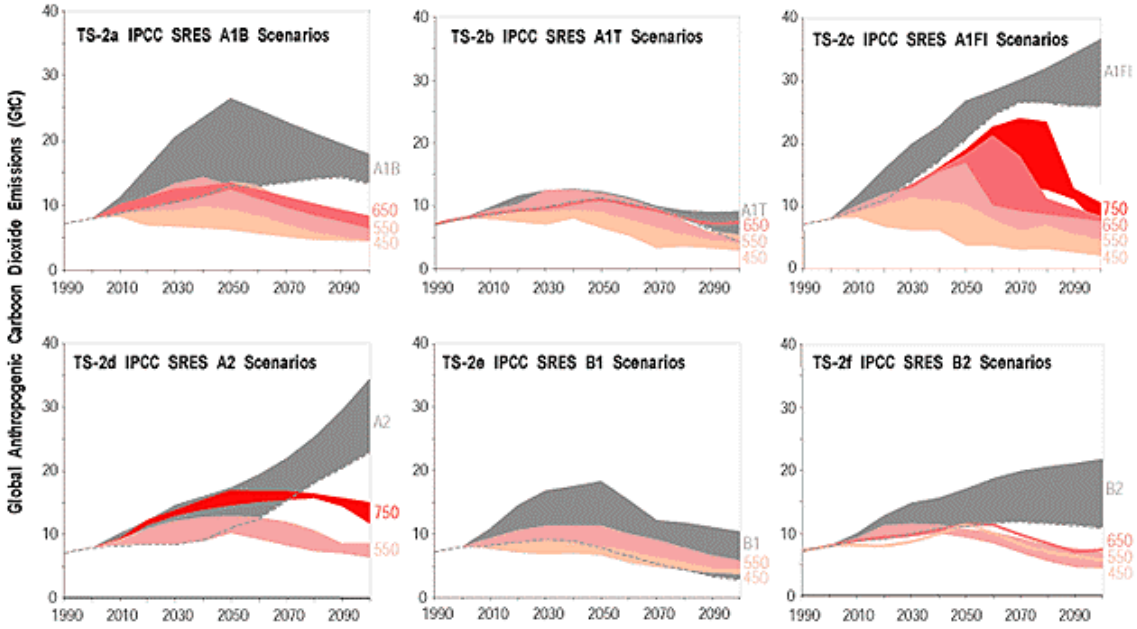
Convergence would involve two aspects: reduction and allocation. The first aspect refers to reducing emissions relative to an agreed baseline. At a global level, it would be necessary to identify the requisite reduction in aggregate GHG emissions corresponding to the desired level of atmospheric GHG concentrations. For the purpose of implementation, however, this identified reduction would have to be allocated across countries. Subjecting non-Annex I parties to emission entitlements would impose a ceiling on their emissions. For Annex I countries, it would be important to ensure that efficiency is not taxed, by incorporating energy intensity of GDP into the criteria for allocation.

It was recognized by several world leaders at COP-6 in November 2000 that in the long run, equity pivoted on a per capita basis is essential for convergence. The Bonn-Marrakesh agreement also emphasizes the centrality of this principle by requiring Annex I efforts to be conducive towards reducing per capita emissions differences between developed and developing countries. However, it is necessary to operationalise this principle in a manner that is acceptable to both developed and developing countries.

Mitigation opportunities and challenges

Recalling the ultimate objective of the UNFCCC (stated in its Article 2), it calls for stabilization of GHG concentrations to a level that avoids dangerous interference with the climate system, and within a time frame sufficient to allow ecosystems to adapt to climate change and ensure food production is not threatened and economic development proceeds in a sustainable manner. There have been various interpretations on operationalising Article 2 and what it implies in terms of GHG concentration levels that we should be aiming for. While there is no international consensus on this number, the EU has agreed on a 2°C target for temperature increases. Translating this target into GHG concentration, however, has associated uncertainties due to climate sensitivity. There has been extensive work and literature on stabilization scenarios, and IPCC has compiled this information on emission scenarios and stabilization levels (Fig 8).

Figure 8 Comparison of reference and stabilization scenarios



The figure is divided into six parts, one for each of the reference scenario groups from the Special Report on Emissions Scenarios (SRES). Each part of the figure shows the range of total global CO_2 emissions (gigatonnes of carbon (GtC)) from all anthropogenic sources for the SRES reference scenario group (shaded in dark grey) and the ranges for the various mitigation scenarios assessed in the TAR leading to stabilization of CO_2 concentrations at various levels: 450, 550, 650 and 750ppmv. The figure illustrates that the lower the stabilization level and the higher the baseline emissions, the wider the gap.

The IPCC has also estimated global average costs for 450 ppmv CO_2 stabilisation scenario to vary between 1-4% lower GDP by 2050 (IPCC 2001).

If there were a consensus on reaching a 450 ppmv CO_2 target, cumulative CO_2 emissions to be avoided between 2000-2100 could range from 1500 Gt-6000Gt, an enormous mitigation challenge (Metz and van Vuuren 2006). This obviously implies a significant role for mitigation technologies. There are several avenues to realize this potential, through energy savings, through decarbonising energy systems, through carbon sequestration and storage, and reducing non-CO_2 gases in sectors other than energy.

In this context, an interesting observation has been put forth that it is possible to introduce stabilization wedges of 1GtC/year of savings in 2055, and these wedges listed in Table 1, are achievable in that these entail technologies that are currently deployed on a commercial scale somewhere in the world and do not entail any new revolutionary ideas (Socolow 2006). The challenge however will lie in the scaling up from current deployment levels and associated issues and barriers.

Table 1 Potential wedges: strategies available to reduce the carbon emission rate in 2055 by 1 GtC/year, or to reduce carbon emission from 2005 to 2055 by 25 GtC

	Option	**Effort by 2055 for one wedge, Relative to 14GtC/year BAU**	**Comments, issues**
Energy Efficiency And Conservation	Economy-wide carbon-Intensity reduction (emission/$GDP)	Increase reduction by additional 0.15% per year (e.g., increase U.S. goal of reduction of 1.96% per year to 2.11% per year)	Can be tuned by carbon policy
	1. Efficient vehicles	Increase fuel economy for 2 billion cars from 30 to 60 mpg	Car size, power
	2. Reduced use of vehicles	Decrease car travel for 2 billion 30-mpg cars from 10,000 to 5,000 miles per year	Urban design, mass transit, telecommunicating
	3. Efficient buildings	Cut Carbon emissions by one-fourth in buildings and appliances projected for 2055	Weak incentives
	4. Efficient baseload coal plants	Produce twice today's coal power output at 60% instead of 40% efficiency (compared with 32% today)	Advanced high-temperature materials
Fuel Shift	5. Gas baseload power for coal baseload power	Replace 1400 GW 50% efficient coal plants with gas plants (4 times the current production of gas-based power)	Competing demands for natural gas
CO_2 Capture and Storage (CCS)	6. Capture CO_2 at baseload power plant	Introduce CCS at 800 GW coal or 1600 GW natural gas (compared with 1060 GW coal in 1999)	Technology already in use for H_2 production
	7. Capture CO_2 at H_2 plant	Introduce CCS at plants producing 250 Mt H_2/year from coal or 500 Mt H_2/Year from natural gas (compared with 40 Mt H_2/year today from all sources)	H_2 safety, infrastructure
	8. Capture CO_2 at coal-to-synfuels plant	Introduce CCS at synfuels plants producing 30 million barrels per day from coal (200 times Sasol), if half of feedstock carbon is available for capture	Increased CO_2 emissions, if synfuels are produced without CCS
	Geological storage	Create 3500 Sleipners	Durable storage, successful permitting
Nuclear Fission	9. Nuclear power for coal power	Add 700 GW (twice the current capacity)	Nuclear proliferation, terrorism, waste
Renewable Electricity and Fuels	10. Wind power for coal power	Add 2 million 1-MW-peak windmills (50 times the current capacity) 'occupying' 30×10^6 ha, on land or off shore	Multiple uses of land because windmills are widely spaced
	11. PV power for coal power	Add 2000 GW-peak PV (700 times the current capacity) on 2×10^6 ha	PV production cost
	12. Wind H_2 in fuel-cell car for gasoline in hybrid	Add 4 million 1-MW-peak windmills (100 times the current capacity)	H_2 safety infrastructure
	13. Biomass fuel for fossil fuel	Add 100 times the current Brazil or U.S. ethanol production, with the use of 250×10^6 ha (1/6 of world	Biodiversity, competing land use

	Option	Effort by 2055 for one wedge, Relative to 14GtC/year BAU	Comments, issues
		cropland)	
Forests and Agricultural Soils	14. Reduced deforestation, plus reforestation, afforestation and new plantations.	Decrease tropical deforestation to zero instead of 0.5 GtC/year, and establish 300 Mha of new tree plantations (twice the current rate)	Land demands of agriculture, benefits to biodiversity from reduced deforestation
	15. Conservation tillage	Apply to all cropland (10 times the current usage)	Reversibility, verification

Source Socolow (2006)

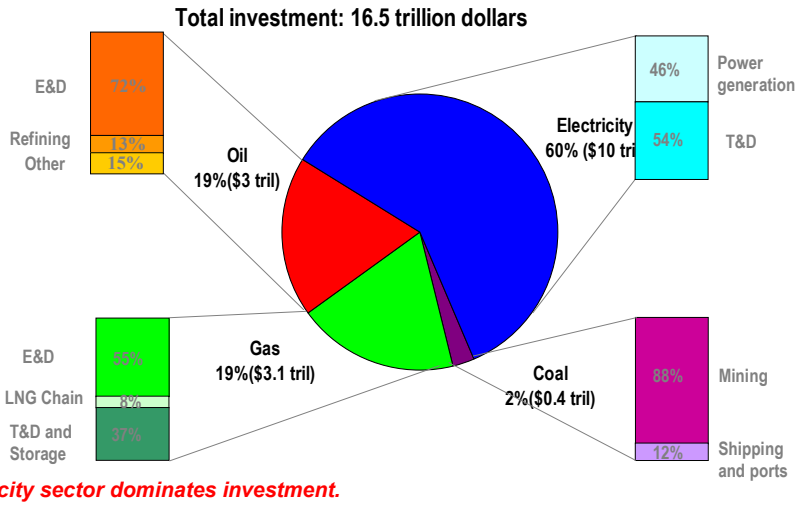
In the medium term, however, there is an opportunity through energy investments, to move to a less CO_2 intensive development pathway. The International Energy Agency has estimated that the investment requirement for energy infrastructure globally is likely to be USD 16 trillion in the period 2001-2030 (Table 2), including new capacities and replacement of old capacities. Of this USD 10 trillion will be the claim made by the electricity sector (Figure 9), 33% of which will be absorbed by China, Russia, India, Indonesia, and Brazil. Together the EITs (economies in transition) and developing countries would require 60% of the total investments in the electricity sector. This not only poses a challenge but also provides opportunities to direct investments in the right technologies in the right sectors in countries that may have a significant footprint on the emissions pathways. This definitely provides an avenue to make a difference in the medium term.

Table 2 Cumulative energy investments , 2001-2030, $ billion, in 2000 $

	2001-2010	2011-2020	2021-2030	2001-2030
OECD	2093	2228	2231	6552
Transition Economies	438	612	622	1672
-of which Russia	260	391	389	1050
Developing countries	1923	2641	3332	7897
Of which China	578	787	888	2253
Other Asia (inc India)	489	689	876	2055
Middle east	268	332	444	1044
Africa	248	393	567	1208
Latin America	339	440	558	1337
World	4551	5610	6320	16481
Annual average	455	561	632	549

Source IEA, 2003. World Energy Investment Outlook

Figure 9 World energy investment 2001-2030



Source IEA, Presentation made by Dr Norio Ehara, at the Fifth Indian Oil & Gas Conference, New Delhi, January 2004

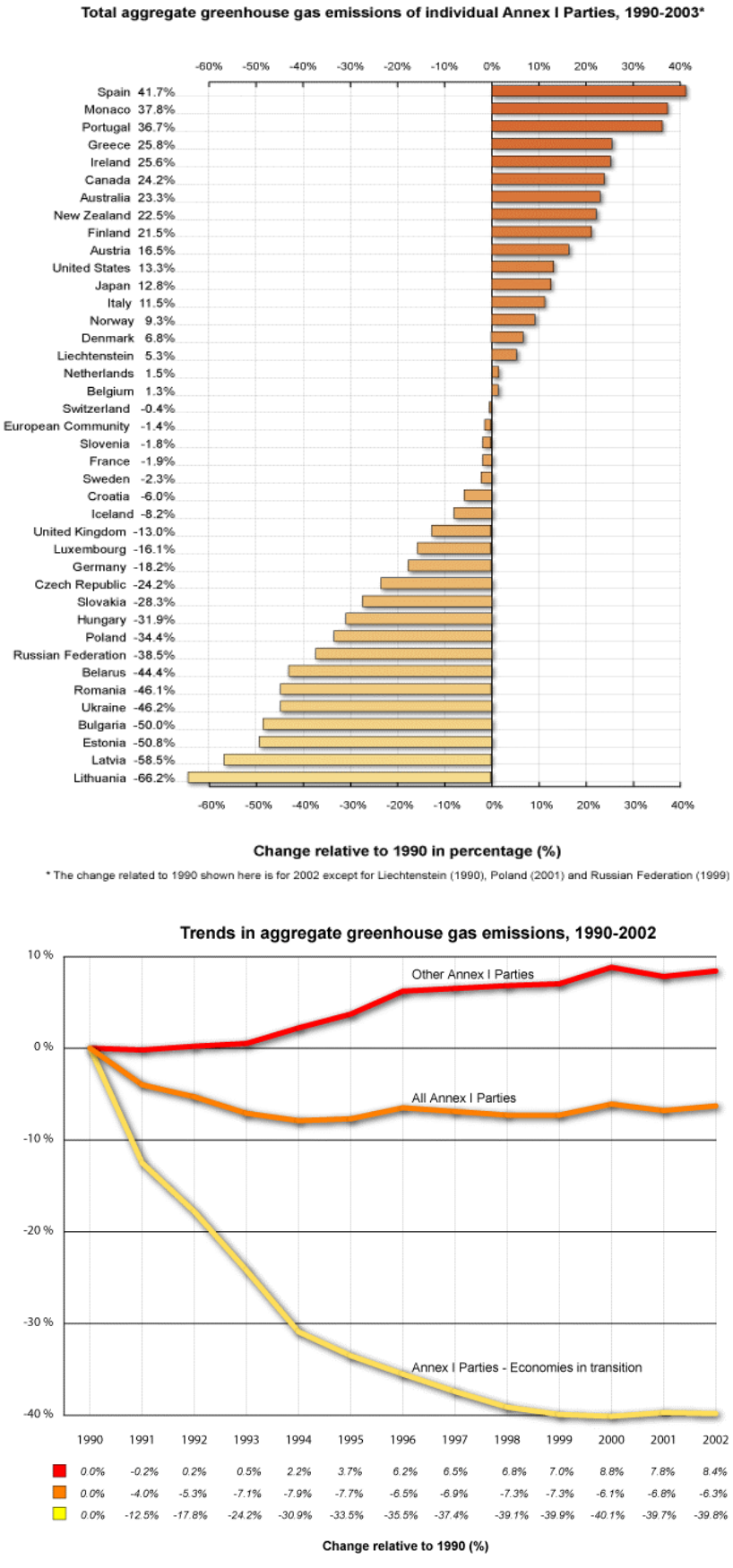
It may also be underscored that while the bulk of the mitigation will necessarily have to deal with CO_2 emissions, the opportunities for abating non-CO_2 GHGs also need to be addressed simultaneously.

International cooperation on climate change mitigation

The Kyoto Protocol is but a small step in directing efforts towards mitigation. The commitments as outlined in the Kyoto Protocol, of reducing emissions in Annex I Parties by an average of 5.6% of their 1990 emissions, if achieved will at best reduce 0.8 Gg of CO_2. With the US and Australia withdrawing from the Protocol, this would be considerably less than envisaged in the Protocol. An assessment of the Annex I achievements in the period 1991-2003, reveals that in 2003, GHG emissions from Annex I Parties, may have declined by 7.4%, but this has been largely due to a 46.8% decline in EIT countries (Figure

10). Emissions in non-EIT Parties have in fact, increased by 12.4% in the same time period (UNFCCC 2005(a)).

Figure 10 Key GHG data : Mitigation scoreboard



It is in this context that accelerated efforts at mitigation assume further importance. The various processes launched in 2005, including the Gleneagles Plan of Action, the Asia Pacific Partnership, and the long term cooperative programme launched at CoP 11 in Montreal, are efforts at dealing with this issue, though from different perspectives, and highlights of these are presented later in the paper.

The pivotal role of technology in responding to climate change was recognised in the UNFCCC process, by the establishment of the Expert Group on Technology Transfer at COP-9. The work of this Expert Group aims to analyse and identify ways to advancing technology transfer under the UNFCCC. Since technology needs seem to dominate mitigation efforts, a quick review of R& D needs and barriers to clean technology deployment is undertaken in the following sections.

Role of research and development

While technologies play a crucial role in climate change mitigation, it is equally important to bring innovations in various sectors to develop newer technologies. In view of this, it is extremely relevant to focus on research & development (R&D) in specified areas of climate change. For instance, strengthening the efforts in R&D in the area of energy has huge potential to address the issue of global energy security. There is a significant role for private as well as public sector to play in R&D efforts, with government R&D efforts focusing on development of long-term technologies for abatement and private sector promoting improved existing technologies providing medium and short-term solutions for the same (ABARE, 2006)

R&D in Clean Coal Technologies (CCT) in China

Looking at enormous potential of coal in energy resources in China (69%), the Chinese Government through the Ministry of Science & Technology (MOST) is supporting a broad array of CCT research, development, and demonstration and popularisation activities.

First, through its National Science and Technology Tackle Program, it focuses on a large scale in a short time. Second, the National High Technology Research & Development Program (also called the "863" program), the biggest science and technology program in China focuses on technologies that can be industrialized in near future. Third, the National Key Fundamental Research Program (also called "the 973" program) focuses on technologies that might be used in the long term.

Source: Energy for Sustainable Development, Volume VII, No. 4, December 2003

It is noteworthy, however, that the public sector investment in energy R&D has declined since early 1980s and a similar trend is also observed in the private sector investment in the area. (Dooley and Runci 1999). There is obviously a gap between the private and social returns of R&D and the positive spillovers associated with R&D, and it is an accepted fact that governments have a role in encouraging private sector R&D and

also themselves investing in R&D in areas underrepresented in the private sector. The different avenues for promoting private sector R&D include grants, subsidies and tax incentives, encouraging public private R&D consortiums (e.g. the Global Climate & Energy Project at the Stanford University) and at the international level too for collaboration on new technologies (ABARE, 2006).

Financial mechanisms for effective technological innovation and transfer

It is well established that development, introduction of a novel technology, its diffusion and adaptation requires substantial investment. The provision of financing, however, critically depends on who has the financial resources and whether they are convinced that their investment is justified.

In this regard, UNFCCC, through its Article 11 provides for a mechanism for financial support to the technology transfer process through Global Environmental Facility (GEF) in terms of grant/ loans or concessional basis for those projects qualifying the criteria with respect to the convention requirements. Financing could also be available bilateral and multilateral institutions, international bodies, multilateral development banks (MDBs), as well as through private entrepreneurs/ TNCs as Foreign Direct Investment (FDI). The public sector also has an invaluable role in the technology transfer process.

The UNFCCC provides financial resources for implementation of the provisions of the convention through the GEF Trust Fund, the Special Climate Change Fund (SCCF), the Least Developed Countries Fund (LDCF) and the Adaptation Fund .

However, the entire issue of technology transfer had been intractable, and the barriers to this are well known and documented. Further, the financing of such transfers through public, multilateral and bilateral means has also not been noteworthy; in fact there is growing recognition that FDI flows may have played a larger role and redirecting these to environmentally sound technologies may need to be examined closely.

At the senior-level round-table discussion on enabling environments for technology transfer, held during COP-9, developing country participants suggested that an agreement on technology development and transfer should be negotiated as a core element of a cluster of post–Kyoto arrangements. Such an agreement will forge a stronger link between international mitigation actions and the requirements of the UNFCCC, and will create better enabling environments for technology transfer at the international level. It will allow Parties to move from their old positions – free transfer of environmentally sound technologies as a commitment (developing countries) or leaving technology transfer entirely to market forces (developed countries) – to a more practical

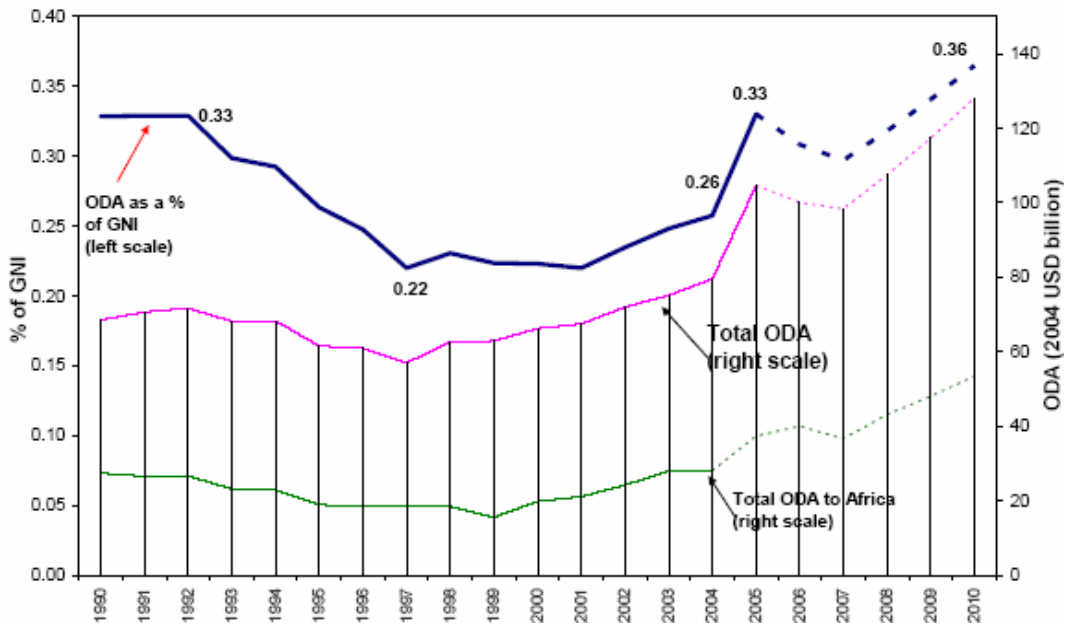
approach based on partnership and mutual benefits (FCCC/SBSTA/2004/2).

Trends in technology transfer and financial flows

The hopes for accelerated transfer and diffusion of ESTs have remained largely unfulfilled (UNCTAD 2000). Most governments have equated transfer of technology with commercialisation and only a small proportion of ESTs resulting from publicly funded R&D are patented, commercialized or transferred.

Policies to encourage technology transfer have mostly taken the shape of ODA contributions. Overall, a downward trend can be seen in ODA in the 1990s, both in absolute terms and as a percentage of funding for projects. It reached relatively high levels in 2004 and 2005 due to large debt relief grants and tsunami aid, but is expected to fall in the next 2 years (OECD DAC). Levels of FDI however have increased during the same period, although the main question remains whether FDI is actually linked to the transfer of ESTs (IPCC 2000).

Figure 11 OECD DAC members' net ODA contributions: 1990-2004 and simulations for 2006-2010



Source OECD DAC Aid Statistics

Table 3 Net flows from OECD DAC countries in USD million (current prices and exchange rates)

	1993-94 average	1998-99 average	2000	2001	2002	2003	2004
ODA for technical co-operation	12911	9560	12767	13602	15452	18352	18764
(as % of total ODA)	(22%)	(21%)	(24%)	(26%)	(27%)	(27%)	(24%)
Direct investment	43446	24767	71729	66041	36286	49799	66041

Source: OECD DAC Aid statistics

The contributions made so far by the Annex II countries and the projects funded by the GEF (Global Environment Facility), the implementing agency for the financial mechanism, are only meagre sums and not adequate.

A review of national communications shows that Annex II governments have a number of environment and development initiatives. But what portion of these constitute climate change measures, and "new and additional financial resources" is not reported. In this context, what new aspirations can we harbour for technology cooperation and technology transfer and market opportunities remains to be seen.

Long-term cooperative action: key developments in 2005

To slow down the rate of GHG build up in the earth's atmosphere it is necessary that all the governments take necessary measure within the Framework of the UNFCCC i.e. common but differentiated responsibilities and respective capabilities. The policies and actions to address climate change should be integrated and linked to sustainable development, this is more important for the developing countries as they can not allocate separate resources for climate change activities due to their limited financial capacities and different overriding priorities.

Annex I countries, in order to meet their emission reduction commitments have taken several measures to such as promotion of less carbon intensive practices, increased use of alternative sources of energy, boosting energy efficiency in industrial, residential, and commercial sectors etc. They also devised and adopted several fiscal measures and financial incentives to support such measures.

Developing countries though do not have emission reduction commitments yet on their way to development they offer large opportunities for emission reduction through introduction of clean technologies and environmentally sound practices. They have taken measures to integrate climate friendly approaches into their sustainable development strategies. Bi-lateral and multi-lateral organizations, including the Global Environment Facility (GEF) have supported many of these activities in developing countries.

In the above context 2005 was a watershed year, not only because it marked the beginning of discussions for the post 2012 period, but also other processes that were unravelled during this year. These processes and their highlights are summarized below.

The Gleneagles Plan of Action (Climate Change, Energy and Sustainable Development)

The G8 summit held at Gleneagles in 2005, marked a recognition by the group that climate change is a serious challenge, which would need concerted action given that world energy demand is expected to rise by 60% in next 25 years and secure and adequate energy supplies are the cornerstone for economic development, and recognized the responsibility of the developed economies to work in partnership with major developing economies to help them access low emitting energy systems. This of course was contextualised within the gamut of meeting "shared and multiple objectives of reducing greenhouse gas emissions, improving the global environment, enhancing energy security and cutting air pollution in conjunction with (our) vigorous efforts to reduce poverty". The Plan of Action with specific reference to climate change targets:

- Transforming energy use patterns (in buildings, appliances, surface transport, aviation, industry)
- Clean power (cleaner fossil fuels, carbon capture and storage, renewables)
- Research and development
- Financing transitions to cleaner energy (including the role of markets, development financing and export credit agencies)
- Managing the impact of climate change
- Tackling illegal logging

The Asia Pacific Partnership for Clean Development and Climate

This partnership between Australia, China, India, Japan, Republic of Korea and the US focuses on development, deployment and transfer of clean technologies. These partner countries account for 54% of global economic output and 50% of global greenhouse emissions, and it is assumed that deployment of cleaner technologies in these economies, led by private sector initiative has the potential to deliver large emission reductions in the future . In this context the Work Plan of this partnership envisages identification of opportunities in 8 sectors, and 8 task forces will be set up for the following sectors:

1. cleaner fossil energy
2. renewable energy and distributed generation
3. power generation and transmission
4. steel
5. cement
6. aluminium
7. coal mining
8. building and appliances

It is also claimed that this Partnership is not an effort to undermine efforts being made under the UNFCCC, but should be viewed as a complementary action.

Dialogue on long term cooperative action to address climate change

At COP-11, a two-year dialogue was launched "to analyse strategic approaches for long-term cooperative action to address climate change." The key areas identified therein include:

- Advancing development goals in a sustainable way
- Addressing action on adaptation
- Realizing the full potential of technology
- Realizing the full potential of market based opportunities

The three processes and actions that dominated in the year 2005, have a common thread in that they are all emphasising the role of technology, financing and markets. In this context an evaluation of how technology and financial transfers in the past have taken place needs to be examined. There is growing anguish that the achievements on these two accounts have not been noteworthy.

The Seminar of Government Experts: Showcasing national priorities and plans

During the Seminar of Government Experts the Annex I as well as non-Annex I countries presented their actions related to mitigation and adaptation and policies and measures that support fulfilment of their commitments under the UNFCCC (UNFCCC, 2005b). Some of the views are summarized below.

Brazil

Brazil, in its presentation, attached high importance to sustainable patterns of production and consumption, referring to the Rio principles, and urged developed countries to take the lead. It also laid faith in the potential of CDM and opined that it could be one of one of the most effective means for addressing climate change. It urged that discussions on the future of the climate change regime should not be used to undermine the credibility of the Kyoto Protocol, especially regarding compliance and the Clean Development Mechanism (CDM).

Participation of developing countries in CDM provides them an opportunity to promote sustainable development initiatives in their countries and ensures their meaningful participation in mitigation efforts, which may not be economically feasible otherwise. CDM may also promote transfer of technology and support the development of local technologies. Brazil strongly asserted that Kyoto Protocol should continue beyond 2012 if the climate change is to be addressed meaningfully.

China

The Chinese Government outlined various measures to address climate change in the country, while giving the country context. China is a developing country with low per capita income and is on its way to economic development and urbanization. The economy is heavily dependent on coal in the energy mix. The efforts to reduce/limit GHG

emissions would thus be quite difficult without efficient international technological cooperation. China therefore urged for practical technological cooperation among countries for combating climate change and promoting sustainable development.

The energy development strategy adopted by China gives priority to energy conservation, diversification of energy supply options, environmental protection and technology progress and innovation. China has also published a mid to long-term energy conservation plan and aims to reduce the energy intensity of China from 2.68 tce/10,000 yuan in 2003 to 2.25 tce/10,000 yuan by 2010 and to achieve energy saving rate of 2.2% per year. During 2010-20, the country will try to bring down further the energy intensity to 1.54 tce/10,000 yuan and increase the energy saving rate to 3% /year.

China is considering promotion of nuclear power so as to improve the energy structure and reduce the growing demand for coal for electricity generation. The country has also issued the Law of Renewable Energy which targets that by 2020 renewable energy will contribute to 10% of the total energy consumption.

To enhance removal of CO_2 from the atmosphere China is extensively promoting reclamation of farmland back to woodland, and large-scale afforestation and reforestation.

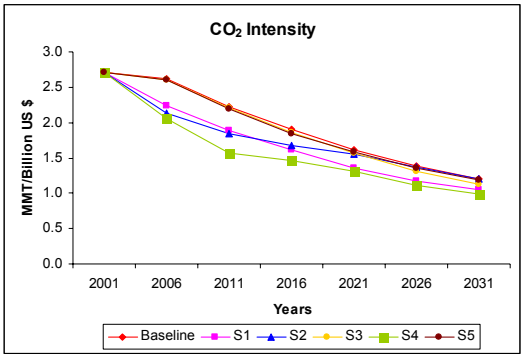
India

India, whileighlighting the fact the Annex I countries have not been able to fulfil their commitments and the emission reductions are mostly due to low levels of emissions from EITs and the dismal record on transfers of finance/technology to developing countries, did emphasise that the per-capita GHG emissions in India are quite low and this has been partly due to the sustainable lifestyles. However, as the country progresses towards higher economic development and urbanization, the emission will increase and therefore the country has to make choices of development pathways. The country has already made some progress in this regard through measures including

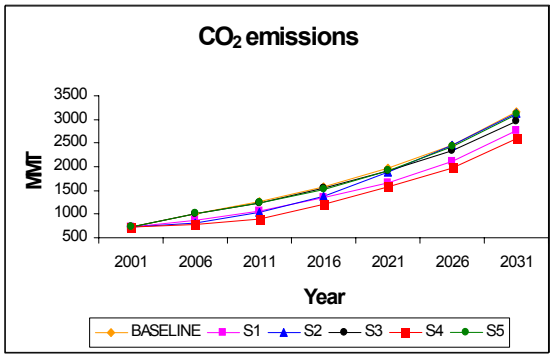
- Improving energy efficiency
- Power sector reforms
- Energy and infrastructure development
- Promotion of clean coal technologies
- Coal washing
- Promoting hydro and renewable energy
- Cleaner and lesser carbon intensive fuel for transport
- Environmental quality management

It also highlighted how it could sustain high rates of economic growth, with relatively lower CO_2 emissions, by introducing different policies and interventions (Figure 12)

Figure 12 (a) Change in India's CO_2 intensity and emissions as a result of Government policy initiatives



(b) CO_2 emission reduction projections under different scenarios



Source TERI (2005) and UNFCCC (2005)

Baseline: Base year 2001, GDP growth 8%, official demographic projections, IPCC emissions factors, 8% discount rate
S1: Cleaner fuels for power generation
S2: Electricity for all by 2012, with decentralized renewable options, efficient cook stoves
S3: 20% increase in share of public road transport, Greater use of CNG in buses, taxis, 3-W vehicles
S4: S1+S2+S3
S5: Average annual GDP growth rate 6.7%

European Commission

The European Commission presented its European Climate Change Programme (ECCP), the objective of which is to help the EU decision makers identify the most cost-effective measures and to drive forward the implementation of EU policies and measures.

Under the aegis of the ECCP a considerable number of EU measures have been adopted. Most important of which is the European Union Emission Trading Scheme (EU ETS), covering approximately 50% of CO_2 emissions in the EU-25, notably in the energy intensive sectors. The purpose is to achieve emission reductions in the most cost-effective and flexible way. For complying with the commitments under EU ETS a "Linking Directive" has also been provided which allows use of credits from Joint Implementation and Clean Development Mechanisms.

Japan

Japan also highlighted the need for further international actions on climate change and called for substantial reductions based upon the precautionary principle. It stressed upon sharing of scientific knowledge on climate change and mentioned that the Kyoto Protocol has been an important first step. It may need to be further developed and improved for addressing climate change on in a significant manner.

Japan has spearheaded science and technology, energy conservation and energy efficiency, and energy saving life-styles for long time and maintained that they will take it up more vigorously to see a low carbon society.

The Government of Japan has drawn up a Kyoto Protocol Target Attainment Plan and the country taking serious actions for implementing GHG reduction measures including efforts to improve energy efficiency.

For taking concrete actions for addressing climate change further emission reduction efforts by Annex I countries is a must. In addition, development and diffusion of innovative technologies as well as diffusion of existing technologies bringing in substantial emission reduction will also contribute significantly in addressing climate change challenge. Japan also underlined the need for massive international investment on science and technology.

United Kingdom

UK highlighted the challenge to meet the growing demand for energy whilst reducing emissions to prevent significant damage from climate change. The IEA projects 70% increase in energy demand in the next 25 years. To meet the target of global temperature not exceeding more than 2°C at least 15 per cent emission reduction would be required by 2050.

The UK representative opined that a number of technological options for reducing emissions at reasonable costs over the long term already exist. Some of the options may be well established while others may need further exploration or feasibility analysis. If these are applied as a portfolio of options, they may prove to be more effective. Delays in action would result into deeper emission reductions at a later date and would increase the costs and it may even reach to irreversible levels.

United States

The United States outlined its approach which integrates the climate change agenda into the broader context of the sustainable development: alleviation of poverty, rule of law, good governance, investment in people, stable economic institutions, protection of human freedom, promotion of economic growth and prosperity, enhanced energy security, and reduction of pollution.

The US representative provided details on various initiatives of the US Government including:

1. to reducing the GHG intensity by 18 per cent by 2012.
2. investments of $ 5 billion in science and technology
3. promoting international cooperation

Information was provided on projects initiated in areas such as climate change research, climate observation systems, clean and advanced energy technologies, carbon capture, storage and sequestration and policy approaches to reducing greenhouse gas emissions. Partnerships including the following:

- Carbon Sequestration Program (CSLF)
- International Partnership for a Hydrogen economy (IPHE)
- Generation IV International Forum (GIF)
- Methane to Markets Partnership
- Group on Earth Observations (GEO), were also mentioned.

The most recent partnership that US has got into is the Asia Pacific Partnership on Clean Development and Climate. Other countries in the partnership are Australia, China, India, Japan, and Republic of South Korea.

Priority areas for clean technology innovation – short medium and long-term technology deployment scenarios

In the above context, it is clear that many countries are taking action, but their intended impact on emissions pathways is not very apparent or clear. The challenge in the dialogue for long term cooperative action would be to harness together the good intentions of all countries in a cohesive framework for moving the globe to a particular "politically acceptable" stabilisation pathway. This combination would require a combination of voluntary and binding measures, as also their institutionalisation while exploiting the technology and market opportunities.

In the short term, perhaps, the way forward is to assess and analyse positive actions being taken in all countries (as evinced in the SoGE), recognize them, and encourage a registry of these affirmative actions.

In the medium term, the opportunities afforded by new infrastructural requirements, capital stock turnover, offer the transition route to more efficient and clean systems, and the mechanisms to operationalise these have to be instituted.

For the very long term, revolutionary technological change may be required for which R&D has to be initiated now—but more so in a

partnership mode—public-private, developing-developed—to provide global solutions to this global challenge of climate mitigation.

Questions for discussion

In light of the issues raised by this background paper, some questions for discussion are identified below.

1. How can enabling environments be created for technology development, diffusion, and transfer?
2. What is required for the scaling up of existing technologies in the medium term?
3. Given that private direct investment is much higher than development assistance, how can "greening" of these flows be achieved?
4. What can be the possible elements of a technology-centred protocol in the post-Kyoto negotiations?
5. How can greater mitigation efforts in developing countries be achieved in synergy with their overall development goals?
6. How can Annex I Parties be encouraged to show leadership in accepting deeper mitigation targets?

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