



The Real Climate Threat to Developing Countries —

Early, Deep Cuts in Emissions

A World Growth Report

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World Growth is committed to support the search for effective global strategies to address climate change. This is one of the major challenges facing the international community.

Much is made of the consequences of failing to take action on climate change. The message — that immediate action today rather than delay while finding the best course of action — has become the refrain in the debate.

Unfortunately, this position has real consequences, which can be severe. Economies demonstrate each day through various policies how easy it is to create and perpetuate poverty by slowing economic growth.

Continued economic growth is necessary for the world to meet the Millennium Development Goal of halving poverty by 2015. According to projections by the World Bank, the proportion of population living in extreme poverty in the developing countries is expected to fall from 29 percent in 1990 to 12 percent in 2015.¹ However, as of now, only the East and South Asian regions are projected to meet this target. Without sustained economic growth it will be difficult, if not impossible, to work towards meeting these goals.

The Agenda 21 consensus on environment and development adopted at the Rio Earth Summit in 1992 and the UNFCCC which was endorsed at the same meeting, both emphasized that the development needs of developing countries should not be subsumed to environmental objectives.

This is not to suggest there is a trade off between economic growth and the environment. In the long run, the only way to guarantee protection for the environment is to ensure we have the prosperity to pay for it.

Yet proposals are being put forward which would clearly reduce the capacity of governments to eliminate poverty and generate the wealth necessary to support the environment. An effective global strategy on climate change needs to do both and to enjoy the support of the world's biggest emitters of greenhouse gases.

This is the third report produced by World Growth to support development of a new consensus for such a strategy.

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Chairman
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¹ The World Bank, 2007a, *Global Monitoring Report 2007 – Millennium Development Goals: Confronting the Challenges of Gender Equality and Fragile States*, Washington, DC

As parties to the United Nations Framework Convention on Climate Change (UNFCCC) gather in Bali, Indonesia to initiate a fresh effort to develop a global strategy to address climate change, the case for basing that strategy on early, deep cuts in emissions is being aggressively touted. To reinforce that case, the argument is being made that if such a strategy is not adopted, developing countries like China and India will be those most adversely affected.

The most substantive case for this argument lies in a report by Sir Nicholas Stern of the economics of climate change which was commissioned and paid for by the British government in 2006.² The Stern Review recommended that all countries implement immediate and substantial cuts in their greenhouse gas emissions, with the goal being to stabilize the concentration of greenhouse gases in the atmosphere so as to avoid significant changes to the global climate.

The Stern Review has recommended its emissions cuts be achieved through a combination of taxes and regulatory caps on emissions. It concluded that, over the long run, its cuts would generate a net economic benefit for all countries, including developing countries.

The Stern Review is an economic counter-argument to the concern of developing countries that significant reductions in emissions of greenhouse gases will increase the cost of energy and reduce the capacity to pursue high economic growth as the primary strategy to reduce poverty and raise living standards.

Yet, the conclusions of the Stern Review are seriously flawed. Simply put, they overestimate the economic benefits of early and deep emissions cuts and significantly underestimate the costs associated with such cuts. If implemented, they would derail efforts to alleviate global poverty.

The Development Challenge

At present one billion people in the developing world are compelled to live on less than US\$1 a day. Such extreme poverty means that:

- more than 800 million people do not have an adequate diet;³
- more than 10 million children a year die before reaching the age of five from preventable or curable diseases;⁴
- over one billion people lack access to potable water; and
- nearly two billion people lack access to the energy necessary to meet basic human needs.⁵

The argument put forth by Stern and others would all but halt efforts of governments to lift people out of poverty and to grow economies. Economic growth is essential for sustained poverty reduction and improvements in human development. The countries that have enjoyed rapid economic growth have pulled more people out of poverty faster than those with static or declining rates of growth. This has been most dramatically demonstrated in East Asia where extreme poverty fell by over 84 percent between 1981 and 2004. In China alone, this transformation was to the benefit of 500 million people.⁶

On one hand, the developing countries recognize that climate change is a serious issue. On the other hand, the very strong relationship between greenhouse gas emissions, energy use and economic growth implies that immediate and substantial cuts in emissions will rapidly translate into reduced access to energy, lower economic growth and a reduced capacity to roll back poverty.

The stakes are high for developing countries as they consider how best to resolve the apparent conflict.

Exaggerated Benefits from Emissions Cuts

The Stern Review has estimated the economic benefits from its proposed emissions cuts (in terms of the damages that would be averted by doing so over the next 200 years) is equivalent to at least 5 percent of global gross domestic product (GDP) each year, now and forever. This translates into US\$85 per ton of carbon dioxide (CO₂).⁷

The Stern Review has significantly overestimated the

2 Stern, 2006

3 Ahmed et al, 2007

4 WHO, 2007

5 The World Bank, 2007a

6 The World Bank, 2007a

7 Stern, 2006

benefits of such an approach. This reflects both its overvaluation of the possible damages of climate change, as well as its use of an implausibly low discount rate for estimating the present value of such damages. The discount rate used by Stern has been widely criticized by economists.⁸ There is little or no empirical support for such a discount rate, as it implies that people would be willing to save virtually all their income for the benefit of future generations.⁹

The damages identified by the Stern Review and its evaluation of them are highly speculative. Its estimate lies well outside those in the peer-reviewed economic literature. For example, Professor William Nordhaus of Yale, a leading researcher on the economics of climate change, has recently re-estimated the benefits at just over US\$7 per ton of CO₂. This is at the top end of the range of estimates in the peer-reviewed literature.¹⁰

Although the Stern Review acknowledges that some adaptation to climate change is inevitable, it significantly understates the scope.

- The Stern Review understates the behavioral changes in response to climate change. For example, it does not admit the possibility that agronomic practices will change — that crops will be planted earlier or later in the year in response to temperature changes, or that dams will be built to cope with precipitation or flooding changes.
- It is biased towards technological pessimism in assessing the cost of climate changes — in contrast to its technological optimism about future mitigation costs.¹¹

Real Costs of Mitigation

The Stern Review has concluded that the economic cost of its recommended cuts in emissions will be no more than one percent of GDP by 2050. Its calculation significantly underestimates the likely costs of mitigation.

The Stern Review's mitigation cost estimates are well above those in the peer-reviewed economic literature. The difference reflects biases in the estimation process used by Stern and the omission of certain costs. The latter include the administration and compliance costs of the policy measures, which are likely to be substantial, as well as the economic efficiency losses they would impose.

The Review has substantially overestimated the scope for technology to reduce the costs of mitigation, and the uncertainty attached to prospective reductions in those costs. In part, this reflects the likely adverse impact of the Stern recommendations on the investment climate, particularly in the initial period of implementation, and therefore on the ability to commercialize any of the potential gains made by the development of new technologies.

Long Term Strategies the Solution

Claims that early and deep cuts in emissions are warranted, in order to mitigate the risk of irreversible damage and to avert the risk of greater adverse impact on developing countries, are not supported by the technical analysis or economic assessments in the Fourth Assessment Report by the Intergovernmental Panel on Climate Change (IPCC).¹²

The IPCC report reminds us that on current settings, levels of greenhouse gases in the atmosphere will continue to increase as a result of previous developments and not peak until between 2100 and 2150. No action taken in the short term will mitigate that. The conclusion to draw is that priority should be given to measures to assist countries to adapt to those changes.

On mitigation, the extensive peer-reviewed literature on the economics of climate reveals a clear and consistent consensus on an optimal policy strategy. This is a *long-term* strategy with *modest* cuts in greenhouse gas emissions to begin with, followed by *progressively deeper* cuts over the medium to longer-term. The strategy is known as the 'policy ramp' and it has survived extensive and rigorous testing in the peer-reviewed literature.¹³

8 Byatt (et al), 2006

9 Dasgupta, 2006 and Nordhaus, 2007

10 Byatt (et al), 2006

11 Byatt (et al), 2006

12 IPCC, 2007

13 Nordhaus, 2007

The logic behind the ‘policy ramp’ is straightforward. At present the investments with the highest rates of return are mostly in tangible, technological and human capital — such as economic infrastructure, plant and equipment, research and development, and education and training. This includes investments in research and development of low-carbon-emissions technologies. As the prospective damage from climate change becomes more evident over the coming decades, it will become more economical to shift investment toward a range of measures that involve progressively more intensive reductions in greenhouse gas emissions.

The practical validity of this strategy has been confirmed by the Copenhagen Consensus. In 2004, a panel of eight distinguished economists, including four Nobel Laureates, ranked how best to spend US\$50 billion on global challenges, including climate change. The 2004 Consensus Conference ranked climate change last and considered that health, water, education and hunger were more pressing issues. At the follow-up Consensus Conference in 2006, 24 distinguished United Nations ambassadors came up with similar rankings. Climate change was again ranked last.¹⁴

A climate change strategy cannot, however, be implemented by any one country in isolation. Implementation will require international cooperation, particularly by those countries that account for the largest share of global emissions or those that are expected to become large emitters in the foreseeable future. These countries include both developed countries, such as the United States, Japan and members of the European Union, as well as developing countries, such as China and India.

While the inclusion of the developing world in the process is crucial, the international community needs to appreciate the importance of balancing implementation of climate change goals with economic development strategies and practices.

This will require accepting certainties such as increases in energy consumption by these countries for some time and a concentration on mitigation efforts like cooperative research and developments in low-emissions technology. Over the medium to long term, these developing countries will be able to progressively realize greater energy efficiencies and lower rates of emissions.

For all countries a long term strategy to address climate change is essential. It allows room for economic growth to raise living standards, while providing the capacity to achieve progressively deeper reductions in emissions if and when they are most valuable to the global community.

¹⁴ Lomborg, 2006

Parties to the UNFCCC will meet in Bali in December 2007 to craft a fresh, global strategy to address climate change. In the lead up to that meeting, a case is being made that unless dramatic action is taken to address climate change, the world's developing nations will be the ones to suffer most.

There is no sound economic basis for this argument. In fact, the reverse is the case. If the world's nations act precipitately to reduce emissions, in the process increasing energy prices and reducing global economic growth, developing countries will pay the highest price. Growth will slow and strategies to reduce poverty and raise living standards will be stifled.

The case for this was best presented in a report released by the Chinese National Development and Reform Commission in 2007. In this report on China's approach to climate change, the Commission noted: "In the history of human beings, there is no precedent where a high per capita GDP is achieved with a low per capita energy consumption".¹⁵

The Commission can speak with authority. It has overseen implementation of economic policies which have dramatically reduced poverty in China. It has concluded that energy consumption, and thereby emissions of greenhouse gases, have to increase if remaining poverty is to be eliminated. It has stated that climate change policies must support development.

Yet there continues to be organized support by governments, Green NGOs and others in the international community to impose dramatic cuts on emissions which clearly would slow growth and retard strategies to reduce poverty.

International environmental groups as well as the British and German governments are calling for deep cuts in emissions in the very long term, such as by 20 to 40 percent by 2020 or even 60 to 90 percent by 2050.

Some environmental groups also argue that unless programs of deep cuts are initiated by 2015, irreversible damage will be done to the Earth's climate.¹⁶ It should be noted that this claim is not supported in the latest IPCC Assessment Report.

To support these contentions, it is now being argued that unless there are early, deep cuts in emissions, it will be the developing countries that will be harmed the most. This was a leading conclusion of the Stern Review. That report remains the leading body of economic analysis supporting this conclusion.

Other reports support the general contention that developing countries will be adversely affected. When releasing the Synthesis Report of the Fourth Assessment, Dr. Rajendra Pachauri, Chairman of the IPCC, referred to the prospective impact of continuing climate change on supplies of water and production of food in developing countries.

The conclusions in the IPCC report itself are less definitive. They show that these impacts will not be caused by climate change alone, but also by population increases, urbanization and poor agricultural policies.¹⁷

The United Nations Development Program's 2007-2008 Human Development Report supports the general contention that poor countries will be adversely affected, but does not contribute significantly to the body of economic analysis of the impact of climate change policies. The report notes that: "The poorest countries and most vulnerable citizens will suffer the earliest and most damaging setbacks, even though they have contributed least to the problem".¹⁸

The world faces a significant development challenge. It is important to be reminded what it is before we consider action necessary to take the climate change challenge.

¹⁵ National Development Reform Commission, 2007, 'China's National Climate Change Program', page 19.

¹⁶ Greenpeace, 2007, 'IPCC latest - climate change evidence unequivocal', *Greenpeace website*, 17 November, accessed at http://weblog.greenpeace.org/makingwaves/archives/2007/11/ipcc_latest_climate_change_evi.html

¹⁷ IPCC, 2007

¹⁸ UNDP, 'Fighting climate change: Human solidarity in a divided world', *UNDP Website*, accessed at <http://hdr.undp.org/en/reports/global/hdr2007-2008/>

Since 1980 the percentage of the global population, suffering from poverty has more than halved while global incomes have doubled. In the developing world, the percentage of the population living on less than US\$1 a day¹⁹ has fallen from 40 percent in 1981 to 18 percent in 2004.²⁰ Economic growth, accompanied by macroeconomic stability and appropriate institutional reforms, has led to dramatic rises in living standards in the developing countries over this period.

Assuming these trends continue, the world should meet the Millennium Development Goal of halving poverty by 2015. The World Bank has forecast that the proportion of the population living in extreme poverty in the developing countries will fall from 29 percent in 1990 to 12 percent in 2015.²¹ However, as of now, only the East and South Asian regions are projected to meet this target.

Poverty in the Developing World

While the World Bank's overall assessment is encouraging, about one billion of the developing world's population continues to live in extreme poverty. Of those, some 500 million subsist on less than 75 cents a day and 162 million on less than 50 cents a day.²² Much remains to be done.

There is significant regional variation in extreme poverty and regions have not performed uniformly in the struggle against it. In 1981, East Asia had the highest incidence of extreme poverty in the world, with 58 percent of its people living on less than US\$1 a day. At that time South Asia had the second highest rate, followed by Sub-Saharan Africa, Latin America, the Middle East and North Africa and lastly, Eastern Europe and Central Asia.

By 2004, Sub-Saharan Africa was estimated to have the highest incidence of extreme poverty, while East

Asia had undergone a dramatic transformation by significantly reducing extreme poverty to move into third place. Progress outside of Asia has not fared as well.

In Sub-Saharan Africa alone, the share of the population in extreme poverty has remained static at 41 percent since 1981 with the region now accounting for 30 percent of the world's extreme poor. It is the only region where the proportion of the 'ultra-poor' (those living on less than 50 cents a day) is greater than that of the 'medial poor' (those living on between 50 and 75 cents a day) or 'subadjacent poor' (those who subsist on between 75 cents and US\$1 a day).²³

Widespread extreme poverty means more than 800 million people do not have an adequate diet.²⁴ Child mortality remains high, with more than 10 million children a year dying from preventable and curable diseases before reaching age five.²⁵ Although significant progress has been made, over a billion people in the developing world still lack access to potable water, and nearly two billion people live without the access to energy that is necessary to meet basic human needs.

The Importance of Economic Growth

There is now wide-standing recognition that economic growth is essential for sustained poverty reduction and associated improvements in measures of human development. The developing countries that have undergone rapid growth in per capita incomes are pulling out of the poverty trap much faster than those countries that have experienced static or declining rates of economic growth — the latter group having been termed the 'bottom billion' by Professor Paul Collier.²⁶ Paul Collier is a Professor of Economics at the Oxford University and author of the book — *The Bottom Billion: Why the Poorest Countries are Failing and What Can Be Done About It*.

19 This is the threshold defined by the international community as constituting 'extreme poverty'.

20 The World Bank, 2007b, *Global Economic Prospects 2007: Managing the Next Wave of Globalization*, Washington, DC, and International Monetary Fund, 2007, *World Economic Outlook October 2007: Globalization and Inequality*, Washington, DC

21 The World Bank, 2007a, *Global Monitoring Report 2007 - Millennium Development Goals: Confronting the Challenges of Gender Equality and Fragile States*, Washington, DC

22 Akhter U. Ahmed, Ruth Vargas Hill, Lisa C. Smith, Doris M. Wiesmann, and Tim Frankenberger, 2007, 'The World's Most Deprived: Characteristics and Causes of Extreme Poverty and Hunger', 2020 Discussion Paper 43, International Food Policy Research Institute (IFPRI), Washington, DC, October

23 Ahmed et al, 2007

24 Ahmed et al, 2007

25 WHO, 2007, *WHO website*, 29 October, accessed at http://www.who.int/features/factfiles/child_health2/en/index.html

26 Paul Collier, 2007, *The Bottom Billion*, Oxford University Press, New York, NY

The 'bottom billion' countries are falling further behind. Since 1980 their economic growth has lagged behind the rest of the developing world by 2 percentage points a year. Over the 1990s, the gap has widened to 5 percent a year. As a consequence, average life expectancy in the 'bottom billion' countries is now only 50 years, compared to 67 years in the rest of the developing world. There are similar disparities in infant mortality. Some 14 percent of children in the 'bottom billion' die before the age of one, as opposed to only 4 percent in the other developing countries.²⁷

Professor Collier argues that the principal reason for the plight of the 'bottom billion' is the lack of economic growth.²⁸ Although there is much debate about the extent to which the poor benefit from economic growth, David Dollar and Aart Kraay have argued that growth benefits society as a whole, such that the incomes of the poorest increase proportionately with overall incomes.²⁹ For this reason policies that promote growth must lie at the center of any effective poverty reduction strategy.

Historical data demonstrates that the economies that underwent steady economic growth achieved the highest standards of living over the long run.³⁰ Between 1820 and 1998 the US, Canada and Western Europe experienced *productivity growth*, as measured by gross national product (GNP) per capita, of around 1.5 to 1.7 percent a year. Consequently they had a fifteen- to twenty-fold increase in their *living standards* over this period, as measured by GDP per capita. This is in sharp contrast to the experience of the economies of Africa. Between 1820 and 1998 the average income per capita in African economies only increased three-fold. Average annual economic growth was only 0.7 percent.

Estimates by the World Bank and International Monetary Fund show that economic growth has reduced the incidence of poverty in 19 low-income

countries.³¹ A one percent growth in GDP per capita has been accompanied by a 1.3 percent fall in the rate of extreme poverty in the population, as well as a 0.9 percent fall in the share of the population that has to live on less than US\$2 a day. This relationship was found to be particularly pronounced in the case of China where one percentage point of growth in GDP per capita reduced the share of the population living in extreme poverty by 1.5 percent.

Sustained economic growth has led to impressive declines in the incidence of poverty.³² This has been most dramatically demonstrated by the recent experience of the East Asian economies. Between 1981 and 2004, the number of people living in extreme poverty fell by more than 84 percent in East Asia. A large part of this occurred in China, where 500 million people were lifted out of extreme poverty.³³

Research at the World Bank indicates that growth in average incomes can help explain around 70 percent of the variation in poverty measures over the short run. In the medium to long-run this figure increases to 97 percent, suggesting that economic growth accounts for nearly the entire change in the percentage of populations living below the poverty line.³⁴ Other researchers have also estimated the share of the variance in poverty that is accounted for by economic growth.³⁵ Their results indicate that economic growth explains a larger share of the changes in poverty for the poorer countries than it does for the richer ones. In other words, sustainable growth is fundamental for poorer countries to achieve their poverty reduction targets.

Global growth is, moreover, increasingly dependent on the economic success of the developing world. Continuing prosperity in today's economy depends on developing countries achieving around 6 percent a year growth in their GDP. China alone has been averaging 10 percent a year.

27 Collier, 2007

28 Collier, 2007

29 David Dollar and Aart Kraay, 2002, 'Growth is Good for the Poor', *Journal of Economic Growth*, 7 (3), pp. 195-225

30 Jeffrey Sachs, 2005, *The End of Poverty: Economic Possibilities for Our Time*, Penguin Books, New York, NY

31 The World Bank, 2007b

32 A recent survey of the relevant literature on this subject is to be found in Humberto Lopez, 2004, 'Pro-Poor Growth: A Review of What We Know (and What We Don't)', *Mimeo*, The World Bank, Washington, DC

33 The World Bank, 2007a

34 Aart Kraay, 2004, *When is Growth Pro-Poor? Evidence from a Panel of Countries*, Policy Research Working Paper No. 3225, The World Bank, Washington, DC

35 H. Lopez and L. Serven, 2004, 'The Mechanics of Growth-Poverty-Inequality Relationship', *Mimeo*, The World Bank, Washington, DC

Recent projections by the World Bank over the period to 2030 reveal that this trend should accelerate.³⁶ In developing countries, the World Bank projects that incomes per capita will grow by 3.1 percent a year on average, which is well up from the 2.1 percent recorded for the period from 1980 to 2005. Between 2005 and 2030, the developing countries' output is expected to triple, thereby increasing their share of global output from one-fifth to nearly one-third.

Any decline in economic growth in the developing countries is therefore likely to have a negative impact upon the rest of the world. Moreover, in the coming decades more than 97 percent of the forecasted growth in population will take place in developing countries.

And while the share of global growth of developing economies is increasing, it also remains the case that most economic growth in the global economy is driven by growth in the industrialized world which still provides the biggest markets for exports from the developing world. Any slowdown of growth in the industrialized world will also slow growth in the developing world.

Meeting the Challenge of Climate Change

The economic development strategies for developing countries rightly focus on economic growth to alleviate poverty. While they recognize that the risk of climate change is a serious issue and one that the developing world is vulnerable to, they see the policy challenge as meeting their development aspirations and addressing the risk of climate change at the same time.

For many countries, the need to grow must take priority, given the strength of the historical and empirical evidence of the link between rising living standards and falling poverty, and sustained and rapid economic growth. These countries are concerned that measures to mitigate climate change must come at the cost of economic growth, given the very strong relationship between greenhouse gas emissions, energy use and economic growth in developing countries — a relationship which is much stronger than the equivalent one in the developed countries.

This is why it is a cardinal feature in the Agenda 21 consensus on environment and development adopted at the Rio Earth Summit in 1992 and the UNFCCC which was endorsed at the same meeting, wherein it was emphasized that the development needs of developing countries should not be subsumed to environmental objectives.

The future growth in global greenhouse gas emissions will occur mainly in developing countries.³⁷ The key here is for the developing world to resolve, in a sustainable manner, the trade-offs between economic development and the mitigation of and adaptation to climate change. Cooperation at the international level is required to ensure the availability of the required resources to the developing countries, including capacity development to respond to and take measures in order to address climate change.

In a sense though, developing countries have an advantage over developed countries when they were at the same stage of economic development. The developing countries can adopt new and more energy efficient technologies faster and more cost-effectively than the developed countries. As the World Bank has concluded, "...the growing developing economies can invest directly in energy-efficient technologies, thereby leapfrogging earlier, inferior processes".³⁸

Any measures to address climate change must not, however, impede the developing world's ability to grow and thereby raise living standards. For poorer countries and those that are just taking off on a growth path, accelerated economic growth and social development provide the most effective means for them to adapt successfully to climate change and to create the capacity to mitigate greenhouse gas emissions.

The Stern Review of the economics of climate change, has recommended that all countries, including the developing countries, implement immediate and substantial cuts in their greenhouse gas emissions.³⁹ Stern argues for cuts in global emissions of 60 percent by 2050 and that developing countries are worse off economically if early deep cuts on emissions are not made.

³⁶ The World Bank, 2007b

³⁷ International Energy Agency, 2007, *World Energy Outlook 2007: China and India Insights*, Organisation for Economic Co-operation and Development/ International Energy Agency, Paris

³⁸ The World Bank, 2007b

³⁹ Sir Nicholas Stern, 2006, *The Economics of Climate Change: The Stern Review*, HM Treasury, London, accessed at www.sternreview.org.uk

The British and German governments support Stern's goals. International environmental groups go further, calling for cuts by 80 and 90 percent by 2050. Intermediate cuts are also being proposed. The E.U. wants cuts in emissions of 20 percent by 2020.

A new proposition that the developing countries are at greatest risk is emerging. When releasing the Synthesis report on the Fourth Assessment Report of the IPCC, the Head of the Panel, Dr. Rajendra Pachauri emphasized the impacts of climate change on Asia and Africa.⁴⁰

This theme is echoed in the *2007/2008 Human Development Report* by the United Nations Development Program (UNDP).⁴¹ Announcements releasing the report were not entirely clear on the extent to which the appropriate response for developing economies is adaptation or mitigation.⁴² This is important. Strong measures to mitigate global warming invariably mean high energy costs and lower growth.

The Director of the U.N.'s Human Development Report Office also pointed to proposals that rich countries to cut their emissions by at least 80 percent by 2050 as compared to their 1990 levels as one means of tackling emissions.⁴³ Any approach that tried to cut greenhouse gas emissions by the 80 percent target for wealthy nations would lead to a reduc-

tion in economic output in the developed countries and global growth, and would therefore be likely to have a substantial negative impact on developing economies.

Climate change must be incorporated into the growth priorities of developing countries by basing those priorities on sound research and sustainable policy solutions that enable economic progress, which creates wealth and technological advancement. In the absence of economic growth, developing countries will lack the necessary resources to avail themselves of effective climate change mitigation measures. Similarly, a lack of social development would mean that these countries will not have the necessary skills and institutions that are required for adapting to and mitigating climate change.

Economic growth is the key driver to poverty reduction and improved human wellbeing. Improved living standards mean a healthier and cleaner environment, as well as enhanced adaptability and mitigation capabilities. Countries of the developing world must, therefore, be given the opportunity to grow in order to escape poverty and build a society capable of combating the potentially negative impacts of climate change. They must be allowed to draw together adequate resources and strengthen capacity while working within the principles of sustainable development.

40 The conclusions in the report itself are less definitive. They show that these impacts will not be caused by climate change alone, but as well by population increases, urbanization and poor agricultural policies. *IPCC Fourth Assessment Report: Synthesis Report – Presentation by Rajendra Pachauri at the IPCC Press Conference*, 17 November, accessed at <http://www.ipcc.ch/> www.ipcc.ch

41 UNDP, 'Fighting climate change: Human solidarity in a divided world', *UNDP Website*, accessed at <http://hdr.undp.org/en/reports/global/hdr2007-2008/>

42 UNDP, 'Decisive Action Must Emerge From Bali Climate Change Conference: Interview with Kevin Watkins, Director of the UN's Human Development Report Office', UNDP website, accessed at <http://www.ipsnews.net/news.asp?idnews=40132>

43 Ibid

BENEFITS OF IMMEDIATE & SUBSTANTIAL CUTS OVERSTATED

The Stern Review is the most recent, substantive contribution to the economics of man-made climate change and its consequences.⁴⁴ Despite the considerable work that went into it, the report has significantly overestimated the economic benefits of the immediate and substantial cuts in global greenhouse gas emissions, which it has recommended to much public fanfare.

This reflects both an overvaluation of the benefits of avoiding climate change, as well as its use of an implausibly low discount rate for reducing future benefits to their present values over a period of two centuries. The Stern Review has also underestimated the uncertainty attached to its estimates. This is due principally to its failure to allow for the increasing scope for economies to adapt to the impacts of climate change in the future due to the accumulated benefits of future economic growth.

How Stern Estimated the Benefits

The headline conclusion of the Stern Review was that immediate and substantial cuts in man-made greenhouse gas emissions are urgently required:

“...if we don’t act, the overall costs and risks of climate change will be equivalent to losing at least 5% of global GDP [gross domestic product] each year, now and forever. If a wider range of risks and impacts are taken into account, the estimates of damage could rise to 20% of GDP or more.”⁴⁵

The economic benefits from cutting emissions were therefore the damages that would be averted by doing so. These damages were based on the Review’s assessment of what could be expected to occur under ‘business as usual’ assumptions. In evaluating these ‘business as usual’ outcomes, the Review considered three sets of impacts:

- Impacts on economic activity. These include impacts on:
 - agriculture — increased droughts and floods, declining crop yields;
 - energy and water supply — loss of sources of supply; and
 - coastal populations — more frequent and more intense storms, rising sea levels;
- Direct impacts on human health and the environment. These include:
 - malnutrition;
 - vector-borne diseases such as malaria and dengue fever;
 - deaths due to thermal stress;
 - acidification of the oceans; and
 - loss of ecosystems.
- Political and economic disturbances. These include political conflicts and large scale immigration triggered by abrupt and severe climate changes, such as:
 - melting of the Greenland ice sheet
 - loss of the Amazon rainforest
 - shutdown of the thermohaline circulation in the oceans.⁴⁶

The Stern Review estimated that the cost of the first set of climate impacts was equivalent to 5 percent of GDP, while the cost of all three was 20 percent or more of GDP. In doing so it put the economic value of the damages as equivalent to US\$85 per ton of CO₂ equivalent (CO₂-e).⁴⁷

Stern Admits to Substantial Uncertainty

The Stern Review used an analytical technique called Integrated Assessment Modeling to estimate the costs of the impacts of climate change under ‘business as usual assumptions’ over the period to 2200.⁴⁸ Most of the costs are incurred in the latter half of this century. These costs were then discounted back to their present values — the issues involved in this part of the

44 Stern, 2006

45 ‘Statement of Conclusions’, page vi in Stern, 2006

46 The thermohaline circulation is the global ocean circulation driven by differences in seawater density, which are, in turn, caused by differences in seawater temperature and salinity. Thermohaline circulation is akin to the convection circulation that occurs within the atmosphere, albeit on a smaller scale.

47 Stern, 2006, p. xvi

48 Integrated Assessment Models are mathematical models that try to simulate the processes of human-induced climate change from greenhouse gas emissions and the socioeconomic impacts that they in turn cause. The first results from the application of Integrated Assessment Models to questions of climate change were only reported in 1996 and such models are still at the development stage. This is in sharp contrast to their economic equivalents — applied general equilibrium models — which have been extensively used in published policy analysis at the national level since the 1970s and are now much more analytically sophisticated than they were then. The Stern Review itself has admitted that Integrated Assessment Models ‘...are computationally demanding... [and]...must make drastic, often heroic, simplifications along all stages of the climate-change chain’ (Stern, 2006, page 145).

analytical process are discussed later in this chapter.

While the report's estimates of the costs of climate change were expressed in very confident terms in the Executive Summary, the main body of its report was far more circumspect. In Stern's own words, its modeling had to be based on '...sparse or non-existent data'.⁴⁹ In particular, the Stern Review found that its modeling '...faces difficulties in valuing direct impacts on health and the environment'.⁵⁰ It also characterized the possible 'catastrophic' climate changes that it had identified as being speculative.⁵¹

Overall, the Stern Review admitted that its analytical approach to the valuation of the costs of climate change was highly uncertain. In doing so it observed that its analytical approach represented:

"... a formidable challenge, involving forecasting over a century or more as the effects appear with long lags and are very long-lived. The limitations in our ability to model over such a time scale demand caution in interpreting the results, but projections *can* illustrate the risks involved..."[italics added]⁵²

The uncertainties acknowledged by the Stern Review are, however, significantly compounded by its many analytical failings.⁵³ These shortcomings are discussed in the rest of this chapter.

Stern Substantially Understates Adaptation

Although the Stern Review acknowledges some adaptation to climate change is inevitable, it significantly understates the scope for adaptation when evaluating

the extent of the impacts of climate change that can be expected under its 'business as usual' assumptions. The understatement in the Stern Review occurs on two fronts.

First, Stern understates the behavioral changes that may be expected, now and in the future, as a consequence of the prospect of significant climate change. The economic assumptions underlying the 'business as usual' modeling scenario used in the review for its measurement baseline assumes that global GDP per head of population will increase at between 1.5 and 3 percent a year over the period to 2100.⁵⁴

At these growth rates, by 2100 global incomes will be fifteen to thirty times higher than they are now in real terms. This means that by 2100 when the impacts of climate change are expected to emerge, most developing countries would have higher real incomes than the developed countries currently enjoy. Such an increase in absolute living standards will provide developing countries with very substantially greater scope to adjust to the impacts of climate change before they are likely to need it.

The most notable example of this understatement is the valuation of the impacts on developing countries. It does not admit the possibility that farmers in developing countries will change their agronomic practices in response to climate changes — for example by planting crops earlier or later in the year in response to temperature increases or by building dams to cope with changes in precipitation and/or flooding.

Second, the Review understates the stimulus that

49 Stern, 2006, page 153

50 Stern, 2006, page 153

51 Stern, 2006, page 156

52 Stern, 2006, page 143.

53 The Review has generally attracted a large body of critical commentary, including by: William D Nordhaus, 2007, *The Challenge of Global Warming: Economic Models and Environmental Policy*, 24 July, accessed at http://nordhaus.econ.yale.edu/dice_mss_091107_public.pdf; Richard SJ Tol and Gary Yohe, 2006, 'A Review of the Stern Review', *World Economics*, 7 (4), October-December, pp. 233-250; Robert O. Mendelsohn, 2006b, 'A Critique of the Stern Report', *Regulation*, 29 (4-5), Winter 2006-2007, Cato Institute, Washington, DC, pp. 42-46; Sir Partha Dasgupta, 2006, 'Comments on the Stern Review's Economics of Climate Change', *Mimeo*, Presentation of the Foundation for Science and Technology at the Royal Society, London, 12 December, accessed at www.econ.cam.ac.uk/faculty/dasgupta/STERN.pdf; S Niggol Seo, 2007, 'Is the Stern Review on Climate Change Alarmist?', *Energy and Environment*, 18 (5), pp. 521-532; Wilfred Beckerman and Cameron Hepburn, 2007, 'Ethics of the Discount Rate in the Stern Review on the Economics of Climate Change', *World Economics*, 8(1), pp. 187-210, January; Robert M Carter, CR de Freitas, Indur Goklany, David M Holland, and Richard S Linzen, 2006, 'The Stern Review: A Dual Critique – Part I: The Science', *World Economics*, 7 (4), October-December, pp. 167-198; and Ian Byatt, Ian Castles, Indur M Goklany, David Henderson, Nigel Lawson, Ross McKittrick, Julian Morris, Alan Peacock, Colin Robinson and Robert Skildesky, 2006, 'The Stern Review: A Dual Critique – Part II Economic Aspects', *World Economics*, 7 (4), October-December, p. 199-229

54 In doing so the Stern Review adopted the GDP and population projections for the period 1990 to 2100, which were used in the Third and Fourth Assessment Reports of the Intergovernmental Panel on Climate Change of the United Nations (IPCC 2001 & 2007).

behavioral changes induced by climate change will provide for business innovation and technological development. This stimulus will encourage the search for and discovery of new ways to reduce the costs of adapting to those impacts. As a number of authors have observed, the Stern Review is biased towards technological pessimism when it assessed the costs of climate change — in sharp contrast to its technological optimism about the future costs of its mitigation.⁵⁵

Compared to those previous studies that explicitly allowed for the possibility of adaptation to climate change, the Stern Review has overestimated the cost of the damages by a factor of more than ten.⁵⁶

Stern's Damages Estimates are Speculative

Most of the impacts of climate change identified by Stern and their Review's evaluation of them in monetary terms are highly speculative. As such they are well outside the range of economic modeling results that have been published in the peer-reviewed literature on the subject to date.

Nordhaus has estimated the benefits at just over US\$7 per ton of CO₂-e.⁵⁷ This estimate may be compared to the Stern Review's US\$85 per ton. The Nordhaus estimate is representative of the estimates in the peer-reviewed literature on the subject.⁵⁸

The estimates from the economics literature have been made with three different Integrated Assessment Models, including the model developed by Nordhaus to make the US\$7 per ton estimate referred to previously — the same modeling technique that was used for the Stern Review.⁵⁹ In sharp contrast to the Stern Review, however, the published results indicate that the GDP impact due to a global warming of between 2°C and 3°C would not be significant, and may even be beneficial. Beyond 3°C, most of the published results indicate that the GDP losses would increase but would stabilize at between 1 and 2 percentage points of GDP.

Only the Nordhaus-Boyer model has suggested that GDP losses would accelerate with rising global temperatures. Their results were driven by speculative assumptions about the impacts of abrupt and large scale climate changes.⁶⁰ Their assumptions were similar to those used by the modeling undertaken for the Stern Review. Subsequent analysis of the Nordhaus-Boyer results has indicated that these speculative impacts accounted for 90 percent of the assessed GDP losses.⁶¹

Discounting and Intergenerational Equity

The ability to trade-off long term benefits against immediate costs requires the two to be expressed in a common basis. This is done by discounting costs and benefits back to their present values. Discounting simply recognizes that a dollar of consumption in the future is worth less than a dollar of consumption today and the longer it is delayed, the less valuable it is.

In most policy analyses, the discount rate used is the rate at which the community as a whole willingly trades-off present against future consumption. In technical parlance this is known as the social rate of time preference and consists of a number of elements. They include the 'pure rate of time preference' and the ethical weight to be given to consumption by future generations, compared to the present one.

The Stern Review assumed that:

- the pure rate of time preference was virtually zero; and
- the interests of future generations should be given equal weight to those of the present generation.

Although neither assumption is in accordance with mainstream economic thinking, their use accounts for virtually all of the differences between the Stern Review's modeling results and those in the peer-reviewed literature, particularly the strategy of substantial and immediate emissions cuts. For this, the Stern Review has been severely criticized. The critics

55 For example Byatt et al 2006 and Robert O. Mendelsohn, 2006

56 Mendelsohn, 2006

57 Nordhaus, 2007

58 Byatt, 2006

59 Robert O. Mendelsohn, Wendy Morrison, Michael E Schlesinger, and Natalia G Andronova, 1989, 'Country-specific market impacts of climate change', *Climate Change*, 43 (3-4), pp. 553-569, William D Nordhaus and Joseph Boyer, 2000, *Warming the World: the Economics of the Greenhouse Effect*, MIT Press, Cambridge, MA, and Richard Tol, 2002, 'Estimates of the damage costs of climate change - part II: dynamic estimates', *Environmental and Resource Economics*, 21, pp 135-160

60 Nordhaus and Boyer, 2000

61 Samuel Frankhauser and Richard Tol, 2003, 'On climate change and economic growth', *Resource and Energy Economics*, 27, pp. 1-17

include highly respected economists such as Sir Partha Dasgupta, William Nordhaus and Richard Tol.⁶²

The near-zero pure rate of time preference used by the Stern Review implies that people are prepared to save virtually all their lifetime income to benefit successive generations. There is no empirical evidence that this is correct. Moreover, since future generations are

expected to be better off than the present generation, it is hardly equitable to expect the present generation to forego consumption to make them even better off than they would otherwise be. Again there is no empirical evidence that this perspective would be widely shared by the present generation; indeed quite the contrary.

62 See Dasgupta 2006, Nordhaus 2007, Tol 2006, Byatt et al 2006, and Mendelsohn 2006

COSTS OF IMMEDIATE & SUBSTANTIAL MITIGATION UNDERSTATED

The Stern Review has significantly underestimated the economic costs of the immediate and substantial cuts in global greenhouse gas emissions, which it has recommended by way of a combination of taxes and regulatory caps on emissions.

Stern's mitigation estimates are well above those in the mainstream peer-reviewed economic literature. The difference reflects biases in the estimation process that was used by the Stern Review, as well as its omission of certain types of costs. The latter includes the substantial administration and compliance costs, as well as the economic efficiency losses that can be expected to be incurred in imposing the proposed tax and regulatory regimes.

In doing so, the Stern Review has substantially overestimated the scope for advances in technology to reduce the costs of mitigation, not to mention the very considerable uncertainty that is attached to prospective reductions in those costs. In part, this reflects the likely adverse impact of the Stern recommendations on the investment climate, particularly in the initial period of implementation and therefore on the ability to commercialize any of the potential gains made by development of new technologies.

How Stern Estimated the Costs

The Stern Review has sought to estimate the resources cost of immediate action to cut global emissions, so as to stabilize the concentration of greenhouse gases in the atmosphere at a level that could be expected to avert the climate changes outlined in the previous chapter. It concluded that the 'upper bound' of the cost of stabilization "...is likely to be around one percent of GDP by 2050".⁶³

In doing so, however, the Review acknowledged that its central estimate was "...subject to important uncertainties".⁶⁴ These uncertainties include the path and pace of technological progress and the evolution of real prices of fossil fuels over a period of up to two centuries, as well as the preparedness of energy users to switch to alternative sources of energy and more energy-efficient ways of using fossil fuels. According

to the Review, these uncertainties mean that the resource cost of mitigation could be as much as 5 percent of GDP by 2050.

Stern Punts on Technology

The Stern Review's estimates of the cost of mitigation are much lower than those in the mainstream economic literature on the subject. Much of the explanation is to be found in the Review's very optimistic perspective on future technological progress. In particular, the Review assumes that a tax and/or a cap on greenhouse emissions, at the levels it has recommended, will lead to a substantial and rapid acceleration in advances in technology so as to contain the real costs of mitigation. The validity of this assumption over the early part of Stern's evaluation time horizon — that is, the period to 2050 — is crucial.

The degree of technological optimism in the Stern Review is difficult to establish from the contents of the published report. The Review is not explicit about the rate and path of technological progress that it has assumed in constructing its 'business as usual' scenario. As a consequence, it is very hard to evaluate the extent of the technological optimism in the Stern's proposed mitigation scenario.

In any event, there is a long history of excessive optimism in official assessments of prospective advances in energy technologies. In the U.K. the most notable example has been the consistently massive underestimation of the future course of the cost of nuclear power generation from the 1950s onwards.⁶⁵ This risk is highlighted by the fact that the technology assessment in the Stern Review is significantly more optimistic than the external assessment of the prospective costs of carbon abatement technologies by Dennis Anderson of Imperial College London, which was commissioned for the Stern Review.⁶⁶

Anderson has estimated that, without advances in technology, the cost of abatement would be about £250 per ton of carbon over the long term — which translates into US\$109 per ton of CO₂-e.⁶⁷ With the benefit of technological progress, he estimated that

63 'Executive Summary', page xiii in Stern, 2006

64 'Executive Summary', page xiii in Stern, 2006

65 Dieter Helm 2003, *Energy, the State and the Market*, Oxford University Press, Oxford

66 Dennis Anderson, 2006, 'Costs and finance of carbon abatement in the energy sector', Paper prepared for the Stern Review, 20 October, accessed at www.sternreview.org.uk

67 Anderson, (2006, page 17) used a Purchasing Power Parity exchange rate of US\$1.6 per £ in all his currency conversions.

abatement costs would be likely to drop to:

- £145 ffl £45 per ton ‘in the near term’;
- £85 ffl £40 per ton ‘in the medium term’ (circa 2025); and
- £60 ffl £150 per ton ‘in the long term’.⁶⁸

Anderson concluded that these advances would require the current level of investment of £20 billion per year in innovation in low carbon technologies to be progressively increased over the next two decades to £70 billion per year.

Anderson’s estimate of US\$109 per ton for the cost of abatement with existing technologies is about 30 percent more than the Stern Review’s estimate of the social benefits of abatement — US\$85 per ton of CO₂-e — which itself is a substantial overestimate compared to the results in the economic literature. This suggests that substantial and immediate cuts to greenhouse gas emissions would be bad economics and bad public policy. Each ton of compulsory emissions cuts would cost the global economy substantially more than the social value of the climate impacts that they would avert. They would also reduce the capacity of the global economy to make emissions cuts subsequently, when they were really needed.

While the cost of abatement should progressively decline as technology advances, it is likely to be decades before emissions cuts of the size recommended by the Stern Review are economically justified. Moreover, Anderson’s estimates of the uncertainty surrounding future technological progress is much larger than that implied by the headline estimates of the cost of abatement in the Executive Summary of the Stern Review.

The commercialization of advances in emissions reduction technologies will require substantial investments. Investors are, however, unlikely to invest or reinvest in sectors with stagnant or declining output. The immediate imposition of substantial taxes or caps on emissions at the levels recommended by the Stern Review is likely to produce stagnant or declining output in the very sectors — such as coal mining, electric-

ity supply, iron and steel, and transport — where the new technologies would be most needed to reduce their emissions. This hurts the poor.

Stern Fails to Address All Costs

The imposition of either a carbon tax or a system of emissions permits as envisioned by the Stern Review will generate very substantial financial transfers from energy users. In estimating the resource cost of mitigation, however, the Review has not explored the full implications of this issue.

In the case of a carbon tax, the government will receive revenue equivalent to the tax rate multiplied by the volume of eligible carbon-equivalents included in the tax base. In the case of a system of emissions permits, the recipients of the financial transfers will depend on how the permits are distributed by the government. If they are auctioned off, the government will benefit from the additional revenue that energy users pay to permit holders as a consequence of the overall cap on emissions.⁶⁹ If the permits are distributed free of charge, it is the permit holders who will benefit.

In other words, the financial implications of a carbon tax and a system of emissions permits are essentially the same where the permits are auctioned off. Where they are distributed free of charge by the government, it is equivalent to the government providing a subsidy to the permit holders.

In estimating the resource costs of mitigation, the Stern Review has treated the financial transfers as a resource benefit on the basis that the funds in question are then available to be used for the benefit of the community. Indeed the scope for ‘active revenue recycling’ — as the Review terms this benefit — is estimated at 1.9 percent of GDP, which makes it the largest single offset to the resource costs of mitigation identified by the Stern Review.⁷⁰

For the transfers involved in ‘active revenue recycling’ to be a benefit, the transfer process has to be costless. This is clearly not true. Any financial transfer generated by the imposition of a new tax or regulation must

68 Anderson, 2006, page 30

69 This reflects the fact that competition between prospective bidders for the permits will tend to drive the successful bids to a level that eliminates any monopoly profit from the use of the permits. The efficiency of this process will be influenced by the design of the permit system and the auction process for allocating individual permits.

70 See Table 10.1 in Stern, 2006, page 243.

involve three sets of economic costs:

- ‘deadweight costs’ associated with the tax and/or regulation.⁷¹
- costs of public sector administration; and
- costs of compliance by the private sector

Deadweight costs

In this case, a proper assessment of these costs would require a comprehensive modeling analysis of the existing tax system with and without a carbon tax. The same is true for the assessment of the costs of introducing any system of emission permits. The Stern Review did not attempt to assess any of these costs even though the economic literature indicates that they are likely to be substantial.

The economic literature has demonstrated that a comprehensive analytical approach is necessary due to the significance of the interaction effects between different taxes. Due to cross-price effects, the introduction of a new tax will generally be expected to increase the deadweight costs associated with the existing taxes.⁷² Empirical studies have shown that such ‘tax interaction’ effects are generally as great as the financial transfers from the new tax, if not greater. Emissions taxes typically interact with taxes on labor and capital such that the overall increase in deadweight losses is generally greater than the increase in revenue.⁷³ In Australia for example, this conclusion has been underlined by estimates that *every dollar* of additional taxation imposed on the transport sector can be expected to generate a *net loss* of GDP of twenty cents.⁷⁴

Any emissions tax and/or permit regime requires techniques, devices and methods to measure, or at

least estimate, the relevant emissions to an acceptable degree of accuracy. Moreover, if such a regime is to minimize the economic cost of abatement it must also extend the relevant financial and regulatory incentives to the use of carbon ‘sinks’ or stores with the implication of the need to be able to measure or estimate stock changes to an equivalent degree of accuracy. The inherent difficulty in measuring or estimating these physical flows at a reasonable cost is one of the reasons why emissions tax and/or permit regimes have been used relatively infrequently.⁷⁵

Administration & compliance costs

Compared to emissions taxes, permits regimes are likely to be even more costly in terms of both public administration and private sector compliance — sometimes referred to as ‘red tape’.

The responsible government agency has to be able to measure or estimate not only the physical flows but also the behavior of the participants in the permit market. Permits have to be tracked and trades recorded. The agency has to be able to confirm when permit owners are abiding by the terms of their permits and to enforce compliance when they do not by imposing appropriate penalties and sanctions. For their part, the permit owners need to be confident that they can demonstrate their compliance to the regulator whenever they operate within the terms of their permits and whenever the regulator requires it.

Globally the most successful emissions permit regimes are the Sulfur Dioxide Allowance Trading Program (SO₂) and the Regional Clean Air Incentives Market (RECLAIM) in the U.S. These programs each cover only a relatively small number of relatively large and technologically sophisticated, stationary point

71 Deadweight costs are the economic losses borne by consumers and producers as a result of a tax or regulation. A tax or regulation reduces consumption of the targeted good, service or activity. This, in turn, reduces the overall net benefit to consumers — the difference between the value they place on their consumption and what it actually costs them. The producers of the targeted good, service or activity can suffer a similar loss of value. These losses are to be distinguished from the financial transfers that are generated by a tax or regulation, which simply redistribute resources within the community.

72 Agnar Sandmo, 1975, ‘Optimal taxation in the presence of externalities’, *Swedish Journal of Economics*, 77 (1), pp. 86-98

73 A Lans Bovenberg and Ruud A de Mooij, 1994, ‘Environmental levies and distortionary taxation’, *American Economic Review*, 84 (4), pp. 1085-1089; Don Fullerton, 1997, ‘Environmental levies and distortionary taxation; Comment’, *American Economic Review*, 87 (1), pp. 245-251; Ian WH Parry, ‘Pollution taxes and revenue recycling’, *Environmental Economics and Management*, 29 (3), pp. S64-77; and A Lans Bovenberg and Lawrence H Goulder, 1996, ‘Optimal environmental taxation in the presence of other taxes: General-equilibrium analyses’, *American Economic Review*, 86 (4), pp. 985-1000

74 Industry Commission, 1991, *Costs and Benefits of Reducing Greenhouse Gas Emissions – Volume II: Appendices*, Inquiry Report No. 15, Australian Government, Melbourne, 15 November

75 Sonja Peterson, 2003, *Monitoring, Accounting and Enforcement in Emissions Trading Regimes*, Report prepared for OECD Global Forum on Sustainable Development: Emissions Trading and Concerted Action on Tradeable Emissions Permits, CCNM/GF/SD/ENV(2003)5/FINAL, OECD, Paris, accessed at www.oecd.org

sources of emissions. The SO₂ program covers 2,100 electricity generation units nationally. In contrast only 254 point sources in the Los Angeles air shed participate in RECLAIM.⁷⁶

The monitoring, accounting and enforcement systems of the two programs are very similar. Both rely heavily on upon complex and intrusive systems, notwithstanding the considerable use that is made of self-reporting by the regulated emitters.⁷⁷

In the case of the SO₂ program, every large generating unit has to install a continuous emissions monitoring system (CEMS). The CEMS provides nearly continuous data (every 15 minutes) on the emissions at each generating unit to the U.S. Environmental Protection Agency (EPA). The data are transmitted automatically in electronic format. Smaller generating units are allowed to install cheaper monitoring systems but they are less accurate. They report to the EPA via additional equipment and specific software, which are regularly audited for accuracy and non-compliance. In both cases, the EPA carries out site inspections and annual performance audits.

The annual cost of monitoring for the SO₂ program, including operating and annualized capital cost, has been estimated at approximately US\$124,000 per generating unit (in 1998 prices).⁷⁸ *Ex ante* estimates of

the total administrative and compliance costs of the program put them at between US\$270 and US\$481 million a year (in 1992 prices). Between US\$50.6 and US\$57.1 million were the incremental costs of public administration and the balance were the compliance costs borne by the regulated firms.⁷⁹

Despite the fact that markets for environmental permits are generally highly developed in the U.S., transactions costs uncertainty, information imperfections, and institutional rigidities have generally hampered their development there. Specifically, such problems have been blamed for the low trading volumes in the early years of the SO₂ program.⁸⁰ In the light of this experience, the costs of administration and compliance for a carbon tax or emissions permit regime are likely to be very substantial compared to the income transfers that will be generated by them.

The administration and compliance costs are likely to be even more substantial for developing countries that have relatively immature or underdeveloped systems of public administration, particularly in the areas of environmental monitoring, accounting and enforcement.⁸¹ A review of the U.S. experience concluded that its success in implementing emissions taxes and tradable emissions caps is unlikely to be replicated in developing countries.⁸²

76 Peterson, 2003, page 6

77 Peterson, 2003

78 Richard Schmalensee, Paul L Joskow, A Denny Ellerman, Juan Pablo Montero, and Elizabeth M Bailey, 1998, 'An Interim Evaluation of Sulfur Dioxide Emissions Trading', *Journal of Economic Perspectives*, 12 (3), pp. 53-68

79 ICF Inc, 1992, *Regulatory Impact Analysis of the Final Acid Rain Implementation Regulation*, Report prepared for the US Environmental Protection Agency, Washington, DC, 19 October

80 Allen Blackman and Winston Harrington, 1999, *The Use of Economic Incentives in Developing Countries: Lessons from International Experience with Industrial Air Pollution*, Discussion Paper 99-39, Resources for the Future, Washington, DC, May

81 Ruth Greenspan Bell, 2006, 'The Kyoto Placebo', *Issues in Science and Technology*, Winter, pp 28-31

82 Blackman and Harrington, 1999

Climate change is a long term problem that requires a long term solution. It is increasingly being asserted in public climate change debate that unless deep cuts are applied early, irreversible climate change may occur.

There is no sound technical or economic analysis which supports the suppositions behind these claims. The Fourth Assessment Reports of the IPCC assesses that levels of carbon dioxide are set on irreversible trend lines to increase and will peak between 2100 and 2150, no matter what action is taken before then.

The IPCC reports, no matter what public commentators claim, also do not assess that it is likely or probable that failure to take early action will cause irreversible damage. It is just one possibility of many in an area where all concede a great deal more research is required.

The IPCC reports remind us that no matter what action is taken in the near or intermediate term, there is going to be change in the climate. The appropriate conclusion to draw from this is that much greater attention should be paid to policies to support adaptation.

Developing countries are expected to be most vulnerable to the adverse consequences of climate change. The supposition is that such damage would hamper the concerted efforts of these countries to raise their living standards and reduce poverty. However, the path of economic development pursued by developing countries will determine, to a very large extent, their ability to address the consequences of climate change, both now and into the future.

Economic growth should be recognized as a priority for developing countries as it provides the possibility of a 'double dividend'. Not only will economic growth provide the wherewithal that enables developing countries to lift their citizens progressively out of poverty, but growth will also increase their capacity both to mitigate and to adapt to the consequences of climate change in a sustainable manner. Any policy response to climate change running counter to this direction risks more than global warming.

Optimal Strategy on Climate Change

In the extensive peer-reviewed literature on the economics of climate change many issues have yet to be unresolved. That aside, there is a clear consensus on the outline of the optimal policy strategy to deal with climate change.

One of the consistent findings in this literature is that the optimal strategy is a *long term* one that involves *modest* cuts in greenhouse gas emissions to begin with followed by *progressively deeper* cuts over the medium to longer term. As a recent survey of Integrated Assessment Models of global climate change has put it: "Perhaps the most surprising result is the consensus that given calibrated interest rates and low future economic growth, modest controls are generally optimal"⁸³

Professor Nordhaus has characterized the optimal climate change strategy as one which follows a 'policy ramp'. Its logic is quite straightforward. In a world where capital is productive, the investments with the highest rates of return are mostly in tangible, technological, and human capital. This includes investments in research and development in low-carbon emissions technologies. As the prospective damage from climate change becomes more evident over the coming decades and countries acquire additional resources and technological know-how, it then becomes more economic to shift investment toward measures that involve progressively more intensive reductions in greenhouse gas emissions.

The exact shape of this 'policy ramp' in terms of the mix and timing of the emissions cuts will depend upon the costs, the prospective damages from climate change, and the extent to which those changes are 'lumpy' and irreversible. That said, what is clear is that the *rate* of emissions reductions would most likely have to accelerate over time. In other words, the upwards trajectory of the 'policy ramp' is best represented by a curve rather than a straight line.

The shape of this 'policy ramp' for addressing climate change has survived extensive and rigorous testing. This has been done by way of sensitivity testing by the relevant authors, peer-review of their work prior to publication, and full public disclosure of their data

83 David L Kelly and Charles D Kolstad, 1999, 'Integrated Assessment Models for Climate Change Control', in Henk Folmer and Tom Tietenberg (eds), *International Yearbook of Environmental and Resource Economics 1999/2000: A Survey of Current Issues*, Edward Elgar, Cheltenham, UK

and quantitative methods, including the computer code. The testing has included:

- multiple alternative modeling approaches; different climate policy goals;
- alternative specifications of the science of climate change; and
- more than a decade of technical developments in integrated assessment modeling.⁸⁴

In sharp contrast to the mainstream economic literature, the Stern Review has eschewed:

- any sensitivity testing of its results;
- any peer review prior to publication; and
- full disclosure of its data and quantitative methods.

These are among the Stern Review's most serious shortcomings. As a direct consequence, the Review was able to ignore the central message of the peer-reviewed literature about the optimal policy strategy and recommend a contrarian policy strategy of immediate and substantial cuts in emissions. It is for these reasons that Professor Nordhaus has observed that "...the *Review* should be read primarily as a document that is political in nature and has advocacy as its purpose."⁸⁵

Drastic and immediate policy measures to reduce emissions, as proposed by the Stern Review, are unlikely to be cost-effective in achieving the desired environmental outcomes. The Stern policy strategy would simply lead countries to invest too little in conventional capital and too much in 'climate capital'. After five decades or so, countries would find their conventional capital — economic infrastructure, plant and equipment, skills and knowledge — to be substantially reduced but any increase in 'climate' capital would be slight.

The Stern strategy would seriously depress the level of real consumption per capita over these initial decades. During this period a very high rate of savings is necessary to provide the resources required for investment in 'climate capital'. In the case of developing countries, such increases in savings would seriously restrict the present generation's ability to consume, literally to the point of *starvation* as described by Dasgupta. This would occur at a time when the rest of the world would have reduced capacity to provide assistance.

The Stern policy strategy is counter-productive. It has

polarized the international debate on climate change rather than inform it. More worryingly, it could encourage resistance to immediate and economically sensible policy responses, such as investments in research and development in low-emissions technologies.

In contrast the optimal policy strategy to address climate change seeks to reverse the investment flows. Compared to Stern, this strategy would encourage greater investment in conventional capital during the initial decades and would make only modest investments in climate capital at this stage. The additional returns from investing more in conventional capital will provide all countries with a greatly enhanced ability to invest much more heavily in 'climate' capital at a subsequent stage, when it is more valuable and economical to do so.

The optimal climate change policy strategy recognizes that the most pressing global problems at the present time are strongly correlated with global poverty. They include but are not limited to: environmental pollution; water shortages; deforestation and loss of biodiversity; population growth; hunger; and pandemics like HIV/AIDS. Therefore, unless the underlying issue of poverty is addressed, policies to correct these environmental outcomes will not be successful.

Resources are scarce, particularly in the developing world. They therefore need to be utilized efficiently and prioritized so that they address the most imperative issues before moving onto less pressing ones. The additional costs imposed by economically inappropriate policy responses to climate change, which tries to rationalize deep and early cuts in emissions, will reduce economic growth, especially in the developing countries. By doing so they will make it harder for countries to respond and adapt to climate change over the long run. And it is the long run that really matters when addressing climate change.

Practical Validation of the Optimal Strategy

The practical validity of the optimal policy strategy has been confirmed by the Copenhagen Consensus project.

In 2004 the Danish government invited a panel of eight distinguished economists, including four Nobel Laureates in Economics, to consider how best to spend US\$50 billion on solving the various challenges

84 Nordhaus, 2007, page 101

85 Nordhaus, 2007, page 103

that face the global community, including that posed by climate change.

Informed by specially commissioned research, the panel of distinguished economists concluded that implementing the Kyoto Protocol or taxing greenhouse gas emissions would cost more than they were worth. Accordingly the panel ranked climate change last in its overall expenditure priorities. They considered that health, water, education and hunger were more pressing issues and that each warranted a greater and more immediate share of the world's limited resources to be applied to it. Given that policies to encourage an abrupt shift to lower greenhouse gas emissions would not be cost-effective, the panel urged that more research be undertaken into affordable carbon abatement technologies.⁸⁶

In 2006 the Danish government followed-up on the 2004 Consensus Conference by inviting 24 distinguished ambassadors to the United Nations to come up with their own priority rankings for this expenditure. The countries invited represented one half of the world's population. The rankings chosen by the 2006 Consensus Conference were surprisingly close to those of the economists in 2004. Climate change again ranked last.⁸⁷

Need for International Cooperation

The optimal policy strategy on climate change cannot be implemented by any one country in isolation, no matter how large it is. To do so would be potentially very costly as economic activity would tend to shift offshore and global emissions would not necessarily be reduced. For this reason its implementation will require some degree of international cooperation, particularly by those countries which account for the larger shares of global greenhouse gas emissions or which are expected to join that group in the foreseeable future. These countries include both developed countries, such as the U.S., the E.U. and Japan, as well as developing countries, such as China and India.

Climate change is considered as a long term challenge by most less developed countries but poverty reduc-

tion is, very understandably, a more immediate priority. In order to meet the challenge of climate change effectively, a developing country needs to work on encouraging economic growth and building-up its productive base. Only then will it acquire the physical, human and technical capabilities that are necessary for addressing climate change issues effectively.

Trying to implement a strategy on climate change without the cooperation of at least the major developing countries is, however, not a viable option. China is already the second largest emitter of greenhouse gases. Its economy is growing rapidly and, as a consequence, China is expected to become the largest emitter the near future. For example, China has plans to build 544 new coal-fired power plants to meet the surge in domestic demand for energy, and is now reported to be building about two power plants every week.⁸⁸ Similarly, India is ranked among the top ten emitters of the world and its economy is growing at historically high levels.⁸⁹

While the inclusion of the developing world in the process of addressing climate change is crucial, the international community needs to appreciate the importance of balancing implementation of climate change goals with economic development strategies and practices. Economic growth in the developing world is, after all, highly correlated with energy use and with greenhouse gas emissions. This will require accepting growth in energy consumption by these countries for some time and concentrating their mitigation efforts on modest investments in researching and developing low-emissions technologies in cooperation with the industrialized countries. Over the medium to long term, they will thereby be increasingly able to realize greater energy efficiencies and progressively lower rates of emissions.

For all countries a long term strategy to address climate change is essential as it allows them sufficient room for economic growth to raise living standards, while providing the capacity to achieve progressively deeper reductions in emissions as and when they are most valuable to the global community.

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About World Growth

World Growth is a non-profit, non-governmental organization established with an educational and charitable mission to expand the education, information and other resources available to disadvantaged populations to improve their health and economic welfare. At World Growth, we embrace and celebrate the new age of globalization and the power of free trade to eradicate poverty and improve living conditions for people in the developing world.

Our Philosophy

World Growth believes that helping the developing world realize its full potential is one of the great moral aims for those of us fortunate to live in the wealthy developed world. We also believe that a misdiagnosis of what ails the underdeveloped world has yielded policy prescriptions that have been useless or even harmful to the world's "bottom billion."

World Growth believes that there is enormous untapped human and economic potential around the world. In order to unlock that potential, and allow the poorest of the world's poor a better life, it is necessary to realize changes in institutions and policies that permit growth and human flourishing.

Instead of aid and handouts, what the populations of developing countries need are social and political institutions and infrastructure that foster productive economic activity and generate robust economic growth. These include, but are not limited to, property rights and protections, the rule of law, free markets, open trade, government accountability and transparency.

For too long, well-meaning governments, aid agencies and others have promoted policies that fail to address the true problems that afflict poor societies. As a result, too many people around the globe remained locked in pre-modern conditions where their talents and inherent capacities are shackled.

The people of the developing world are fully capable of helping themselves to ensure a more prosperous existence. The path to prosperity does not begin with handouts from the West. Instead it requires identifying the genuine obstacles to growth and highlighting paths to reform that will yield sustainable and lasting change.



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