Climate change – a developing country perspective

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This article looks at the issue of climate change from a developing country perspective and develops an outline of a win-win-oriented climate policy around development priorities. It demonstrates how the great climate debate between the 'skeptics' and 'supporters' does not lead developing countries anywhere. The article shows that the emerging middle-path approach, which suits developing countries will lead to win-win opportunities both for the environment and the economy. The proponents of this approach are termed as 'climate realists', who consider climate mitigation as a by-product of sustainable development solutions. The article also discusses the issue of discount rate that should be applied for problems which are likely to peak in the medium to long-term future. Finally, various market-based mechanisms with 'no-regret options' are discussed and we advocate the use of sustainable development paradigm for climate-change policies.

Keywords: Climate change, developing countries, energy, environment.

IN recent years, the main focus of the global environment has been on climate change and the related policy responses. Human-induced climate change is related to the use of fossil fuels as the emission of carbon dioxide (CO_2), the most important of the greenhouse gases (GHGs), is a direct result of the combustion of such fuels. Increased GHG concentrations is likely to raise the earth's average temperature, influence precipitation and some storm patterns as well as raise the sea level[1]. It is worth noting that developing countries are in a catch-22 situation in the context of climate change. On the one hand, these countries, with per capita energy consumption and CO_2 emission being one-sixth that of the industrialized world, are not primarily responsible for the climate deterioration. On the other, they are the most vulnerable to climate change impacts because they have fewer resources to adapt – socially, technologically and financially[2]. It is a known fact that historically developed countries, since the days of the industrial revolution, have emitted most of the anthropogenic GHGs into the atmosphere[3]. Developing countries would account for three-quarters of the increase in global CO_2 emissions between 2004 and 2030 and will overtake Organization of Economic Co-operation and Development (OECD) as the biggest emitters by 2010 and thereafter[4]. Hence, the developing countries have an important role to play in the future state of climate change. However, these countries are in the process of industrialization and there is a need for economic growth to meet the basic needs of the people and fight against poverty. The United Nations Framework Convention on Climate Change (UNFCCC), in its formative years, had acknowledged that the share of global emissions originating in developing countries would grow to meet their social and development needs[5]. Thus, development, not emission reduction per se, is the priority for the developing countries. Hence, climate consideration throws a fundamentally different challenge for these countries.

The division of world opinion on the certainty of climate change adds to the woes of developing countries. Scientists acknowledge a temperature increase of the earth and attribute this episode of global warming to human activity of fossil-fuel burning. However, what scientists disagree is on the magnitude and speed of future climate change and hence the response pattern. One school of thought urges 'rapid action', whereas the other advocates 'wait and watch' policy. The uncertainties hover around the following facts: whether GHGs and aerosol concentrations increase, stay the same or decrease; how strongly the features of the climate (e.g. temperature, precipitation and sea level) respond to changes in GHG and aerosol concentrations, and how much the climate varies as a result of natural influences (e.g. from volcanic activity and changes in the intensity of the sun) and its internal variability (referring to random changes in the circulation of the atmosphere and oceans)[6]. The uncertainty of the exact nature or timing of the impacts means that a flexible and responsive approach to climate preparation will be needed.

Faced with these challenges of climate change, economic development and sustainability, the future of energy and environmental policies in developing countries has been a hot topic among policy makers and academics. The most promising policy approaches would be those that capitalize on natural synergies between development priorities and climate protection, which simultaneously advance both these efforts. The aim of this

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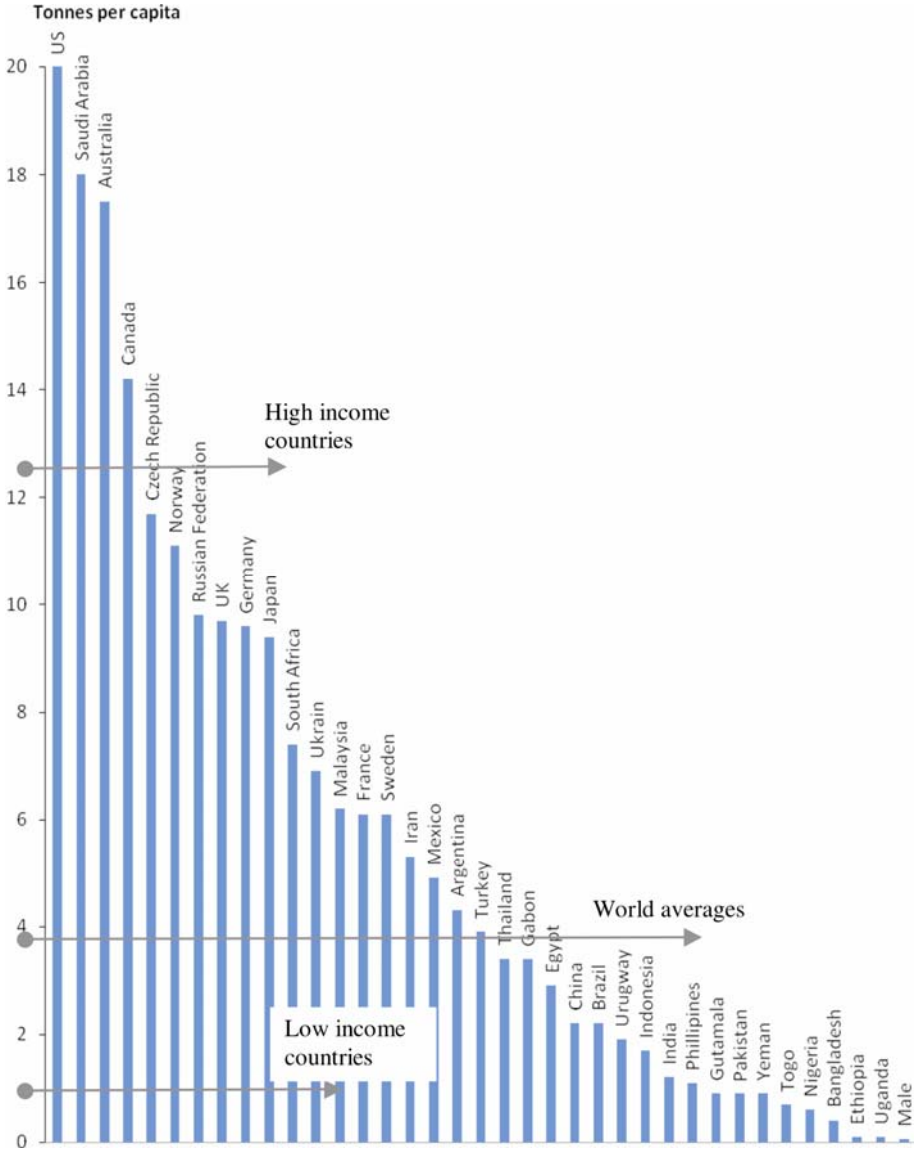

Figure 1. CO_2 emission by different countries in 2002. Source: UNEP[3].

article is to understand the position of developing countries in climate-change negotiations. It attempts to demystify the climate advocacy by briefing on the great climate debate and highlights the middle path therein. It attempts to provide market-based solutions with a view from a developing country perspective. This will enable the reader to participate in one of the most important debates and policy discussions of our times.

The developing country dilemma

The developing countries with 80% of the world's population still account for only 20% of the cumulative emissions[7] since 1751. They are relatively new entrants in the sphere of industrialization and urbanization. These countries are releasing pollutants into the atmosphere only for the last couple of decades, whereas the developed world has done the same for hundreds of years. The striking contrast in the emission levels among different countries of the world is evident from Figure 1. Developing countries like China, Brazil and India have per capita emissions lower than the world average. According to data from the World Bank database, the high-income countries emit CO_2 at 13 t/yr per capita, whereas the same for middle and low-income countries[8] is no more than 3 t/yr. Recognizing this huge gap between the developed and developing countries, UNFCCC has incorporated the principle of 'common but differential responsibility' into the legal instruments to combat climate change. Under this differential treatment, developed countries are obliged to lead climate mitigation through national policies, make financial resources available to developing countries to meet the cost incurred in complying with the convention, and promote technology transfer to develop-

ing countries to implement the measures under the Convention.

However, in recent years, developing countries, largely China and India have contributed the biggest increase in emissions, while those from the developed countries are growing slowly. The International Energy Agency (IEA)[9] projects that more than two-thirds of the world energy will come from developing countries between 2003 and 2030. Figure 2 gives a comparison of the projected annual CO_2 emissions from the OECD and non-OECD countries. The non-OECD emissions from 2005 to 2030 (2.5%) are five times higher than the projected increase of the OECD countries (0.5%)[10]. China surpassed the US as the biggest CO_2 emitter, and India will soon overtake Russia to become the third largest emitter. Currently, more than half of the global emissions comes from the less developed countries[7]. In 2004, together, the developing and least-developed economies accounted for 73% of global emissions growth[11]. In short, developing countries are into high energy and emission path, and will contribute substantially to the climate deterioration in the near future.

More than their climate-change potential, developing countries are a subject of concern worldwide for their high climate-change vulnerability. In the coming decades, it is predicted that billions of people from the developing countries will face shortages of water and food, and greater risks to health and life as a result of climate change[2]. CO_2 emissions from fossil-fuel burning and industrial processes have been accelerating at a global scale[11], with their growth rate increasing from 1.1% yr^{-1} for 1990–99 to >3% yr^{-1} for 2000–04. The geographical location of the developing countries acts to their disadvantage in terms of the climate-change impact on them. Majority of the developing countries (countries of Asia, Africa, Latin America and small island states) are in tropical and subtropical regions – the areas most likely to be affected by climate-change impacts. Under a business as usual scenario, GHG emissions could make the earth warm by 3°C during this century. Even with a temperature rise of 1–2.5°C, the IPCC predicts serious effects, including reduced crop yields in tropical areas leading to increased risk of hunger, spread of climate-sensitive diseases such as malaria, water stress in Africa, increased risk of floods followed by drought and water scarcity for millions of people living in the catchment areas of the Himalayas and Andes, inundation of coasts and threat of tropical cyclones worldwide, complete submergence of small island states and an increased risk of extinction of 20–30% of all plant and animal species[2,12].

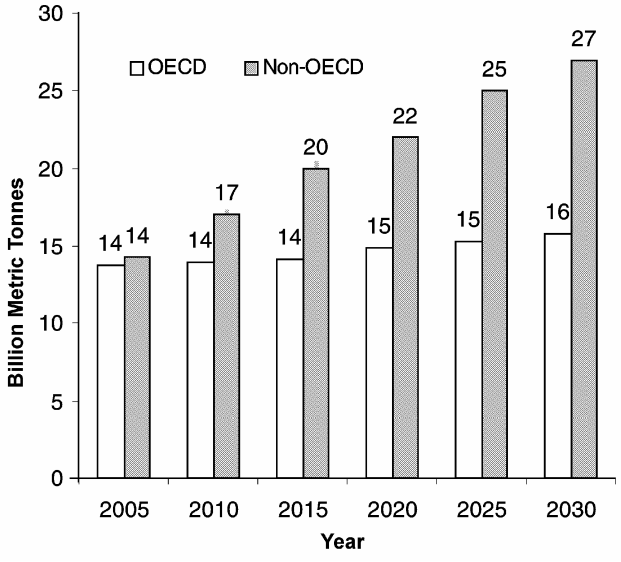

Figure 2. World energy-related CO_2 emissions. Source: EIA[9].

Some instances of climate-change impacts on developing countries are: (i) Between 1990 and 1998, 97% of all natural disaster-related deaths occurred in developing countries. (ii) About 90% of all natural disasters are climate, weather and water-related. (iii) In 2004, severe flooding in Bangladesh, caused by excessive rains of the annual Asian summer monsoon, killed over 600 people and displaced over 20 million[12]. The increase in frequency of weather disasters[13,14] is evident from Table 1. With impact on life and livelihoods, climate change will have far-reaching effects on the sustainable development of developing countries[15], including their ability to attain the United Nations Millennium Development Goals by 2015.

Climate policy – historical perspective

The question of how climate change might affect human activities appeared on the international agenda in 1979 at the World Climate Conference (WCC; note 1). In 1988, UNEP and the World Meteorological Organization (WMO) established the Intergovernmental Panel on Climate Change (IPCC) with the mandate '(…) to assess on a comprehensive, objective, open and transparent basis of the scientific, technical and socio-economic information relevant to understanding the scientific basis of risk of human induced climate change, its potential impacts and options for adaptation and mitigation'. Since its establishment, the IPCC released four Assessment Reports (note 2) in 1990, 1995, 2001 and 2007, which summarized the state of scientific knowledge available at that time. These reports formulated a consensus opinion, while pointing to areas that are uncertain or controversial and need further research. The 'First Assessment Report' released in 1990, was influential in the development of the UNFCCC (note 3), which was adopted at the Earth Summit in 1992. In this non-binding document, 154 countries, plus the European Community, agreed on the '(…) stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system'[5]. To achieve this goal, the countries were divided into two

Table 1. Great weather disasters (1950–2001)

	1950–59	1960–69	1970–79	1980–89	1900–99	1992–2001
Number	13	16	29	44	72	64
Economic losses (US$ bn)	41.2	54.1	79.4	126.1	425.4	362
Insured losses (US$ bn)	–	7.2	11.5	23	98.9	79.3

Source: Innovest[13] and MunichRe[14].

groups: the developed countries were encouraged to cut their emissions of GHGs back to 1990 levels, while the remaining countries did not have to commit to such reductions, following a principle of common but differentiated responsibilities. In practice, differentiated responsibilities meant that developed countries were obliged to assume leadership in efforts to mitigate climate change (note 4). Another significant tenet in the UNFCCC is the precautionary principle[16] (note 5). Article 3 of the Convention describes the notion as follows: 'Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures'[5]. According to the precautionary principle, policy decisions must be made under uncertainty when there is a risk of catastrophic damage. Also, the precautionary principle suggests that many segments of the private sector may be better-off if serious costs are avoided by adopting precautionary measures.

The development of the UNFCCC and other international environmental treaties was accompanied by the establishment of the Global Environment Facility (GEF) as a joint venture of the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP), and the World Bank. At the Rio meeting, a process was put in place to strengthen the regime over time. The participants agreed that the supreme decision-making body of the UNFCCC, the Conference of the Parties (COP), would meet regularly to discuss further steps to mitigate climate change. At its first session, which took place in Berlin in 1995, the COP concluded that the 1992 UNFCCC commitments were insufficient and that there was a need to establish compulsory targets. The Kyoto Protocol (note 6) was adopted on 11 December 1997 at the COP3. The Protocol for the first time set legally binding emissions targets for a group of countries. In Article 3 of the Protocol (note 7), the countries commit to reduce their emissions of GHGs by at least 5% below the 1990 level by the years 2008–12. The Kyoto Protocol focuses on six GHGs: carbon dioxide, methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6). These gases are to be combined in a basket, with reductions in each gas translated into CO_2 equivalents that are then added up to produce a single figure. As of June 2007, 172 Parties had signed and ratified or acceded to the Kyoto Protocol. With the withdrawal of the United States, Russia's ratification became pivotal for reaching the 55% threshold for bringing the Protocol into force.

According to the third volume of the Fourth Assessment Report of the IPCC, approved on 4 May 2007, between 1970 and 2004, global emissions of CO_2, CH_4, N_2O, HFCs, PFCs and SF_6, weighted by their global warming potential (GWP), have increased by 70%, from 28.7 to 49 Gt of carbon dioxide equivalents. The largest growth in global GHG emissions has come from the energy-supply sector (an increase of 145%), transport 120%, industry 65% and land use, land-use change and forestry 40%.

The great climate debate – clashing position between sceptics and supporters

The sceptics are those who see climate change as a hoax inflated by the media and maintain that the only sensible solution is to do nothing. According to them, the risks are exaggerated by making selective use of evidence. Wilfred Beckerman, one prominent sceptics (note 8), expressed this position when he claimed that 'Global warming is no cause for alarm or dramatic action. If dramatic action were taken, the effects on human welfare would be horrendous – even more horrendous perhaps than the effects of global warming itself'[17]. The sceptics backed by conventional fossil energy lobbyists are able to influence the media and spread anti-climate action. Most effective GHG emission reduction policies are potentially expensive in the short term, while the benefits may not be evident until sometime in the future. So the big question sceptics ask is why take costly action today to fix something that may not really be broken, or that can be addressed when the negative affects are more apparent[3].

Supporters of climate change are the ones who argue that the theory of human influence on the climate is well established and appeal for immediate action. They believe that many consequences of climate change, although not certain, are documented so well already that it would be irresponsible to wait for action. If nothing is done, or the 'wait and watch' policy of the sceptics is followed, it would be more difficult to mitigate serious consequences, including rising sea levels, more extreme weather events, disruption of agriculture and impaired health. All of this could lead to major reductions in economic well-being and quality of life[18]. George Marshall

argues on behalf of the supporters that waiting for a complete scientific understanding will not be accepted as an excuse by future generations affected by global warming. Moreover, he states that '(…) there is far more certainty about climate change than there is about many other aspects of science on which policy decisions are routinely made'[19]. In support of their call for action, the supporters refer to evidence of serious impacts. A report prepared by Innovest for the UNEP shows that banks, insurances and other businesses have incurred significant losses due to climate change already, and that these losses will likely multiply if global warming is left unchecked[13]. Hence the main issue for supporters is not whether to do something about climate change, but what to do *and* when. The debate centres on the effectiveness, cost and ethical appropriateness of various courses of action. While some supporters favour command and control mechanisms, such as for example regulated limits on GHG emissions, others would like to rely on economic instruments, for instance, carbon taxes and market-based mechanisms such as emission trading. And some argue that lasting solutions to environmental problems require more fundamental transformation, including changes in economic structure, the media, and education[20].

The supporters and sceptics differ on the sufficiency of scientific knowledge, the urgency of precautionary principle, and the kinds of response to the situation. The little common ground where sceptics and supporters agree is the need of more research to be done on climate change as with more knowledge, it is easier to take a stand on climate change and direct actions accordingly. Both the sceptics and supports use developing countries as their main weapon of argument. The supported feel this is the right opportunity for them to revise the energy paradigm and leapfrog developed countries in terms of adopting cleaner technologies as a basis for development[21]. In this respect, a wide array of actions need to be developed specifically for policy makers, market regulators, commercial bank managers and other key decision makers.

'No-regrets' and 'win-win' opportunities – view of the climate realists

Between supporters and sceptics, there has been a tiny minority of analysts who are convinced about the urgency of the problem while remaining profoundly tactical of the solution mechanisms. Most of them are from developing countries and their voices have largely gone unheard. This set of analysts can be termed as 'climate realists', who acknowledge the emission divide between developed and developing countries (like global emissions, on a per capita basis, is 8.4 t in the EU-15 and 19.7 t in USA, whereas it is 2.6 t in China and 1.0 t in India)[22], but do not use this disparity as an alibi for inaction of the developing countries. Climate realists understand that for the developing countries, climate-change issues are not the main concern in relation to problems such as poverty, natural resources management, energy and livelihood needs. From their perspective, development should come first, i.e. one should start from a sustainable development perspective which prioritizes poverty reduction and equity. The challenge for such a type of development is the practical question of choosing sustainable pathways that provide food and energy security, employment opportunities and at the same time minimize environmental impacts. Hence a less-polarized way of meeting the challenges of climate change is to build policies upon development priorities that are vitally important to developing countries. Such an approach views the risks of climate change not as a burden to be avoided, but as a side-benefit of sustainable development. And this could then lead to an alternative strategy for establishing cooperation between developing and developed nations. Such a strategy should involve efficient utilization of natural resources, increase in service levels, lower spending by the consumer on resource-related expenditure reduction and also reduction in air pollution levels. In this connection, energy efficiency and clean energy technologies can play a significant role to provide a net positive economic benefit – monetary, health and environmental – to the society as a whole. Investments in energy efficiency result in long-term benefits such as reduced energy consumption, local environmental enhancement and overall economic development[23]. Cost-effective energy efficiency is the ultimate multi-pollutant reduction strategy.

Already in 1992, the UNFCCC encouraged the use of cost-effective mechanisms for tackling climate change. This principle was reaffirmed later in the Kyoto Protocol. The principle of cost-effectiveness influences (1) the type of project and (2) the type of policy instruments. Here we briefly describe various win-win pathways for direct and indirect benefits under different types of projects and programmes aiming at spurring economic development and reducing the climate-change impacts. These 'no-regrets options' have the potential to be welcomed by both sceptics and supporters as they provide the dual benefit of climate-change mitigation and economic improvement. The concept of no-regrets can be considered as a synonym for the concept of win-win. There are two types of no-regrets: (i) economic win-win and (ii) financial win-win. Economic win-win is achieved when a problem is mitigated at a negative net economic cost, thus leading to a win for problem-solving and a win for the economy. And financial win-win is achieved when a problem is mitigated at a profit (negative net financial cost), thus leading to a win for problem solving and a win for the particular investor, company, or industry[24] (note 9).

The essence of the theory of private capital mobilization (PCM) is that win-win opportunities can be created. The key is to focus on such opportunities that require only a small subsidy or intervention that creates large

external benefits. If we wish businesses and financial institutions to be active participants in solving the problem, it is not sufficient to demonstrate that their participation will be good for the economy or the society as a whole. We have to show that it will improve the balance sheet of the particular organization concerned. If financial win-win situations can be created by mobilizing private capital, it is possible to strengthen the case against the argument that companies cannot afford to take environmental action.

It is worth distinguishing between real win-win arrangements that involve a net positive pay-off for all stakeholders, and relative win-win arrangements, where some parties may have to pay something, but not as much as under alternative arrangements. The latter is the case, for example, if car manufacturers facing a costly carbon tax, see a requirement to increase sales of clean cars as preferable.

There is another way to conceptualize the win-win issue by using a stakeholder perspective. From a narrow view of this approach, win-win outcomes are achieved if the participant benefits from a particular project. From a wider view, win-win outcomes are related to the distribution of benefits to all stakeholders, and also to those who are not directly involved within a project. In an ideal scenario, the government will achieve its policy goals; for instance, reduce public expenditure, improve the environment or protect disadvantaged social groups, firms and financial institutions to achieve their business objectives, i.e. make profits and improve their reputation, and the civil society organizations to attain their aims, i.e. improve the environment, ensure democratic legitimacy and prevent corruption. A win-win solution means to achieve those particular goals that the stakeholders define as such for themselves. These options should be looked from various perspectives.

Governmental perspective

This perspective looks at the net costs of the no-regret measures as resource options based on the total costs to the government and the customer. This perspective includes national development goals, social equity, national priorities, self-reliance, energy security, policy-making, as well as institution forming. Power industry is a case in point. During the power-plant construction land, energy, steel, concrete, and transportation facilities are required. During the operation, power plants use coal with significant ash content and emit CO_2, SO_x, NO_x, etc. which pollute air, water and land. While pricing the electricity, we look at the capital and operating costs only and ignore these environmental and social costs. If these are included, the cost of energy generation through these conventional technologies will be high and comparable with energy through renewables. Another important issue is energy security that has to be tackled by the government. Over the last three decades, we have witnessed events that have transformed the outlook for the global oil market.

Business perspective

The relative novelty of the energy efficiency field together with its technical nature, and the invisibility of energy caused a lack of good information on energy efficiency technologies, their potentials and costs[25]. There are also other issues pertaining to the attitudes of the business establishment. They include the lack of recognition of non-market needs of consumers, and the focus of the private sector on environmental remediation rather than pollution prevention. Leaving aside that business goals and the measurement of their successes are complex and a matter of debate, it can be safely assumed that businesses establishments are profit-seeking organizations. Energy efficiency involves efficient use of resources, which is key to industrial development. Industries not only prevent pollution, but can also enhance profits by reducing energy and material use. They save the direct costs of these resources, as well as reducing disposal costs, avoiding fines, and minimizing bad publicity. In addition, resource efficiency often enhances productivity, streamlines production and improves workplace conditions.

Society perspective

Perhaps the most important, but least discussed and appreciated benefit of no regret options is the impact on local economies. Clearly, households, enterprises and the government benefit directly by improving the efficiency of energy use. If they improve energy efficiency, they have more disposable income. However, there is an important net benefit to local economies too. If expenditures on energy are reduced, the savings will improve the performance of the local economy via the 'multiplier effect' to the extent that the savings are spent in the local economy. The multiplier effect is an economic phenomenon characteristic of all economies, relating the spending and re-spending effects of money on the output of local economies. Also, the expenditures on energy efficiency improvements themselves will improve local economic performance because the materials and labour for those improvements are likely to come from the local economy.

Table 2 provides the economic costs and benefits to an individual household as well as carbon emission benefits to the society through technology shifts. As shown in Table 2, a standard technology for cooking activity is replaced by an efficient one; energy/family/yr will be saved to the tune of 50–300% depending upon the type of technology that is being replaced. With the reduction in

Table 2. Benefits to individuals and society through energy efficiency – Indian scenario

Service	From	To	Investment (Rs)	Energy saved (GJ)	Savings (Rs/yr)	CO_2 emission abated (kg)
Cooking	WS-T (10%)	WS-E (30%)	250	16.0	1000	1680.0
	WS-T (10%)	Biogas stove (60%)	10,000	19.4	1250	2520.0
	KS-T (30%)	LPG stove (65%)	2000	2.3	300	226.2
Water heating	WS-T (10%)	WS-E (30%)	250	4.6	250	487.2
	WS-T (10%)	Biogas	10,000	5.7	320	840
	WS-T (10%)	Solar water heater	15,000	8.0	500	840.0
	Electric water heater	Solar water heater	15,000	3.2	1780	627.5
Lighting	IB (60 W)	CFL	140	0.75	660	190
	FL (36 W)	CFL	100	0.60	500	160
	Kerosene lamp	CFL	100	1.1	830	296

WS, Wood stove; T, Traditional; E, Efficient; IB, Incandescent bulb; CFL, Compact fluorescent lamp.
Figures in parentheses are efficiencies of the devices. Rs 100 = 2.5 USD.

energy consumption, the GHG emission reduction also will be achieved. The use of efficient devices demonstrates the advantages of climate benefits in terms of reducing the emission levels and reducing the incremental costs. Thus, the cost and benefit of reducing a tonne of emissions in technological (inefficient to efficient) shifts might be more than a tonne of emissions averted while shifting from one fuel to another (kerosene to LPG). The estimates of carbon emission for lighting are indirect emissions due to the use of electricity generated mainly utilizing coal.

Energy efficiency investment can create significant employment opportunities too. Although providing employment was never a key aim of the energy-efficiency policy, the positive employment side effects of policies and programmes will prove to be useful in building support for energy-efficiency investments across various governments. New jobs can be created, especially in the manufacturing and construction sectors. This is particularly the case where EE projects can demonstrate positive impacts for social groups currently disadvantaged in the employment market, for example, those with low skills and few qualifications, living in economically deprived areas. Joanne Wade and Andrew Warren have co-authored a paper in which the employment impacts of energy-efficiency investment programmes in nine EU Member States are discussed. Based on detailed case studies of 44 individual programmes and modelling of the wider effects, the study investigated short- and long-term impacts, both on total number of employed persons and on the skills utilized in the economy. The results confirm that there are net employment gains in virtually all cases. Table 3 illustrates these results in terms of net employment impacts.

Finally, we have to distinguish between win-win opportunities which are exploited and those which are latent. The first type are win-win opportunities which do not require any intervention from governments, multilateral institutions, or other parties, because the private sector is aware of them and is exploiting them already. As they are privately financed without special incentives, there is no need to mobilize private capital. The second type of win-win opportunities are latent ones. They may or may not be known to the private sector, and require a stimulus or some other form of intervention. The intervention may be regulatory, informational, financial, or a combination of these. The intervention may be economy-wide – affecting all firms and financial institutions – sector-wide, or targeted at particular companies and individuals. Any win-lose situation can be turned into a win-win situation by compensating the losers.

Cost of climate change and choice of discount rate

A key issue in the debate on climate change is how much will it cost to reduce GHG emission levels. Supporters of climate change believe that the cost of delay is much higher than the cost of immediate action. They believe that there are significant opportunities in almost every country to achieve climate-change mitigation at a zero or negative net economic cost. Indeed, the calculation of climate-change mitigation costs depends largely on the assumptions underlying it. Many climate–economy models are based on the assumption that all profitable energy savings have already been bought, and therefore, greater energy savings will be worth purchasing only at higher energy prices. Using this as a starting point, computer models are developed to calculate the value of the energy tax needed based on historic elasticities, the subsequent negative effects on the economy, and the cost of climate-change mitigation. Climate models also tend to assume that the public sector will invest directly in GHG reduction, thus neglecting that the government may focus on mobilizing private capital instead. In doing the latter, major cost savings could be realized. However, it is difficult to

Table 3. Employment benefits due to energy efficiency in EU countries

Country	Net employment (person/yr)	Net employment per million invested	Net employment per million – government invested
Fiscal, residential schemes			
France	71,400	12.9	106.9
Germany	–4200	–9.5	–31.7
UK	3815	9.3	9.3
The Netherlands	1000	12.6	
Germany	3800	Negligible	
UK	17,400	4.5	
Miscellaneous (others)			
France	81.7	11.5	11.5
The Netherlands	3800	12	372.5
Spain	3344	50.7	265.4
UK	12,260	98.1	

Source: ref. 41.

say exactly how much money could be saved, because there is little historical experience apart from public–private partnership programmes which did not focus on climate change. The spectrum of scenarios presenting costs for global climate-change abatement ranging from billions to net negative costs illustrates that costs are uncertain and difficult to calculate accurately. Based on figures from the IPCC, an IEA report claims that '(…) the potential for realisable no-regret, cost-effective energy saving is very uncertain. Current estimates by the IPCC suggest a range of 10–30% gains on baseline trends over the next two to three decades'[4].

There are three types of capital investments: those that have a net economic cost, those that are costless, and those that yield a profit. Mobilizing private capital is not different: it can be costly, costless, or profitable. How much money should be invested in climate-change mitigation or in mobilizing private capital for climate-change mitigation partly depends on the discount rate. Discounting converts the (full) values of the impacts that occur at different points of time into common units, for example, translating the costs of future climate change damages into '(…) equivalent values in today's monetary units'[26].

The application of discounting in environmental policy has long been controversial[27]. In the climate area, the basic fault line runs between supporters who prefer to use a low or zero discount rate and those who want to apply a similar discount rate as in any standard public investment decision. Applying a discount rate means that damages, which are expected to occur in the long-term future have a low present value, even if a reduced discount rate of 3–4% is applied. Since the costs associated with climate change may peak in 50, 100, or more years, the discount rate methodology tells us to pay very little now to avert these damages[28] (note 10). The higher the discount rate, the lower the investments we are willing to make today. The use of discount rates is based on Irving Fisher's time-preference theory of interest.

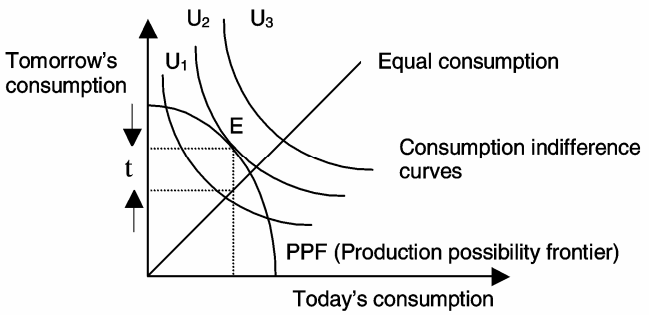

Figure 3. Fisher's time-preference theory of interest.

Figure 3 shows the preference for today's relative to tomorrow's consumption[29]. According to Fisher, the interest rate is determined by impatience and technological progress. The indifference curves U_1, U_2 and U_3 represent the level of impatience about tomorrow's consumption of society or an individual. The production possibility frontier (PPF) demonstrates the possibility to transfer today's consumption into consumption of tomorrow. E is the equilibrium in which satisfaction is maximized. The slopes of PPF and U_2 in E are equal to minus $(1 + r)$, with r representing the real interest rate. The slopes express how much of the future goods are equivalent to today's goods. The assumption is that economic subjects are not willing to sacrifice today's consumption without getting any benefit for it. They favour today's consumption over tomorrow's consumption and want to be paid for waiting.

How much the choice of discount rate matters for the design of policy was illustrated by a study undertaken by William Nordhaus. Using the example of a tax on GHGs, he sought to determine an efficient policy response to climate change. In his 'maximum damage' scenario, a discount rate of 4% suggests that an efficient level of the tax is US$ 2.44/t of carbon, and the result would be a less

than 5% decrease in emissions compared to business as usual. A discount rate of zero, however, suggests an efficient tax of US$ 65.94/t of carbon, which would lower emissions by one-third[30].

Market-based climate policy

All environmental policy instruments, including traditional command and control mechanisms, such as performance standards, and economic instruments, such as taxes and subsidies, can have an impact on private investment decisions. However, market-based measures have the greatest potential to attract profit-minded investors for climate-change mitigation. The main idea of market-based mechanisms is to solve environmental problems in an economically efficient way by sending appropriate price signals to private investors to internalize the societal costs of their business decisions and to provide an economic incentive for firms to reduce those costs.

Market-based measures are sometimes favoured due to ideological reasons, for example, the belief that the government is not capable or efficient enough for providing solutions[31]. However, markets require clear price signals and a legal framework. Therefore, market-based measures necessarily imply a role for the government. They would not thrive in an environment entirely free from regulation, where the government does not provide clear rules and frame-working conditions[32].

Warwick McKibbin and Peter Wilcoxen argue that mitigation policies which do not minimize cost are doomed to fail. For example, they propose coal market reform through reducing coal subsidies and trade barriers as a solution that will generate both economic and environmental benefits. While price reforms of this kind may be a disadvantage to the fossil-fuel industries, the renewable energy sector can anticipate inflows of capital that would otherwise go to carbon-intensive industries.

Apart from subsidy reform, trading emissions may be an instrument with the greatest potential in terms of climate-change mitigation. The first emission-trading schemes have been developed in the United States[33]. The most well-known programme is the sulphur dioxide-trading scheme established at the beginning of the 1990s to tackle acid rain. This system enables firms to buy and sell rights to emit sulphur dioxide in a manner equivalent to buying and selling currencies in a foreign exchange market. The fact that it combines both environmental and economic benefits makes it an attractive model for carbon-trading systems. High penalties have prevented sources from violating the cap level – the maximum amount of allowable emissions. Indeed, since the acid rain programme commenced in 1995, sources included into the scheme comply with their caps at lower costs than predicted at the time the programme was implemented.

Experience has shown that the programme can ensure emission reductions at the least cost to society. This outcome should make it attractive even in the eyes of those who tend not to trust market solutions. The programme is successful as the trade is beneficial to both the buyers and sellers. Sources that have a high cost of abatement can buy additional allowances at a lower price, while sources that are able to reduce emissions below their cap are rewarded for better environmental performance by selling their extra allowances and making a profit. The total cost of reducing emissions through trading is smaller than that of other policy mechanisms. For instance, it was calculated that using taxation policy than emission trading, the cost of reducing GHG emissions by 21% is nine times more for Denmark and 24 times more for the EU to achieve 8% abatement[34].

With regard to pollution permit trading, there is a clear incentive for decreasing emissions, as there is a monetary value attached to allowances. Emission-trading systems stimulate research and development, as the business sector can anticipate profitable emissions abatement. Furthermore, emission-trading systems provide high flexibility in choosing the type of emission reduction – including investment into abatement technology, fuel switch, energy efficiency measures, or utilization of renewable energy sources. In contrast, command and control approaches that, for example, specify the types of pollution control devices to be installed do not provide the same degree of flexibility[35].

In 2009, a new scheme will come into operation, which promises to become the largest emission-trading market in the world. The Emission Trading Scheme (ETS) of the EU would be applicable not only in the EU, but also in accession countries and countries of the European economic area. The ETS is designed to contribute to GHG reduction commitments under the Kyoto Protocol. The first emission trades have already been agreed to, indicating the interest of private-sector actors. For example, Shell Trading will sell a considerable number of allowances to Nuon during the first compliance year[36].

If an emission-trading system is implemented at an international level, it could create strong demand for investment projects designed to reduce GHG emissions. Private capital could be mobilized through this mechanism because GHG reduction projects would yield credits that can be sold in the market. Firms that are able to reduce GHGs at a price below the trading price can make a profit out of mitigating climate change. In this way, climate change could become the basis for a growing sector of business activity, ultimately developing into a major economic driving force in the coming decades. Specialists from Natsource, DZ Bank and other organizations involved in climate-change mitigation see a big advantage of a carbon market in that it will enable '(…) bringing future revenues from forward GHG contracts to

the beginning of the project, rather than payments at the back end'.

In terms of actual policy developments currently under implementation, the development of a GHG-trading system would be an essential component of a reform of incentive structures. If the effectiveness of such a system is not whittled down in negotiation, and if compromise does not result in the lowest common denominator, it has the potential to mobilize large sums of private capital, especially if combined with carbon taxes and other policy instruments. The question is how to make these ideas work in practice. In order to make GHG markets operate efficiently, the main tasks include producing demand, enhancing buyer confidence in pricing, bringing greater liquidity to the GHG market, overcoming the short-term cash flow problems, and creating larger economies of scale[37].

The main task for private investors is to calculate the effects of GHG regulations and carbon price sensitivities into the analysis of project economics[38]. The interest of investors will increase if it can be shown that technologies become cheaper as a result of commercialization and that GHG emission markets offer opportunities to create profits from project cash flows and advisory fees. The alternative to voluntary action on climate change is higher taxes and stricter environmental regulations, as well as higher indirect costs due to environmental and health damages, which ultimately are charged to households and firms. An important advantage of GHG trading is that it includes incentives based on self-interest, such as direct profit opportunities for firms which can reduce pollution at less than the trading price. Thus, GHG trading is not favoured by arguments about enlightened self-interest, although these arguments may be important to long-term profits and business competitiveness.

Market-based mechanisms should not be treated as a panacea for solving environmental problems, since there are cases which require complementary mechanisms, including economic instruments and command-and-control approaches. However, market-based provisions should be further investigated and exploited when they offer advantages. The US sulphur-trading programme has shown that market-based approaches can be cost-effective in mobilizing private capital for clean technologies, which gives ground for optimism concerning carbon-trading schemes. Using a mix of measures, climate-change mitigation policy can provide a stimulus for speeding up the commercialization of clean energy technologies[39].

Discussion – application to a developing country

The impacts of climate change can be reduced if a transition is made from supply obsessed planning to focusing on demand side management and renewable energy programmes. Oil giants redefined themselves as energy companies and, together with a host of engineering and technology companies, increased their exposure to clean energy technology.

From the perspective of developing countries, international agencies such as the United Nations have not adequately addressed their priorities for sustainable development. These agencies provide policy advice to the developing countries to focus on climate-change issues as top priority, since it might be difficult to implement them in many developed countries which are the real culprits. It is unfair to make the developing countries repay the environmental debt of the developed world. For the developing countries, climate-change issues are not the main concern when compared with problems such as poverty, natural resources management, energy and livelihood needs. It may often be possible to build environmental and climate policy around development priorities that are vitally important from the developing-country perspective. The climate-change benefits will eventually come as a result of implementing these policies. In such a scenario, climate-change policies may be seen not as a burden to be avoided but rather as an attendant benefit of sound and environment-friendly development projects and programmes.

Adaptation and mitigation strategies have to be developed for sectors such as energy, transport, land use, industry and waste, to see how such plans can be implemented in practice. In many countries, energy initiatives and other climate-favouring activities emerge as additional benefits of sound development programmes. Price reform, agricultural soil protection, sustainable forestry and energy sector restructuring are being undertaken without any reference to climate change. These initiatives help in mitigating environmental risks and at the same time enhance economic and social development.

In the interest of global sustainability and moving on to environmentally more desirable paths, the concept of economic and social development should be the top priority for developing countries. This means that the climate-change issue must be viewed through the lens of human development. The challenge for such a type of development is the practical question of choosing sustainable pathways that provide food and energy security, employment opportunities and at the same time minimize environmental impacts. Instead of focusing attention on policies to reduce climate-change risks, the starting point should be the development issues that are vital to the economic development and how these can be achieved in an environment-friendly manner. This means that environmental policies should be derived from development priorities. This needs a conceptual framework that places sustainable human development before climate change by reversing the existing framework. For this one has to find out alternative and cleaner pathways to achieve sustainable development goals that can also contribute to

climate-change goals. To achieve this objective one has to reframe the global climate-change debate as deriving from and complementing development priorities which can be approached on multiple levels and from various perspectives, and should take into consideration the rapid economic growth to be achieved by the developing countries. There is also the need to build scientific and technical capacity, advancing scientific knowledge, and linking economic, social, technological and policy making. This 'reversal thinking' should map development, equity and vulnerability onto the GHG emission problem. The determinants of this include financial resources, technology, and importantly the availability of trained personnel to use them effectively. Access to information and institutional mechanism (legal, social, etc.) is also important.

Integrated development and environmental policies are needed so that the developing countries can stay on the paths that minimize the local and global environmental costs of relieving poverty, providing adequate food, and electricity to households and industry, and also providing employment and transportation facilities consistent with the needs of the developing-country people. It may not be easy to reframe global environmental policies as deriving from development priorities and solve the climate-change problem. However, this new framework suggests that global collaboration on climate change should be approached at multiple levels through local and national development projects, as well as through multilateral efforts to establish cooperation mechanisms within an equitable and efficient global climate-change regime.

According to this approach, a less-polarized way of meeting the challenges of sustainable development and climate change is necessary to build environmental and climate policy upon development priorities that are crucial to billions of people from the developing world. For example, international financiers are expected to prioritize projects that have a low financial cost per unit of GHG emission reduction, while national stakeholders are keen on national benefits of the activity in the form of employment generation, social development and local environmental improvements. Following that, it will be relevant to measure multiple financial, economic, social and environmental benefits of mitigation policies. Then negotiation can take place between national stakeholders and international financiers to develop a portfolio of policy options that balance sustainable development and climate-change policy priorities. Another issue is that of generalized methodologies. The parameters that are included in the models vary significantly by nation and region, and with time. Hence, it is important to develop localized models of environmental impacts, population exposure, preferences and valuation. This type of methodology is useful in understanding synergies and trade-offs between global and local environmental policies. Research is required on inter-linkages between sustainable development and climate-change policies.

However, a number of barriers – technical, financial and capacity – exist for implementing these initiatives[40]. Barrier removal is an essential part of technology transfer and efficiency improvement. In this regard, public sector participation in technology diffusion should be seen as a way of obtaining economic, environmental and social benefits of clean technologies, since the private sector cannot be expected to bear the full transaction cost for barrier removal. To achieve this, policy-makers need to design appropriate policy measures to promote cleaner technologies. There are also cause and consequence facing energy efficiency and renewable energy technology (RET) markets. On one hand, the capital markets will not finance RET projects in the absence of sufficient volume. On the other hand, the market for RET projects will not develop to be of sufficient volume in the absence of adequate financing. Such issues have to be addressed. An innovative financial, institutional and implementational mechanism is needed that can support such integrated objectives.

Conclusion

In the great climate-change debate, the developing countries are being sandwiched between the sceptics and the supporters. As climate realists, developing countries need to take a middle path and opt for market-based solutions.

Given the uncertainties about the costs of reducing GHGs, the best way to proceed may be the introduction of more flexibility into the form of international trading programmes for carbon credits. While there are important implementation issues regarding the design and monitoring of such programmes that must be addressed, a well-planned emission-trading system could succeed in getting governments to start moving towards climate protection, despite or because of worries about high climate-change mitigation costs. If such systems are implemented, they are likely to create strong demand for investment projects designed to reduce GHG emissions. Private capital would be mobilized, because GHG reduction projects would yield credits that can be sold in the market.

The adoption of flexible mechanisms may well be the key to increased spending on environmental technologies, including energy efficiency and renewable energy. Whether the flexible mechanisms are effective or not depends on the their design, implementation and the behaviour of participants within the regime. Nobody can predict how international action on climate change will evolve in the coming years and decades. After a boost through the adoption of the Kyoto Protocol in December 1997, international climate-change negotiations have, at least temporarily, lost their momentum in two key areas. First, ratification has been slow and contentious, and second, there has been a lack of consensus on the modalities for implementing the so-called flexible mechanisms –

joint implementation, the clean development mechanism and emission trading.

There is a need for using sustainable development as a framework for climate-change policies. The advantage of the sustainable development approach is that it looks at real needs and real human development. It aims at useful value for the consumer. It can fit into the 'livelihood' approach. However, the reverse may not be true. For this we have to analyse dispassionately where the good niches exist and where the obstacles lie, both technically and institutionally. We need to study sustainable development approaches around the world that have succeeded and failed, and draw lessons about the way to proceed further.

Development may well be a better strategy for reducing the impacts of climate change than focusing on GHG emission reduction. Developing countries, with lesser ability to prosper, afford and use new technologies, have higher rates of hunger, poor public health services, greater incidence of infectious and parasitic diseases, less access to education, safe water or sanitation and therefore, greater mortality rates and lower life expectancies. Hence the resources that are spent on CC for the sake of avoiding impacts are better spent on vulnerability reduction in developing countries. This approach would enhance the abilities of the societies to cope not only with climate change but adversity in general, regardless of its cause, or whether it is man-made or not. Such a multifaceted and holistic approach would help improve the lives of people living in poverty, without compromising on the ability to address future challenges, whether or not caused by climate change.

Climate negotiations will succeed only if developing countries are driven by development priorities, and if there are countries or groups of countries among them willing to take a leadership role to push the process forward. In the absence of leadership, there will be lack of coordination, which increases the transaction costs. Hence, the issue of climate change should be approached at multiple levels through local and national development projects, as well as through multilateral efforts to establish cooperation mechanisms within an equitable and efficient sustainable development regime.

Notes

1. The term 'climate change' is preferable to 'global warming'. The latter refers to the observed heating of the earth's atmosphere, whereas climate change refers to a broader set of alterations in climate patterns, which include warming as well as cooling trends and other meteorological changes. Although some of the changes could be explained as natural climate variability, there is an increasing scientific consensus that climate change in recent history has been increasingly caused by human activities, including the burning of fossil fuels, deforestation, and industrial activities such as cement production. These and other anthropogenic activities result in the emissions of GHGs, including carbon dioxide (CO_2), chlorofluorocarbons (CFCs), methane (CH_4), and nitrous oxide (N_2O), and water vapour. Among these gases, CO_2 accounts for more than 90% of GHG emissions. About three-quarters of annual CO_2 emissions result from burning fossil fuels, including coal, oil and natural gas [International Energy Agency, 1997. *Energy and Climate Change: An IEA Source-Book for Kyoto and Beyond*, Paris, OECD/IEA].
2. The IPCC is a scientific body that includes 2500 scientists, including eight Nobel laureates. It has just finalized its Fourth Assessment Report 'Climate Change 2007', also referred to as AR4.
3. The Convention entered into force on 21 March 1994, 90 days after the receipt of the 50th instrument of ratification [United Nations Environmental Programme & United Nation's Framework Convention on Climate Change, 2002. *Climate Change Information Kit*. [Internet]. United Nation's Environmental Programme & United Nation's Framework Convention on Climate Change, July 2002 (cited 16th December 2002). Available from http://unfccc.int/resource/iuckit/]. An international convention must be ratified by national parliaments in order to be valid under national law.
4. This is the first of five guiding principles laid down in Article 3 of the UNFCCC.
5. This principle is considered necessary for environmental and health damage prevention in a forward-looking society. The precautionary principle was first applied in Germany in the 1970s. Later on, it was incorporated into international agreements, including the Bergen Declaration on Sustainable Development and the UNFCCC. The precautionary principle is described as a tool with ethical power and scientific rigour'[16].
6. The full name is The Kyoto Protocol to the United Nations Framework Convention on Climate Change.
7. Emission reductions need not be achieved by a fixed year, but the average of the committed five-year period will determine whether the Kyoto targets are achieved.
8. Wilfred Beckerman has been one of the favourite targets of environmentalists ever since he published the book, *Two Cheers for the Affluent Society: A Spirited Defence of Economic Growth* (1974) in response to Donella Meadows' *The Limits to Growth* (1972) and other early environmental literature.
9. We must distinguish between immediate and delayed financial win-win opportunities. Immediate opportunities yield a direct profit on a project, whereas delayed ones will improve corporate profits/competitiveness over time. Michael Porter, a professor at Harvard Business School, popularized the notion of delayed win-win opportunities (although he uses a different terminology). Porter argued that a well-designed environmental regulation improves corporate competitiveness over time by prodding firms to invest in more efficient technologies that not only improve environmental performance but also lower costs and improve the bottom line[24].
10. The question for economists is not only to estimate the cost of future damages, but also how much the gains from, for example, saved species are worth. The benefits could be vaccines, or just the enjoyment of the existence of the species[26]. 'Put a proper value on an environmental "good", and the balance between costs and benefits will start to look greener.' (Heathfield and Russell[28], quoting an unpublished lecture by Pearce).

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