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Author(s):	CLAs	Jayant Sathaye (USA) and Adil Najam (Pakistan)		
	LAs:	Chris Cocklin (New Zealand), Thomas Heller (USA), Franck Lecoque (France), Juan Llanes (Cuba), Jiahau Pan (China), Gerhard Petschel-Held† (Germany), Steve Rayner (USA), John Robinson (Canada), Roberto Schaeffer (Brazil), Youba Sokona (Senegal), Rob Swart (Netherlands), Harald Winkler (South Africa)		
	CAs:	Sarah Burch (Canada), Rutu Dave (Netherlands), Andrew Wyatt		
	REs:	Hans Opschoor (Netherlands), Mohan Munasinghe (Sri Lanka)		
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Sustainable Development and Mitigation

EXECUTIVE SUMMARY

The concept of sustainable development involves a comprehensive and integrated approach to economic, social and environmental processes. Discourses of sustainable development, however, have historically focused primarily on the environmental and economic dimensions. The importance of social, political and cultural factors – for example, poverty, social equity, governance – is only now getting more recognition. Sustainable development is beginning to be quantified at the macro and sectoral level through improved monitoring and analytical techniques, and standards are being developed and implemented in order to be able to verify claims about sustainable practices.

Policies that pursue sustainable development and climate change can be mutually reinforcing. Framing the debate as a sustainable development problem rather than an environmental one may better address the immediate goals of all countries. Decisions about technology, investment, trade, poverty, biodiversity, community rights, social policies, or governance, which may seem unrelated to climate policy, may have profound impacts upon emissions, the extent of mitigation required, and the cost and benefits that result. The carbon emissions associated with non-climate actions vary widely ranging from fiscal policies which affect all global emissions to rural development actions that affect only a fraction of global emissions.. The wide variation in magnitude allows nations a way to prioritize mainstreaming of climate change mitigation into development activities (Figure 12.1).

One of the findings in the Third Assessment Report was that it will be extremely difficult and expensive to achieve stabilization targets below 650 ppm from baseline scenarios that embody high emission development paths. The notion of adaptive and mitigative capacity reinforces the idea that the capacity to develop and implement climate response strategies are essentially the same as those required to develop and implement policies across a wide variety of domains. A common finding of the studies for South Africa, Senegal, Bangladesh, Brazil, China and India is that it is possible to develop pathways which combine low GHG emissions with effective responses to pressing regional problems.

GHG emissions are influenced by, but not rigidly linked to economic growth, but policy choices can make a difference. To have a lasting impact, however, what matters is not only that a "good" choice is made at a certain point in time, but also that the initial policy has persisted for a long time – several decades.

There has been an evolution in our understanding of how sustainable development and climate change mitigation decisions are taken by societies. In particular, this includes a shift from government defined strictly by the nation-state to a more inclusive concept of governance. The more that climate change issues are routinized as part of the planning perspective at the appropriate level of implementation, the national and local government, the firm, the community, the more likely they are to achieve desired goals. However, merely piggybacking climate change onto an existing political agenda is unlikely to succeed.

How can the concept of alternative development pathways be used to bring about more sustainable development? Operational guidelines have been proposed for the integration of development and climate policies into future development pathways of developing countries. In industrialized countries, climate change continues to be regarded mainly as a separate, environmental problem that is to be addressed through specific climate change policies.

There is a growing understanding of the possibilities to choose mitigation options and their implementation in such a way that there will be no conflict with other dimensions of sustainable development; or, where trade-offs are inevitable, to allow rational choices to be made. The increasing use of sectoral indicators of sustainable development is paving the way for better quantification of the concept while serving as a goal for governments and businesses to strive for.

12.1 Introduction

The concept of sustainable development had its roots in the idea of a sustainable society (Brown, 1981), and in the management of renewable and non-renewable resources. The concept was introduced in the World Conservation Strategy (IUCN 1980) and adopted by the World Commission on Environment and Development, which launched sustainability into political, public and academic discourses and defined the concept as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987; Böjö et al., 1992). While this definition is commonly cited, there are divergent views in academic or policy circles on the concept and how to apply it in practice (Cocklin, 1995; Pezzoli, 1997; Banuri et al., 2001; Robinson, 2004).

The discussion of sustainable development in the IPCC process has evolved since the First Assessment Report which focused on the technology and cost-effectiveness of mitigation activities. This focus was broadened in the SAR to include issues related to equity, both procedural and consequential and across countries and generations, and to environmental (ancillary benefits) and social considerations (IPCC (Intergovernmental Panel on Climate Change) 1996). The Third Assessment Report further broadened the treatment of SD by addressing issues related to global sustainability (TAR). The report noted three broad classes of analyses or perspectives: efficiency and cost-effectiveness, equity and sustainable development, and global sustainability and societal learning (Chapter 1, TAR). The preparation of the TAR was supported by IPCC Expert Group Meetings that were specially targeted at sustainable development and social dimensions of climate change, which noted the various ways that the TAR's treatment of SD could be improved (Munasinghe and Swart 2000; Jochem, Sathaye et al. 2001).

In light of this evolution, every chapter of this AR4 WGIII report focuses on its links to sustainable development practices. Chapter 1 introduces the concept, Chapter 2 provides a framework for understanding its economic, environmental, and social dimensions, Chapter 3 addresses the issue of alternative development paths in a modeling context, the sectoral Chapters 4 through 10 and the cross-sectoral Chapter 11 examine the impacts of mitigation options in their respective chapters on sustainable development goals, and Chapter 13 describes the extent to which sustainable development is addressed in international policies. Further, AR4 WGII devotes two chapters (17 and 18) that are linked to the WG III mitigation discussion. Chapter 18 is on the interrelationships between adaptation and mitigation and Chapter 17 on sustainable development and adaptation.

The goal of this chapter is to (1) describe the evolution of the concept of sustainable development with emphasis on its two-way linkage to climate change mitigation (Section 12.1), (2) illustrate the role of alternative development paths, how these can be changed, and the role that state, market, and civil society could play in mainstreaming climate change mitigation into development choices (Section 12.2), and (3) summarize the impacts of climate mitigation on attributes of sustainable development (Section 12.3). Section 12.1 (this section) provides an introduction to the evolution of the concept of sustainable development, its goals and principles, and ways to measure its progress. Section 12.2 dwells on the link between non-climate drivers of sustainable development, as exhibited in the past and in scenarios of future development paths, and climate change mitigation. It also presents ways to mainstream climate change mitigation into sustainable development choices and actions. Since alternative development paths depend on the capacity for climate change mitigation and adaptation and vice versa, this section introduces the nature of this duality. As noted above, Chapters 3-11 and 13 cover the impacts of climate change mitigation on various attributes of sustainable development. Section 12.3 provides a summary of that discussion.

12.1.1 Sustainable Development ←→ Climate Change

There is a growing literature on the two-way nature of the relationship between climate change and sustainable development, which is introduced in Chapter 2 (Cohen et al., 1998; Munasinghe and Swart, 2000; Schneider et al., 2000; Banuri et al., 2001; Morita et al., 2001; Smit et al., 2001; Beg et al., 2002; Markandya and Halsneas, 2002; Metz et al., 2002; Najam et al., 2003; Swart et al., 2003; Wilbanks, 2003). The notion is that policies that pursue sustainable development and climate change mitigation can be mutually reinforcing. Much of this literature, as elaborated upon in Chapters 4 through 11, emphasizes the degree to which climate change mitigation can have effects, sometimes called ancillary benefits or co-benefits, which will contribute to the sustainable development goals of the jurisdiction in question. This amounts to viewing sustainable development through a climate change lens. It leads to a strong focus on integrating sustainable development goals and consequences into the climate mitigation policy framework, and on assessing the scope for such ancillary benefits. For instance, reductions in greenhouse gas emissions might reduce the incidence of death and illness due to air pollution and benefit ecosystem integrity – both of which are elements of sustainable development (Beg et al., 2002). The challenge then becomes ensuring that actions taken to address global environmental problems help to address regional and local development (Beg et al., 2002). Section 12.3 of this chapter summarizes the impacts of climate mitigation actions on economic, social and environmental aspects of sustainable development that are noted in Chapters 3 through 11, and 13.

The alternative approach is based on the finding in the Third Assessment Report that it will be extremely difficult and expensive to achieve stabilization targets below 650ppm from baseline scenarios that embody high emission development paths (also see Chapter 3). Conversely, low emission baseline scenarios may go a long way toward achieving low stabilization levels even before climate policy is included in the scenario(Morita et al., 2001). (See Chapter 3.1.2 for a discussion of the distinction between a baseline and stabilization or mitigation scenario.) This approach recognizes the contribution that sustainable development can make to climate change mitigation —equivalent to viewing climate change through a sustainable development lens—and emphasizes the need to study how best to achieve low emission development paths (Metz et al., 2002; Winkler et al., 2002b; Davidson et al., 2003; Heller and Shukla, 2003; Robinson et al., 2003; Shukla et al., 2003; Swart et al., 2003). Section 12.2 of this chapter focuses on this critical question of the link between sustainable development and ways to mainstream climate change mitigation into SD actions. Section 12.2 forms a central element of this chapter since this topic is not addressed elsewhere in the AR4 to the same depth.

It has further been argued that sustainable development might decrease the vulnerability of all countries, and particularly of developing countries, to climate change impacts, thereby contributing to both mitigation and adaptation efforts (see Chapter 17 and 18 of WGII). Framing the debate as a development problem rather than as a mainly environmental one may better address the immediate goals of all countries and particularly developing countries and their special vulnerability to climate change, while acknowledging that the driving forces for emissions are linked to the underlying development path (Yohe, 2001; Metz et al., 2002; Winkler et al., 2002a).

Development paths underpin the baseline and stabilization emissions scenarios, which are discussed in Chapter 3 of this report and used to estimate emissions, climate change and associated climate change impacts[1]. For a development path to be sustainable over a long period, wealth, re-

[1] The climate change and climate change impact scenarios assessed in the Fourth Assessment Report will be primarily based on the SRES family of emission scenarios, which define a spectrum of different development paths, each with

sources, and opportunity must be shared in such a manner that all citizens have access to minimum standards of security, human rights, and social benefits, such as food, health, education, shelter, and opportunity for self-development (Reed, 1996). This has also been emphasized by the World Summit on sustainable Development (WSSD) in Johannesburg in 2002 which introduced the WEHAB[2] framework.

Different underlying scenarios imply different levels and types of mitigative and adaptive capacities, and thus different likely or even possible levels of mitigation and adaptation. Winkler *et al.* (2006) have suggested that mitigative capacity be defined as "a country's ability to reduce anthropogenic greenhouse gases or enhance natural sinks." There exists a close connection between mitigative and adaptive capacities (here collectively called response capacity) and the underlying socio-economic and technological development paths that give rise to those capacities. In important respects, the determinants of response capacity are critical characteristics of such development paths.

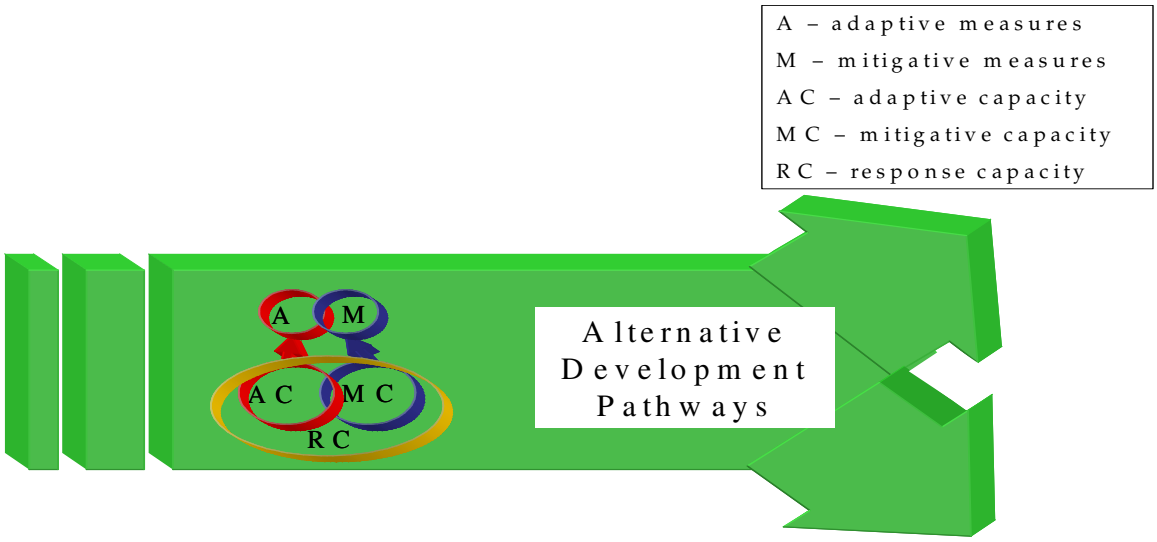

***Figure 12.1**: mitigation and adaptation measures as being rooted in mitigative and adaptive capacity.*

This situation is summed up in Figure 12.1, which shows mitigation and adaptation measures as being rooted in mitigative and adaptive capacity. The mitigative and adaptive capacities, in turn, arise out of the more general pool of resources called response capacity, which is strongly affected by the nature of the development path in which it exists. The figure also illustrates that mitigation, adaptation, and their respective capacities overlap substantially but are not identical. The two types of capacities and their links to alternative development paths are discussed in more detail in Section 12.2. At the sectoral level, Chapter 6.5.2 emphasizes the interaction and notes that mitigation and adaptation efforts need to be balanced when formulating building sector climate change strategies.

Prior to exploring these issues, we report on the evolution of the sustainable development concept in Section 12.1.2, and the growing use of indicators to measure SD progress at the macro and sectoral levels in Section 12.1.3. This review concludes that while the use of quantitative indicators is helping to better define SD, there are few macro SD indicators that explicitly take greenhouse gas emissions and climate change impacts into consideration.

associated socio-economic and technological conditions and driving forces. Each family of emission scenarios will therefore give rise to a different set of response capacities.

[2] Water, Energy, Health, Agriculture, Biodiversity

12.1.2 Evolution and articulation of the concept of sustainable development

Since the 1992 Earth Summit in Rio de Janeiro there is general agreement that sustainable development involves a comprehensive and integrated approach to economic, social and environmental processes (Munasinghe 1992; Banuri, Hyden *et al.* 1994; Najam, Rahman *et al.* 2003). The environment-poverty nexus is now well recognized and the linkage between sustainable development and achievement of the Millennium Development Goals (MDGs) has been clearly articulated (Jahan and Umana 2003). In order to achieve real progress in relation to the MDGs, different countries will settle for different solutions (Dalal-Clayton 2003), and these development trajectories will have important implications for the mitigation of climate change. As noted in Chapter 4.5.4.4 and Chapter 6.5.1, consideration of clean energy services, which are not explicitly mentioned in the MDGs, will be a vital factor in achieving these goals.

However, discourses of sustainable development have historically focused primarily on the environmental and economic dimensions (Barnett, 2001), while overlooking the need for social, political and/or cultural change (Barnett 2001; Lehtonen 2004; Robinson 2004). As Lehtonen (2004) explains, however, models of sustainable development conceive of social, environmental (and economic) issues as 'independent elements that can be treated, at least analytically, as separate from each-other' (p. 201). From a climate change perspective, this integration is essential in order to define sustainable development trajectories.

As noted in Chapter 2, the term 'sustainable development,' has given rise to considerable debate and concerns (Robinson, 2004). First, the variety of definitions of sustainable development (Pezzoli, 1997; Meadowcroft, 1997; Mebratu, 1998) has raised concerns about definitional ambiguity or vagueness. In response, it has been argued that this vagueness may constitute a form of constructive ambiguity that allows different interests to engage in the debate, and the concept to be further refined through implementation (Robinson, 2004); Banuri and Najam, 2002). The concept of sustainable development is not unique in this respect, since its conceptual vagueness bears similarities to other norm-based meta-objectives such as 'democracy,' 'freedom,' and 'justice' (Meadowcroft, 2000; Lafferty, 1996).

Second, the term 'sustainable development' can be used to support cosmetic environmentalism, sometimes called greenwashing, or simply hypocrisy (Najam, 1999; Athanasiou, 1996). One response to such practices has been the development of greatly improved monitoring, analytical techniques, and standards, in order to be able to verify claims about sustainable practices (Hardi and Zdan, 1997; OECD, 1998; Bell and Morse, 1999; Parris and Kates, 2003) (see Section 12.1.3).

Finally, the most serious concern about sustainable development is that it is inherently delusory. Some critics have argued that because biophysical limits constrain the amount of future development that is sustainable, the term "sustainable development" is itself an oxymoron (Dovers and Handmer, 1993; Mebratu, 1998; Sachs, 1999). This leads some to argue for a 'strong sustainability' approach in which natural capital must be preserved since it cannot be substituted for by any other form of capital (Pearce et al., 1989; Cabeza Gutes, 1996). Others point out that the concept of sustainable development is anthropocentric, thereby avoiding a reformulation of values that may be required to pursue true sustainability (Suzuki and McConnell, 1997). While very different in approach and focus, both these criticisms raise fundamental value questions that go to the heart of present debates about environmental and social issues.

Principles of sustainable development

Despite these criticisms, basic principles are emerging from the international sustainability discourse, which help to establish commonly held principles of sustainable development. These include, for instance, the welfare of future generations, the maintenance of essential biophysical life support systems, more universal participation in development processes and decision making, and the achievement of an acceptable standard of human well-being (Swart et al; 2003; Meadowcroft, 1997; WCED, 1987).

The principles of sustainable development have progressively been internalised in various national and international legal instruments (Boyle and Freestone 1999; Decleris 2000). Law contributes to the process of defining the concept of sustainable development through both international (treaty) law and through national law. At a national level, principles of sustainable development are being implemented in various regions and countries, including New Zealand and the EU. For example, New Zealand's Resource Management Act 1991 requires all decisions under the Act to consider and provide for sustainable management of natural and physical resources (Furuseth and Cocklin 1995, G.N.Z.(Government of New Zealand) 1999). Similarly, the 2000 EC Water Framework Directive is seeking to operationalize principles of sustainable use in the management of EU waters (Rieu-Clarke.2004).

International environmental treaties generally cite sustainable development as a fundamental principle by which they must be interpreted, but rarely provide any further specification of content. In response to the necessity to build a framework of equitable, strong, and effective laws needed to manage humanity's interaction with the Earth and build a fair and sustainable society (Zaelke et al. 2005), the International Network for Environmental Compliance and Enforcement (INECE) launched an initiative at the 2002 WSSD for making law work for environmental compliance and sustainable development.

12.1.3 Measurement of progress towards sustainable development

To measure progress requires the development and systematic use of robust set of indicators and measures. Agenda 21 explicitly recognizes in Chapter 40 that a pre-requisite for action is collection of data at various levels (local, provincial, national and international) indicating the status and trends of the planet's ecosystems, natural resources, pollution and socio-economy. As pointed out by Farsari and Prastacos (Farsari and Prastacos 2002), indicators have evolved as a useful tool for making development more sustainable, evaluating progress made and illustrating the complexity of this task and concepts and parameters involved.

Various alternative approaches to estimate macro progress towards sustainable development have been developed. Indeed, several well known monetary indicators assess welfare by including corrections to GNP. Others include Hueting's Sustainable National Income (SNI), and efforts by Pearce-Atkinson to develop a Measure of (weak) Sustainability (Hueting 1993, Yohe and Moss 2000). The necessity to quantify the demand for natural resources that a society generates in terms of space or the environmental load of society leads to the establishment of spatial indices. These indices are based on the concepts of environmental space (Buitenkamp, Venner *et al.* 1993), ecospace and ecological footprint (Opschoor 1995; Rees 1996). Vitousek *et al.* (Vitousek, Ehrlich *et al.* 1986) proposed the index of Human Appropriation of Net Primary Production (HANPP). This approach specifies the amount of energy that humans divert for their own use in competition with other species.

In trying to avoid shortcomings from the concept of carrying capacity applied to human societies the formula I = PAT, where I is the human impact on the environment, P the human population, A the affluence (presumably per capita income) and T the effect of technology on the environment has been commonly used in decomposing the impact of population, economic activity, and fuel use on historical and future carbon emissions (Schipper, Ting *et al.* 1997; Schumacher and Sathaye 2000; IEA 2004b). Other approaches include the development of a "global entropy model" that inspects the conditions for sustainability (Ruebbelke 1998) by employing available entropy data to demonstrate up to which extent improvements in entropy efficiency should be accomplished to compensate the effects of increasing economic activity and population growth.

Swanson *et al.* (Swanson, Pinter *et al.* 2004) have compiled country case studies with clear mechanisms and responsibilities for process monitoring of sustainable development related strategies. They emphasize that "the selection of outcome indicators reflects what is important and, therefore, ultimately must identify priority issues that should be monitored. As such, the development of indicators may best be integrated with a process for setting sustainable development objectives (e.g., in the leadership stage of strategic management). Once priority issues are identified, SMART indicators need to be developed, that is, indicators that are Specific, Measurable, Achievable, Relevant/Realistic and Time-bound.

As noted in Chapter 2, Boulanger (2004) observes that the various indicators can be classified according to four main approaches: (1) the socio-natural sectors (or systems) approach, which focuses on sustainability as an equilibrium between the three pillars of sustainable development but which overlooks development aspects, (2) the resources approach, which concentrates on sustainable use of natural resources and ignores development issues, (3) a human approach based on human well being, basic needs, and (4) the norms approach, which foresees sustainable development in normative terms. Each of the approaches has its own merit and weaknesses. Despite these efforts at measuring sustainability, few of them offer an integrated approach to measuring environmental, economic and social parameters (Corson 1996; Farsari and Prastacos 2002; Swanson, Pinter *et al.* 2004). This review of indicators illustrates a significant gap in these macro-indicators in that few include measures of progress with respect to climate change.

At the sectoral level, several initiatives are being implemented to measure and monitor progress towards sustainable development, including the reduction of greenhouse gas emissions. In the buildings sector for instance, the US Green Buildings Council, has established Leadership in Energy and Environmental Design (LEED) that sets a voluntary, consensus-based national standard for developing high-performance, sustainable buildings. About 2000 large buildings have received certificates. The Global Reporting Initiative (GRI) is a multi-stakeholder process whose mission is to develop and disseminate globally applicable Sustainability Reporting Guidelines. These Guidelines are for voluntary use by organizations for reporting on the economic, environmental, and social dimensions of their activities, products, and services. Over 700 large industrial corporations are annually reporting their SD progress using these guidelines. Industry sectors, such as cement and aluminium, have their own initiatives to track progress to-wards SD (See Section 12.3.1 for further discussion of sectoral indicators).

12.2 Implications of development choices for Climate Change Mitigation

One of the major findings of TAR in terms of sustainable development was that development choices matter (Banuri, et al., 2001). The literature on long-term climate scenarios (Nakicenovic, 2000; **Metz** *et al.*, 2002; **Swart** *et al.*, 2003), and especially the SRES Report (Morita et al., 2000),

points to the same conclusion. Climate outcomes are influenced not only by the climate specific policies that are put in place, but also by the mix of development choices that are made and the development trajectories that these policies lead us to. Of course, there are always going to be a variety of alternative development pathways that could possibly be followed. The choice of development policies can, therefore, be as consequential to future climate stabilization as the choice of climate-specific policies.

However, not only is the range and mix of development policy choices that can be made very large, but determining which mix of policies will lead to which development pathway is not straightforward. This is because development pathways are not simply the result of previous policies or decisions of governments, but are also influenced by the dispersed decisions and embedded practices at all levels of society from households to firms and to international regimes.

While this note of caution is important to underscore, it is also important to recognize that which development path, from amongst the many alternatives, a society eventually gets on can and will have significant and lasting impacts on ultimate climate outcomes. Hence, it is important to think seriously but cautiously about possible and plausible future states of the world, and which broadly defined alternative development pathways might lead to such future outcomes. This section seeks to do so, first by discussing the general lessons learnt from the now robust literature on alternative development pathways, and then by probing deeper into the issue by looking at key sectors and the set of non-climate-specific development decisions that are available within these sectors which might have significant impacts of climate outcomes.

12.2.1 Alternative Development Pathways

Development pathways can be useful ways to think about possible, even plausible, future states of the world. Over the last century, for example, human health has been improved significantly in most of the world under very different socio-economic pathways and very different health care systems. Advances have been uneven and improvements are under constant pressure from new developments (e.g., new infectious diseases), but in general the health example suggests that human choice can make a positive contribution towards reaching a common goal (Frenk et al., 1993, Smith, 1997). The same could be true for sustainable development in general, and reduced greenhouse gas emissions in particular. But it is important to note that changing development pathways is not about *choosing* a mapped out path, but rather about *navigating* through an uncharted and evolving landscape.

The very act of developing scenarios depicting alternative development pathways can falsely suggest that these are in some sense latent pathways or routes through the future that have been uncovered through insight or research. In reality, well-defined alternative pathways are not waiting to be selected. Even understanding the much smaller set of current development paths can be difficult. These are not simply the result of previous policies or decisions of governments, although these certainly affect the outcomes. As Shove et al (1998) argue with respect to energy usage, the present is the result of the unforeseen over-determination of complex systems by myriad small activities and practices adopted or developed in the course of everyday life.

In reviewing the literature on alternative development pathways, and in respecting the caveats described above, we find four key lessons that emerge from the literature:

Alternative development paths as well as climate policy determine GHG emissions
New global scenario analyses confirm the importance of alternative development pathways

Regions (and countries) have different conditions and priorities for alternative development pathways. Different sectors also have alternative development choices to make

This section is organized around a discussion of these four findings.

12.2.1.1 Alternative development paths as well as climate policies determine GHG emissions

For much of the last century, the dominant path to industrialization was characterized by high concurrent emissions of greenhouse gasses. The IPCC Third Assessment Report concluded that committing to alternative development paths can result in very different future greenhouse gas emissions. Development paths leading to lower emissions will require major policy changes in areas other than climate change. The development pathway pursued is an important determinant of the costs of mitigation and can be as important as the emissions target in determining overall costs (Hourcade, Shukla et al. 2001). These findings were based on an extensive analysis of both model-based emissions scenarios (Morita and Lee 1998), a survey of more qualitative studies (Robinson and Herbert 2001) and a comparison of stabilization scenarios (Morita, Nakicenovic et al. 2000), based on the IPCC SRES scenarios (Nakicenovic and Swart 2000).

While developing countries tend to follow the example of developed countries in terms of energy use, this need not be so, since the early stages of infrastructure development offer opportunities to satisfy the populations' needs in different ways. Many of the factors that determine a country or region's development pathway, and, closely related, its energy and greenhouse gas emissions, are subject to human intervention. Such factors include economic structure, technology, geographical distribution of activities, consumption patterns, urban design and transport infrastructure, demography, institutional arrangements and trade patterns. The later choices with respect to these factors are made, the fewer opportunities there will be, because of lock-in effects. An assessment of mitigation options should not be limited to technology, although this is certainly a key factor, but should also cover the broader policy agenda. Climate change mitigation can be pursued by specific policies, by coordinating such policies with other policies and integrating them into these other policies, but also by mainstreaming climate mitigation objectives into general development choices, i.e. taking climate mitigation objectives routinely into consideration in the pursuance of particular development pathways.

Development policies not explicitly targeting greenhouse gas emissions can influence GHG emissions in a major way (Box 12.1). For example, six developing countries (Brazil, China, India, Mexico, South Africa and Turkey) have avoided approximately 300 million tons a year of carbon emissions over the past three decades, with many of these efforts being motivated by common drivers such as economic development and poverty alleviation, energy security, and local environmental protectio n (Chandler, Schaeffer et al. 2002). Many other developing countries have pursued similar policies. Put another way, there are multiple drivers for actions that reduce emissions, and they can produce multiple benefits, with the most promising policy approaches being those that capitalize on natural synergies between climate protection and development priorities, to simultaneously advance both objectives. Many of these synergies are in the area of energy demand (e.g., efficiency and conservation), some in energy supply (e.g., renewable options).

Capturing these potential benefits is not always easy, since there are many conflicts and trade-offs. From the perspective of energy security, for example, it can be politically attractive to give priority to domestic coal and oil resources over more environmentally friendly imported gas. Some studies have shown that, depending on how priorities are set, some conflict between local atmospheric pollution problems and global climate change issues may arise. This is because some of the most cost-

effective, environmentally-friendly power generation technologies for the global environment available in developing countries, such as biomass-fired or even some hydroelectric power plants, may not be sound for the local environment (due to NO_x and particulate emissions in the former case, and flooding in the latter). Conversely, abating local air pollution generally is also beneficial from a global perspective. Still, there are a few exceptions. For example, some of the most environmentally-friendly power generation technologies for the local environment, such us natural gas fired-thermal plants and even natural gas fueled-fuel cells may be better than coal and oil from a global environmental perspective but still have carbon emissions. Decreasing sulphur and aerosol emissions (with the exception of black carbon) to address local air pollution problems can increase local radiative forcing. Thus, exploring alternative development paths requires careful assessment of both local environmental priorities and global environmental concerns (Schaeffer and Szklo 2001).

In developed countries too, development choices made today can lead to very different energy futures. In the TAR, Banuri *et al. (Banuri, Weyant et al. 2001)* distinguished between strategies decoupling growth from resource flows (e.g., resource light infrastructure, eco-intelligent production systems, "appropriate" technologies and full-cost pricing) and strategies decoupling well-being from production (intermediate performance levels, regionalization avoiding long-distance transport, low-resource lifestyles).

The connections between alternative development pathways and international trade are often left unexplored. International trade allows a country to partially "de-link" its domestic economic systems with its domestic ecological systems, as some goods can be produced by other economic systems. In such cases, the impacts of producing goods impact the ecological systems of the exporting country (where production takes place) rather than the ecological system of the importing country (where consumption occurs), One popular way of showing that the impacts of the economic activities in many nations affect an area much larger than within their national boundaries is the ecological footprin t (Wackernagel and Rees 1996; Venetoulis, Chazan et al. 2004). The environmental effects of soy and hard wood production for export as fodder and construction material, respectively, are well-known concrete examples. As a consequence, when it comes to discussing the implications of development choices for climate change mitigation, it is not enough to discuss alternative development pathways for individual countries. To fully address global emissions reductions, an integrated multi-country perspective is needed (Machado, Schaeffer et al. 2001).

Box 12.1 Greenhouse gas emissions avoided by non-climate drivers: a Brazilian example

In the field of energy, experience with policies advancing energy efficiency and renewable energy use confirm that although developing countries need to increase their energy consumption in order to fuel their social and economic development, it is possible to do so in a cleaner and more sustainable manner. These policy choices can have a significant impact on energy trends, social progress and environmental quality in developing countries (Geller, Schaeffer et al. 2004). In Brazil, programs and measures have been undertaken over the past two or three decades in order to mitigate economic and environmental problems, which have included not only improvements in the energy supply and demand side management but also specific tax incentive policies encouraging the production of cheap, small-engine automobiles (<1000 cc) to allow industry to increase their production (and create more jobs while increasing its profits) and to make cars more accessible to lower-income sectors of the population. These policies have led to lower carbon dioxide emissions than would otherwise have been the case. Results of these programs and measures show that, in the year 2000 alone, some 11% in CO_2 emissions from energy use in Brazil have been reduced compared to what would have been emitted that year, had

previous policy decisions not been implemented . Interestingly, though these actions were not motivated by a desire to curb global climate change, if the inherent benefits related to carbon emissions are not fully appraised in the near future, there is a chance that such "win-win" policies will not be pursued to the extent desirable in the future, and may even be discontinued. (Szklo, Schaeffer et al. 2005).

12.2.1.2 New global scenario analyses confirm the importance of alternative development paths for mitigation

After the publication of the IPCC TAR, several new baseline scenarios relating to climate change or global sustainability were published – and most of them in fact confirm the main findings of SRES (See also Chapter 3).

For the *Millennium Ecosystems Assessment* (MEA), four scenarios explored implications of alternative development pathways for global and regional ecosystem services, loosely based on the SRES but developed and enriched furthe r (Alcamo and Et al 2005; Carpenter and Pingali 2005; Cork, Peterson et al. 2005). For the next 50 years, all scenarios find that pressures on ecosystem services increase with the extent of the pressure being determined by the particular development path. The MEA scenarios identify climate change next to land use change as a major driver of biodiversity loss in the coming century. The quality of the services do differ strongly by scenario - with the most positive scenarios finding a clear improvement of some services and the most negative scenario (Order from Strength) finding a general decrease. The MEA scenario analysis thus emphasizes that the development of ecosystem services, biodiversity, human well-being and the capacity of the population to deal with these developments is largely determined by the choice of the development pathway.

The United Nations Environment Programme (UNEP, 2002) used the SRES scenarios as well as the scenarios of the World Water Vision (Gallopin and Rijsberman 2000) and the Global Scenario Group (Raskin, Gallopin et al. 1998) as inspiration for the development of four alternative development pathways for the third Global Environmental Outlook (UNEP/RIVM 2004). Shell's Low Trust Globalization, Open Doors and Flags scenarios explore how different future development pathways could affect the company's business environment (Shell 2005). Four scenarios developed by the US National Intelligence Council (Davos World, Pax Americana, A New Caliphate and Cycle of Fear) explore how the world may evolve until 2020 and what the implications for US policy might be, focusing on security concerns (NIC (National Intelligence Council) 2004). While environmental and climate change concerns play a marginal role in the NIC analysis, the scenarios show the possible impacts of alternative development pathways in some regions for other regions.

Important in all of these scenarios is the finding that future global climate is likely to be determined by the development paths as much as, if not more than, just climate-specific policies.

12.2.1.3 Different regions have different conditions and priorities for alternative development pathways

In a heterogeneous world, an understanding of different regional conditions and priorities is essential for mainstreaming climate change policies into sustainable development strategies. Since regions and countries differ in many dimensions, it is impossible to group them in a way consistent across all dimensions. There is a diversity of regional groupings in the literature using many criteria

that are specific to their purpose within the underlying context. In the development literature (e.g., UNDP 2005, World Bank 2004, and IPCC 2000), income levels are often used to differentiate country groups. Geography is another natural basis for national groupings. Stages of industrialization are another relevant criteria for reporting energy consumption and emissions of greenhouse gases (Ott, Winkler et al. 2004), (Pan 2004b).

Baumert and Pershing (Baumert, Pershing et al. 2004) single out top 25 emitters using aggregate amount of emissions by political entities. In the context of UNFCCC, international politics has been a rationale for country groupings (Yamin and Depledge 2004 and Metz, Davidson et al. 2005). Negotiating blocks in the UNFCCC process are highlighted in the mitigation literature, such as Annex I, non-Annex I, and Annex B countries, and those with economies in transition. In the IPCC SRES, two indicators are used to group countries: levels of economic development and geographic location. IPCC Working Group III TAR investigates regional variations from geo-political and socio-economic dimensions.

Nevertheless, all the country groupings can overlap one another. Some EIT and developing countries are members of the OECD, and some developing countries have income level higher than developed nations (Baumert, Pershing et al. 2004; Ott, Winkler et al. 2004). Given the complexities of the criteria used in country groupings, Table 12.1 follows Baumert and Pershing (Baumert, Pershing et al. 2004) and UNEP (UNEP (United Nations Environment Programme) 2004) and adopts a combination of income and political considerations. For convenience, in the following we use the commonly used groupings of developed countries, economies in transition (together forming the industrialized countries) and developing countries.

Table 12.1: Profiles of emissions and human development at different levels of development

	Units	Developed/industrialized / Annex I countries (c)		Developing/ Non-Annex I countries (d)	
		OCED	EIT	Developing	Least developed
Emissions profiles by gases, 2000(a)		100		100	100
CO2 FF	%	81		41	4
CH4	%	11		16	22
N2O	%	6		10	12
LUC	%	0		33	62
High GWP gases	%	2		0	0
Human development profiles (b)					
HDI, 2003		0.892	0.802	0.694	0.518
Life expectancy at birth	Years	77.7	68.1	65.0	52.2
Adult literacy	%	100.0	99.2	76.6	54.2
GDP/capita, 2003	$(ppp)/ capita	25915	7930	4359	1328
Population growth rate (2003-2015)	%/yr	0.5	-0.2	1.3	2.3
GDP/c growth rate (1990-2003)	%/yr	1.8	0.3	2.9	2.0
Electricity consumption per capita, 2002	kWh/ capita	8615	3328	1155	106
CO2 emissions per capita, 2002	tonnes/ capita	11.2	5.9	2.0	0.2
Vulnerability assessment (e)					
Vulnerability scores		10-15	14-22	18 - >40	

(a) Source: Baumert and Pershing (2004, p. 6). FF: fossil fuel combustion; High GWP (global warming potential) gases: sulfur hexafluoride (SF6), perfluorocarbons (PFCs), and hydrofluorocartbons (HFCs).

(b) Source: UNDP (2005). HDI range: 0.00<HDI<1.00; PPP: purchasing power parity. PPP normally deflates the income level of the developed nations while inflating those in the developing world as one dollar would have larger purchasing power that it has in the developed world.

(c) Annex I countries include both developed OECD and EIT countries. However, a few newly admitted OECD countries are not in Annex I list, including South Korea, Singapore, and Mexico. The group of economies in transition (EIT) countries contains several sub-groups: those that are part of the enlarged EU, central Asian Republics, and other members of the CIS. In UN DP (UNDP, 2005) categorization, the coverage is larger, including Central and Eastern Europe and the Commonwealth of Independent Sates (CIS).

(d) In emissions profiles, these two subgroups were counted separately while in the UNDP human development profiles, least developed is a subgroup of the developing world.

(e) Source: Adger et al. (Adger et al., 2004b). Vulnerability scores range from 10 to 50, with 10 the least vulnerable and 50 the most vulnerable. These scores are derived from a series of proxy variables for vulnerability including food security, ecosystem sensitivity, settlement/infrastructure sensitivity, human health sensitivity, economic capacity, human resource capacity, governance capacity and environmental capacity (see, (Baumert et al., 2004), p. 17).

The mitigative capacity of these countries varies with their ability to pay for abatement costs. Winkler, Baumert, et al. (in press 2006) analyse the mitigative capacity of different countries as shaped by two economic factors, namely average abatement cost and ability to pay, as approximated by GDP per capita. Ability to pay, measured by GDP per capita, is an important factor in mitigative capacity, since more wealth gives countries greater capacity to reduce emissions. The cost of abatement can act as a barrier in turning mitigative capacity into actual mitigation. Examining these factors together, Winkler et al (2006) found that the abatement costs are not linearly correlated to the level of income. Some countries have high mitigative capacity (income) and are also able to translate this into actual mitigation due to low costs. For others, mitigative capacity is clearly low. Relatively high average abatement costs mean that this capacity can be turned into even less actual mitigation. Interestingly, there are some poorer countries with low abatement costs. Conversely, there are also countries with high mitigative capacity, as approximated by income, but high average abatement costs. However, this group of countries still has higher mitigative capacity, simply by virtue of their higher ability to pay. On the other hand, low-income countries do not spend on mitigation even if they have low-cost mitigation opportunities, simply because the opportunity cost in terms of basic development needs is too high.

Developed economies:

Developed economies are included in Annex I to the UNFCCC and are members of the OECD. CO_2 emissions from fossil fuel combustion account for over 80% of their total emissions with negligible amounts from land use change (Table 12.1). These countries also account for GHGs with high radiative forcing. Their population growth is projected to be low or negative (United Nations 2004), income and level of human development are in the upper middle and high end of the spectrum (UNDP 2004), and energy consumption and GHG emissions per capita are above the world average (IEA (International Energy Agency) 2005). These developed countries are assessed to be least vulnerable when compared to other groups of countries (Adger, Brooks et al. 2004), with vulnerability scores lower than 15, close to the lower end of the spectrum (Table 12.1). In general, mitigative capacity in these economies is high but mitigation potentials vary. For instance, passenger vehicle fuel economy is the lowest in the United States, even lower than the recent standards adopted by China (An and Sauer 2004). Barring a few newly industrialized countries, most are highly industrialized with limited scope or need for large scale expansion of the physical infrastructure such as public utilities, physical transport infrastructure, and buildings (Pan 2003).

Notwithstanding this limited scope or need for infrastructure expansion and economic growth figures often much lower than in many developing countries, the future will look different from today and alternative pathways are possible, which have different implications for mitigative capacity. Improving energy efficiency, modernizing production and changing consumption patterns would have a large impact on future GHG emissions (Kotov 2002). Developed nations possess comparative advantages in technological and financial capabilities in mitigation of climate change. As the impacts of climate change in these countries seem to be manageable, priority mitigation areas for countries in this group may lie in improving energy efficiency, building new and renewable energy and carbon capture and storage facilities, and to foster a mutually remunerative low-emissions global development path through technological and financial transfer of resources to the developing world.

In industrialized countries, climate change continues to be regarded mainly as a separate, environmental problem that is to be addressed through specific climate change policies. One example is the Sustainable Development Strategy proposed by the European Commission (European Commission 2001). The strategy addresses climate change, but only through dedicated climate change policies, rather than more holistic changes. While the Strategy suggests policies should be coordinated, it

does not propose mainstreaming climate change impacts into economic, financial and other policies. This appears to be typical for the approach many developed countries take.

In many industrial countries (Japan, Europe), implications of energy systems with very low carbon emissions have been explored, often jointly by governments, energy specialists and stakeholders (e.g., Kok, Vermeulen et al 2002). However, a fundamental and broad discussion in society on the implications of alternative development pathways for climate change in general and climate change mitigation in particular in the industrialized countries has not seriously been initiated. Alternative pathways do not only apply to energy choices. For example, in North-America and Europe, UNEP (UNEP, 2002) identifies land-use development, particularly infrastructure expansion, as a key variable determining future environmental stresses, including GHG emissions. Pathways which capitalize on advances in information technologies to provide a diverse range of lifestyle and spatial planning choices, will also affect energy use and GHG emissions. Scenarios could be used further by developed countries to explore alternative development pathways, and to understand the possible impact of development choices on climate change.

12.2.1.4 Economies in transition

With the enlargement of the EU, economies in transition as a single group no longer exist. Nevertheless, central and eastern Europe and Commonwealth of Independent States do share some common features in socioeconomic development (UNDP 2005) and in climate change mitigation and sustainable development (IPCC TAR; Adger, Brooks et al. 2004). With respect to social and economic development, countries in this group fall in between the developed and developing countries (Table 12.1). In terms of level of human development and vulnerability for instance, these countries fall behind the developed nations but are well ahead of the developing countries. In certain key areas, however, they are closer to the developed nations in terms of population growth, levels of industrialization, consumption of energy, and emissions of greenhouse gases. In other areas, they show features similar to the developing world. GDP per ca pita level in some of these EIT countries is as low as that in the lower middle income developing countries (World Bank 2003a) and energy intensity is in general high (IEA (International Energy Agency) 2003c).

Although the 0.3 percent per annum rate of economic growth in the past 15 years has been low, it is expected that in many countries future rates could be high, which would contribute to an upward trend in GHG emissions. Measures to decouple economic and emissions growth might be especially important for this group (Kotov 2002). This would suggest a large potential for emissions reductions through institutional reform and increase in energy efficiency.

Developing economies:
Recently, interest at the regional level in exploring development pathways which are consistent with lower greenhouse gas emissions has increased (e.g. , Kok and the Coninck 2004). This appears to be valid primarily for developing countries. Case studies for South Africa (Davidson, Halsnaes et al. 2003), Senegal (Sokona, Thomas et al. 2003), Bangladesh (Rahman, Alam et al. 2003), Brazil (La Rovere and Americano 2003), China (Jiang, Dadajie et al. 2003) and India (Shukla, Nair et al. 2003) focus on the future in the priority areas of energy supply, food security and fresh water availability. A common finding of these studies is that it is possible to develop pathways which combine low GHG emissions with effective responses to pressing regional problems. In the energy sector, energy security and reduced health risks can be effectively combined with low greenhouse gas emissions, even without explicit climate policies. Enhanced soil management, avoiding deforestation and encouraging (re-)afforestation can increase carbon storage, while also serving the primary goals of food security and ecosystem protection.

Although the developing economies are highly diverse, their general features stand in contrast to those of the industrialized world. Levels of human development, and consumption of energy per capita, are much lower than in the developed countries and in the economies in transition (Table 12.1). GHG emissions from land use change and agriculture are a significant proportion of their total emissions (Ravindranath and Sathaye 2002; Baumert, Pershing et al. 2004).

Given the fact that energy consumption and emission per capita are low in the developing world, focus on climate mitigation alone may not be compatible with meeting sustainable development goals. With respect to levels of human development, UNDP (UNDP 2005) projects that by 2015 almost all developing regions would not be able to meet their Millennium Development Goals. With respect to access to clean water, for example, by 2015 some 210 million people on earth will not have access, with half of them in South Asia, 40% in Sub-Saharan Africa, 7% in East Asia and the Pacific. Non-climate policies for sustainable development goals, on the other hand, can be more effective in addressing climate change, such as population control, poverty eradication, pollution reductions, and energy security, as demonstrated in Chin a (GOC (Government of China) 2004 and Winkler, Spalding-Fecher et al. 2002b).

In aggregate terms, some large developing countries are included in the list of top 25 emitters (Baumert, Pershing et al. 2004). These handful of developing countries are projected to increase their emissions at a faster rate than the industrialized world and the rest of developing nations as they are in the stage of rapid industrialization (Pan 2004a). For these countries, climate change mitigation and sustainable development policies can reinforce one another, however, financial and technological assistance can be of help for these countries to pursue a low carbon path of development (Ott, Winkler et al. 2004).

For most other developing countries, adaptation to climate change takes priority to mitigation as they are more vulnerable to climate change and less carbon dependent (Hasselmann, Latif et al. 2003). However, both adaptive and mitigative capacities tend to be low (Huq, Reid, et al. 2003). OPEC countries are unique in a sense that they may be hurt by development paths that reduce the demand for fossil fuels. Diversification of their economy is high on their agenda. Although climate change mitigation can be one consideration in evaluating poverty alleviation options, it is important to note that poverty has to be alleviated regardless of greenhouse gas emissions. Improved access to energy can lead to increasing greenhouse gases, for example where kerosene and propane use is more appropriate than biomass renewables.

For most Small Island States, the key issue to SD is the adoption of a comprehensive adaptation and vulnerability assessment and implementing framework with several priorities: sea level rise (high percent of the population located in coastal areas), coastal zone management (including specially coral reefs and mangroves), water supply (including fresh water catchments), management of upland forest ecosystem, and food and energy security. For some islands, extreme events like tropical hurricanes, and El Niño and La Niña events are an important threat.

In several developing countries, different future development pathways have been explored in systematic scenario exercises, e.g. for China (Ogilvy and Schwartz 2000), the Mont Fleur scenarios for South Africa (Kahane 2002), the Guatemala Vision (Kahane 2002), Destino Colombia (Cowan, Eidinow et al. 2000), Kenya at the crossroads (SID/IEA (Society for International Development and the Institute of Economic Affairs) 2000).

12.2.1.5 Sectors also have alternative development choices

The most important development choices relevant to climate change need to be made in the energy sector and to a lesser extent in the forestry sector, so we use these as examples of how alternative development choices are also available at the sectoral level. Energy plays a critical role in improving quality of life, especially for developing countries, but traditional energy choices have high associated GHG emissions. Though per-capita energy use is growing, developing countries are unlikely to catch up with the industrialized world within this century (UNDP (United Nations Development Programme) 2000). Energy services are crucial for economic development and to provide adequate food, shelter, clothing, water sanitation, medical care, schooling and access to information.

Increased access to energy services can have a range of consequences for climate change, depending on the pathway pursued. Developing countries need to increase their energy use in order to fuel their social and economic development, but by pursuing energy efficiency and renewable energy, a cleaner and more sustainable energy future is made possible. In South Africa, for example, policies intended to address fuel diversification through import of natural gas from Mozambique and to improve efficiency in the coal sector have simultaneously reduced air pollutant and GHG emissions (Davidson, Halsnaes et al. 2003). Similarly, in Senegal, programs to reduce deforestation are coupled with reductions of local air pollution and lower GHG emissions (Sokona, Thomas et al. 2003). Such policy choices can have a significant impact on energy trends, social progress and environmental quality in developing countries (Geller, Schaeffer et al. 2004).

Access to cleaner forms of energy has several direct and indirect effects on well-being, including reduced birth rates, increased life expectancy and improved health,[3] increased ability to learn and study, and reduced pressure on local fuel resources. Access to energy is frequently identified as among the highest development priorities of the poor. The net effects of increased access to energy on greenhouse gas emissions depends on the balance of all direct and indirect effects. In India, pathways with improved regional co-operation lead to more rapid development and penetration of environmentally sound technologies, which are likely to lead to reduced health risks through reduction of air pollutants, while at the same time lowering GHG emission s (Shukla, Nair et al. 2003).

Policies which promote a more sustainable energy supply can promote economic and social development while also helping to mitigate climate change. Policies which strive to "de-couple" energy use from economic growth (e.g. moving towards a more service-based economy with a major role for information and communication technology) decrease the vulnerability of the energy system to external influences (such as increasing oil prices) and also have a major impact on GHG emissions. For Brazil, more sustainable agricultural practices (e.g., zero-tillage), agroforestry and reforestation in the Amazon and elsewhere, the ethanol programme and improved access to electricity through decentralized renewable energy supply are all policies compatible with low carbon emissions (La Rovere and Romeiro 2003). Similarly, in Bangladesh, pathways are being explored with an emphasis on increasing energy and food security with low associated GHG emissions (Rahman, Alam et al. 2003).

[3] Access to sound energy in developing countries can imply lower reliance on polluting biomass stoves, improved access to safe drinking water and as a consequence lower child mortality, enhanced employment for women and reduced child labour in households (UNDP, 2000).

But also in the industrialized world the energy sector is confronted with a diverse set of challenges, including environmental ones, like climate change and health problems caused by particulate matter and other environmental problems, but also the increasing concentration of remaining oil and gas resources in a limited number of sometimes politically unstable regions. Also in these regions alternative development choices affect environmental and economic implications of energy demand and supply. Decreasing dependency on expensive energy imports can go hand in hand with addressing environmental effects of energy consumptions in industrialized countries.

12.2.2 Changing Development Paths

The business-as-usual futures in countries with similar economic characteristics can result in very different emission profiles, depending on the development path that is adopted. The aim of this section is to explore how development paths can be changed. The section asks three main questions. First, under what circumstances do choices between high and low emissions trajectories emerge? Second, how are those decisions made? And third, why are "win-win" decisions not always adopted?

Since economic growth figures prominently among the objectives of policy-makers worldwide, this section first reviews what is known about the relationship between economic growth and emissions at the national level. A major conclusion is that there are degrees of freedom between economic growth and GHG emissions, and therefore we will explore these degrees of freedom further, by examining how individual policies aimed at achieving economic growth and other development goals have resulted in lower or higher emissions.

12.2.2.1 The relationship between economic growth and GHG emissions

Economic activity is a key driver of CO_2 emissions. How economic growth translates into new emissions, however, is ambiguous. On the one hand, as the economy expands, demand for and supply of energy and of energy-intensive goods also increases, thereby pushing CO_2 emissions upward. On the other hand, economic growth may drive technological change, increase efficiency and foster the development of institutions and preferences more conducive to environmental protection and emissions mitigation (see Chapter 3). Both factors contribute to reducing the impact of economic growth on national emissions, but only the former factor results in a reduction of emissions. Specialization of economies in services only displaces the problem as manufacturing and heavy industries emissions are relocated in other countries.

The balance between the scale effect of growth and the mitigating factors outlined above has generated intense scrutiny since the early 1990s. Much of the literature focuses on the "environmental Kuznets curve" (EKC) hypothesis, which posits that at early stages of development, pollution per capita and GDP per capita move in the same direction, but that beyond a certain income level, emissions per capita will decrease as GDP per capita increases, thus generating an inverted-U shaped relationship between GDP per capita and pollution. The EKC hypothesis was initially formulated for local pollutants in the seminal analysis of Grossman and Kruege r (Grossman and Krueger 1991), but it was quickly expanded to carbon dioxide emissions—although it is recognized that some of the theoretical foundations of the EKC hypothesis for local pollutants, namely that higher income individuals would be more sensitive to environmental concerns, are less relevant for GHGs that do not have local environmental or health impacts. The EKC hypothesis has generated considerable research, and the field is still very active. Recent summaries can be found in Stern (Stern 2004), Copeland and Taylor (Copeland and Taylor 2004) or Dasgupta et al. (Dasgupta, Hamilton et al. 2004). With regard to carbon dioxide, the following conclusions can be drawn;

First, using GDP and emissions data over multiple countries and time-periods, studies consistently find that GDP per capita and emissions per capita move in the same direction among most or all of the sample (e.g., (Schmalensee, Stocker et al. 1998; Heil and Selden 2001; Wagner and Müller-Fürstenberg 2004; Ravallion, Heil. et al. 2000). A one percent increase in GDP per capita is found to lead to an increase in CO2 emissions per capita of 0.5% to 1.5% depending on the study. All studies also find evidence that this coefficient – the so-called elasticity of per capita CO2 emissions relative to per capita GDP – is not constant but varies as per capita income rises.

Second, earlier studies consistently found that, beyond a certain level of GDP per capita (usually, but not always, higher than the highest per capita GDP in the sample considered), per capita CO2 emissions would start decreasing as income increase – thus confirming the EKC hypothesis for carbon dioxide. However, the reliability of these estimates has been challenged recently on technical grounds (e.g., Harbaugh, Levinson et al. 2002; Millimet, List et al. 2003) for general discussions, and Wagner and Müller-Fürstenberg (2004) for a critical review focusing on carbon dioxide). Two main points emerge from more recent reviews. First, they cast doubt on the idea that the EKC hypothesis could be validated based on existing data. Second, they conclude that the relationship between GDP and emissions data is less robust than previously thought.

Third, studies using time-series at the country level find less robust relationships between GDP per capita and CO2 emissions per capita. For example, (Moomaw and Unruh 1997) show that international oil price shocks, and not per capita GDP growth, explains most of the variations in per capita emissions in OECD countries. Similarly, Coondoo and Dinda (Coondoo and Dinda 2002) find a strong correlation between emissions and income in developed countries and in Latin America, but a weaker correlation in Africa and Asia. Recent work on the EKC (e.g., Dasgupta, Hamilton et al. 2004) also show that the relationship between GDP per capita and pollution is not as rigid as it seems, and in fact mostly disappears when other explanatory variables, notably governance, are introduced.

Fourth, country-level relationships between levels of GDP per capita and levels of emissions appear to be very sensitive to the inclusion of trade. Including trade intensity among the explanatory variables of CO_2 emissions usually yield EKC curves peaking farther in the future (e.g., Frankel and Rose, 2002), although there are methodological issues associated with this approach (e.g., Heil and Selden, 2001). Using trade-corrected emissions data for U.S. States, Aldy (2005) also shows that taking trade into accounts leads to curves that peak much later.

To sum up, the econometric literature on the relationship between GDP per capita and CO_2 emissions per capita does not support an optimistic interpretation of the EKC hypothesis that "the problem will take care of itself" with economic growth. On the other hand, the monotonically increasing relation between economic activity and CO_2 emissions that emerges from the data does not appear to be econometrically very robust, especially at country level and at higher GDP per capita level. In other words, the pessimistic interpretation of the literature findings that growth and CO_2 emissions would be irrevocably linked is not supported by the data either. There is apparently some degree of flexibility between economic growth and CO_2 emissions. However, the econometric studies mentioned do not distinguish between structural emissions and those that result from policy decisions. Thus, they provide limited information about how future policy choices may or may not influence CO_2 emissions paths. Recent examples, such as the stabilization of China's CO_2 emissions from fossil-fuel combustion from 1997 to 2001, in the midst of very high economic growth (+30% over that period of time, (IEA (International Energy Agency) 2004a), illustrates how important these

elements of flexibility can be (Wu and Kaneko 2005). To explore these choices, a more disaggregated approach is necessary. This is the objective of the next subsection.

12.2.2.2 How socio-economic policies impact GHG emissions

In seeking to review how individual policies that are not intended for climate mitigation have impacted GHG emissions, we will be drawing only from examples of policies that have already been adopted and implemented. However, a difficulty in doing so is that there are few case studies that directly analyze the link between a given policy and GHG emissions, and these are mostly in the energy sector.

In fact, assessing the impact of specific policies on GHG emissions, even *ex post*, is difficult for at least four reasons. First, policy packages usually encompass a wide range of measures, making it difficult to disentangle their individual effects. Second, absent command-and-control policies, or cases in which the emission-producing sectors are directly controlled by governments, public policies are only one of many incentives that decision-makers react to. Third, indirect effects of policies on emissions - such as increased demand induced by energy efficiency programs - are even more difficult to evaluate. And last, there is rarely a control group on the basis of which carbon savings can be evaluated.

To make up for the scarce literature on the relationships between policies and emissions, studies of the relationships between policies and proxies and/or key determinants of GHG emissions are also included in the review: for example, studies linking land-use policies with deforestation rate. This allows for drawing examples from a wider range of sectors, namely energy, transportation and construction, rural development, as well as from macroeconomic and trade policies. The depth of the literature, however, remains very variable across sectors. Finally, it is important to recall that the examples below are intended to discuss the relationships between given policies and CO_2 emissions, and not to discuss the pros and cons of each policy.

Energy:

Four broad categories of energy policies are discussed here: provision of energy services to the poor, liberalization, energy efficiency, and energy security.

Access to Energy: Access to energy is critical for the provision of such basic services as lighting, cooking, refrigeration, telecommunication, education, transportation or mechanical power (Najam and Cleveland, 2003). Yet an estimated 2.4 billion people rely only on wood, charcoal or dung for cooking, and 1.6 billion are without access to electricity (International Energy Agency, 2002b, 2004b). Providing access to commercial fuel and efficient stoves would have highly positive impacts on human development by reducing child mortality, improving maternal health, and freeing up time used to collect fuelwood, especially for females (Najam and Cleveland, 2003; Modi et al., 2006). Providing reliable access to electricity would also have highly positive impacts on human development, by providing preconditions for the development of new economic and social activities, e.g., allowing for education activities at nig ht (World Bank 1994; Toman and Jemelkova 2003) (Karekezi and Majoro 2002; Spalding-Fecher, Clark et al. 2002).

The implications of improved access to commercial fuels for cooking on GHG emissions are ambiguous. On the one hand, emissions from fossil-fuels increase. On the other hand, unsustainable use of fuelwood and related deforestation decreases. For example, the "butanization" program adopted in Senegal in 1974 to support LPG use through a combination of subsidies to LPG, support for the development for stoves suitable for local conditions and removal of tax on imported equipment, is estimated to have resulted in a 33-fold increase in LPG use, and in a 15% drop of charcoal consumption (Davidson and Sokona, 2002). The implications of electrification programs for GHG emissions are ambiguous. Energy demand is likely to increase as a result of easier access and induced economic benefits. On the other hand, emissions per unit of energy consumed might decrease depending on the relative carbon content of the fuel that is used in the baseline (typically kerosene) and of the electricity that is newly provid ed (de Gouvello and Maigne 2000). Public policies have a strong influence on this technology choice. In some cases, the technology is set directly by public decision makers. But even in case where it is left to private entities, public policies, such as the choice between centralized or decentralized models of electrification, or the nature of the fiscal system strongly constrain the technology choices.

One example of such indirect impact is documented by Colombier and Hourcade (1989). They find that the "equal price of electricity for all" principle embedded in French law has generated vast implicit subsidies from urban to rural areas and discouraged, over time, the development of cost-effective decentralized electrification alternatives to grid expansion. The expanded grid the country is locked into, however, is the source of very high maintenance and upgrading to accommodate increased demand from rural households and firm – much higher than would have occurred had decentralized solutions been implemented at the onset. The implications for GHG emissions (not studied in the paper) are probably limited given the share of nuclear power in France. But similar dynamics could have more important GHG emissions implications in country with fossil-fuel dominated power grids.

Liberalization: Many countries have embarked in the liberalization of their energy sector over the past two decades. These programs, with the objective to reduce costs and improve efficiency of energy services, have often several components, including inter alia privatization of the energy producers, separation between production and transmission activities, liberalization of energy markets, and lifting restrictions on capital flows in the sector. Some studies examine the effects of liberalization programs as a whole, while others focus on one component only, usually energy subsidy removals. Removing subsidies for energy prices has well-documented economic benefits. It frees up financial resources for other uses and discourages overuse of natural resources (UNEP (United Nations Environment Programme) 2004). On the other hand, reducing energy subsidies might have important distributional effects, notably on the poor, if not accompanied by appropriate compensation mechanisms. The impact of policies to reduce energy subsidies on CO2 emissions is expected to be positive, as higher prices trigger lower demand for energy and induce energy conservation. For example, econometric analysis have shown that price liberalization in Eastern Europe during the 1992-1999 period was an important driver of the decrease in energy intensity in the industrial sector (Cornillie and Fankhauser 2002). Similarly, removal of energy subsidies has been identified as instrumental in reducing GHG emissions compared with the baseline in China and India over the past 20 years (Chandler, Schaeffer et al. 2002). On the other hand, without appropriate safety nets, subsidies removal can actually result in increased emissions if poor consumers are forced off-grid and back to highly carbon intensive fuels, such as non sustainable charcoal or diesel generators. For example, removal of the subsidies for LPG in Senegal under the "butanization" program discussed above are expected to increase charcoal and unsustainable fuelwood use (Deme 2003).

Energy Efficiency: Policies that increase energy efficiency – both on the demand and on the supply side – are pursued to reduce demand for energy without affecting, or while increasing, output at very low costs -- although some of the direct efficiency gains might be offset by increased demand due to lower energy costs per unit of output. The impact on CO_2 emissions, in turn, tends to be positive, but depend heavily on the carbon content of the energy supply. For example, Brazil National Electricity Conservation Program (PROCEL), created in 1985, has saved an estimated 12.9 TWh and an estimated 2.6bR$ from 1986 to 1997, i.e., 25 times as much as the amount invested in the program, while reducing emissions by an estimated 3.6MtCO2e over the same period of time (La Rovere and Americano 1999; Szklo, Schaeffer et al. 2005). Similarly, Gillingham et al. (Gillingham, Newell et al. 2006) estimate that the annual energy savings generated by all current Demand-Side Management programs in the U.S. represent about 6% of the country's non-transportation energy consumption, and lead to reductions in CO_2 emissions equivalent to (at most) 3.5% of the country's total. Over the period 1973-1998, the IEA (2004b) estimates that the decline in energy intensities—driven both by policies and by autonomous technical improvements—have resulted in energy savings corresponding to almost 50% of 1998 IEA-11 energy consumption levels. In other words, absent these savings, energy use (and CO_2 emissions) in 1998 would have been almost 50% higher than observed.

Energy Security: Energy security—broadly defined as ensuring long-term security of energy supply at reasonable prices to support the domestic economy—is a major concern for Governments worldwide, and it has taken new prominence in recent years with inter alia the political instability in the Middle East, increased oil prices, or the tensions over gas in Europe (Dorian et al., 2006, Turton and Barreto, 2006). Energy security concerns, however, translate into very different policies depending on national and historical circumstances (Helm, 2002). Their impact on carbon emissions is ambiguous, depending on the nature of the policies and, in particular, on the fuel sources that are being favored. For example, in response to the first oil shock, Brazil launched in 1975 the National Alcohol Fuel Program (PRO-ALCOOL) to increase the production of sugarcane ethanol as a substitute for oil, at a time when Brazil was importing about 80% of its oil supply.[4] The program resulted in large emission reductions, estimated at 1.5 Mt CO2/yr (Szklo, Schaeffer et al. 2005). Brazil, on the other hand, also provides an example where emissions actually increased as a result of energy security considerations. During the 90s, Brazil faced lack of public and private investment in the expansion of the power system (both generation and transmission) and a growing supply-demand imbalance, which culminated in electricity shortage and rationing in 2001. This situation forced the country to install and run emergency fossil-fuel plants, which led to a substantial increase in GHG emissions from the power sector in 2001 (Geller, Schaeffer et al. 2004). Hourcade and Kostopoulo (1994) show how reactions to the first oil shock by France, Italy, Germany and Japan led to very differentiated emissions with relatively similar economic outcomes (see Box 12.2).

[4] PRO-ALCOOL was also as a way of assisting the domestic sugar industry at times of low international sugar prices.

Box 12.2: Differentiated reactions to the first oil shock in France, Italy, Germany and Japan

An example of how very different development paths can unfold in relatively similar countries is given by Hourcade and Kostopoulou (Hourcade and Kostopoulou 1994) who analyze how France, Italy, Germany and Japan—countries with similar levels of GDP per capita in 1973—responded to the first oil shock. They show that France moved aggressively to develop domestic supply of nuclear energy, that Japan made an aggressive shift of its industry towards less energy-intensive activities and simultaneously used its exchange-rate policies to alleviate the burden of oil purchases, and that Germany built up industrial exports to compensate the trade balance deficit in the energy sector. Much of the variations of CO2 emissions per unit of GDP from 1971 to 1990 can be attributed to these choices (Figure 1). Yet while this indicator diminished by half in France, by a third in Japan, and "only" by a quarter in Germany (IEA (International Energy Agency) 2004a).

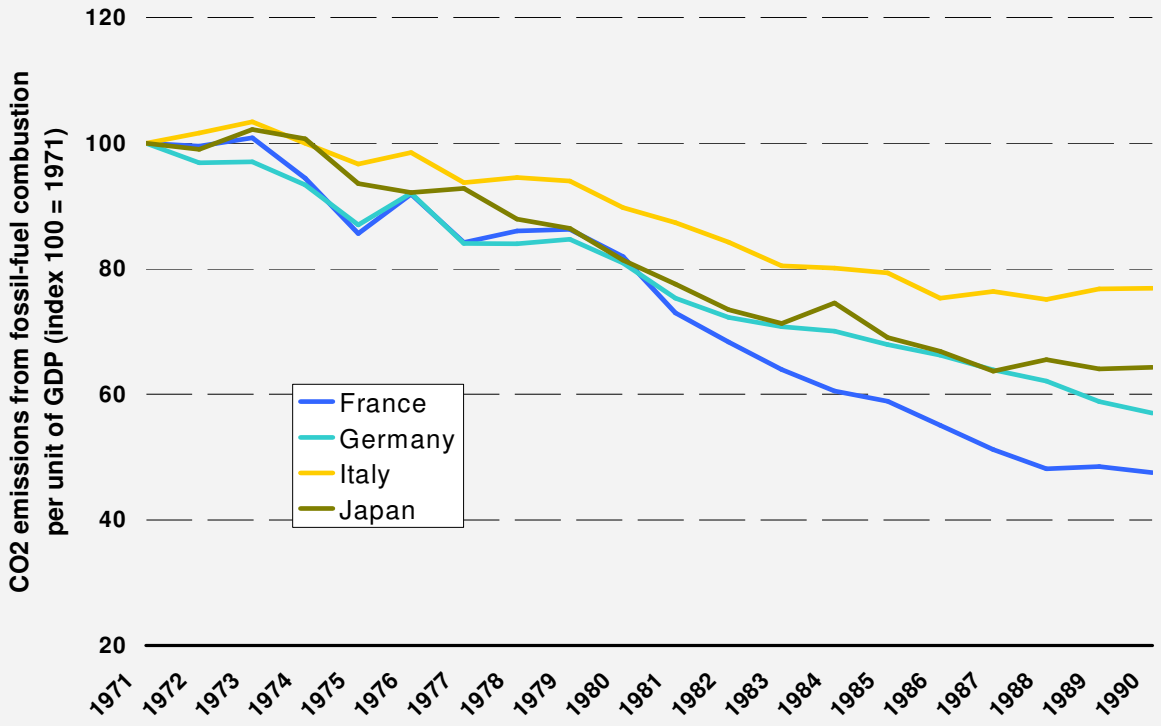

Figure 12.2: *Evolution of CO_2 emissions from fossil-fuel combustion in France, Germany, Italy and Japan between 1971 and 1990*
Source: IEA (2004a)

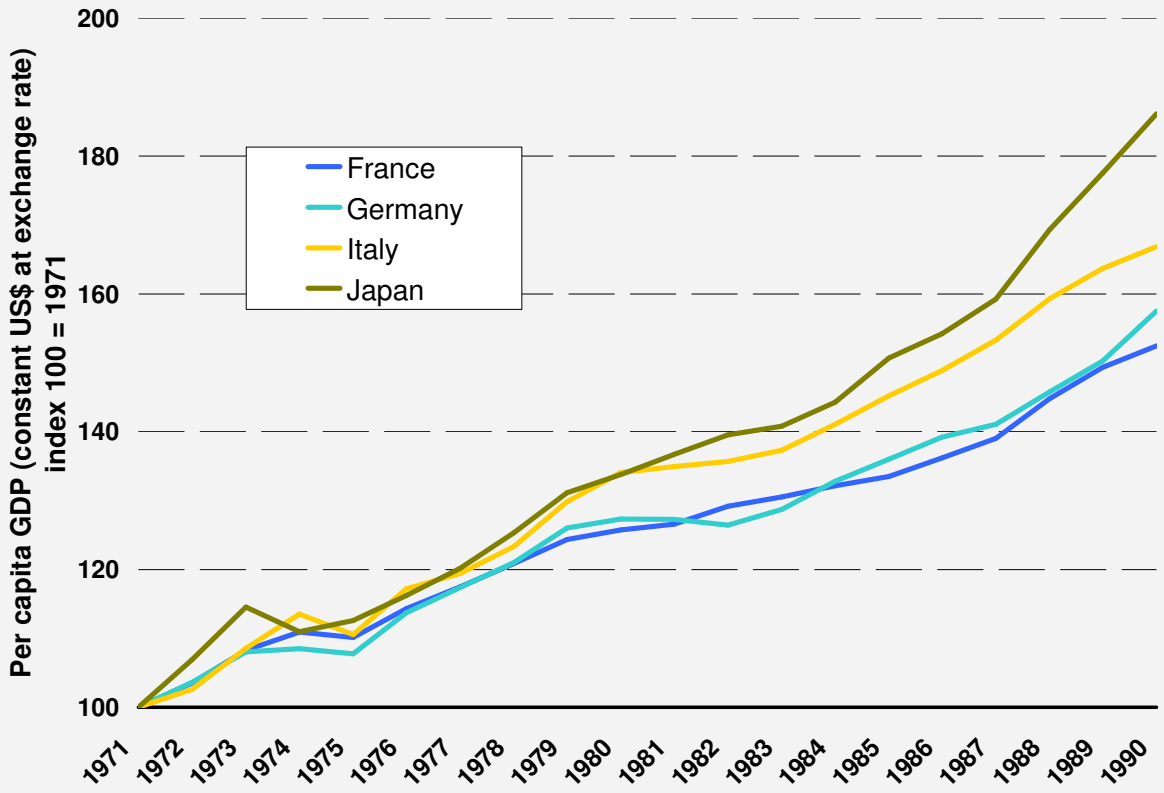

Figure 12.3: *Evolution of GDP per capita in France, Germany, Italy and Japan between 1971 and 1990*
Source: IEA (2004a)

Hourcade and Kostopoulou also observe that the macroeconomic performances of these countries have been relatively comparable from 1973 to 1990 (Figure 2), suggesting that widely different environmental outcome can be obtained at similar welfare costs in the long-run. In addition, they observe that the responses were for a large part driven by the country's pre-existing technologies and institutions, an issue that is explored more in depth in the following section.

Transportation and Urban Planning

Transportation is the fastest growing segment of CO_2 emissions in both the developed and the developing world. The level of these emissions results from the combination of the amount of travel that goods and people do make, and of the set of technologies with which those trips are made. Demand for and supply of transportation are largely inelastic in the short-run, but become elastic in the longer run as people and activities change location, as new infrastructure are developed and as preferences evolve. A very wide array of policies affect these long-term dynamics. The set of transportation technologies available at any point in time, and their relative costs, are also influenced by public policies.

Two examples of how public policy choices have affected transportation supply, transportation demand, technology, and ultimately emissions from the transport sector are discussed in this section: one of urban planning at city level, and the other of national policy driving urban forms. the first example is the development and steady implementation of an integrated urban planning program in the city of Curitiba (Brazil) from 1965 onwards, which has allowed the city to grow 8-fold from 1950 to 1990 while maintaining 75% of travel commute by bus – a much higher public transport modal share than in other big Brazilian cities (57% in Rio, 45% in São Paulo) – as well as little

congestion. As a result, Curitiba uses 25% less fuel than cities of similar population size and socio-economic characteristics. Two characteristics of the program seem to have particularly contributed to its success: (i) the fact that it integrated infrastructure and land-use planning, and (ii) the consistency with which successive municipal administrations have implemented the plan over nearly three decades (Rabinovitch and Leitman 1993). In Mexico City, on the other hand, Lankao et al. (2005) find that privatization of state-run transportation firms, together with decreased expenditures on public transportation, and a shift of some of the industries and people to the periphery of the city are one of the major driver of the shift from high- (e.g., metro and buses) to low-capacity (e.g., minibuses) transportation modes (the share of minibuses and combis has increased from 5% in 1986 to 59% in 2000).

The second example concerns urban forms in the United States and Europe (and Japan), the latter being on average rather compact while the former exhibit important sprawl. Nivo la (Nivola 1999) notes that this difference cannot be explained only by differences in demography, geography, technology or income. He argues that the combination of such public choices such as (1) an acute bias towards public financing of roads to the detriment of other modes of transportation in the U.S. – against a more balanced approach in Europe; (2) dedicated revenues for highway construction in the U.S.– against funds drawn from general revenues in Europe; (3) lower taxes on gasoline in the U.S. than in Europe; (4) housing policies more geared towards supporting new homes, (5) a tax system more in favour of homeowners in the U.S.; (6) lower support from the federal Government to local governments in the U.S. than in Europe; and (7) the quasi-absence of regulations favoring small in-city outlets against shopping malls in the U.S., is responsible for most of the differences in urban sprawl between the U.S. and Europe. In turn, this difference in urban forms generates widely different demands for transport services, for energy consumption (Newman and Kenworthy 1991), and for CO_2 emissions. (Per capita CO_2 emissions from travel in the U.S. are nearly three times as high as in major European countries, due mostly to a larger number of trips per capita and a higher energy intensity, Schipper et al., 2001.) A key point in Nivola's analysis is that most of these consequences were totally unintended, as these policies were adopted for non-transportation reasons (let alone for emissions reasons).

Rural Development

Rural development policies have a direct impact on the emissions of or on the sequestration rate from biomass and soils. If few studies examine the direct impact of rural policies on CO_2 emissions, there is a widespread literature on the impact of such policies on deforestation rates, which can be taken as a proxy for emissions.[5] The drivers of deforestation are complex, and involve an interaction of cultural, demographic, economic, technological, political and institutional issues(Angelsen and Kaimowitz 1999; Geist and Lambim 2002), and most of these drivers are influenced by policy decisions.

Examples include agriculture intensification policies, which have ambiguous effects on deforestation. On the one hand, intensification increases the productivity of existing agricultural land. On the other, if it is accompanied by lower demand for labour, or if it results in higher attractiveness of agriculture relative to non-farm activities and thus triggers migration, it might in fact increase deforestation. Careful design of agriculture intensification policies is thus necessary to avoid unintended outcome on deforestation (Angelsen and Kaimowitz 2001). Evidence also suggest that rural road construction or improvement may have positive economic implications by providing better access to markets and basic services for remote population in developing countries (Jacoby 2000). New roads, however, may also encourage future deforestation (Chomitz and Gray 1996).

[5] Using this proxy, however, does not allow us to estimate how rural development policies might impact on emissions through other channels, e.g. via changes in demand for energy to transport agricultural products to markets.

Macro-economy and Trade

Macroeconomic policies like exchange rate policies, fiscal policies, government budget deficits, or trade policies may have profound impacts on the environment, even though they are designed for other purposes. This link has been extensively studied in the past decades, notably in the context of the evaluation of structural adjustment programs in developing countries. A key finding from this literature is that the relationship between macroeconomic policies and the environment are often complex and country-specific, and depend on whether or not other market or institutional imperfections persist (Munasinghe and Cruz, 1995, Gueorguieva and Bolt, 2003). No case study discusses the impact on structural adjustment on GHG emissions, but some discuss the relationship between structural adjustment and deforestation and thus, by extension, GHG emissions from land-use change. Again, the effects depend on the mix of policies that was adopted as part of the structural adjustment program, and of country-specific characteristics. For example, Kaimovitz et al. (1999) report that the structural adjustment program implemented in Bolivia in 1985 strongly increased profitability of soybean production, and led to massive deforestation in soybean productive areas. Symmetrically, Benhin and Barbier (2004) find that a structural adjustment program implemented in Ghana in 1983 led to a reduction of deforestation linked to extension of cocoa culture because, among others, of increased producer price for cocoa, higher availability of inputs, and other measures aimed at rehabilitating existing cocoa farms. Another channel through which structural adjustment programs could impact deforestation is through the timber market. Pandey and Wheeler (2001) analyze cross-country panel data on the markets for wood products in countries where World Bank supported adjustment programs were implemented. They find that these programs greatly affect imports, exports, consumption and production in many forest product sectors, but that the impacts on deforestation tend to cancel out. If domestic deforestation does not increase, however, imports of wood products do, suggesting increased pressures on forest in other countries. Finally, they find that currency devaluation strongly increases the exploitation of forest resources.

Among macroeconomic policies, trade policies have attracted particular attention in recent years, due to the fact that international trade has increased dramatically over the past decades. There is a general consensus that, in the long-run, openness to trade is beneficial for economic growth. The pace of openness, and how to cope with social consequences of trade policies, on the other hand, are subject to much controversy (see (Winters, McCullough et al. 2004) for a review). Trade has multiple implications for GHG emissions. First, increased demand for transportation of goods and people generate emissions. For example, freight transport now represents more than a third of total energy use in the transportation sector (Chapter 5). Secondly, trade allows countries to partially "de-link" consumption from emissions, since some goods and services are produced abroad, with opposite implications for the importing and exporting countries. For example, Welsch (Welsch 2001) shows that foreign demand for German goods accounts for nearly a third of the observed structural changes in the composition of output and decrease in emissions intensity of West Germany over the period 1985-1990. At the other end, Machado et al. (Machado, Schaeffer et al. 2001) report that inflows and outflows of carbon embodied in the international trade of non-energy goods in Brazil accounted for some 10 percent and 14 percent, respectively, of the total carbon emissions from energy use of the Brazilian economy in 1995. And the game is often not zero-sum, when production technologies are less carbon-efficient in the exporting country than in the importing one. For example, Shui and Harriss (2006) estimate that US-China trade represents between 7% and 14% of China's total CO2 emissions, and that US-China trade increases world emissions by an average of 100 MtCO2e per year over the period 1997-2003 because of higher emissions per kWh and less efficient manufacturing technologies in China. Finally, policies favorable to trade have been accused of favoring the relocation of firms in "pollution heavens" where environmental constraint

would be lower. Empirical analysis, however, do not confirm the "race to the bottom" hypothesis (Wheeler, 2001).

12.2.2.3 Lessons learned

The previous two sections suggest that GHG emissions are influenced by, but not rigidly linked to economic growth, and that policy choices do make a difference. Although the examples discussed are very diverse, some general patterns emerge:

First, in any given country, sectors that are farther away from the production frontier – i.e., in sectors where effective production is close to the maximum feasible production with the same amount of inputs – have opportunities to adopt "win-win-win" policies, i.e. policies that free up resources and bolster growth, meet other sustainable development goals and also, incidentally, reduce GHG emissions relative to baseline. Examples of such "win-win-win" policies discussed above include the removal of energy subsidies in transition economies, or the mitigation of urban pollution in highly polluted cities in the developing world. Of course, implementing these policies may still generate winners and losers, but compensation mechanisms can be designed to make no-one worse off in the process.

Second, sectors that are closer to the production frontier – i.e. where production is close to the optimal given available inputs – also have opportunities to reduce emissions by meeting other sustainable development goals. However, the closer one gets to the production frontier, the more trade-offs are likely to appear. For example, diversifying energy supply sources might be desirable for energy security reasons, but may come at a cost to the country if, for example, it requires to make more risky investments (Dorian et al., 2006).

Third, in many of the examples reviewed above, what matters is not only that a "good" choice is made at a certain point in time, but also that the initial policy has persisted for a long time – sometimes several decades – to truly have effects. The reason is that some of the key dynamics for GHG emissions, such as technological development or land-use patterns, present a lot of inertia, and thus need sustained effort to be oriented. This raises deep institutional questions about the possibility of Governments to make credible long-term commitments, particularly in democratic societies where policy-makers are in place only for short spans of time (see e.g., Stiglitz, 1998). These will be discussed in the next section.

A fourth element that stems out of some of the examples outlined above is that it is often not one policy decision, but an array of decisions that are necessary to influence emissions. This is especially true when considering large-scale and complex dynamics such as the structure of cities or the dynamics of land-use. This raises, in turn, important issues of coordination between policies in several sectors, and at various scales.

Fifth, national circumstances, including endowments in primary energy resources, but also institution s (World Bank 2003b) matter to determine how policies ultimately impact on GHG emissions. For example, as discussed above, higher powers granted to local and regional governments relative to the central government appear to be an important factor contributing to the higher prevalence of urban sprawl in the U.S. than in Europe.

12.2.3 Role of State, Market, Civil Society and Interactions

The potential for nations to take alternative development paths, some relatively more climate-friendly, implies that climate policy cannot be separated from mainstream policy decisions in key sectors such as energy, transport and land use. These policies lie at the core of both developed and developing countries' economic growth and security concerns unlikely to be strongly constrained by climate specific goals and instruments. Mainstreaming climate, in turn, implies the central importance for climate of political, commercial and societal institutions for decision-making and governance.

The current diverse patterns of institutional histories and of institutional reforms in the majority of nations suggest that the study of alternative development paths and their effects on climate requires specific political economic and organizational knowledge in order to understand their national priorities and the policy choices under consideration by empowered agencies and actors. In addition to widespread reforms in the political constitution of governance, development paths are also the products of each national government's political culture, preferred regulatory instruments and regulatory capacity - all factors that are still changing rapidly in both Annex I and non-Annex I states. These reforms in process enlarge the prospect that mainstream development policies and climate favoring options may be shaped to coincide.

12.2.3.1 From government to governance

Many changes in the way government is understood have occurred in response to social, economic, and technological changes our societies have undergone in the past several decades.

This includes a shift from government defined strictly by the nation-state to a more inclusive concept of governance which recognizes the contributions of various levels of government (global, transnational/regional/local) as well as the roles of the private sector, non-governmental actors, and civil society (Goodwin 1998: 10; Rhodes 1996). The emergence of these new forms of governance has been attributed to the need for new institutions to address the more complex problems of present-day society (Beck 1992; Giddens 1998; Howes 2005).

Ideology and economic globalization have also played a role in the shifting focus from government to governance. Free market competition is now perceived by many actors as superior to government direction of the economy and commercial activities. (Goodwin 1998; Lewis, Moran et al. 2002; Levi-Faur 2005). Trade liberalization and privatization have diminished the ability of governments to directly control their economies. Simultaneously, command-and-control strategies are losing favor while market-based mechanisms, voluntary initiatives, and partnerships with non-governmental organizations have gained acceptance. (Lewis, Moran et al. 2002). According to Goodwin (Goodwin 1998): 'The role for government is seen as one of identifying stakeholders and then developing the relevant opportunities and linkages for them to be brought together to act for themselves'. (See also Little 2001)

Recognizing the difficulty and limitations of trying to directly control their domestic economies in an increasingly open and globalize economy, governments now try to pursue economic growth through strategic policies designed to increase access to foreign markets, encourage inward foreign investment, maintain national competitiveness, and obtain favourable outcomes from trade agreements (Jessop 1997). While some believe that globalization has made national governments less powerful, others argue that rather than simply eroding government power, globalization has changed the ways in which governments operate and influence situations (Levi-Faur 2005). For example, the three key institutional sectors of society – government, market and civil society – have begun to work in closer collaboration, partnering with each other in multiple and diverse ways when their goals are common and their comparative advantages are differentiated (Najam, 1996,

Hulme and Edwards, 1997; Davis, 1999). Of course, this is not to imply that they always, or even mostly work in partnership or have synchronous priorities; but it does mean that they have so more often than they did, including in terms of global climate change mitigation (Najam, 2000). The nature of global governance on a range of issues, including on climate change, is today best understood not only as what states do but as a combination of that which the state, civil society and markets do, or not do (Najam, Christopoulou and Moomaw, 2004).

The concept of sustainability has raised many questions about the traditional development model and the relationship between society, economy and the environment. It has also raised questions about the suitability of the traditional government model to meet the demands of managing the environment and economy sustainably (Lewis, Moran et al. 2002). Thus, responsibility for "environmental management has been shifted – upwards to international bodies and to transnational companies, and downwards to local governments and to businesses and resource users." In addition, individuals play a greater role in environment as consumers, private owners of land, and participants in the policy discourse as does civil society as one of the prime policy entrepreneurs in society. .

The more prominent role businesses and civil society groups has played in governance has not been without controversy. Some believe that only the state can act in the public interest, while industry and citizens are motivated by self-interest. Others see all actors as motivated by self-interest and, in this context, believe competition and the market ensure the best outcomes – public and private. In this view, civil society, consumers and industry bear greater responsibility and share the risks, while the state maintains a role in setting standards and auditing performance (Dryzek 1990; Dryzek 1997; Howes 2005).

While the roles, responsibilities and powers assigned to the respective actors remains a hotly contested subject, it is widely acknowledged that the responsibility for the environment and sustainability has become a much broader project, no longer primarily the preserve of governments, but one involving civil society, the private sector, and the state. This section rests on the notion that greenhouse gas emissions mitigation, climate impacts adaptation, and sustainable development all depend on the institutional capability of humans in all arenas - the state, the market, and the comunity - to modify the practices of actors in each of those arenas.

12.2.3.2 State

It has long been recognized that different countries have different political constitutions and cultures that determine non-climate policies that impact emissions, as well as different institutional capacities to implement emissions mitigation strategies (Gerlach and Rayner 1988). The transition from government to governance recognizes the changing trends among political constitutions in developed and developing countries. These institutional reforms, while of varied speed and scope in individual states, broadly span the domains of government and market activity, the powers of public executive administration relative to that of legislatures and courts, the degree of federalism within nation states, the organization of the financial system and capital markets, the demands of corporate governance and corporate social responsibility, the structure of industrial organization and public utilities, the strength and engagement of civil society organizations, and the delegation of national sovereignty to multinational and regional law and regimes. (Heller 2003, Hollingsworth and Boyer 1997, Berger and Dore 1996, and Schmidt 2002).

The specific constellation of these reforms depends upon the pre-existing institutions in a given nation and the local politics of reform and resistant domestic interests. Yet in almost all cases the reorganization of governance institutions will have important implications for the choice among po-

tential national development paths in key input sectors. For example, a recent study of electricity sector reforms in five leading emerging nations—China, India, South Africa, Brazil and Mexico—found that in no cases did the changes away from power provision through state monopolies correspond closely to the orthodox designs of electricity market reforms (Box 12.3). While all five electricity sectors did separate the ownership of generation from transmission and distribution and allow participation in the generation markets by independent, often foreign, power producers, nowhere have competitive generation markets flourished or has the state withdrawn substantially from system planning, tariff setting based on social and political criteria, infrastructure financing, or predominant ownership of major power sector firms. In particular, independent regulation has been difficult to implement, resulting in ongoing uncertainty about the rules of sectoral operations. In this face of this uncertainty, partially privatized or politically influential companies have established a comparative advantage in investment because of their greater ability to manage the political risk remaining in the system (Victor and Heller 2006). Yet, the consequences for climate friendly energy development have varied across these emerging markets because of nationally specific characteristics. Social goals, including increasing access and renewable power development, have not been interrupted and in some cases, such as the Indian state of Gujarat, the substitution of privately developed captive for grid power has increased the rate of substitution of natural gas for coal-fired generation. (Shukla 2005). In Mexico, complex, financially problematic, government guarantees of tariffs have also encouraged gas fuel diversification from oil to gas. In other cases, including China, the ongoing flux in institutional reforms creates both risks of intensive coal-based power development and the opportunities of more climate friendly energy growth.

The choice of policies that governments seek and are able to pursue are influenced by the political culture and regulatory policy style of a country or region and the extent of public expectations that their governments will take a strong or weak lead in pursuing policy responses. Earlier efforts addressing the issues of institutional capacity for mitigation include a compendium of policy instruments (DOE 1989), two collections of country studies (Grubb and et al. 1991; NIGEC (National Institute for Global Environmental Change) 1993) and a review of the relevant social science literature on institutions (O'Riordan, Cooper et al. 1998).

Box 12.3: Poverty tariff in South Africa

South Africa undertook a national electrification programme that increased electrification rates from roughly one-third to two-thirds by 2002 (NER (National Electricity Regulator) 2002). However, consumption levels of electricity remained lower than expected, since poor households often can afford only limited use of the electricity. In an attempt to address the question of affordability, the South African government committed itself to implementing a free supply of electricity for basic needs (DME, 2004). The 'poverty tariff' stipulates a uniform electricity basic support services tariff (EBSST) of 50 kWh at zero cost to all grid-connected poor customers. This is considered sufficient for lighting, ironing, water heating, TV and radio (National Treasury 2003), and could make cooking and heating more attractive. By subsidising the use of electricity for some basic needs, government is seeking to increase the social benefits of electrification. (Gaunt 2005)

The extent to which the policy alleviates poverty depends on the energy burden (the percentage of the total household budget spent on energy). The energy burden of poor households in remote rural villages can be up to 18% of the total household budget, according to data from a case study reported in Table 12-2; see also (UCT 2002). The 50 kWh provided by the poverty tariff would reduce the energy burden by two-thirds (6 percentage points). Monthly expenditure on electricity and other fuels decline by 18% and 16% respectively, due to the poverty tariff.

Table 12- 2*: Mean household expenditure on electricity and other fuels and energy as a percentage of total household expenditure*

Expenditure on	**Before subsidy**	**After subsidy**	**Difference**	
Electricity (R/month)	38	31	7	18%
Fuels excluding electricity (R/month)	70	59	11	16%
Energy as % of household expenditure	18%	12%	6%	

Source: (Prasad 2003)

A recent study in the poor areas of Cape Town showed that monthly electricity consumption has risen by 30 – 35 kWh/month per customer since the introduction of poverty tariff, a substantial rise against an average consumption ranging from 100 to 150 kWh per month (Borchers, Qase et al. 2001). This rise is less than the full 50 kWh/month, suggesting that households both make greater use of electricity, but also value some saving on their energy bills (Cowan and Mohlakoana 2005).

The impacts on climate change mitigation have been broadly scoped. If extended to all customers in a broad-based approach, the poverty tariff might at most increase emissions by 0.146 MtCO2 under the assumption that all the free electricity would be additional to existing energy use (UCT 2002). In practice, it is likely that electricity might displace existing use of paraffin, coal, wood, candles, batteries and other fuels to some extent. This upper-bound estimate represents 0.04% of total GHG emissions, but about 2% of residential sector emissions in 1994. This example from South Africa show that poverty-alleviation and environmental objectives can be simultaneously addressed.

A substantial body of political theory identifies and explains the existence of national policy styles or political cultures. The underlying assumption of this work is that individual countries tend to process problems in a specific manner, regardless of the distinctiveness or specific features of any specific problem; a national "way of doing things". Richardson (Richardson, Gustafsson et al.

1982) identify national policy style as deriving from the interaction of two components "(a) the government's approach to problem solving and (b) the relationship between government and other actors in the policy process." Using a basic typology of styles, Richardson et al subdivide countries according to whether national decision-making is anticipatory or reactive and whether the political context is consensus based or impositional. Many studies of national differences in institutional arrangements for making and implementing environment and technology policy emphasize the essentially cooperative approach to environmental protection in Europe and the more confrontational approach that predominates in the United States (eg, (Lindquist 1980; Kelman 1981; Kunreuther and et al. 1982). Jasanoff (Jasanoff 1986) shows how information about established technologies, such as formaldehyde use, is interpreted differently by scientific advisory bodies in different countries. In particular, Brickman (Brickman and et al. 1985) argue that the decentralization of decision making in the US both increases the demand for scientific details of technological and environmental hazards and engenders competition between different explanations.

On the other hand, Europeans generally expect the national government to take the lead in all matters pertaining to environmental safety and health, as well as economic and social welfare. The contrast between the US and Europe is not so much dissemination of information or the level of concern, but the view of which institutions in society ought to take the lead in any climate response strategy. In Europe the burden clearly falls upon the national government, whereas there appears to be a widespread expectation that the appropriate agents of change in the USA are the State governments, communities, and nongovernmental/philanthropic organizations. Reviewing case studies from five countries, Rayner (Rayner 1993a) concludes:

In sum, the overall picture is that there is a dynamic relationship between centralized programmes and local decentralized initiatives through which informal institutions are becoming an increasingly critical factor in shaping and implementing environmental policy…wide variations in political culture do seem to exert a significant influence on the choice of policy instruments and how legitimate targets are defined.

Recent empirical studies confirm the view that only detailed and case-specific analyses of government institutions and policies can illuminate national differences in the pursuit of environmental and other regulatory objectives. Weiner (Weiner 2002) finds that, contrary to common assertions, that the United States and Europe have not differed substantially in their use or implementation of the precautionary principle. Stewart finds that the United States has successively moved between alternative forms of environmental policies, beginning with command and control, before switching toward market instruments (permits and taxes), and later experimentation with flexible negotiated regulation and information based instruments. In these cases, what distinguishes national political and regulatory cultures are institutional factors such as the judicial doctrines of administrative review and regulatory standards of general treatment more than cultural predilections that support or restrict government action. Presumptions about the likelihood of regulatory capture by concentrated interests (or corruption) also may restrict administrative flexibility in many societies. Other dimensions of particular institutional national histories concern the distribution of government responsibilities and powers between agencies. Reliance on inter-agency task forces to coordinate policies such as climate and energy across bureaus have customarily been less effective than forecast. Given the proclivity of all organizations, including line or sectoral ministries, to protect and maintain their core technologies (Scott 1987), the introduction of new environmental or sustainable development agencies may produce only weak effective change in established policies and priorities. Finally, different governments do appear to have varied traditions of policy preferences and authority. European governments and populations appear more comfortable with lifestyle (demand)

regulation than do North American, which often tend to look to longer-run technology development support in collaboration with market actors (Nelson 1993).

The selection of policy instruments is likely to be influenced by the relative strength of institutional sectors in the national polity. Generally the private sector (the market) is likely to prefer carrots (subsidies) to sticks and policy instruments that set goals and leave maximum discretion to firms as to how they achieve them. Hence they are likely to lobby for fiscal instruments or, if direct regulation is unavoidable they will prefer performance standards over equipment standards. On the other hand, firms may be suspicious of informational programmes that hint at moral persuasion or jawboning, which could put firms at a competitive disadvantage.

At the other extreme, environmental organizations (civil society) often emphasize sticks rather than carrots (though they often favor subsidies to alternative energy technologies). They often favour command and control regulation, uniformly applied without the exercise of discretion by regulators or regulated firms. Such discretion violates principles of strict equality. Fiscal incentives may be acceptable, especially if linked to regulation. However, systems such as emissions permits are frequently greeted with suspicion as licenses to pollute (Mott 1990). Information programmes, particularly those designed to expose weaknesses in the compliance records of firms, are also well received here, where information can be used as a stick to beat those who are slow to comply.

Regulatory agencies (the state) may find themselves pulled in two directions. Their orderly instincts may incline them toward the predictability and ease of monitoring associated with command and control regulation. However, the need to reconcile their own agendas with those of the firms that they must regulate may lead them to favour a combination of fiscal incentives backed up by regulation. In any case, regulators are often sympathetic to demands from market constituencies for the exercise of discretion in the application of rules. Regulators' ability to exercise such discretion (e.g., by grandfathering activities of firms that were practiced prior to a rule making) is likely to be restrained in proportion to the strength of environmentalist objectors. Information is likely to be favoured by regulators to the extent that it facilitates their own regulatory tasks, although they may tend towards scepticism as to the usefulness of public information programmes. So we may expect regulators to favour policy instruments that combine carrots and sticks according to pressures from the other two constituencies.

An important, though often neglected issue in the choice of policy instruments is the institutional capacity of governments to implement the instrument on the ground. This is often a matter of what countries with highly constrained resources think that they can afford. However, even industrialized nations exhibit significant variation with respect to the characteristics that would be considered ideal for the successful application of the complete suite policy instruments listed above. These attributes include:

- a well developed institutional infrastructure to implement regulation;
- an economy that is likely to respond well to fiscal policy instruments because it possesses certain characteristics of the economic models of the free market;
- a highly developed information industry and mass communications infrastructure for educating, advertising, and jawboning; and

a vast combined public and private annual RD&D budget for reducing uncertainties and establishing pilot programmes (O'Riordan, Cooper et al. 1998).

To the extent that these close to ideal conditions for conventional policy instruments are missing policy makers are likely to encounter obstacles to their effectiveness. For example, both Brazil and

Indonesia (Petrich 1993) have carefully crafted forest protection laws that could be used to secure carbon sequestration goals. However, neither country is able to allocate sufficient resources to monitoring and compliance with those laws to ensure that they are effective. Even in industrialized countries, competition for resources among state agencies responsible for promoting economic development and those responsible for environmental protection are almost universally resolved in favour of the former. In much of the developing world, the shortage of programme resources is exacerbated by pressures to exploit natural resources to earn foreign income, increasing demands of population for energy, and pressures to convert forest land to human habitation. As a result, legislative initiatives often seem to "leave more marks on paper than on the landscape" (Rayner and Richards 1994).

Less industrialized countries often have poor infrastructures to begin with, exacerbated by lack of human, financial, and technological resources. In addition, these countries are likely to be focused on more basic considerations of nation building and economic development. In principle, the economic conditions of less-industrialized countries also present opportunities to achieve both sustainable development goals and emissions reductions measures at lower cost than in the industrialized nations that have already made capital intensive commitments to fossil fuel technologies and may lack the land resources available for carbon sequestration programmes. This is the basis for the Joint Implementation provisions of the FCCC that permit countries to share credit for emissions reductions outside their territorial boundaries. However, both Joint Implementation and its complementary programme, the Clean Development Mechanism, have been controversial from the viewpoints of both industrialized and less-industrialized countries.

A comprehensive review of the social science pertaining to "institutional frameworks for political action" on climate change concludes that "Effective actions designed to mitigate or respond opportunistically or adaptively to climate change are likely to be those that are most fully integrated into more general policy strategies for economic and social development" (O'Riordan, Cooper et al. 1998). The notions of adaptive and mitigative capacity advanced in the IPCC Third Assessment Report appear to reinforce the idea that the capacity to develop and implement climate response strategies are essentially the same as those required to develop and implement policies across a wide variety of domains. In other words, they are largely synonymous with those of sustainable development. The issues and cases discussed in this section suggest that the challenges of building the capacity for sustainable development is not confined to the less industrialized countries, but that industrialized countries also fall short of the capacity to respond to climate mitigation challenges in a sustainable fashion.

The more that climate change issues are routinized as part of the planning perspective at the appropriate level of implementation, the national and local government, the firm, the community, the more likely they are to achieve desired goals. Climate policies per se are hard to implement meaningfully. However, merely piggybacking climate change onto an existing political agenda is unlikely to succeed.

12.2.3.3 Market

Industry is a central player in environmental and sustainability stewardship. Increasingly, the private sector has been recognized not only as a partner in implementation, but also as a stakeholder in the design of sustainability policy. Accordingly, over the past 25 years or so, there has been a progressive increase in the number of companies that are taking steps to address sustainability issues (Holliday, Schmidheiny et al. 2002; Lyon, 2003) at either the firm or industry level (see Box 12.4). A number of companies have, as part of their corporate strategy, voluntarily defined a number of

goals that reflect social responsibilities and environmental concerns that go beyond traditional company obligations (Halsnæs, 2005). Following this line of thinking, an increasing number of companies are defining targets for GHG emissions and sinks. Some of the more widely acknowledged corporate sustainability drivers include regulatory compliance, increasing market opportunities, and enhancing reputational value. Lyon (2003) hypothesises that voluntary action on the environment might be explained by a recognition by firms that pollution is a symptom of production inefficiencies, or a perception that consumers are willing to pay more for products with better environmental credentials. Either explanation would signal that markets are overtaking regulation as a incentive for improved environmental performance, but Lyon (2003) suggests instead that instead "it is the opportunity to influence regulation that makes corporate environmentalism profitable" (Lyon, 2003: 36).

Box 12.4 Role of Business: Examples

One well-known example of a corporation which has embraced sustainability is Interface Inc, a U.S. manufacturer of carpets and upholstery. Since embracing sustainability in 1994, Interface has reduced the carbon intensity of its products by 36% (Hawken, Lovins et al. 1999; Anderson 2004) Many of these reductions came through investments in energy efficiency and renewable energy (Anderson 1998; Holliday, Schmidheiny et al. 2002; Anderson 2004). However, it is important to note that Interface has also substantially reduced GHG emissions through other elements of its sustainability strategy, including reduction in use of raw materials and recycling of materials that do not relate directly to energy consumption (Hawken, Lovins et al. 1999; Suzuki and Dressel 2002; Anderson 2004). As most of the materials used by Interface in its production are derived from petrochemicals (Anderson 1998; Hawken, Lovins et al. 1999), these strategies have led to substantial reductions in the company's carbon footprint.

CEMEX, a Mexican-based cement manufacturer, was able to achieve similar emissions results through adoption of sustainability-oriented business model. One of the major environmental issues facing cement manufacturers is energy use (Wilson and Change 2003). As part of its sustainability strategy, Cemex has focused intently on its energy use in an effort to reduce its environmental burden. For example, in 1994 CEMEX embarked on an eco-efficiency program to "optimize its consumption of raw materials and energy" (Wilson and Change 2003), p29). Through this and other measures, CEMEX has been able to reduce its emissions of carbon dioxide by 2.7 millions tons between 1994-2003 (Wilson and Change 2003), p32).

ITC Limited, an Indian conglomerate and third-largest company in terms of net profits in the country, reportedly sequestered almost a third of its carbon dioxide emissions in 2003-04, and plans to become a carbon positive corporation through a program of energy savings and sequestration of carbon dioxide through its farm and social forestry initiatives. Through programs for rainwater harvesting it plans to become a water-positive corporation as well. Its "e-Choupal" intervention has eliminated the need for brokers and helped 2.4 million farmers across six Indian states participate in global sourcing and marketing of products.

All the same, some companies have recognised that pursuing sustainability offers the potential to make cost savings (Thompson 2002; Dunphy, A.Griffiths et al. 2003). For example, by increasing energy and material efficiency in production and by reducing wastes, companies can reduce costs per unit of production and thereby gain a competitive advantage in the market (Hawken, Lovins et al. 1999; Schaltegger, Burritt et al. 2003). This is the concept of "eco-efficiency", which further acknowledges that businesses which constantly work to evaluate their environmental performance will be more innovative and responsive businesses as well. DuPont, for example, has sought to elevate sustainability to the strategic level, using a three-pronged strategy involving integrated science, knowledge intensity and productivity improvements (Holliday, 2001). Using its 'six-sigma' methodology, the company has been able to achieve financial savings in excess of US$1 billion per annum, partly through reduced energy and raw material use and less waste (Holliday, 2001).

Lyon (2003) suggests that the influence of 'green marketing' is modest in terms of shifting industry behaviour with respect to the environment, but Senge and Carstedt (2001) position consumers as a key influence in shaping the 'next industrial revolution', founded on an economic system that genuinely connects industry, society and the environment. Using a term coined by Alvin Toffler – 'prosumers' – they outline a future in which customers will play a more influential role in determining the values provided by goods and services. Their view is that a shift in consumer attitudes and val-

ues is an essential prerequisite to building sustainable societies and that "Many market-oriented companies sense just such a shift emerging in consumer preferences" (Senge and Carstedt, 2001: 33). Schaefer and Crane (2005) arrive at a different conclusion, though, suggesting that a change in behaviour by the majority of consumers is not imminent. They outline to the myriad complexities that sit at the juxtaposition of consumer behaviour and sustainability, not the least being the potentially inherent contradiction between consumption and sustainability. Their suggestion is that it will require a sense of crisis to bring about a sea change in consumption patterns, and thus "recognition of the sustainability implications of consumption and a full and open debate about the important social and cultural roles of consumption in people's lives and how this might be achieved more sustainably is important and urgent' (Schaefer and Crane,2005: 89).

Managing stakeholder relations has also been identified as a corporate environmental driver. Many companies seek to improve relations with government, NGOs and local communities, because this can offer benefits such as faster approvals for projects or pro ducts, (Thompson 2002), a continuing 'licence to operate', and greater scope for self-regulation. In regard to NGOs, improved relations can reduce or eliminate protests, such as consumer boycotts and direct lobbying (Thompson 2002). Companies are also improving their environmental and social performance in response to demands from their corporate clients. Many large corporations, in particular, have introduced purchasing guidelines that place demands on suppliers to meet environmental performance standards (Thompson 2002).

Demands of investors, insurers and other financial institutions are providing further incentives in relation to sustainability. Through improved sustainability performance, companies can potentially increase the attractiveness of their shares in the market, reduce insurance premiums and obtain better loan terms (Thompson 2002). For example, the rapid growth of socially responsible investment funds (SRIs) in the last decade is providing an incentive for greater corporate sustainability (Thompson 2002; Borsky, Arbelaez-Ruiz et al. 2006). Disclosure of environmental impact is increasingly seen as a crucial element of a firm's risk profile, for legal liability as well as competitive position in the face of possible future regulation. For example, re-insurers, companies providing insurance to insurance companies, have shown considerable concern about how climate change could impact insurance claims. Zanetti et al. (2005) suggest that climate change should be a core element in a company's long term risk management strategy.

It is acknowledged that some changes in firm behaviour and practice are being driven by beliefs among senior executives and other employees that promoting sustainability is the 'right thing to do' (Dunphy and Benveniste 2000; Thompson 2002; Holliday, 2001). The pursuit of sustainability by companies has substantial implications for climate change mitigation, both through programs oriented directly towards GHG emissions reductions and indirectly through the promotion of eco-efficiency and other integrated management approaches.

Notwithstanding these achievements, there is widespread debate as to whether the responses of industry to environmental decline and sustainability issues more generally is sufficient. Luke (Luke 1999): 132), for example, talks of sustainability in this context as a 'remoulded economic growth ideology'. Initiatives taken by business to reduce waste, improve resource efficiencies, and prevent pollution satisfy a public desire for environmental protection, but at the same time usually work within the mainstream business model. Even business scholars and academics have questioned whether existing business models are up to the challenge of implementing sustainability (Elkington 2001; Sharma 2002; Doppelt 2003; Dunphy, A.Griffiths et al. 2003). According to (Doppelt 2003): 17): 'Because they do not understand that sustainability often entails whole new business models, few organizations institute meaningful cultural change efforts'

At the most fundamental level, the presiding view in western economies is that businesses do not have a responsibility, beyond regulatory compliance, to internalize sustainability issues. Following the thinking of Friedman and the Chicago School, the only responsibility of firms is to their shareholders, leading Stormer (Stormer 2003): 281) to comment that '…the conceptualization of business as more than a profit-maximising system has not permeated the business system itself'.

Despite the pre-eminence of the "shareholder" thesis, notions of corporate social responsibility (CSR) have gained a wider hold. The essence of the CSR perspective is that there is a clear basis for businesses to widen their focus from simply profit maximization (the "shareholder" view) to include other economic, social and environmental concerns. The arguments in support of CSR include, inter alia, competitive advantage (e.g., (Porter and C. van der Linde 1995; Porter and Kramer 2002), notions of corporate citizenship (Marsden 2000; Andriof and McIntosh 2001), and stakeholder theory (Post, Sauter-Sachs et al. 2002; Driscoll and Starik 2004; Windsor 2004). Drawing on the experience of DuPont, Holliday (2001) acknowledges the importance of shareholder value, but adds that business practices focussed on sustainability outcomes can generate financial gains. Thus: "Sustainable growth should be viewed not as a program for stepped-up environmental performance but as a comprehensive way of doing business, one that delivers tremendous economic value and opens up a vast array of new opportunities" (p 134). The ecological modernization thesis (e.g., (Christoff 1996; Mol and Spaargaren 2000; Dobson 2003a) proposes a reform of the growth ethic, to give greater recognition to social wellbeing, equity, and ecological limits.

While the theoretical and ideological debates continue, there is no question that firms are doing more in support of the environment and sustainability issues. Colman (Colman 2002) reported that forty-five percent of the Fortune Global Top 250 companies have issued environmental, social or sustainability reports.

Similarly, CSR would seem to have become a more serious concern to European companies, though Pharaoh (Pharaoh 2003) suggests it is primarily sales driven. In the UK, socially responsible investment (SRI) grew from £23 billion in 1997 to £225 billion in 2001 (Sparkes 2002), while Borsky et al (Borsky, Arbelaez-Ruiz et al. 2006) report that the $2.16 trillion of socially responsible investments held in the US accounted for approximately 11 percent of the total investment assets under management in 2003. It is important to recognize that the standards used by SRI funds to evaluate firms vary widely in what issues they address (with many simply staying away from weapons, tobacco, alcohol, and gambling) and how rigorously these standards are applied. Some SRI firms emphasize diversity and labor relations, while others focus on environment; there is no set of common criteria, and thus not all firms on SRI lists can be considered sustainable. However, growing public interest in SRI has led more firms to be concerned about a variety of social and environmental issues.

From the perspective of firms, there are both internal and external barriers to change. Internal barriers include an absence of commitment and leadership at senior levels, corporate culture, organizational structure, and the specific characteristics of plant and operations (Howes 2005). External impediments to change in support of sustainability include a persistent emphasis in the markets on short-term profit, accountability systems that ignore social and environmental performance, the inability to adequately influence supply chain relationships, and the risks to the individual firm of enacting fundamental change while the mainstream remains locked into the neo-classical growth model. Additionally: "Regulatory barriers include: regimes that do not encourage firms to go beyond compliance, that do not provide a constant long-term direction for change or are not backed up with a consistent political will of enforcement' (Howes 2005): 163). There is also the fact that

social and environmental costs are largely externalized by firms (Sharma and Starik 2004), a situation that could be redressed, in part at least, by full-cost accounting of the environmental and social impacts of firms.

Though there has been progress, the private sector can play a much greater role in making development more sustainable. As the number of companies which operate both profitably and more sustainably increases, the view that addressing social and environmental issues is incompatible with shareholder maximization may loose ground. There are many opinions on the extent to which business can be relied upon to meet sustainability objectives, ranging from those who feel that business is inherently self-interested and exclusively profit-driven, to those who feel that socially-responsible businesses going "beyond compliance" are on the forefront of the sustainability curve. Though the issues are complicated, there can be no question that the shift towards improved sustainability is fundamentally connected to the social, economic and environmental performance of the private sector. This is especially true in relation to the issue of climate change.

Levy and Newell (2000) suggest that while sociocultural factors have traditionally provided an explanation for the variability in responses of businesses to environmental issues, regional differences are becoming less obvious in relation to global environmental change, at least as far as trans-Atlantic corporate behaviours are concerned. Taking the ostensibly different examples of climate change, GM foods and ozone depletion, Levy and Newell found similarities in the way businesses have worked with stakeholders, institutional frameworks and responding to public concerns.

12.2.3.4 Civil Society

There are many definitions of civil society. Civil society refers to the arena of uncoerced collective action around shared interests, purposes and values. In theory, its institutional forms are distinct from those of the state, family and market, though in practice, the boundaries between state, civil society, family and market are often complex, blurred and negotiated. Civil society commonly embraces a diversity of spaces, actors and institutional forms, varying in their degree of formality, autonomy and power. Civil societies are often populated by organisations such as registered charities, development non-governmental organisations, community groups, women's organisations, faith-based organisations, professional associations, trades unions, self-help groups, social movements, business associations, coalitions and advocacy groups.

As this definition emphasizes, civil society is closely related to the more recent concept of "social capital". As described by **Putnam** (1993) social capital describes the overlapping networks of associational ties that bind a society together. Few of these, at first blush, have anything much to do with providing basic human needs, national infrastructure or technical capacity building (Rayner & Malone 2000). However, following Putnam's detailed empirical demonstration of the positive relationship between a rich and diverse civic life in Northern Italy and the economic and governmental success of the northern provinces, much recent attention from development agencies now recognizes the much earlier suggestion of Esman & Uphoff (1984) that a vigorous network of participatory membership organizations is essential to the development of the less-industrialized world.

Does a strong civic community result from economic development or does civic community create conditions for economic growth? Putnam's statistical analysis of these pathways revealed an astonishingly compelling finding that the mainstream assumption shared by both Marxists and free-market economists that the economy ultimately determines the shape of society is quite misplaced. Using measures such as agricultural and industrial employment he shows that in Italy civic engagement in the period between 1860 and 1920 is a very powerful predictor of present

socioeconomic development while economic development over the same period has no impact whatsoever on contemporary levels of civic engagement.

What explains the robust role of civil society in shaping development outcomes? Putnam attributes the impact of civil society to the importance of interpersonal trust underpinning social and economic transactions. This view is echoed by Fukuyama (1995) who argues that the extended moral network of civil society is a precondition for competitive success in the new global economy. Conversely, absence of civil society leads to fear of the state, accompanied by demands for a strong state to regulate the behaviour of others who cannot be trusted (Banfield 1958). Other commentators (Rayner & Malone 2000) have emphasized the importance of a third sector, in addition to government and business, to provide the potential for complex strategy switching.

During the past three decades the mantle of civil society has been increasingly claimed by nongovernmental organizations (NGOs). The NGO sector has experienced an explosion in numbers worldwide as well as a proliferation of types and functions. A 1995 UN report on global governance estimated that there were nearly 29,000 international NGOs. At the national level, the USA and India each had about two million NGOs, most of which are of recent originhas. In Russia, where almost none existed before the fall of communism, there were at least 65,000.

There is considerable debate about the extent to which NGOs' claim to being, or even representing civil society in the traditional sense can be maintained. Certainly, their dependence on either government or business raises questions about the extent that they are truly independent of the state and the market. According to *The Economist* (2000) a quarter of Oxfam's £98m ($162m) income in 1998 was given by the British government and the EU. World Vision US, which claims to be the world's largest privately funded Christian relief and development organisation, receives millions of dollars worth of resources from the US government. The role of governments in supporting NGOs is not limited to financial support. Governments of some developing countries, where the civil service capacity is limited, enlist international NGOs to help with the paperwork required by the World Bank and other international institutions. At least one UK based NGO has advised various small governments in climate negotiations and has even drafted text. Other NGOS are closely associated with the market sector, known as BINGOSs (Business Initiated NGOs). While it is perfectly legitimate for the firms to establish organizations that pursue common interests or through which top channel corporate philanthropy, it is once again questionable whether these are independent representatives of a third nongovernmental and non-business civil sector. A question that is frequently raised about NGOs is that of accountability (Jordan & van Tuijl 2006). Relatively few NGOs are directly accountable to members in the same way that governments are to voters or businesses are to shareholders, raising further questions about the extent to which their claims to the mantle of civil society are justified.

Whether they are truly "civil society" or not, there is little doubt that NGOs can be effective in shaping development and environment. A multitude of interest groups, including civil society in its various manifestations, seek to influence the direction of national and global climate change mitigation policy (Michaelowa, 1998). Nongovernmental organizations (NGOs) have been particularly active and often influential in shaping the societal debates and policy directions on this issue (Newell, 2000; Gough and Shackley, 2001; Corell and Betsill, 2001). The literature on the various ways in which civil society, and especially NGOs, influence global environmental policy in general and climate policy in particular, points out that civil society employs 'civic will' to the policy discourse and that it can motivate policy in three distinct but related ways (Banuri and Najam, 2002). First, it can push policy reform through awareness-raising, advocacy and agitation. Second, it can pull policy action by filling the gaps and providing such policy services as policy research, policy advice and, in a few cases, actual policy development. Third, it can create spaces for champions of reform

within policy systems so that they can assume a salience and create constituencies for change that could not be mobilized otherwise.

The image of civil society 'pushing' for climate change mitigation policies is the most familiar one. At the global, national and even local levels, one finds numerous examples of civil society organizations and movements seeking to push policy reform. The reform various interest groups within civil society desire can differ (Michaelowa, 1998) but what is common is the legitimate role that civil society has in articulating and seeking their visions of change through a multitude of mechanisms that include public advocacy, voter education, lobbying decision-makers, research, public protests, etc. Given the nature of the issue, civil society includes not just NGOs but also academic and other non-governmental research institutions, business groups, and broadly stated the 'epistemic' or knowledge communities that work on understanding the climate change problematique better. Some have argued that civil society has been the critical element in putting global climate change into the policy arena and relentlessly advocating its importance so that governments eventually began responding to these calls from civil society for systematic global climate change mitigation policies (Gough and Shackley, 2001; Najam, Christoupoulou and Moomaw, 2004). In particular, studies of the negotiation processes of global climate change policy (Newell, 2000; Corell and Betsill, 2001) highlight the role of nongovernmental and civil society actors in advancing the cause of global climate change mitigation.

The role of civil society in 'pulling' climate change mitigation policy is no less important. In fact, the IPCC assessment process itself, as a voluntary knowledge community seeking to organize the state of knowledge on climate change for policy-makers is an ideal example of how civil society, and particularly how 'epistemic' or knowledge communities can directly add to or 'pull' the global climate policy debate (Siebenhuner, 2002; Najam, Rahman, *et al.*, 2003). In addition, the knowledge communities as well as NGOs have been extremely active and instrumental in actually servicing the needs of national and sub-national climate policy. This is done by universities and research institutions writing local and national climate change plans (add reference), NGOs helping in the preparation of national climate change positions for international negotiations and increasingly being part of the national negotiation delegations (Corell and Betsill, 2001), in civil society and epistemic actors playing key roles in climate change policy assessments at all levels from the local to the global, etc.

Finally, we find civil society playing a very significant role by 'creating spaces for champions of policy reform' and providing platforms where these champions can advance these ideas. For example, the Pew Climate Initiative and Millennium Environmental Assessment are just two examples of how civil society has created forums and space for discourse amongst different actors, and not just civil society actors, to interact and advance the discussion on where climate change mitigation and sustainable development policy should be heading. Increasingly, civil society forums such as these are very cognizant of the need to broaden the participation in these forums to those from other institutional sectors of society.

12.2.3.5 Interactions

The shift from 'government to governance' has been accompanied by both a theoretical and a practical interest in how the three main arenas of actors – state, market and civil society – interact, including how they might work in concert to achieve improved outcomes from a sustainability perspective. The international social science literature offers a variety of perspectives that cast light on these questions including, but not limited to, work on 'partnerships' (Forsyth, 2005; **Najam** and Cleveland, 2003; **Hale**, 2004), 'deliberative democracy' (Gutmann and Thompson, 2004;

O'Riordan and Stoll-Kleeman, 2002; Levine, 2000), 'new institutionalism' (Scott, 1995; Dacin et al., 2002), 'institutional thickness' (Amin and Thrift, 1994; Day, 1998), and 'transition theory' (Elzen and Wieczorek, 2005; Geels, 2004).

We will discuss Deliberative Democracy, Partnerships and Transition Theory in more detail. Each of these has considered issues of governance in the context of climate change mitigation. The literature on deliberative democracy deals with issues of representation in decision-making, that on partnerships considers forms of cooperative governance and action, while the literature on transition theory seeks to explain how technological innovation occurs and how these processes might be channeled towards changing the technological composition of development pathways, e.g., in support of de-carbonisation.

Deliberative Democracy

According to Pimbert and Wakeford (2001) various social and political factors have brought support to the use of deliberative processes in policy making, planning and technology assessments, including 'uncertainty in the face of complexity' (p 25) of which climate change is an example. Taking a more moral perspective, "The premise of the 'democratic efficiency storyline' is that in order to build more effective multilateralism groups who are affected by environmental problems, or have a legitimate interest or stake, should have a voice in finding solutions" (Bäckstrand and Lövbrand, 2006: 55). And: "Attention has been given to the 'participation gap' in global environmental politics where the inclusion of so-called marginalised groups (women, youth, indigenous people, etc.) is seen as critical in realizing sustainable development" (Bäckstrand and Lövbrand, 2006: 55). Levine (2000) offers a more grounded justification, based on three observations. First, public debate over issues like global warming provides the public the opportunity to form opinions, where otherwise such an opportunity might not exist. Second, deliberative processes provide decision-makers with insight into the public mood. And, third, public deliberation affords the opportunity for the public to justify their views on matters of concern. In concert with this third point, Gutmann and Thompson (2004: p 3) state that "deliberative democracy affirms the need to justify decisions made by citizens and their representatives."

Notions of deliberative democracy emerge from the observed shift from 'government to governance', in that they refer to shared responsibility for the design of policy. O'Riordan and Stoll-Kleeman (2002) suggest that policy spaces are no longer characterised by hierarchical orders, and that opportunities have been opened for a variety of forms of public-private cooperation, policy networks, formal and informal consultation, working across scales from the multinational through to the local. The drivers, they suggest, include a need for new approaches to decision-making, occasioned by new mixes of private, public and civic actors. In order for processes of deliberative democracy to function, O'Riordan and Stoll-Kleeman posit that three principles must apply:

All this takes place in a political arrangement in which power is diffuse and shared, and where groups can form to create a combined opinion and articulate their biases persuasively and comprehensively (O'Riordan and Stoll-Kleeman 2002: p. 88). The practical implementation of such principles might be achieved in a variety of ways. For example, Levine (2000) advocates the reform of political campaigns, a role for media in cultivating deliberation, changes in the practices of civil society, regulatory reform and a resort to partnerships (see also the discussion below). O'Riordan and Stoll-Kleeman (2002: p. 93) present the following list of conditions under which deliberative democracy would be made possible in the context of policy decisions:

Patterns of government become more interconnected via a combination of partial empowerment, and more open partnerships.

Governance through processes of shared responsibility operate through networks of connected responsibilities rather than hierarchies of power and policy dominance.
Advocacy emerges through organised combinations of pressure and interest articulation, assisted by a fairly open and responsive media, and greater freedom of civil rights.
Procedures for respectful representation enable governing arrangements of common purpose and agreed rules of discourse and resolution to operate in an open and revealing manner, so that coalitions of interests are enabled to understand and appreciate each other.

However, the turn to deliberative democracy is not without its critics. In a sympathetic, but critical vein, Rayner (2003) points out that the advocates of public participation often rely on an implicit notion of the citizen who is: (a) socially embedded in the community, (b) locally knowledgeable and intuitively reflexive about society and nature, and (c) focuses on the common good as a core value of public life relies on inclusionary deliberation to deliver truth. This idealized model of the citizen, combined with key assumptions about how to create "ideal free speech" (Habermas 1984) may mask the realities of indifference, politics, and power that characterise real communities. The "discipline" imposed by deliberative processes can be profoundly alienating and serve to suppress deep disagreements about values and politics.

There are at least five issues that continually challenge social scientists engaged in the design and implementation of participatory mechanisms such as consensus conferences, focus groups, citizens' juries, and community advisory boards. These are:

Representation – Who and how to select? The challenge is both achieving representativeness of a community and establishing the legitimacy of those participating to speak on behalf of others
Resources – Participatory decision making requires substantial investment by all parties. Chiefly funding and logistical support on the part of governments and business and time on the part of citizens
Agenda framing – Too narrow a framing prejudges what the issues are, but overly broad framing frustrates closure
Effectiveness – Does consultation actually have impact on decisions? Disaffection deepens when citizens' deliberations are not seen to have traction and people think their time has been wasted
Evaluation – This is seldom done. Where it is done, it is usually self-evaluation of process rather than of outcomes.

Cooke & Kothari (2002) highlight particular problems of the participatory turn in the developing world, where women and other groups may be inadequately represented and where the process often serves to add legitimacy to government and donor driven development projects. Of course, critical perspectives such as these are not fatal to the ideal of increased public engagement in decision making. However, at the very least they should serve to remind us that participation and deliberation are in no sense a panacea for policy making.

Partnerships:
Partnerships between public and private actors can maximize impact by taking advantage of each partners' unique strengths and skill sets. The strategies of partnership, self-help and community empowerment have been used to encourage participation and to promote the idea that environmental problems are best addressed through communities working together and with government and industry. Partnership programmes can provide citizens groups with a lever for increasing pressure on both governments and industry to change in support of improved sustainability. Larner and Craig (2005) position partnerships as an outcome of neoliberal policy agendas, to the extent they

advocate collaboration, trust and partnership, and which cut across social, economic and environmental arenas.

One well-known example of an environmental partnership is the Australian Landcare programme, designed to rehabilitate degraded rural land. Landcare originated as a partnership between the Australian Conservation Foundation, Australia's largest environmental NGO, and the National Farmers Federation. Subsequently, the partnership was joined by the Commonwealth Government. Landcare was constructed in a way which appealed to both the farming and environmental sectors (Higgins and Lockie 2002). Many evaluations of Landcare and allied partnership programs indicate that they are well accepted by the community and have high participation rates (Curtis 1998). They have also enabled the development of programs that are locally meaningful and have increased awareness of sustainability issues (Cocklin 2004). On the other hand, Landcare and other partnership programs have been criticized for their excessive expectations of volunteers and their inability to demonstrate meaningful environmental outcomes (Wilson 2004). The shortcomings of Landcare – namely the burdens on participants and particularly community members, limited resources, and the absence of a clearly defined strategic vision – would seem to be almost endemic to the partnership concept (see, for example, Larner and Craig, 2005). Also, as "boundaries between and within public and private sectors have become blurred" (Stoker 1998): 17), questions have arisen about the authority, responsibility and accountability of different actors (Jessop 1995).

From an economic development perspective, one of the potentially fruitful styles of partnership has been between governments and industry through what is known as BOT projects – Build, Operate, Transfer. As Box 12.5 shows, however, despite their promise as a means of financing large-scale capital intensive projects, there have been significant difficulties in practice.

Box 12.5: Public- Private-Partnerships (PPPs)

Globally, public-private-partnerships (PPPs) are an increasingly popular tool governments use to fund large-scale infrastructure projects. Broadly, PPPs involve the investment of private capital and the use of private sector expertise to deliver public infrastructure and services. There are various forms of PPPs. In the power generation sector, popular examples of PPPs are Build-Operate-Transfer (BOT) projects. In a BOT project, private partners (investors) provide the financing and technology, they build, and they operate the power generation facility for a concessionary period of up to 35 years. During the concession, a government partner provides the investor with ownership rights and gradually buys back the project by providing the developer with the right to charge consumers a fee for its product. At the end of the concession period, the facility is transferred to government ownership at no further cost to the government.

BOT projects have enabled developing country governments with growing energy needs to access new financial capital for green or intermediate fuel technologies for power generation. For example, Vietnam is utilising such investments for natural-gas fired turbines, and Laos is engaging in a large program of hydropower construction to supply electricity to a regional power grid in the Greater Mekong Subregion. However, they have also enabled governments to bring on-line more conventional fossil-fuel powered generating capacity in regions where alternative fuels are not available - heavy oils in some regions of China and coal in Thailand.

While PPPs have assisted governments with access to new financial capital and expertise to invest in cleaner power generating capacity, care needs to be taken in evaluating their costs, benefits and risks to governments and consumers. In uncertain investment environments such as that in developing countries, private partners require a range of onerous guarantees from governments

to reduce their investment risks over the life of the projects. These include take-or-pay guarantees where governments commit to purchase a minimum level of production, guarantees to cover currency exchange risks, fuel supply price guarantees, political risk guarantees to protect against government regulatory change, etc.. In the aftermath of the East Asian financial crisis that began in 1997, governments such as the Philippines and Indonesia paid a high price for guaranteed power purchases that were denominated in US dollars as their currencies devalued respectively and power demand from industry dropped.

A fusion of ideas about partnerships and the mechanisms of deliberative democracy, such as stakeholder dialogue and input, leads Forsyth (Forsyth 2005) to suggest that local involvement in public-private partnerships may help resolve the stand-offs over global environmental agreements like the UNFCC. Cooperative environmental governance models offer advantages such as a more structured framework for pluralist contributions to policy, consensus-building, more stable policy outcomes, and social learning. Though these cooperative models do allow for more stakeholder participation, it can be argued that they fail to fully address exclusion of minority and less powerful groups, non-representative outcomes, and a failure to integrate local knowledge. Forsyth's analysis of waste-to-energy projects in the Philippines and India confirms that such problems will be encountered. He concludes that "deliberative public-private partnerships work most effectively when investors, local governments and citizen groups are willing to work together to implement new technologies, and produce arenas to discuss these technologies that are locally inclusive" (Forsyth 2005). Further:

"Building capacity for deliberative partnerships that address both global concerns such as climate change policy and local environment and livelihood concerns does not simply mean educating local people about predefined institutional structures or environmental risks. Instead, it means creating a deliberative space between investors and citizen groups that allow open communication between all parties, an act that frequently requires actors to define their own spaces (or negotiating arenas) rather than accept usual models such as public consultations with the local government".

The notion that partnerships between sectors is the wave of the future was given particular credibility by the World Summit on Sustainable Development in Johannesburg, South Africa, in 2002 where several 'Type II' partnerships were launched involving various combinations of governments, business and civil society actors (Najam and Cleveland, 2003; Hale, 2004; Bäckstrand and Lövbrand, 2006). Although it is too early to evaluate the impacts of these particular partnerships, they do represent a larger trend whereby the last decade has seen a far greater level of partnership activities between governments and NGOs on the one hand, between government and business on the others, and now increasingly all three. Such multi-sector forums and partnerships are no longer a phenomenon limited to a few industrialized countries nor to particular sectoral mixes. One finds cross-sectoral partnerships and the search for meaningful cross-sectoral partnerships in developing and industrialized countries alike and one finds them being initiated equally by governments, business and civil society.

The partnerships perspective relies on the conscious collaboration of the partners in pursuit of commonly defined and agreed goals. Yet domestic and international debates about climate change highlight the problem of decision making in situations where the relevant actors may approach an issue with very different definitions of what the problem is and where there is conflict over appropriate courses of action (Thompson & Rayner 1998). The concept of "clumsy institutions" (Shapiro 1988) was devised to help understand how new solutions can emerge from situations where participants are operating with contradictory, even conflictual definitions of a problem and the available solutions that arise from those definitions.

In clumsy situations, the perspectives of governments, business and civil society interact in a conflictual mode in which no single perspective or pair of perspectives is able to achieve dominance over the others. The emergent outcome can be of three sorts: gridlock; unstable compromise; or a stable, emergent solution, in which all of the participants participate through mutual accommodation of the others' viewpoint in practice, but without necessarily agreeing on any single conceptualisation of the problem or appropriate solutions. The emergence of clumsy solutions in environmental and development issues is well documented (Verweij & Thompson 2006).

Transition Theory:
Although the terminology of clumsiness has not been consistently used, there is a relatively small, but persistent body of thought that has advocated adopting a clumsy approach to climate policy formulation at national and international levels (Rayner 1991, Rayner & Malone 1997, Thompson & Rayner 1998, Verweij et al 2006). What can loosely be referred to as 'transition theory' (Elzen and Wieczorek, 2005) offers another perspective on 'society – market – state' relations, but importantly also presents some insights into how societies can shift onto more sustainable trajectories. Berkhout (2002) observed that policy communities are confronted with a major challenge in the form of shaping a substantially de-carbonised future and that this necessitates a better understanding of the links between technologies and the institutions in which they are imbedded (see also Geels, 2004). According to Elzen and Wieczorek (2005: 651):

"In a transition, both the technical as well as the social/cultural dimensions of such a system change drastically. This emphasis on the co-evolution of technical and social change distinguishes transitions from incremental processes, which are primarily characterised by technical change (through successive generations of technologies) with relatively little alteration of the societal imbedding of these technologies".

The important questions that arise refer to the factors that impede transitions and, of particular interest to policy communities, how transitions could be induced.

Geels (2004) identifies three interrelated dimensions that influence the processes of innovation. These are the: (1) socio-technical systems, which include material artefacts, knowledge, capital, labour and cultural meaning; (2) rules and institutions, wherein rules may be regulative (formal rules), normative (values, norms), and cognitive (beliefs, agendas), and; (3) human actors, organisations and social groups, which include public authorities, consumers, NGOs, firms, financiers, etc. Each of these dimensions has characteristics of stability and resistance to change (see also Walker, 2000). For example, socio-technical systems are often characterised by technological lock-in and path dependency, while actors and organisations become imbedded in interdependent networks and mutual dependencies (Geels, 2004; Berkhout, 2002; Walker, 2000).

The question is how this inherent stability can be overcome. Elzen and Wieczorek (2005) outline options for inducing innovation under different governance paradigms – the top-down, command-and-control approach (state), a market model, or through policy networks (processes, interactions, networks). Geels (2004) and Smith (2003) approach the same question, but from a different perspective, both concluding that radical innovations are nurtured in 'niches'. Niches exist in a hierarchy of levels, where they sit below what Geels (2004) labels 'sociotechnical landscapes' and 'regimes'. Both of these levels are resistant to change, for the reasons outlined above. However, they can be destabilised by a wide range of factors: "Climate change, for instance, is currently putting pressure on energy and transport sectors, triggering changes in technical search heuristics and public policies" (Geels, 2004: 914). In instances where instability arises, innovations developed at the

niche level are diffused, leading ultimately to a situation in which both regimes and sociotechnical landscapes are shifted onto new trajectories (Geels, 2004; 2005).

While Geels (2004; 2005) describes the characteristics of niches, there is less insight provided into how they are created, sustained and then nurtured in order to bring about transitions. Berkhout (2002) offers that this will require substantial commitments from governments and businesses. This alone is unlikely to be sufficient and Elzen and Wieczorek (2005) caution further that 'transition policy' is a misnomer in any event, because it involves a time frame and diversity of effort that is inconsistent with political realities. They do suggest, though:

"Since innovation in technologies and markets cannot be limited to the actions of individual firms, but involves networks of firms and other actors (especially users), the role of government agencies in 'network governance' can be legitimately re-examined. Possibly, public authorities need not to pick the winners themselves, but could take upon them facilitating roles such as network builder, information exchanger, or agenda builder for the most desirable directions to be followed (as in foresighting activities). In transition management, there is probably no clear-cut divide between the public and private spheres – the question is how to balance the most effective levers of change" (Elzen and Wieczorek, 2005: 660).

While the extant literature on transition theory is vague on how to induce innovations, such as those that might bring about a shift onto a more sustainable development trajectory, it usefully emphasises the importance of interactions amongst actors/organisations, technology and institutions. As far as a shift to a more sustainable trajectory is concerned, though, Smith (2003) provides an important reminder that technical change has traditionally occurred in the context of economic growth. Sustainable development, he suggests, implies that "the problem ordering shifts subtly yet profoundly", which will establish new challenges if we are to achieve "publicly managed transitions towards environmentally sustainable technological regimes" (Smith, 2003: 134). In the context of climate change, acknowledged in the literature on transition theory as an impetus for technological innovation, it is clearly important to address this challenge; this will require new approaches to the governance of technological change and innovation (Berkhout, 2002; Elzen and Wieczorek, 2005).

12.2.4 Mainstreaming climate change into development choices

The previous IPCC assessment highlighted the vulnerability of the poor to the impacts of climate change, and the need to focus on adaptation. Still, mainstreaming climate change mitigation into development policies is also important and involves major challenges.

Mainstreaming requires that policies, programs and/or individual actions that otherwise would not have taken climate change mitigation into consideration be explicitly included when making development choices. Mainstreaming may be implemented in order to facilitate reaching a baseline pathway and also to further reduce emissions.

The ease or difficulty with which mainstreaming is accomplished will depend on both the mitigation technology or practice, and the underlying development path. No-regrets energy efficiency options, for instance, are likely to be easier to implement (and be labelled as climate change mitigation actions) than others that have higher direct cost, require coordination among stakeholders, and/or require a trade-off against other environmental, and social and economic benefits. Weighing other development benefits against climate benefits will be a key basis for choosing development sectors for mainstreaming climate change considerations. In some cases, it may even be rational to

disregard climate change considerations because of an action's other development benefits (Smith 2002).

Mainstreaming demands that non-climate policies take climate change mitigation into consideration. Non-climate policies, such as electricity privatization, can increase emissions if they result in construction of natural gas power plants in place of hydroelectric power for instance, but they can reduce emissions if coal power plants are avoided from being built. Judicious and informed choices will be needed when pursuing non-climate policies in order to ensure that GHG emissions are reduced and not increased.[6] Which sectors should receive priority for mainstreaming climate change mitigation into development choices? Are there sectors that are better off not pursuing mainstreaming? Which stakeholders might have a bigger stake and voice in mainstreaming?

Prioritizing Sectors for Mainstreaming:
Prioritizing requires that the current and future associated emissions of the targeted sector and the mitigation potential of the non-climate SD action be estimated. Policy makers can then weigh the emissions reduction potential against other benefits of the SD action in choosing the appropriate policy to implement. In order to implement such an approach empirical analyses are needed which would estimate future associated emissions and current and future mitigation potential of SD actions. Few, if any, global analyses exist that provide complete guidance of this type. In light of the lack of empirical analyses, in the discussion below, we present the associated emissions for selected sectors in which SD actions may be pursued. This provides an initial guidance in ranking SD actions. A more complete analysis is needed, however, which would require the estimation of future associated emissions and current and future mitigation potential of SD actions.

Figure 12.4 shows selected examples of CO2 emissions associated with sectors where sustainable development actions could be implemented. These are described below:

Emissions associated with selected sectors:

- Through fiscal tax and subsidy policies public finance can play an important role in reducing emissions. Rational energy pricing based on long-run-marginal-cost principle can level the playing field for renewables, increase the spread of energy efficient and renewable energy technologies, improve the economic viability of utility companies, and can reduce greenhouse gas emissions. Non-climate taxes/subsidies and other fiscal instruments, can impact the entire global fossil fuel emissions of CO_2, which amounted to 23.7 Gt CO_2 in 2002. Those that directly reduce fossil fuel use could be easily relabelled and mainstreamed as climate taxes, but others, for example a tax on water use, would need to be evaluated for their fossil fuel impacts and climate benefits.
- Adoption of forest conservation and sustainable forest management practices can contribute to conservation of biodiversity, watershed protection, rural employment generation, increased incomes to forest dwellers and carbon sink enhancement. The forestry sector emissions show a high and low range to signal the uncertainty in estimates of deforestation. Chapter 9.3 of this report notes that these emissions amounted to 4.0 Gt CO_2 with a +-1 Gt CO_2 uncertainty. There are many country-specific studies of the potential to reduce deforestation, but most global studies of such a potential are driven by climate considerations, i.e. in response to a carbon price (Chapters 3 and 9). One global study (Sohngen and Sedjo 1999) for instance estimated a long-term potential of setting aside 10% of forest land in North America and Europe to be between -0.54 to 2.86 Gt C by 2045.

[6] See Section 12.2.2.2 for a discussion of the ambiguous impact of certain policies.

- Adoption of cost-effective energy efficiency technologies in electricity generation, transmission distribution, and end-use reduce costs and local pollution in addition to reduction of greenhouse gas emissions. Electricity deregulation or privatization can be practiced in any country and can impact the global electricity-related emissions which amounted to 8.2 Gt CO_2.
- Energy security is important to ensure reliable supply of fuels and electricity. Diversification of oil imports, through increasing imported and domestic sources oil and other energy carriers is an approach that has been adopted by countries concerned about energy security. The percentage of net oil imports serves as one indicator of a country's energy security. Figure 12.4 shows the CO_2 emissions associated with net oil imports for 80 and 87 countries where these accounted for more than 75% and 50% of their primary oil[7] supply respectively. These emissions amounted to 5.1 and 7.4 Gt CO_2. Reducing oil imports as a strategy to improve energy security thus offers a significant global opportunity to reduce emissions. Minimizing the use of coal as a substitute, and increasing use of LCI fuels and reducing energy intensity of the economy are options that could be pursued to achieve this goal (IEA, 2004b).

Example of a sector where other benefits outweigh mainstreaming:

- Development of rural regions, better irrigation and water management, rural schools, better cook stoves, etc. in developing countries can promote sustainable development. The emissions associated with rural household activities, mostly derived from energy needed for cooking and some heating, are relatively small however, estimated to be between 10% -15% of developing-country residential sector emissions or 170-255 Mt CO_2, because rural areas of developing countries rely primarily on traditional biomass fuels[8] and consume comparatively small amounts of fossil fuels. The use of improved cook stoves is one way to reduce biomass and fossil fuel use.
- The worldwide amount estimated by Smith (2002) for provision of LPG as fuel for roughly two billion households is about 2% of global GHG emissions. From a global perspective, Figure 12.4 suggests that smaller sectors that have significant other welfare benefits need not be burdened with having to reduce CO_2 emissions since larger gains from sustainable development actions that address climate change mitigation are to be had elsewhere.

Emissions that key stakeholders can influence:

- While climate change mitigation is an important component of the multilateral bank (MDB) strategies, in practice climate change issues are not systematically incorporated into lending for all sectors. Multilateral development banks could explicitly integrate climate change considerations into their guidelines for country and sector strategies, and apply a greenhouse gas accounting framework in their operations (Sohn, Nakhooda et al. 2005). Multilateral development banks (MDBs) can directly influence their own lending and indirectly influence the emissions of borrowing countries. The annual emissions from World Bank-funded energy activities alone for instance were estimated to range from 268 to 323 Mt CO_2 (World Bank, 1999). MDBs could directly influence more than the aforementioned amounts once emissions associated with all lending activities of all MDBs are counted. Indirectly, through policy dialogue and conditionality, MDBs could influence the emissions from developing countries, which amounted to 11.2 Gt CO_2 in 2002.
- Buildings and transport vehicles form bulk of the insured activities. Assuming that 90% of the emissions in industrialized countries, 50% in former Soviet Union region, 20% in developing countries, and those from all international marine vessels and aircraft are from insured sources yields a total emissions of 9.6 Gt CO_2, giving insurers a significant potential role in controlling emissions. Insurers are increasingly recognizing climate-change risks to their business (Vellinga et al. 2001; Mills 2005). Examples of such actions may include premiums differentiated to re-

[7] Oil includes crude oil, natural gas liquids, feedstock, and petroleum products.
[8] Biomass fuel use is assumed to be GHG emissions neutral.

flect vehicle fuel economy or distance driven; liability insurance exclusions for large emitters; improved terms to recognize the lower risks associated with green buildings; or new insurance products to help manage technical, regulatory, and financial risks associated with emissions trading (Mills 2003).

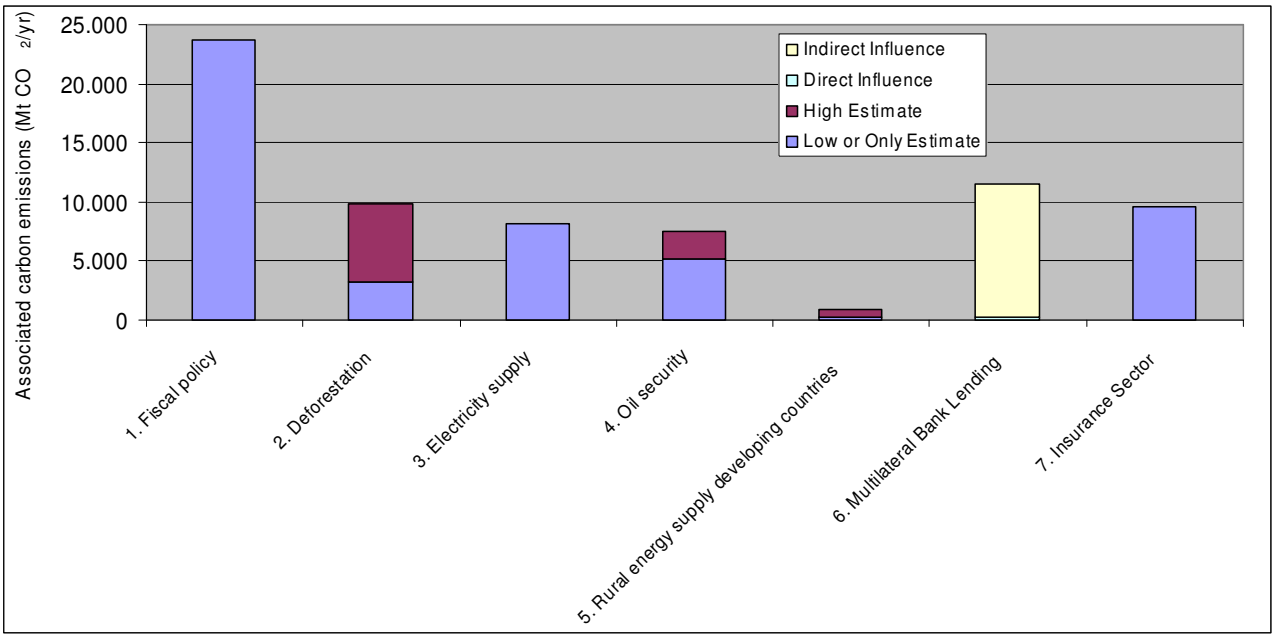

***Figure 12.4**: CO_2 emissions associated with sectors that could be targeted for non-climate actions (2002)*

Source: Energy sectoral data from Price et al. (2006)

Notes: Chart shows 2002 CO_2 emissions associated with selected significant sectors where non-climate actions could lead to either increases or decreases in GHG emissions. The size of the bar shows the opportunity for mainstreaming mitigation. (The global mitigation potential of non-climate actions is only sparsely reported in the literature. Data on other sectors, and mitigation potential will be added to this chart, after the completion of the SOD, to the extent the latter is reported in other AR4 chapters.)

Operationalization of mainstreaming

Case studies in Tanzania (Agrawala, Moehner et al. 2003), Fiji (Agrawala, Ota et al. 2003b), Bangladesh (Agrawala, Ota et al. 2003a), Nepal (Agrawala, Raksakulthai et al. 2003), Egypt (Agrawala, Moehner et al. 2004b) and Uruguay (Agrawala, Moehner et al. 2004a) show how climate change adaptation can be integrated with national and local development policies, often as a no-regrets strategy. Implementation of such no-regrets strategies is however, not without challenges. Based on a number of Indian case studies, Heller and Shukla (Heller and Shukla 2003)note operational guidelines which can integrate development and climate policies into the future development pathways of developing countries. In developing countries, which by and large have not yet enacted domestic GHG legislation, the CDM can play a role as one component of national GHG reduction strategies and sustainable development.

Based on a USEPA (2006) report on best practices for implementation of clean energy policies and programs, Sathaye et al. (2006) conclude that following best practices would benefit the operationalization process: (i) commitment of publicly elected and/or regulatory bodies, (ii) involvement and support of key stakeholders, (iii) sound economic and environmental analyses that are conducted using simple and transparent tools, (iv) longer time frames for programs so that they can overcome market and funding cycles, (v) setting annual and cumulative targets to gage progress of mainstreaming, (vi) ensuring additionality over and above existing and other planned programs,. (vii) selection of an effective entity for implementation, (viii) education and regular training of key par-

ticipants, (ix) monitoring and evaluation of mainstreaming results, and (x) maintenance of a functional database of a project's or program's sustainable development performance.

A study of the Baltic region explores a sustainable development pathway addressing broad environmental, economic and social development goals, including low GHG emissions. It points out that a majority of the population could favor — or at least tolerate - a set of measures that change individual and corporate behaviors to align with local and global sustainability (Raskin, Gallopin et al. 1998). Kaivo-oja *et al.* (Kaivo-oja, Luukkanen et al. 2004) concludes that climate change as such may not be a major direct threat to Finland, but the effects of climate change on the world's socio-economic system and the related consequences for the Finnish system may be considerable. The Finnish scenario analysis, which is based on intensive expert and stakeholder involvement, suggests that such indirect consequences have to be taken into account in developing strategic views of possible future development paths for administrative and business sectors.

MNP (MNP (Netherlands Environmental Assessment Agency) 2005)has developed the four IPCC SRES scenarios into more elaborate for a sustainability outlook for the Netherlands, noting that the four scenarios represent four world perspectives with four different views on future priorities for action to make development more sustainable. This outlook points at several dilemmas. Surveys showed that 90% of the population prefers a future which would be different from the globalizing, market -oriented A1 scenario, while A1 appears to be the future they are heading for. A majority of the population also thinks that something has to be done about unsustainable production and consumption patterns, but suggest that the government should do more. The study suggests that the regional (European) level may be the most appropriate level to address sustainability issues: global political, economic and cultural differences make effective global policy difficult, while many of the sustainability issues go beyond the local or national capacity to develop and implement effective policies.

12.3 Implications of Mitigation Choices for Sustainable Development Goals

As documented in the TAR, the current array of commercially available technologies and practices, if deployed on a wider scale, can be adequate to stabilize climate change. Many or most of these technologies and practices are being deployed at various scales in the world today. The use of renewable energy and energy efficiency technologies, for instance, is growing worldwide as countries pursue pathways to reduce deleterious impacts and improve energy productivity. Carbon sequestration is being enhanced by the annual planting of tens of millions of ha of land, and landfill methane gas capture is spreading quickly worldwide. The sectoral chapters provide an overview of the impacts of the implementation of such technologies and practices. In this section, we summarize their synergies with local sustainable development goals, cite conditions for their successful implementation, and note tradeoffs where the climate mitigation and local sustainable development may be at odds with each other (Table 12.3).

As documented in the sectoral chapters current development paths may not always be sustainable with respect to all three dimensions of SD -- economic, environmental and social. Some pathways are not directly related to the generation process of greenhouse gases themselves, but induced by shifts in the technical and socio-economic background. For example, removing subsidies for coal increases its price and creates unemployment of coal mine workers, independently of the actual mitigation (IPCC (Intergovernmental Panel on Climate Change) 2001b). Other pathways are more indirect by creating side-effects of reducing GHG-emissions. For example, an increase in energy efficiency in heating or cooking, in particular in developing countries, reduces the emission of pol-

lutants like SO_2 and/or carbon particulates. This has beneficial effects for local or indoor air quality and in the longer term also for human health.

Possible side effects of mitigation policies can either be positive or negative with respect to the promotion of sustainable development. For the time being, uncertainties on the different SD impacts are high and often only qualitative information or individual case studies exist. Therefore, it is not always possible to assess the net outcome of the various effects.

The sustainable development benefits of mitigation options vary within a sector and over regions. Generally, mitigation options that improve productivity of resource use, whether it is energy, water, or land, yield positive benefits across all three dimensions of sustainable development. In the agricultural sector (Table 8.4.5) for instance, improved management practices for rice cultivation and grazing land, and use of bioenergy and efficient cook stoves enhance productivity, and promote social harmony and gender equality. Other categories of mitigation options have a more uncertain impact and depend on the wider socioeconomic context within which the option is being implemented. Nuclear and large hydro energy supply reduce carbon emissions but can have other environmental and social impacts that are not beneficial.

Some mitigation activities, particularly in the land use sector, have GHG benefits that may be of limited duration. A finite amount of land area is available for forestation, for instance, which limits the amount of carbon that a region can sequester. And, certain practices are carried out in rotation over years and/or across landscapes, which too limit the equilibrium amount of carbon that can be sequestered. The incremental sustainable development gains to be had would thus reach an equilibrium condition after some decades unless the land yields biofuel that is used as a substitute for fossil fuels.

In the sectoral discussion below we focus on the three aspects of sustainable development -- economic, environmental and social. Sectoral costs of various mitigation policies have been widely studied and a range of cost estimates are reported for each sector at both the global and country-specific levels in the sectoral chapters 4 through 10. Among the various sectors, the costs of mitigation in the energy supply sector have been reported more than in the other sectors. Yet mitigation costs are just one part of the broader economic impacts of SD. Other impacts include growth and distribution of income, employment and availability of jobs, government fiscal budgets, and competitiveness of the economy or sector within a globalizing market.

The social dimension includes issues such as gender equality, governance, equitable income distribution, housing and education opportunity, energy security, health impacts, and corruption. All forms of development paths, including those that pursue climate mitigation, impact these issues. Since there are lessons to be learned about the impacts of all development paths, the discussion below is not confined to the implementation of mitigation options alone.

Environmental impacts include those occurring in local areas on air, water, and land, including the loss of biodiversity. Virtually all forms of energy supply and use, and land-use change activity cause some level of environmental damage. The emission of greenhouse gases (GHG) is often directly related to the emissions of other pollutants, either airborne, e.g. sulfur dioxide from burning coal which causes local or indoor air pollution, or waterborne, e.g., from leaching of nitrates from fertilizer application in intensive agriculture

12.3.1 Energy Sector

Mitigation options in the energy sector may be classified into those that improve energy efficiency and others that reduce the use of carbon-intensive fuels. The latter may be further classified into domestic and imported fuels. Table 12.3 shows the synergies and tradeoffs of these options with economic, local environmental, and social sustainable development goals. In the case of energy efficiency, it is generally thought to be cost effective and its use reduces or eliminates local pollutant emissions. Improving energy efficiency is thus a desirable option in every energy demand and supply sector.

***Table 12.3**: Sectoral Mitigation Options and Sustainable Development (Economic, Local Environmental and Social) Considerations: Synergies and Trade-offs*

Sector and Mitigation Options	Potential SD synergies and conditions for implementation	Potential SD trade-offs
Energy Sector		
Energy efficiency improvement in all sectors (buildings, transportation, industry, and energy supply)	Almost always cost-effective, reduces or eliminates local pollutant emissions and consequent health impacts, improves indoor comfort and reduces building noise level, creates business opportunity and jobs, socially neutral and improves energy security Government and industry programs can help to overcome lack of information and principal agent problems Programs need to be implemented at all levels of government and industry Programs targeted at poverty reduction and gender empowerment needed to ensure that SD goals are met	Interaction between energy and other factors of production should be considered in assuring that these are complementary Important to ensure that low-income household energy needs are given due consideration, and that the process and consequences of implementing mitigation options are gender-neutral Indoor air pollution and health impacts of improving biomass cook stove thermal efficiency in developing country rural areas are uncertain
Fuel switching and other options in the transportation sector	Institutionalizing planning systems for CO_2 reduction through coordination between national and local governments is important for drawing up common strategies for sustainable transportation systems. CO_2 reduction costs may be offset by increased health benefits Promotion of non-motorized transport has large and consistent co-benefits	Switching fuels can incur tradeoffs Diesel engines are generally more fuel-efficient than gasoline engines and thus have lower CO_2 emissions, but increase particle emissions. Other measures (CNG buses, hybrid diesel-electric buses and taxi renovation) may provide little ancillary climate benefits.
Replacing imported fossil fuel with domestic alternative energy sources (DAES)	Important to ensure that DAES is cost-effective Reduces local air pollutant emissions. Can create new indigenous industries (e.g., Brazil ethanol program) and hence generate employment opportunities	Balance of trade improvement is traded off against increased capital required for investment Fossil-fuel-exporting countries may face reduced exports DAES construction may displace local populations and cause environmental damages to water bodies and biodiversity Important to ensure that IAES implementation is gender and income neutral
Replacing domestic fossil fuel with imported alternative energy sources (IAES)	Almost always reduces local pollutant emissions Implementation may be more rapid than DAES Important to ensure that IAES is cost-	Could reduce energy security Balance of trade may worsen but capital needs may decline Important to ensure that IAES implementation is gender and income neutral

	effective Economies and societies of fuel-exporting countries would benefit	
Forestry Sector:		
Forestation	Can reduce wasteland, arrest soil degradation, and manage water runoff Can retain soil carbon stocks if soil disturbance when planting and harvesting is minimized Can be implemented as agroforestry plantations that enhance economic benefits and increase food security Can benefit rural economy, generate employment opportunities for women, and create rural industry May require joint management of community and forest lands Clear delineation of property rights would expedite implementation of forestation programs	Use of scarce land could compete with agricultural land and diminish food security Monoculture plantations can reduce biodiversity and increase risk of severe economic loss Conversion of floodplain and wetland could hamper ecological functions
Avoided deforestation	Can retain biodiversity, water and soil management benefits, and local rainfall patterns Reduce local haze and air pollution from forest fires If suitably managed, it can bring revenue from ecotourism Successful implementation may be achieved by providing alternative livelihood to local deforesters, enforcing laws to prevent migrants from encroaching on forest land, and joint forest management	Can result in loss of social welfare (economic). Reduced timber supply may lead to reduced timber exports and increased use of GHG-intensive construction materials Local dwellers and migrant labor may lose jobs
Bio-energy production	Can be practiced synergistically where crop residues (shells, husks, bagasse, and/or tree trimmings) are utilized. Brings positive SD benefits. Planting crops/trees exclusively for bioenergy production also brings positive SD benefits similar to those noted for forestation, but requires that adequate agricultural land be available for planting bioenergy crops	Potential problem wih food security (location specific); competition can be re land, labour, finance and … (FAO, ….)
Forest Management	Most practices bring positive SD benefits.	Fertilizer application can increase N2O production and nitrate runoff degrading local water quality Prevention of fires and pests has short term benefits but can increase fuel stock for later fires unless managed properly
Agriculture:		
Cropland mgmt. – Agronomy, and management of nutrient, tillage/ residue, and	Environmental benefits are positive, but social and economic benefits are uncertain for these practices Improved nutrient management can enhance	Tillage/residue management has positive environmental impacts but other impacts are uncertain

organic soils, and agroforestry	ground water quality and environmental health of the cultivated ecosystem	
Cropland mgmt. – Water, Rice, and set-aside and land-use change	Environmental, economic, and social benefits are generally positive for these practices Largest water-using sector worldwide Perverse policies aid and abet water overuse	Short-run, changes in water policies would aggravate social cohesiveness and clash of divergent interests
Grazing land mgmt.	Improves livestock productivity, reduces desertification, and provide social security to the poor Requires laws and enforcement to ban free grazing as was done in China	
Livestock management	Mix of traditional rice cultivation and livestock management would enhance incomes even in semi arid and arid regions	
Waste Management:		
Recycling and Reuse	SD benefits increase with level and sophistication of implementation Requires laws, regulations, and/or programs to foster implementation.	There is a sizeable but undocumented unofficial market in waste collection and reuse by scavengers in many developing countries. While this does provide employment to a large number of people, it is also prone to adverse health impacts on scavengers and is not a desirable employment option.
Biomass combustion	As above	Is itself a source of CO2 emissions.
Biological treatment	Can be a potential source of fertilizer.	
Landfilling	Can lead to the creation of public spaces for recreation and other social purposes.	When not done properly can cause leaching that leads to soil contamination with potentially negative health impacts

As noted in Section 12.1.2, over the last decade, quantification of the progress towards sustainable development has gained ground. In the industrial sector, several trade associations provide platforms for organizing and implementing GHG mitigation programs. Chapter 7 in this AR4 report, notes that performance indicators are being used by the aluminium, semiconductor, and cement industry to measure and report progress towards SD. The Global Reporting Initiative (GRI) a UNEP Collaborating Centre initiative, for example, reports that over 700 companies worldwide make voluntary use of its Sustainability Reporting Guidelines for reporting their SD achievements. Industrial sectors with high environmental impacts lead in reporting and 85% of the reports address progress on climate change (GRI (Global Reporting Initiative) 2005, and KPMG Global Sustainability Services 2005). Another example is in the buildings sector, where several thousand commercial buildings have been certified by the US Green Building Council's program on Leadership in Energy and Environmental Design (LEED), which uses 69 criteria to award certificates at various levels of achievement. The certification ensures that a building meets largely quantitative criteria related to energy use, indoor air quality, materials and resource use, water efficiency, and innovation and design process (www.usgbc.org) (USGBC (U.S. Green Building Council) 2005). Economic and ethi cal considerations are the most cited reasons by businesses in the use of these two guidelines.

12.3.1.1 Energy Efficiency

:In the buildings sector energy efficiency options may be characterized as integrated and efficient designs including passive and performing technologies, and urban planning to limit heat island effect and allow passive solar designs. Considering energy efficiency as the guiding principle during the construction of new homes results in both reduced energy bills —enhancing the affordability of

increased energy services— and GHG abatement (Chapter 6.5.1). Policies that actively promote integrated building solutions for both mitigating and adapting to climate change are especially important for the buildings sector (Chapter 6.5.2). Good urban planning, including increasing green areas as well as cool roofs in cities, has proven to be an efficient way to limit the heat island effect, which also aggravates the increased cooling needs. Mitigation and adaptation investments may compete for the same, limited set of financial resources. It is thus essential to identify those measures that address both goals simultaneously.

In developing countries, efficient cook stoves that use clean biomass fuels are an important option. These can have significant health benefits including reduction in eye-diseases, the incident of which is disproportionately high amongst rural women in many developing countries where fuel wood is a principal source of ener gy (Porritt 2005). It has also been shown, for example, that the availability of cleaner burning cookers and solar cookers in developing countries not only has important health benefits but also significant social benefit in the lives of women in particular (Dow and Dow 1998). For example, in many cases a dependence on fuel wood also means the investment of time and effort in gathering fuel wood. A move to a more reliable and cleaner fuel not only has benefits in terms of carbon emission and health it also has the effect of freeing up significant amount of time for women and children which can then be applied to more socially beneficial activities, including going to schools in the case of children. The air pollution benefits of improved stoves is controversial, however, as other studies have noted that efficiency was improved at the expense of higher emissions of harmful pollutants (Chapter 4.5.4.1).

In the transport sector, the energy efficiency measures may be categorized into those that are vehicle specific and others that address transportation planning. Vehicle specific programs focus on improvement to the technology and vehicle operations. Planning programs are targeted towards street layouts, pavement improvements, lane segregation, etc. that improve vehicle movement. Cost-effective mitigation measures of both types have been identified that result in higher vehicle and/or trip fuel economy and reduce local air pollution. Institutionalizing planning systems for CO2 reduction through coordinated interaction between national and local governments is important for drawing up common strategies for sustainable transportation systems (Chapter 5.4.1). A voluntary agreement for contribution of a cess by private oil companies to the Swiss government is noted as an effective example for improving transportation systems in that country. While there are many synergies in emission controls for air pollution and climate change, there are also trade-offs (Chapter 5.4.3). Promotion of non-motorized transport (NMT) has large and consistent co-benefits of GHG reduction, air quality, and people health improvement. On the other hand, measures in the transport sector (CNG buses, hybrid diesel-electric buses and taxi renovation) proved to provide little ancillary climate benefits for instance. Diesel engines are generally more fuel-efficient than gasoline engines and thus have lower CO_2 emissions, but increase particle emissions. Air quality driven measures, like obligatory particle matter (PM) and NOx filters and in-engine measures, mostly result in higher fuel use and consequently higher GHG emissions.

In the industrial sector, energy efficiency options may be classified as those aimed at mass-produced products and systems, and those that are process-specific. The potential for cost-effective measures is significant in this sector. Measures in both categories would have a positive impact on the environment. To the extent the measures improve productivity, they would increase economic output and hence add to government tax revenue. Higher tax revenue would benefit national, state and local government fiscal balance sheets (Chapter 7.7, Phadke, Sathaye et al. 2005, Nadel, S. et al. 1997 and Barrett, Hoerner et al. 2002). The impact of industrial energy efficiency improvement on gender and the poor is uncertain unless programs are specifically designed to address the issues of gender equality and empowerment of the disadvantaged.

Since energy efficiency improvement reduces the reliance on energy supply, it is likely to improve a nation's energy security. Using prices as an instrument to promote energy efficiency mitigation options is often difficult due to the many barriers that impede their progress. Lack of information about such mitigation options and the principal agent problem have been documented to be particularly significant barriers in the residential sector, but these also prevail in the small and medium scale industries sectors (Sathaye and Murtishaw 2005). Programs that can overcome such barriers would increase energy efficiency penetration. Both the implementation process and goals of such programs could be made gender neutral and to favour the disadvantaged.

While in the above example, energy efficiency mitigation measures are estimated to increase productivity, economic growth, competitiveness and jobs, this may not always be the case. Privatization of electricity systems is a common theme worldwide. As noted in Section 4.5.4, privatization of many systems in Latin America and Africa is likely to increase competitiveness at the cost of new and existing jobs. A prioritization of mitigation options on the basis of these attributes will be essential to ensure that other sustainable development objectives are not compromised for the sake of rapid economic growth.

12.3.1.2 Switching to less carbon intensive (LCI) fuels:

Switching to less-carbon-intensive (LCI) fuels is the other mitigation measure in the energy sector. This can be achieved through either increased reliance on imported or indigenous fuels. Using a higher proportion of LCI imported fuels will almost always reduce local air pollution. Its direct impact will be to increase payment for fuel imports that may result in worsened balance of payments unless these are utilized to increase a nation's exports (Sathaye et al. 1996). The higher fuel imports will increase dependence on international fuel supply that may result in reduced energy security unless diversification of supply mitigates concerns about increased dependence. Economies and societies of LCI exporting countries would benefit from the higher trade.

Increased reliance on most indigenous LCI fuels would also reduce local air pollution although the local environmental benefits in certain solid biofuel applications appear to be uncertain (Chapter 4.5.4.1). While indigenous LCI fuels can reduce fuel imports, these have to be balanced against higher capital requirements for investment in the extraction, processing and delivery of fuel (Sathaye et al. 1996). The development of large hydro LCI sources can displace local populations and put their livelihood in jeopardy, and in reservoirs with large surface area, the resulting methane emissions may reduce their net GHG benefit substantially. For example, although hydroelectric plants have the potential of reducing greenhouse emissions significantly, there is a large environmental literature that points to important environmental costs (McCully 2001; Dudhani, Sinha et al. 2005), highlights the social disruptions and dislocations (Sarkar and Karagoz 1995) (Kaygusus 2002), and also questions the long-term economic benefits of major hydropower development.

At the same time many technological innovations can have incidental environmental benefits along other dimensions. For example, a move away from coal to cleaner fuels will reduce ecosystem pressures that often accompany mining operations (Azapagic 2004). Similarly, a move away from charcoal and fuel wood as a source of energy will have the attendant environmental benefits of reducing the pressures of deforestation (Masera and B. D. Saatkamp 2000; Najam, Rahman et al. 2003). This points towards the need to optimize technology choice decisions not only along the dimension of carbon emissions but also other environmental costs.

Energy interlinks with health in two contradictory ways (Chapter 4.5.4.1). It is essential for provision of health services but its use can create pollutants harmful to health. Health impacts of energy extraction and use can affect local communities and households. A key barrier is the differentiated responsibility between beneficiaries of investment and those that bear the health costs. Leaders of a community may be willing to allow oil extraction that generates tax revenue even when its households suffer higher health costs, largely because the tax benefit accrues to local authorities (Chapter 4).

Increased use of indigenous LCI fuels can reduce export of fuels from other countries to the extent the latter are substituted away. These may adversely affect the trade balance of exporting countries (Sathaye et al. 1996)

The implementation of mitigation options often creates new industries, e.g., for energy efficient products like cookstoves, efficient lamps, or higher-fuel-economy automobiles. The success of these new industries depends on various factors, such as the degree of information, costs, the image of the product and its traditional competitors or its attributed other than being energy efficient. New industries can create new jobs and income, and might be a pioneer in the new market with significant competitive advantage. Ethanol production from sugar waste has created a new industry and generated employment opportunities and tax revenue for the government of Brazil. On the other hand, the older, outpaced industry may lose jobs. Besides the uncertainty on the overall net effect, major regional distortions might be created with high unemployment rates in traditional regions.

Many of the sectoral policies and choices represent significant opportunities for promoting economic development with respect to these issues. Nevertheless, careful analyses are required to assess the potential risks of these policies. For example, the increased production of biofuels for transportation, or energy production in rural areas, is expected to protect existing employment and to create new jobs in rural areas (Sims 2003). Renewable energy systems are more labour intensive than fossil fuel systems and a higher proportion of the jobs are relatively highly skilled. Thus an increase in employment of the rural people can only be achieved, if corresponding learning opportunities are created. If, however, labour intensity decreases over time, the long-term effect on jobs might be less pronounced than originally anticipated.

Some renewable energy sources, wind power for example, can cause harm to bird populations, and may not be aesthetically appealing. Increased use of biomass is viewed as a renewable alternative, but indoor air pollution from solid fuels has been ranked as the fourth most important health risk factor in least developed countries (Chapter 4). Tradeoffs among pollutants are inevitable in the use of some mitigation options, and need to be resolved in the specific context in which the option is to be implemented.

Section 4.5.4.3 provides several examples of corruption that either increases the price of electricity and/or prevents the proceeds from extracted resources to meet development needs. It also denies government from receiving tax revenue and can allow shareholders to reap higher profits than legally warranted. Absence and poor implementation of legal frameworks has been documented to deny the transfer of revenue from resource extraction to local governments in Peru, Nigeria, Gabon, and other countries. BP's reporting of its tax, and other financial, payments to the Angolan government is one example where the potential for corruption in these transactions was reduced (Section 4.8.4.3).

12.3.2 Forestry Sector

Mitigation options in the forestry sector may be categorized as those that (1) avoid emissions such as from deforestation, (2) sequester carbon through forestation, and (3) substitute for energy intensive materials or fossil fuels. The first category of options is unlikely to be cost effective since the opportunity cost of deforested land is extremely high due to its high timber and land benefits. Reducing or avoiding deforestation has considerable environmental benefits. It can retain biodiversity, ecosystem functions, and in cases of large land areas affect local weather patterns (Chapter 9.7.2). Reduction of forest fires improves local air quality. Many deforesting countries have laws that promote conservation of forest areas. The lack of enforcement of laws that ban or limit deforestation or timber extraction has allowed illegal extraction of logs and the burning of forests in Indonesia and Brazil (Boer 2001) and (Fearnside 2001).

Transparency and participatory approaches have played a key role in reducing communal tensions and allowed communities to reap the same or larger benefits within an organized legal framework. The Joint Forest Management Program in India has created a community-based approach to manage forest fringe areas to reduce forest logging for fuelwood and encroachment on forest lands for agriculture (Behera and Engel 2005). Successful implementation requires that alternative livelihood be provided to the deforesters, programs to promote joint forest management be pursued, and that enforcement be made stricter.

Forestation can provide carbon benefits by increasing carbon stocks on land and in products. Trees planted on wasteland can arrest soil degradation and help manage water runoff. Soil carbon can be increased to the extent soil disturbance during planting and harvesting is minimized. Planted in conjunction with agricultural crops (agroforestry) enhances economic benefits while increasing food security. Forestation activities are generally undertaken in rural areas and benefit the rural economy, generate employment for rural dwellers and can act as a catalyst for rural industry. Clear delineation of property rights would expedite the implementation of forestation programs. A major concern is that forestation may diminish food security if it were to occur primarily on rich agricultural land, and that monoculture plantations would reduce biodiversity and increase the risk of catastrophic failure due to diseases. Conversion of floodplains and wetlands to forest plantations could hamper ecological functions.

Forestation activities can also yield biomass fuel that may be used as a fossil fuel substitute in power plants or as a liquid fuel substitute. The aforementioned sustainable development benefits and potential tradeoffs also apply to bioenergy plantations. In regions, where crop residues (rice husks, sugarcane bagasse, nut shells, and/or tree trimmings) are available, these can be harvested synergistically with the other crops and pose less potential SD tradeoffs. Palm-tree plantations can also be a source of bio-diesel fuel.

Forest management activities include sustainable management of native forests, prevention of fires and pests, longer rotation periods, minimizing soil disturbance, reduced harvesting, promoting understory diversity, fertilizer application, and selective and reduced logging. Most of these activities bring positive social and environmental benefits. Minimizing soil disturbance may result in less use of fossil fuels, less emissions from biomass burning, and more employment if less machinery is used. The prevention of fires may result in larger fire events later due to excessive accumulation of fuel. Therefore such practice should be linked to other practices like sustainable wood fuel production. Theoretically, N fertilizer application increases NPP (and CO_2 removals) but there is a tradeoff since at the same time increases emissions of N_2O and may contaminate waters with nitrates.

Some of the social effects of mitigation policies are more directly induced, in particular if measures like education, training, participation, etc. are an integral part of a policy. Participatory approaches

to forest management can be more successful than traditional, hierarchical programs(Stoll 2003). These participatory programs can also help to strengthen civil society and democratization. This shows that the social effects of sectoral mitigation policies depend on factors which are not directly related to the sector itself, i.e. in the example just given this relates to the way participation is carried out which in turn depends on the legal and institutional framework. Participatory approaches can create social capital (Dasgupta 1993), i.e., networks and social relations which allow humans to better to cope with their livelihoods. Social networks have also been credited as a means for the rapid transfer of energy efficient cookstoves to rural areas (ESMAP 2002).

12.3.3 Agriculture Sector

Table 12.3 also evaluates the impact of different mitigation activities in agriculture sector on the constituents and determinants of sustainable development i.e. vector of social, economic at environmental factors (see also Chapter 8.4.5). The table provides a description and tentative direction of impact but the exact magnitude of impact would depend upon the scale and intensity of the irrigation activities in the context where they are undertaken. Agriculture which contributes more than half of the greenhouse gases like CH_4 & N_2O (Bhatia 2004) can substantially mitigate those gases through activities mentioned in the Column 1 of the table. Rice, nutrient, water and tillage management are the most prominent mitigation options From rice fields, N_2O and CH_4, both are emitted. A careful designing of drainage with effective institutional arrangement would reduce the cost of irrigation for the farmers (Rao 1994). An appropriate and optimal mix of rice cultivation with livestock known as integrated annual crop-animal system and traditionally found in West Africa, India and Indonesia and Vietnam would enhance the net income, improve the condition of cultivated ecosystems and over all human well being (Ma, 2005). Such combinations of livestock and crop farming esp. for rice would prove effective in income generation even in semi arid and arid areas of the world.

Nutrient management in agriculture through greater use of farmyard manure and improved variety of pesticides help in enhancing the ground water quality decelerates the trend of biodiversity loss (Hooper 2003). While the impact on social aspect of this mitigation measure remains uncertain, economic aspect too remains hazy. But nutrient management would greatly improve the environment health of the cultivated ecosystem.

Controlling overgrazing through pasture improvement will have favourable impact on livestock productivity (greater income from the same number of the livestock); halt the pace of desertification (environmental aspect) and provide social security to the poorest of the poor people during event like drought and other crisis (especially in Sub Saharan Africa). One of the effective response strategies for livestock management would be banning the free grazing as it was done in China (Rao, 1994).

Effective use of water in agriculture would not only influence the sustainability goal of irrigation activity in agriculture but it would critically determine the goal of sustainable development. Agriculture contributes 24% of global GDP (World Bank, 2003). and provides employment to 1.3 b people – 22% of the world population (Dean 2000). This critical sector of the world economy is the biggest, user of the water. As per the World Bank's estimate, in the low-income countries, agriculture extracts 87% share in the total extracted water, while; this figure is 74% in middle-income countries and 30% in high-income countries (World Bank, 2000). Today there are 276 Mha of irrigated cropland (FAOSTAT 2004)- five times higher than what it used to be in the beginning of the twentieth century. Forever increasing irrigated cropland; water management is a serious issue. Perverse policies on energy (electricity, petroleum) due to political compulsion, there is tendency for

misuse of water as the true economic cost inclusive of environmental and social costs do not get reflected in the pricing and other incentive structure. The overuse / over exploitation of water becomes too common leading to inefficient decision at all levels of planning and policies. Through proper institutions and effective functioning of market, water management can be operationalized with favourable impact on environmental and economic goals. In the short run, social cohesiveness through clash of divergent interests might aggravate but in the long run they would get adjusted for better harmony.

Land cover and tillage management will help in having favourable impacts on environmental goal. Mix of horticulture with optimal crop rotation would yield carbon sequestration and enriched watershed functions. Both the regulating functions would enhance the societal well being through provisioning of water and enhanced productivity. Tillage/ residue management somehow has direct and positive bearing on environmental aspects but other impacts seem to be uncertain. Land restoration through conversion of wasteland will have positive impact on environment through reduction in land degradation but conversion of floodplain and wetland would hamper the ecological functions (reduced water recharge, bioremediation and nutrient cycling etc) and therefore will have adverse impact on the sustainable development goal (Kumar, 2001).

Livestock management and manure/biosolid management mitigation measures are context and location specific. An appropriate adoption of those measures would most likely help the environmental goal but equally likely is the situation where farmers would need to incur additional costs reducing their return and hence income. But as is the usual case, this trade off would be most visible in the short run. In the long run, synergy among the constituents of sustainable development would emerge through improved natural capital. The trade-off between economic and environmental aspects of sustainable development would appear lesser stark if the intangible ecological gains out of those mitigation measures are acknowledged, qualified and incorporated in the decision making framework.

12.3.4 Waste Management Sector

Better waste management is itself an important sustainable development goal because it can lead directly to improved health, productivity of human resources, and better living conditions. It can also have direct economic benefits in terms of higher value of property due to improved living conditions. The 2002 Johannesburg World Summit on Sustainable Development added a new goal on sanitation, calling for the reduction by 50% of the number of people living without access to safe sanitation.

Chapter 10 of this report highlights that, especially for developing countries, environmentally-responsible waste management at an appropriate level of technology can significantly promote sustainable development and improves public health. It points out that a key aspect of sustainable development is the selection of appropriate and sustainable technology for a particular country. This is important because without the proper technology being selected, there can be adverse impacts on sustainable development.

For example, while landfills can be an attractive and quick option for many developing countries, when not implemented properly, or in the absence of properly implemented laws and regulations, and without the appropriate landfill technology being selected, landfills can themselves become a major and costly source of air, water and ground pollution, and a concomitant health hazard.

In many developing countries, particularly the poorest developing countries, waste is managed by informal networks of scavengers, especially in urban areas, who collect and sift through waste to derive value through recycling and reuse. As such, this is a source of employment for some of the poorest segments of these societies. However, this also happens to be hazardous employment with significant health costs and subsistence or sub-subsistence existence. Crafted in the context of sustainable development, policies for waste management in these societies need to consider alternative employment options for these populations.

Biological waste, particularly in rural areas, is also used in many developing countries as fertilizer or fuel. Here again, the introduction of modern waste management systems can deprive these populations of something they view as a 'resource' rather than as 'waste'. However, proper technology choice can put the waste to better use for the same communities, especially through generation of bio-energy from waste that can be more efficient in terms of its energy output as well as its fertilizer output. The sustainable development challenge is to ensure that such benefits are brought back to the communities who are currently utilizing and 'managing' this waste.

In the waste sector, there is a wide range of technologies to choose from and their diffusion is limited by local costs, policies, available land area, and public perceptions. Chapter 10 argues that there is no single best option; rather there are multiple commercially-available technologies which have to be selected on the basis of local conditions, constraints and realities. This choice should also be made in terms of the sustainable development implications regarding social, economic and environmental benefits and costs. Developing countries have a variety of promising strategies to choose from, many of which have sustainable development benefits, including: small-scale wastewater management such as septic tanks and recycling of grey water, construction of medium-technology landfills with controlled waste placement and use of daily cover, and implementation of landfill "biocovers" to optimize microbial CH_4 oxidation. The selection of sustainable waste and wastewater strategies is very important for both the mitigation of climate change and achieving truly sustainable development.

12.4 Future research needs

Although the adaptive and mitigative capacity literature does not claim that building capacity will necessarily lead to improved responses to the climate change risk, little work has been done to explicate the widely noted variation in response to climate change among communities and nations with similar capacities. It is apparent, therefore, that capacity is a necessary, but not sufficient, condition for mitigative action. Phenomena such as risk perception, science/policy interactions, and relationships between industry and regulators, for instance, may play some role in determining whether or not capacity is turned into action in response to the climate change risk.

Considerable research must be carried out to further investigate the nature of the capacity/action link, and its connection with components of the underlying development path. Paradoxically, the reviewed literature suggests that a fundamental discussion on the implications of alternative development pathways for climate change in general and climate change mitigation in particular has been and is being explored more extensively for the developing countries than for the industrialized countries.

A better understanding is needed of how countries might get from current development trajectories onto lower-carbon development paths – i.e., how to make development more sustainable. What is the role of mitigative capacity, internal and external resources, technologies, and lifestyles in

achieving the transition to sustainable development pathways? What are the best practices that should be followed in mainstreaming?

There is little if any literature to date on which SD actions should be the focus of mainstreaming. The global GHG emissions reduction potential of such actions varies from a few tens to million tons of carbon, and empirical research is needed to identify and quantify actions that will yield the most emissions savings.

Section 12.1.3 cites several macro-indicators of sustainable development that are being used to track its progress at the national and international level. Few of these take climate change mitigation directly into consideration. Future research may look into the inclusion of this aspect in the use of macro indicators.

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