12 TOWARDS AGREEMENT ON GLOBAL AND NATIONAL EMISSIONS LIMITS

Key points

Only a comprehensive international agreement can provide the wide country coverage and motivate the coordinated deep action that effective abatement requires.

Global emissions reduction goals can best be defined in terms of emissions trajectories and multiyear budgets.

The only realistic chance of achieving the depth, speed, and breadth of action that is now required from all major emitters is explicit allocation of internationally tradable emissions rights across countries. For practical reasons, allocations across countries will need to move gradually towards a population basis.

All developed and high-income countries, and China, need to be subject to binding emissions limits from the beginning of the new commitment period in 2013.

Other developing countries—but not the least developed—should be required to accept one-sided targets below business as usual.

The international response to climate change is too slow and patchy to be effective. How can we build on existing international frameworks and negotiations to deliver an international agreement that embodies the level of ambition required to avert high risks of dangerous climate change?

A satisfactory international agreement will be difficult to reach. The prospects depend on the community interest in mitigation in many countries, together with increasing international knowledge of the urgency of the risks, expanding the political possibilities in the period ahead.

Progress will be helped by unilateral, bilateral and regional mitigation initiatives that can generate working models for progress and reassure others that they are not acting alone. Nevertheless, only an international agreement can provide the wide country coverage and motivate the deep coordinated action that effective mitigation requires.

An effective international global agreement to limit the risks of climate change will need to cover two main areas. First, the quantum of mitigation effort needs to be agreed: by how much are emissions going to be reduced, both worldwide, and in each country? Second, while each country will be responsible for achieving its climate change goals, mechanisms for international collaboration will need to be in place to underpin and support national action. The most important of these will be international market trading and public funding for technological development and adaptation.

All of these areas are covered by the Kyoto Protocol, which takes as its starting point the global stabilisation goal of the United Nations Framework Convention on Climate Change (UNFCCC) and allocates emissions limits to most developed and transition countries. The Kyoto Protocol also introduces mechanisms for international collaboration. As argued in the previous chapter (section 11.5), while the Kyoto Protocol is clearly not an adequate global response to climate change, any more effective response will have to build on it. There is not the time to start again.

This chapter covers the first of the two areas: reaching agreement on global and national climate change mitigation goals. Chapter 13 discusses mechanisms for international collaboration.

12.1 Agreeing on a global goal

Determining limits over time on global emissions involves striking a balance between the benefits associated with smaller and slower climate change and the costs associated with greater and faster mitigation. The approach favoured by the Review is to limit the cost of climate change up to the point where the additional gains from mitigation are similar to the additional costs. In the end, a judgment needs to be made about the level of climate change that corresponds to the best estimate of a balancing point.

Targeted limits on climate change can be defined at three levels: at the highest level, in terms of impact or global temperature increase; at the next level, in terms of the concentration of greenhouse gases in the atmosphere, which drives temperature increase; and at the next level again in terms of emissions of greenhouse gases, which drive atmospheric concentration.

12.1.1 Impact goals

Targets for global mean temperature have been used to compress the multiplicity of possible impacts (ranging from glacial melting to increased weather-related calamities) into a single variable. The European Union, for example, has argued that global mean warming should not be allowed to exceed 2°C from pre-industrial levels (Council of the European Union 2007) .

Endorsement of a temperature threshold (and therefore of any target derived from it, for example, in terms of greenhouse gas concentration) cannot imply indifference to other factors. There may be tipping points associated with particular temperature thresholds, but the thresholds are not known with certainty.

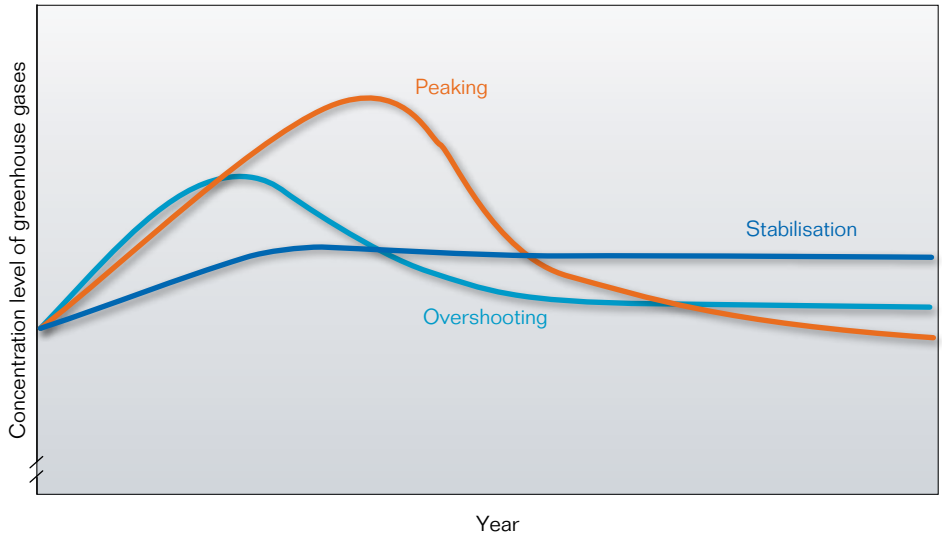
12.1.2 Concentration goals

Global warming increases temperature with a long lag. It might take more than a century after stabilisation of greenhouse gas concentrations for a new equilibrium temperature to be reached. Therefore, any goals in terms of temperature need to be translated into goals for the atmospheric concentration of greenhouse gases.

Chapter 3 introduced various types of concentration goals: stabilisation, peaking and overshooting (illustrated in Figure 12.1). Most attention has focused on stabilisation scenarios, and the global goal articulated in the UNFCCC is the 'stabilization of greenhouse gas concentrations in the atmosphere' (Article 2).

However, as discussed in Chapter 3, special challenges are introduced by the need to reduce greenhouse gas concentrations to low levels. There is great difficulty in doing that monotonically from where the world is now. Whether the ultimate aim is stabilisation (overshooting) or prolonged decline (peaking), there is a good chance that the optimal response to climate change will need to involve a period (of uncertain duration) during which concentrations fall. This assumes that emissions can be brought below the natural level of sequestration. Reducing emissions below this level would probably require the development and deployment of technologies for carbon capture, such as new approaches to biosequestration (see section 3.6.1).

Figure 12.1 Different concentration goals: stabilisation, overshooting and peaking



The Review models two global mitigation scenarios, one less ambitious, the other more. The strong global mitigation case is a stabilisation scenario at which the concentration of greenhouse gases in the atmosphere approaches 550 ppm carbon dioxide equivalent (CO_2-e) and stabilises at around that level thereafter. The ambitious global mitigation case is an overshooting scenario, which peaks at around 500 ppm CO_2-e and then stabilises at around 450 ppm CO_2-e. Any lower stabilisation objective, for example at 400 ppm CO_2-e, would need to involve a longer period of overshooting.

12.1.3 Emissions goals

Any concentration profile has an emissions trajectory associated with it. (An emissions trajectory defines the flow of greenhouse gases that converts, through various physical and chemical processes, into a stock of greenhouse gases in the atmosphere.)[1]

There are different ways in which goals for emissions can be expressed:[2]

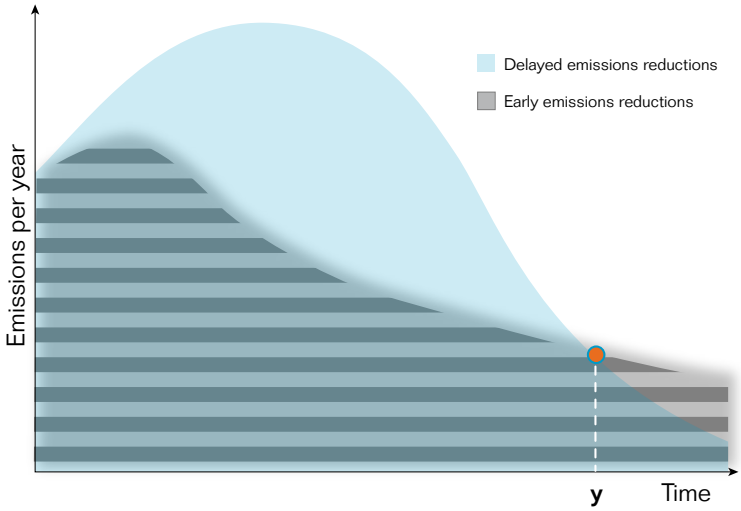
- **End-period emissions:** This is the most common way of announcing targets (for example, that emissions will be reduced by 50 per cent by 2050). The advantage of this approach is its simplicity. The disadvantage is that a target at one point of time says nothing about the rate at which emissions should approach their target level, and so does not constrain cumulative emissions and therefore the concentration level at that point of time (see Figure 12.2).
- **Annual emissions:** Since a concentration profile implies annual values for emissions, annual targets for emissions can be articulated. The disadvantages of this approach are its complexity and lack of flexibility. There will be little difference in the environmental impact of two very similar concentration paths (since this is dependent on the stock of emissions), but there could be significant year-to-year cost differences (since the annual emissions would tend to vary with short-term economic and weather conditions).
- **Cumulative emissions:** This is the budget approach, by which the total emissions associated with a target profile over a number of years are summed up into a single target budget. In this approach, year-to-year variation from the target profile is allowed; what matters is that the multi-year budget is adhered to.

The Review makes extensive use of emissions trajectories (see, for example, section 14.2) to express emissions goals, and emissions budgets to provide intertemporal flexibility.

The benefit of the budget approach is its flexibility: it allows intertemporal trade-offs and smoothing. Costs could arise if the budget approach leads to long-delayed mitigation. There could be environmental costs (a faster rate of warming). Or, if there are climate–carbon cycle feedbacks, then slower

mitigation could reduce the emissions budget associated with a stabilisation target since the faster rate of warming could reduce more quickly the ability of the terrestrial ecosystem to absorb carbon dioxide emissions (Jones et al. 2006). However, it is not clear that the budget approach would lead to deferred mitigation since smaller emission reductions in earlier years would have to be made up by greater, and possibly much more expensive, reductions in later years (Allen Consulting Group 2006). And variations in timing would have to be large to have material environmental impacts. Variations within five-year periods as proposed in Chapter 15 would not have material effects.

Figure 12.2 Different cumulative emissions from the same end-year target



12.1.4 Global goals for emissions to 2050

The 2007 Bali Roadmap calls for agreement on a 'long-term global goal for emission reductions' (UNFCCC 2007). Defining such a long-term goal, as well as a medium-term goal for around 2020, will be important for progress towards a meaningful global mitigation effort. Judgments about the level of stabilisation that is in Australia's interests will depend in part on the economic modelling currently under way for the Review's supplementary draft report. However, preceding chapters have already made the case that Australia is relatively vulnerable to climate change. Given the costs of international climate change mitigation, it is unlikely that the international community will want to go further than Australia judges to be in its interests.

IPCC (2007) analysis shows a global reduction range of 50–85 per cent at 2050 compared to levels in 2000, for the most ambitious class of stabilisation scenarios considered. Though, as discussed above, the emissions trajectory is just as important as the end point, a reduction in global emissions of 50 per cent

by 2050 may be a natural attractor in defining a global goal. The Japanese Government has made this a focus of its agenda for the G8 Summit in Toyako in July 2008.

12.2 What form should national commitments take?

Once a global goal has been agreed, responsibility for its achievement needs to be allocated among countries. Unless all major economies agree to limit their emissions, it will be impossible to ensure that action at the global level adds up to an effective mitigation effort.

While any global agreement will emerge from negotiations—especially between the major emitters, and, of these, in particular between the two largest emitters, China and the United States—it is useful to spell out basic principles that could provide a framework for reaching agreement.

Proponents of price-based emissions control have argued for the adoption of national carbon taxes (Cooper 2000; Nordhaus 2007), or a common global carbon tax (Stiglitz 2006). Hybrid policies combining quantity and price controls have also been proposed, principally through cap and trade schemes, but with a government-backed price cap determining the cost at the margin (Roberts & Spence 1976; McKibbin & Wilcoxen 2002, 2008; Pizer 2002). A variant of the hybrid scheme has the price cap agreed internationally.[3]

At the heart of the economic argument for price control is uncertainty about abatement costs. The theory of prices versus quantities for pollution control (Weitzman 1974) shows that such uncertainty will invariably lead the policy to under- or overshoot the optimum: imposing a quantitative target will lead to higher or lower marginal abatement costs than expected, while a given tax rate will lead to greater or lesser abatement effort than expected. The resulting efficiency costs are thought to be lower under a price-based instrument for stock pollutants such as greenhouse gases, so getting the price wrong under a tax imposes lesser welfare losses than getting the quantity wrong under a quantity target.

Proponents of price-based emissions control have pointed out that a common global carbon tax or an agreement on an internationally harmonised price to apply in domestic permit trading schemes would avoid both questions of distribution between countries inherent in a cap and trade system, and the potentially destabilising effects of large-scale international financial flows.

While the introduction of a tax-based mitigation system would take the world significantly forward, the Review has come to the view that only an international agreement that explicitly distributes the abatement burden across countries

by allocating internationally tradable emissions entitlements has any chance of achieving the depth, speed and breadth of action that is now required in all major emitters, including developing countries. Countries would take on quantitative commitments to limit and reduce emissions, differentiated according to broadly accepted principles, with trade in emissions rights between countries (cap and trade). Such an approach, after a period of confidence building, could help resolve the prisoners' dilemma that otherwise blocks mutually beneficial collective action. A quantity-based international agreement is more likely to succeed than a tax-based one for a number of reasons.

First, the tradable emissions entitlements approach builds on current international architecture and national practice. Quantitative targets have been the dominant form of greenhouse gas commitments so far. As in the Kyoto Protocol, quantitative targets frame the various existing and emerging national and regional climate goals and emissions trading systems, as well as the negotiations about national target commitments for the post-2012 period. Perhaps this is in part because the framing of commitments as quantitative targets appears to be politically more acceptable than taxes even if they imply similar costs. Be that as it may, as argued in Chapter 11, given the urgency of the situation, current efforts need to be built on, not overturned. Different architectures could be designed that might be superior, at least in theory, but time has run out for starting with completely new approaches that would require periods of trial and error.

Second, a cap and trade scheme provides incentives for developing country participation. Crucially for the goal of international cooperation, targets can be differentiated between countries without sacrificing economic efficiency. Under a price-based regime, commitments could be differentiated among countries by agreeing on lower emissions penalties for developing countries, but this would compromise the efficiency of the global mitigation effort and do less to provide a level playing field for emissions-intensive industries.

As discussed in Chapter 13, international trading in emission entitlements allows financial flows between countries. Such financial flows could offset abatement costs in developing countries, and so become a cornerstone of drawing them into an international policy framework.

Third, setting quantitative targets can control emissions levels more directly than setting emissions prices. This not only allows the extent of commitments to be more easily communicated, but also is preferable as climate change risks become more urgent to society and policy makers and as the possibility of catastrophic damage from climate change gains recognition (see Chapter 5).

Fourth, trajectories and budgets can be implemented with flexibility to prevent cost blow-outs of the sort feared by advocates of carbon taxes. Flexibility can be provided by defining emissions budgets over a number of years, allowing intertemporal flexibility across commitment periods, allowing substitution

between different greenhouse gases, and allowing international trading of emissions rights. Emissions targets could be fine-tuned over time to yield the desired balance between abatement costs and emissions levels, just as taxes can, with similar costs associated with business uncertainty.

Fifth, uncertainty about emissions pricing within a cap and trade scheme has to be seen in the context of the manifold other demand and supply shocks, especially the natural price volatility in the energy and resource sectors. In particular, demand for and price of permits can be expected to fall in response to any large increase in the price of fossil fuels, as of the kind that the world has experienced over 2007 and 2008. This would be to some extent stabilising, unlike the rigid application of a fixed carbon tax.

Sixth, the adoption of national limits gives countries freedom to apply their own preferred mix of policies. A quantitative commitment under an international agreement does not mean that *domestic* policies need to be framed in quantity terms. A country could choose to place a tax on domestic emissions, introduce regulation aimed at reducing emissions, introduce a domestic emissions trading scheme, or use a combination of these instruments (see Chapter 14). International supervision of emissions commitments would be limited to monitoring emissions. By contrast, adoption of a carbon tax would require more intrusive international oversight (Frankel 2007). It would be necessary, for example, to ensure that countries did not offset a carbon tax by an increase in fossil fuel subsidies. Given the different tax treatment of fossil fuels around the world, it would be difficult, if not impossible, to ensure that national carbon taxes were both additional and comparable.

Carbon taxes could, however, play a useful role in international commitments in specified areas. In the foreseeable future, it is not realistic to expect each and every country to be subject to quantity limits. It would be reasonable in such a situation for those countries that are not subject to quantity limits to be under international pressure to introduce an offsetting carbon tax on at least the main trade-exposed, emissions-intensive industries (section 13.4). The revenue raised by such a tax would be retained by the government that imposed it. Such sectoral approaches would also be viable for emissions control in international aviation and shipping (section 13.6).

To help countries live within their emissions limits, there will need to be an international effort to boost investment in the research, development and commercialisation of low-emissions processes and products. The development of new low-emissions technologies is an international public good, the supply of which will need to be assured by national funding commitments. National funding commitments for both mitigation and adaptation assistance are discussed in detail in Chapter 13.

12.3 A graduated approach to national commitments

As discussed in Chapter 11, Annex B of the Kyoto Protocol allocates internationally tradable emissions rights to countries that belonged to the OECD in 1992 and transition economies (the Annex I countries of the UNFCCC). This group excludes a number of high-income countries including Singapore and Saudi Arabia. It excludes recently industrialised countries such as South Korea and Mexico, even though they are now members of the OECD. Many more countries will join the ranks of high-income countries over the years to come.

The principle that all high-income countries should adopt binding commitments to limit their right to emit would receive widespread support. There is also broad agreement that developing countries need to take on greater obligations, although no political resolution of this issue has been in sight. So far, developing countries have resisted taking on emissions targets. The 2007 Bali Roadmap calls on developing countries only to take *actions* to reduce emissions, in contrast to the *commitments* to be taken on by developed countries. How can a way be found through this conundrum?

Clearly, differentiation is needed within the group of developing countries. The poorest, least developed economies are not ready for a national approach. They could be involved in the mitigation effort through offset mechanisms such as a strengthened clean development mechanism, and international sectoral agreements where applicable (see Chapter 13).

But middle-income countries such as South Africa and Brazil and many others need to do much more. Some argue for a highly flexible approach, which would allow 'different countries to assume different types of international commitments—not only absolute targets, but also indexed targets, taxes, efficiency standards, and so forth' (Bodansky 2007: 65). Too many options, however, would make comparative assessment impossible, and therefore invite dilution of effort. Lack of a common framework would also place formidable obstacles in the way of international trading, which is the most likely route for developing countries to receive large-scale financing in support of their mitigation efforts.

Most developing countries cannot initially be expected to sign on to targets that would require them to buy emissions rights from other countries if they exceed their emissions budgets. One-sided targets—also referred to as opt-out or non-binding targets (Philibert 2000)—could be a helpful expedient for a transitional period. With a one-sided target, countries could benefit from taking on a commitment by going further than their target required and selling emissions rights, without obligation to buy if they missed the target.

Allowing countries to adopt one-sided targets has a cost. It increases uncertainty about whether countries will indeed follow through with their target commitments. To achieve similar global abatement as with binding targets for all countries, the countries with binding targets would need to take on more stringent commitments in order to reduce any shortfall from countries that opted out (Jotzo & Pezzey 2006). The very existence of an opt-out option might weaken the resolve of national governments to follow through with mitigation policies, particularly where there are vested interests to be tackled or politically difficult decisions need to be made, such as the removal of subsidies on petroleum products.

While recognising these drawbacks of one-sided commitments, the Review also recognises the reality that most developing countries, given their low income per capita, would simply not be prepared or, in many cases, able to purchase emissions permits internationally. The risk of such an obligation would prevent many from accepting a binding target in the first place. The Review therefore supports the use of one-sided targets for most developing countries, to facilitate immediate uptake of target commitments and as a transitional measure in place until perhaps 2020. After that, these countries would be expected to accept binding targets.

Some argue that developing countries should be given targets, but that those targets, at least initially, should be their business-as-usual levels. Under this approach, promoted by Stern (2008) in his proposal for a global agreement, the Growth Commission (2008) in its report, and Frankel (2007), developing countries would only reduce emissions below business-as-usual levels if developed countries paid them to do so. Essentially, this approach amounts to an expansion of the Clean Development Mechanism to an economy-wide level.

The flaw with this business-as-usual approach is that it would put the entire burden of emission reductions on developed countries. Since these countries account for a falling share in global emissions (see Chapter 5), it is unrealistic to hope to achieve substantial cuts in global emissions in this way. Developing country targets, albeit one-sided, need to be below business-as-usual levels.

The Review's proposal—for middle-income developing countries to adopt one-sided, below-business-as-usual emissions targets—goes further than most, if not all, current proposals for developing country commitments. Given the rapid growth in emissions, any international agreement that embodies a lower level of ambition will be an inadequate response to the urgency of the problem at hand. And, in the Review's framework, developing countries will have incentives to agree to such an approach: not only the prospect of financial gain through international selling of permits, but access to international public funding in support of both mitigation and adaptation.

The Review's proposal thus requires establishment of three groups based on level of commitment. At the top of the income range, countries are subject to binding emissions commitments. At the bottom, countries are subject to minimal commitments. In the middle, countries are subject to one-sided, below-business-as-usual commitments. How should countries be assigned to these three groups?

It is in the global interest for as many countries as possible to be in the first group with binding targets. This group should at a minimum consist of all countries currently in Annex I plus all other high-income countries. Where the high-income threshold is actually drawn, and therefore what other countries might be in this group, would be a matter for negotiations.

China is a special case. Because of its size, geopolitical importance and emergence as the world's largest emitter, no global agreement would be effective unless China took on binding targets. China's fiscal and technological position would allow it to do so. Of course, because of its lower income status, China's targets would not be as stringent during a transition period as those of developed countries (section 12.4).

Note that this first group, if it did include China, existing Annex I members and other high-income countries (using, for this purpose, the World Bank per capita income threshold of US$11 000) would account for approximately three-quarters of global emissions of carbon dioxide from fossil fuel combustion, the main source of greenhouse gases.

The second group, expected to take on one-sided targets, would comprise most of the developing countries. This would include all members of the US-led Major Economics Meeting process (section 11.1.4) that are not in the first group. As discussed in the next section, countries would be differentiated through per capita principles in the setting of their emissions limits. The second group would account for almost all of the remaining quarter of present-day global emissions from fossil fuels.

The third group would comprise countries classified as 'least developed' by the United Nations. It would also include any other developing countries that, on an objective assessment, do not yet have the necessary preconditions for a national approach—for example, those experiencing conflict or lacking the prerequisites for reliable emissions accounting. Countries in this group would be welcome but not required to take on one-sided targets at any time. They would be able to host clean development mechanism–type activities and sell offset credits, and would be expected to place a carbon tax on emissions-intensive industries producing tradable goods that were the subject of global sectoral agreements (Chapter 13).

It is worth reiterating that the above arrangements are proposed only as an initial, short transitional stage directed at achievement of a sound multi-decade international approach. At an early future point, desirably 2020, countries in the

third group would be expected to take on one-way targets, and countries in the second group binding targets. Countries would graduate from group to group over time.

12.4 Principles for allocating emissions entitlements across countries

In the approach outlined in the previous section, all except the least developed countries would have national emissions limits, albeit of differing types (binding for high-income countries and some others, and one-sided for most developing). This leaves the important question of how emissions rights are to be allocated across countries. This section discusses possible principles and suggests for discussion an approach to guide the allocation of emissions entitlements.

Under the Kyoto Protocol, emissions budgets for Annex I countries for 2008–12 were defined as percentages of 1990 emissions, ranging within a relatively narrow band from 92 per cent to 110 per cent of base year emissions, around the average allocation of 95 per cent, with further differentiation within the European Union. Differentiation between countries was negotiated on an ad hoc basis, with little reference to underlying principles for allocation across countries, although on average richer countries signed up to larger reductions.

In future negotiations, involving a greater number of and more diverse countries, simply requiring somewhat differentiated reductions from a historical base, as under the Kyoto Protocol, will not serve the purposes of supporting international agreement. The stark differences in per capita emissions levels across countries need to be factored in, in order to gain acceptance by most developing countries. Emissions entitlements for the lower-emissions countries, which typically are at a relatively low income level also, would need to continue to grow but at a slower pace, while emissions entitlements in the richer countries would need to fall. For ambitious mitigation scenarios, few countries could be afforded growing emissions budgets, but strong differentiation in the rates of reductions would be required to make commitments acceptable.

Leaving emissions reductions to politics, negotiations and arm-twisting, without explicit criteria, would prove deeply problematic. While politics and special circumstances will inevitably have some role, limiting the scope for discretion will be critical if the pace of coordinated international mitigation action is to quicken. An allocation framework based on simple principles, if it received widespread international support, could facilitate international negotiations, and in the meantime guide individual countries' commitments ahead of a new international agreement.

To be effective, a future international policy regime will require the mitigation effort to be distributed using principles that are widely accepted and regarded as fair and practical. To be widely accepted, principles to guide the allocation of a global emissions budget across countries will need to be simple, transparent and readily applicable. To be considered fair, they will need to give much weight to population. To be considered practical, they will need to allow long periods for adjustment towards positions that give weights to population.

Various principles have been suggested. The UNFCCC emphasises *capacity*, with its call for greater and earlier mitigation effort by developed countries (those with more capacity). Graduation of a country to a more stringent level or type of commitment once it reaches some income threshold is a common feature of many proposals. Examples are the Pew Center Pocantico Dialogue (Pew Center 2005), the South–North Dialogue's proposal in Ott et al. (2004), and the São Paulo proposal (BASIC Project 2006). Section 12.3 argued for countries to take on more stringent types of commitments as they move from low to middle to high income status.

Some countries emphasise *responsibility*, and argue that future emissions rights should take account of how much each country has already drawn on the global emissions budget, by way of emissions in past years. Current industrialised countries have a disproportionate share in past cumulative emissions. Historical responsibility was formally introduced to the UNFCCC by the government of Brazil. The Brazilian proposal (UNFCCC 1997) called for the mitigation burden to be shared on the basis of the contribution to climate change of countries' past emissions.

It has also been argued that emissions rights should be based on the *effort* required to meet the limits imposed. Effort could be measured in terms of the impact of mitigation action on national GDP. However, this approach takes no account of differential starting points, and would require comparing the future state of the world to the counterfactual of what would have prevailed in the absence of the scheme. Quantitative estimates of future effort are highly uncertain and would be contested.

Underlying all these approaches is a concern with international *equity* made explicit in many allocative proposals. For example, the recent Greenhouse Development Rights framework (Baer et al. 2007) would apply equity considerations comprehensively to include adaptation costs and domestic income distribution. It is difficult, however, to see how broad agreement on what is equitable could be achieved in anything other than a very simple framework.

While all of these approaches have their strengths and weaknesses, the approach that seems to have the most potential to combine the desired levels of acceptability, perceived fairness and practicality is one based on *population* or *per capita emissions*. An approach that gives increasing weight over time to population in determining national allocations both acknowledges high emitters'

positions in starting from the status quo and recognises developing countries' claims to equitable allocation of rights to the atmosphere. Any allocative formula that does not emphasise population as the basis for long-term emissions rights has no chance of being accepted by most developing countries.

The per capita approach is also broadly consistent with the emerging long-term emissions-reduction goals of several developed countries. Per capita emissions of the developed countries are today well above the global average of about six tonnes of carbon dioxide equivalent. Per capita emissions in, for example, the United Kingdom, Japan and the United States are (as of 2000) 11.5, 10.6 and 21.6 tonnes respectively. Under the long-term emissions-reduction goals announced by or anticipated in these countries, these levels would fall by 2050 to 3.9 tonnes (United Kingdom), 4.0 tonnes (Japan) and 2.7–5.5 tonnes (United States, using the commitments made by the two presidential candidates). These levels are all below today's global per capita average, and close to the 2–3 tonnes per capita average that stabilisation scenarios summarised by the IPCC (2007), together with UN population projections, suggest will be required for stabilisation at 450 to 550 ppm carbon dioxide equivalent.[4]

Indeed, it is inevitable that if global per capita emissions fall to as low as 2–4 tonnes per person by 2050, then (though variation in national emissions levels will still be possible through the trading of emissions rights), the current stark divergences in national per capita emissions will diminish over time.

The per capita approach also has the virtue of simplicity, in contrast to many other proposals on the table. Equal per capita emissions is a natural focal point, and contestable computations based on economic variables do not need to enter the allocation formula.

The per capita approach is generally referred to as 'contraction and convergence' (Global Commons Institute 2000) and has figured in the international debate for some time. It has been promoted by India and has been discussed favourably in Germany and the United Kingdom (German Advisory Council on Global Change 2003; UK Royal Commission on Environmental Pollution 2000). Recent reports have shown increasing support for this approach internationally: see, for example, Stern (2008) and the Commission on Growth and Development (2008).[5]

Under contraction and convergence, each country would start out with emissions entitlements equal to its current emissions levels, and then over time converge to equal per capita entitlements, while the overall global budget contracts to accommodate the stabilisation objective. This means that emissions entitlements per capita decrease for countries above the global average, and increase (albeit typically at a slower rate than unconstrained emissions growth) in countries below the global average per capita level. Importantly, emissions

entitlements would be tradable between countries, allowing actual emissions to differ from the contraction and convergence trajectory.

The per capita approach addresses the international equity issue transparently: slower convergence (a later date at which per capita emissions entitlements are equalised) favours emitters that are above the global per capita average at the starting point, while faster convergence gives more emissions rights to low per capita emitters. The convergence date is the main equity lever in such a scheme.

An important group that would have difficulty with a straight convergence towards equal per capita emissions is the rapidly growing middle-income countries such as China, which are already around the global per capita average for greenhouse gases and would find it difficult or impossible to stop the per capita growth in their emissions immediately. To account for this, the per capita approach could be modified to provide 'headroom' to allow these countries to make a more gradual adjustment, without immediately needing to buy large amounts of emissions entitlements from other countries. (See section 12.5 for more detail.)

Some argue that relying on just one criterion is excessively simplistic. The UNFCCC itself states that national policies in developed countries to limit emissions should take into account 'differences in these Parties' starting points and approaches, economic structures and resource bases' (Article 4.2(a)). Submissions to the Review raised similar points about Australia's circumstances and resource endowments.

Contraction and convergence does, of course, take differences in starting points as the main consideration in the early years, gradually shifting the weight towards population. Moreover, country differences are handled within the per capita approach by allowing those with emissions-intensive economies to buy emissions entitlements from those with economies of lower emissions intensity. This maintains the competitiveness in emissions-intensive industries of countries with tight allocations relative to existing emissions, so long as all substantial economies are subject to constraints that generate similar carbon prices. For the domestic producer of emissions-intensive goods, the higher international price for the product compensates in an economically efficient way for the need to buy permits.

It might also be argued that a population-based allocation encourages environmentally damaging global population growth. This is unlikely, as population growth is decided by far more fundamental economic and social determinants. This argument is even less appropriate to countries—mostly developed countries, and first of all Australia, the United States and Canada—where population is growing through immigration.

Another argument against per capita approaches sometimes raised in developed countries is that emissions entitlement trajectories for some low-growth developing countries could be above their underlying emissions growth trajectory, allowing them to benefit from the sale of excess permits while making minimal mitigation efforts themselves. The modelling under way for the Review will give an indication of the likely empirical significance of this concern. Fundamentally, however, this argument overlooks the reality that international trading gives the incentive to implement mitigation measures to reduce emissions further, irrespective of the allocation.

Some submissions to the Review have argued that a per capita approach is against Australia's interests because of our current high per capita emissions. This is mistaken, for several reasons.

First, Australia's biggest national interest is in effective international action, and an emphasis on population is going to be required in any practicable allocation rule. Of course, Australia would gain from an international agreement that recognised only our own special circumstances. But special circumstances would then need to be recognised for all countries. Striving for such a system would be against Australia's interests because it would be difficult to agree on and thus would delay global mitigation action, and because such an agreement would probably have its environmental benefits diluted by special pleading (everyone would find a reason not to do very much).

Second, Australia's ongoing strong population growth means that Australia will find it easier to cut emissions in per capita rather than absolute terms. Australia's population growth rate is already above the world average. The reference case (Chapter 9) suggests that Australia's population will increase almost three times as much as global population through this century. If emissions entitlements and targets are framed in per capita terms, countries with growing populations will receive greater absolute allocations. Population growth considerations are centrally important to equitable distribution of the adjustment burden between Australia and other developed countries.

Third, reducing over time Australia's per capita emissions entitlements to the global average would not mean the end of Australia's emissions-intensive industries. The necessary condition is that the adjustments occur within an effective global agreement—towards which the allocation principle suggested here is directed. Rather, their continued expansion would be possible through permit purchases. Where Australia produces emissions-intensive goods for export, it is logical to cover the emissions from that production with purchases of emissions rights from international markets.

12.5 Shaping a per capita approach to the allocation of emissions entitlements

There are many ways to give effect to the principle that, over time, population will figure increasingly largely in any practical allocation rules for emissions rights across countries. Three aspects deserve particular consideration.

First, a *starting date* is needed. For example, base levels could be defined as actual emissions levels at the conclusion of the first Kyoto Protocol commitment period (2012). For Kyoto Protocol ratifiers, using the Protocol target levels (average emissions for 2008 to 2012) would ensure that good performance in the first commitment period is rewarded in the next.

Second, the *convergence period* needs to be defined. As discussed above, the convergence period is the main equity lever under the per capita approach, and would obviously be subject to negotiation. Since 2050 is a strong focal point in international negotiations, it would be a candidate target date for convergence.

Third, as discussed earlier, *headroom in emissions allocations* needs to be provided for emissions growth in rapidly growing developing countries. Headroom could take the form of challenging emissions-intensity targets for fast-growing developing countries, up to a predefined limit. Intensity targets (Baumert et al. 1999), also referred to as relative targets, would link emissions budgets to economic output. For example, annual permit allocations could be allowed to increase by half the rate of GDP growth for the countries that are being provided headroom. This definition of parameters would roughly coincide with the combination of China's (so far unachieved) goals for reductions in energy intensity and increases in the share of renewable sources of energy in the economy. This would be an important factor in making the approach work for the world's largest emitter and a possible standard throughout the developing world.

Other countries will need to have their allocations adjusted if the world is to remain on the same trajectory to a stabilisation target. A limit would need to be placed on the provision of headroom. One possibility would be to cap the growth in emissions rights allocations at the point where the developing country's rising emissions per capita reached a benchmark trajectory in per capita emissions. This benchmark trajectory could be based on an average of the emissions profiles of moderately emitting developed countries, which would be expected to be lower than at present at the point where the two trajectories intersect. Note that even with the provision of headroom, emissions entitlements to most

developing countries and on average would be expected to fall substantially below business-as-usual levels.

The Review has developed an approach to the international allocation of emissions along the lines described above, which is being tested through economic modelling. The supplementary draft report will include quantitative allocation scenarios based on the modelling currently under way.

Notes

1 Just as with converting from concentration levels to temperature increases, so too converting from emissions to concentration levels involves uncertainty, in particular involving climate–carbon cycle feedbacks, the treatment of which can reduce permissible cumulative emissions associated with atmospheric stabilisation targets by 20 per cent or more (Jones 2006).

2 The issue of aggregating over different greenhouse gases is not tackled here (see Chapter 3).

3 A price-based commitment is an example of an input-based commitment. Another variant of input-based commitments is the 'sustainable development policies and measures' (Winkler et al. 2002) approach which would directly reward countries (normally developing countries) for implementing agreed policies.

4 For the actual commitments made by these countries, see section 11.2. UNFCCC data has been used as a baseline. All population projections are the 2006 medium variant projections from the United Nations. The exact global per capita emissions average at 2050 under the various stabilisation scenarios depends heavily on the trajectory of emissions through time, as well as on future population growth.

5 Neither report uses the term 'contraction and convergence', but both point to the need for all countries to aim for equal per capita emissions over the 'long term' (Commission on Growth and Development 2008) or by 2050 (Stern 2008). Stern (2008: 10) notes that this approach 'is a pragmatic … one. It should not be regarded as strongly equitable since it takes little account of the developed countries' much larger per capita contribution to stocks of greenhouse gases.'

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