

**Twenty-second Colin Clark Memorial Lecture  
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**Removing Climate Change as a Barrier to  
Economic Progress**

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**I. INTRODUCTION**

It was my privilege to attend what was probably Colin Clark's last public lecture, at an Economics Society meeting in the ANU's Coombs Lecture Theatre.

He was reflecting on early Australian economic policy, when sometime Prime Minister Alfred Deakin loomed large.

"Deakin was everything that I abhor," Clark said. "An irrigationist, an immigrationist, a protectionist and a prohibitionist."

I felt sympathetic on irrigation (where Australia with its special constraints was the focus), protection and prohibition.

I favoured immigration for Australia then and now, and wondered for a while whether on that issue Clark was still speaking the book of his earlier commission to advise the Pope on population: with a pro-natal policy, Australia could breed its own. I shouldn't have wondered. Clark was a conscientious empiricist. I thought then and think now that Clark was wrong on global population (and that raises very different issues from Australian immigration), but he would have been speaking from firmly held views based on his own assessment of voluminous data.

Clark shares with William Shakespeare a legacy of ideas and phrases that are much used by people who have no idea of their origins. I was with Bob Hawke at a meeting in the Oval Office at the White House in 1983, when Ronald Reagan commented that "someone said that an economy gets into trouble if taxation rises above 25 percent". "Colin Clark", I whispered to the Australian Prime Minister (Clark, 1945).

Manning Clark would have described Colin Clark's as a "teaming mind" if he had turned his thoughts to the history of Australian economics. If you read now his major works from the mid-thirties to the early sixties, you are struck by the originality of thought; the capacity to follow an empirical trail to a conclusion that is way beyond the conventional wisdom and to declare the outcome forcefully and with clarity.

Only a few economists share with Colin Clark an ability to open new areas of inquiry. Many others toil for decades on this new ground once it has been broken, modestly augmenting the original contribution.

Angus Maddison said in his Colin Clark Lecture in 2003 that Clark would have been recognised more highly as an economist if he had not written on so many things. Maddison was probably right. If Clark had written more deeply on a smaller number of issues he may have been regarded more highly in the formal ways of the economics profession. But I am glad of how he spent his time. There is no shortage of economists digging deeper on small ground.

Clark's work on national income concepts and measurement in *The National Income 1924-31* (1932) defined the modern approach to international comparisons of national income. In *Conditions of Economic Progress* (1940) he also set out the limitations of what became the standard measures of economic growth, half a century before non-economists' belatedly "discovered" those same weaknesses with the excitement of Archimedes in the bathtub.

Clark's book with John Crawford that pioneered modern national income accounting in Australia applies Keynesian insights sure-footedly just one year after the *General Theory*.

"There is a school of thought among bankers, economists and politicians, members of which hold the key positions in the Australian economy at the present time, to whom these suggestions of public works expenditure, low interest rates and credit expansion are anathema; and they lose no opportunities of saying so. This does not obviate the need for counter-measures against a possible depression..."

(Clark and Crawford, 1938).

So contemporary for the developed world in 2012!

We will discover too late that there is much relevance for us today in Clark's emphasis on the phenomenon of monopoly in shaping national economic performance. Absorbed from Cambridge in the 1930s, the focus on monopoly and economies of scale caused him to be sceptical of rigid attachments to free markets as the preferred form of industry organisation for all seasons ("*The Conditions of Economic Progress*", Preface to Second Edition, written 1947).

In the year of the Australian White Paper on *The Asian Century*, it is bracing to recall Clark's anticipation in 1942 of the industrialisation and rapid growth of China and Japan, which would shift the terms of trade decisively in favour of foodstuffs and raw materials (Clark 1942). The timing was out by four decades (although not if you don't focus too much on the temporary nature of the Japan commodities boom of the sixties and early 1970s) but the economic analysis sound.

Here in Brisbane I should reflect on the philosophic foundations of Clark's economics. He thought that economics as an intellectual discipline was subordinate to moral philosophy and to history (Clark, *Conditions of Economic progress*, Third Edition, Chapter 1, pp1-2). The values that surrounded his conversion to Catholicism fitted with the pragmatic and rational

democratic socialism of the early decades of his professional life. He eased comfortably into one and a half decades of policy advice within the Labor and Catholic political traditions that had emerged in Queensland under some of the most creative political leaders served by at least a couple of the most creative economists in Australian history—before Queensland political culture passed into a dark night. This dimension of the values that underpin Clark’s intellectual contributions was remembered by B.A. Santamaria in a tribute in *News Weekly* after his death in 1989.

It helped Clark’s originality to have begun his intellectual life outside economics. Perkins and Powell (1990) attribute his empiricism to his early training in chemistry. Be that as it may, the science left an awareness of the inter-relationship between economic outcomes and the natural foundations of life on earth. Clark introduced the idea that we would now call “sustainability” in 1940, and suggested that deductions should be made from national income and national product for reductions in the natural fertility of the soil in the course of agricultural production.

Clark discusses the challenge to modern economic growth of its dependence till now (then 1940) on fossil fuels. He notes that we can calculate the likely amount of undiscovered fossil fuel from the carbon that was once in the atmosphere. “However, we must not set out to burn them up too fast, even if we do find them, at any rate not faster than the rate at which the carbon dioxide can be converted by photosynthesis...” But he reassures us that keeping the use of fossil fuels within the limits of what can be absorbed by photosynthesis need not be the end of economic growth. There is an abundance of solar energy falling on the earth, if we know how to tap it. The best method at present, he said, is the proven process of photosynthesis in trees. The eucalypt is the most productive agent for conversion of solar energy into biomass at present, he calculated. Algae had the potential to do better. The silicon battery and other recent discoveries, he said, may do better still some day (“Conditions for Economic Progress”, Third Edition, pp 488-9).

That’s not a bad place to start on my theme for today: the international context of Australia’s efforts to reduce carbon emissions.

Climate change is the most pressing and complex of several existential threats to the conditions of economic progress. War on the scale of the past, or extreme civil disorder, or financial crisis, or bumble-footed economic policy can slow or even reverse the beneficent processes of modern economic growth for a large part of humanity for a while. But the traditional sources of hiatus come to an end, and the conditions of economic progress are restored.

The deprivations of unmitigated or weakly mitigated climate change would not play themselves out within time frames that are relevant to the human experience.

Climate change on this scale would be a threat to more than economic growth. When human society receives a shock that is outside the normal experience, things fall apart (Garnaut 2008, pp 591-2).

In the year after all the six Premiers, the two Chief Ministers and Kevin Rudd asked me to undertake the first of my reviews on climate change policy, I feared that the problem might be too hard for our brilliantly successful but flawed species to manage.

Climate change is a diabolical policy problem. It is harder than any other issue of high importance that has become before our polity in living memory. Climate change represents a new kind of challenge. It is uncertain in its form and extent, rather than drawn in clear lines. It is insidious rather than (as yet) directly confrontational. It is long term rather than immediate, in both its impacts and its remedies. Any effective remedies lie beyond any act of national will, requiring international cooperation of unprecedented dimension and complexity. While an effective response to the challenge would play out over many decades, it must take shape and be put in place over the next few years....

Observation of daily debate and media discussion in Australia and elsewhere suggests that this issue might be too hard for rational policy making. It is too complex. The special interests are too numerous, powerful and intense. The time frames are too long, and the time frames within which action must be taken too short. (Garnaut, 2008, xviii)

Regrettably, the experience since 2008 has not repudiated this assessment.

## II. CLIMATE CHANGE POLICY IS DIFFICULT BECAUSE THE ISSUES ARE COMPLEX

There is uncertainty in the science; not about the scientific reality of the link between greenhouse gas emissions and temperature, but about the extent of the change and its effects. Things might turn out to be much worse than the mainstream of the science suggests is the median of the probability distribution; or better. As I noted in the Update of the Review in 2011, the early experience suggests that reality is unfolding towards the worse rather than the better end of what the most recent synthesis of the mainstream science describes as the range of possible outcomes (Garnaut 2011b, IPCC 2007).

No serious climate scientist suggests that unmitigated emissions would not have substantial climate effects; scientists hold different views about the extent of change and its likely impacts. The average of the expectations is for severe, probably catastrophic damage. But the fact that there is uncertainty about the extent of the effects challenges the capacities for analysis of the human mind. It is normal human behaviour in response to familiar kinds of uncertainty to take out insurance at some cost when the possibilities include some that are hugely damaging. But uncertainty in an unfamiliar context induces a tendency to postpone responses in forlorn hope that the problem will go away.

Climate change mitigation is an urgent problem. Large reductions in the trajectories of emissions must begin now and in the absolute volume of emissions soon if there are to be reasonable prospects of reducing the risks of dangerous climate change to levels that rational and well informed people would judge to be acceptable. But it takes time for humans to adjust expectations and behaviour and political positions to a major new challenge.

There is a lag of decades between emissions and their effects on climate. The worst effects may reveal themselves a long time into the future. For many people, seeing is believing, so the lags between emissions and climate change make it easier to raise doubts about the crucial scientific relationships.

While the benefits of mitigation—the avoidance of future climate change with its costs—come with a considerable lag, the costs of mitigation are greatest in the early years. This

raises the need for unfamiliar comparisons of the value of the welfare of humans living at different times.

Effective mitigation requires changes in economic structure. As Machiavelli advised the Medici princes, such change mobilises “the enmity of all who would profit by the preservation of the old institution and merely lukewarm defenders in those who gain by the new ones” (Machiavelli, 1532, Chapter 6) How much larger the problem confronting reform when the largest beneficiaries have not yet been born!

Responses that are effective enough to reduce the risks of climate change to acceptable levels require collective action, within each country and across the international community. The free rider problem of collective action is never easy to overcome. Effective collective action within or between countries invariably requires intellectual and institutional innovation, and new dimensions of political leadership. The emergence of ideas, institutions and political leadership and capacity for collective action on particular issues and at particular times can never be taken for granted.

The climate change issue makes exceptional demands on capacity for collective action and on the leadership that is necessary for effective action.

On the other hand, the interests that would be damaged by effective mitigation and which seek to resist it are favourably placed to resist an effective policy response. The losers from effective action are disproportionately concentrated in large companies that are already geared to heavy investment in the political process to influence policy, in democratic and authoritarian political systems alike. The complexity of the science increases the impact of mindless slogans that are favoured for the time being by contemporary communications technology and (at least in Australia) majority media culture.

### III. THE LIST OF BARRIERS TO EFFECTIVE ACTION IS DAUNTING AND AT FIRST SIGHT IMPASSABLE

But there are countervailing pressures. The conclusions from the science are clear and becoming stronger over time. Large numbers of citizens are taking the issue seriously—so seriously that they are prepared to contribute personal effort to increase the chances of effective action.

I will argue in this lecture that the resultant of the pressures on the climate change policy-making process has supported the building of a base from which it is realistic to consider the possibility of ambitious and effective global action.

I focus on just one aspect of the climate change policy challenge : the development of an effective system of international cooperation.

### IV. WE HAVE TO START WITH A CLEAR VIEW OF THE PROBLEM

The objective is for the world as a whole to invest in reducing greenhouse gas emissions to the point where the cost of a billion dollars of increased expenditure on mitigation equals the benefit of reduced climate change damage as a consequence of that expenditure.

What is the right amount of global warming that we should accept, given the costs of mitigation? That question has been the subject of serious analysis by academic economists

since the last decade of the twentieth century (Cline 1992, Nordhaus 1994, 2008). It was the focus of the Stern Review, commissioned by the United Kingdom Government (Stern 2007). The studies cited above calculate the interests of the international community as a whole in climate change mitigation, but policy decisions will actually be made in sovereign nation states.

Even if it were clear that a specified degree of mitigation were in the international collective interest, that perspective would be ineffective unless individual nation states took decisions on mitigation that added up to an effort that was consistent with attainment of the global goal. This is the challenge of international collective action on climate change.

Individual countries are affected differently by climate change, and by policies to reduce greenhouse gas emissions. Costs of climate change are likely to be lower in high latitudes and in developed countries and in countries with relatively weak political and economic interdependence with more vulnerable countries. Mitigation costs would fall unusually lightly on countries with large opportunities for producing low-emissions energy and more generally for meeting demand for goods and services with relatively low emissions, for countries with relatively low costs of capital for investment in low-emissions industries and processes, and for countries with high structural flexibility and capacity for innovation. The costs of climate change and the costs of mitigation would fall more heavily on countries with contrasting characteristics. Each country's calculations of its interests in climate change mitigation is affected by its assessment of its vulnerability and of the costs of its own mitigation.

The Garnaut Review (Garnaut, 2008) focussed on how one country decides on the level of mitigation that serves its own interests. The Review's analysis indicated that the costs of unmitigated climate change would be higher for Australia than for any other developed country.

The initial costs of effective global mitigation would also be relatively high for Australia, principally because other countries especially in Asia would reduce their demand for fossil fuels, especially thermal coal, that are major Australian exports. Note that the latter is a cost of other countries' and not our own reduction in greenhouse gas emissions. Longer term costs of mitigation in Australia are probably relatively low, because of Australia's potential for producing low-emissions energy at comparatively low cost.

For a country with resource endowments that make it naturally a large exporter or importer of emissions-intensive goods, the costs of mitigation depend a great deal on whether the international mitigation regime allows international trade in emissions entitlements. A large, diverse economy with energy resource endowments relative to endowments of labour and capital that are fairly similar to the world as a whole—which is not naturally a large importer or exporter of emissions-intensive goods—is not affected directly by the presence or absence of opportunities for international trade.

Here the interests of Australia in international trade can be contrasted with those of the United States. Australia has strong comparative advantage in production and export of emissions-intensive goods, and would benefit greatly from international trade in emissions entitlements. The United States would tend towards self sufficiency in an open trading system. It is greatly to Australia's advantage (and not so strongly to the advantage of the United States) that the international mitigation system allows trade in emissions entitlements.

How each country comes to assess the amount of mitigation that the world should seek depends on how any global effort comes to be allocated amongst countries.

A single country has direct control over the extent of its own mitigation effort. It has only indirect influence over the mitigation efforts of other countries. In deciding on the extent of its own effort, a single country must form and act on expectations about the efforts of other countries.

So the assessment of the extent of mitigation that makes sense from the perspective of a single country is at once more complex and more directly relevant to policy decisions than assessment of what makes sense for the world as a whole. It is more complex because each country's contribution to a global effort must embody expectations of the mitigation efforts by others. It is more important because the sovereign state is the locus of policy decisions.

My Climate Change Review broke new ground in analysis of optimal levels of mitigation effort in one country in a many-country world (Garnaut, 2008). It applied that analysis to the case of Australia.

The Climate Change Review defined a couple of mitigation ambitions (those associated with holding greenhouse gas concentrations to 450 parts per million and 550 parts per million of carbon dioxide equivalent in the atmosphere — corresponding roughly to having a reasonable chance of holding the human-induced increase in temperature from pre-industrial levels to 2 degrees Celsius and 3 degrees Celsius respectively).

The quantitative analysis for the Review confined the calculations to benefits of mitigation (reduced costs of climate change) that had their effects through markets and which were amenable to measurement within a computable general equilibrium economic model. The modelling was extended forward to the end of the current century, which tested the limits of the methodology. It drew attention to a number of additional benefits of mitigation which were important but not realistically amenable to measurement: insurance against the substantial possibility that outcomes might be much worse than the median of the probability distributions of outcomes upon which the computations were based; non-monetary costs of climate change (benefits of mitigation) such as damage to the natural and human heritage including to political stability; and monetary benefits beyond the century-long reach of the economic models that were developed for the purpose. It therefore excluded from quantitative assessment what are probably the majority of the benefits of effective mitigation. The Review said that these unquantified benefits of mitigation should be taken into account qualitatively outside the model.

The quantitative analysis alone suggested that the benefits of Australia participating in a strong global mitigation effort (an objective of limiting increases in greenhouse gas concentrations to 450 parts per million or temperature increases to two degrees) were similar to the costs. The qualitative benefits, probably more important than the quantitative, made the case for participation overwhelming.

The modelling was based on the premise that Australia would do its "fair share" in an international mitigation effort. I will come back to the international effort, and to what is a fair share for Australia.

A system of collective action can emerge in one of three ways, in both domestic and international spheres.

A system of collective action can emerge through the exercise of power by strong interests, enforced by economic sanctions or the threat or reality of violence.

It can emerge through agreement—like Locke’s social contract establishing order out of an anarchic state of nature. The agreement can extend to sanctions against breach contract.

Or a system of collective action can emerge through shared acceptance by individual citizens or states of constraints on decisions and behaviour. This is typically established by the gradual building of norms of behaviour that advance shared interests, to which individual parties conform to achieve shared goals. These can emerge from discussion leading to shared recognition that certain types of behaviour are conducive to the advancement of shared interests. The norms are strengthened over time by observation of the conforming behaviour of others, and by peer pressure against non-conforming behaviour.

All three sources of effective collective action have been important in development of civilised domestic relations amongst citizens and international relations among states. All three have been important in early attempts to find a basis for effective global climate change mitigation.

My 2008 Review emphasised the Lockean social contract. That emphasis was corrected in the 2011 Review Update, which noted the gradual emergence of an international system built mainly on the third of the three sources of collective action—the emergence of shared norms. Mainly but not exclusively: the norms are being shaped by emerging implicit agreements on what constitutes reasonable efforts by individual states and by recognition that free riding may incur costs in relations with other states, including in market access.

My Review discussed at length the nature of an international mitigation regime that could avoid high risks of dangerous climate change (Garnaut 2008, Chapters 8, 9 and 10). The amount of emissions over a long period of time that was consistent with avoidance of high risks of dangerous climate change would be calculated and allocated amongst countries according to agreed principles. I noted in the 2008 Review that convergence over time to equal per capita entitlements was likely to be the foundation principle for agreement on allocation of a global emissions budget.

Within such a system of “contraction and convergence” of greenhouse gas emissions, per capita entitlement to emit greenhouse gases would converge linearly from 2000 levels towards the low levels required for stabilisation of climate—with reductions of around 90 percent for Australia and other developed countries. I suggested that the principle be modified, to allow some additional headroom for the developing economies which were growing most rapidly.

Developing countries felt and expressed concerns that “contraction and convergence” demanded too little of high-income countries which had utilised already the greater part of the earth’s capacity safely to absorb emissions. Not only had the currently developed countries exhausted much of the world’s capacity to absorb greenhouse gases already, but they would be allowed exceptionally high per capita emissions entitlements for a number of years yet. In response, I endorsed a suggestion by Jagdish Bhagwati (2006) that this historical legacy could be addressed by developed countries providing financing for innovation in low-emissions processes, goods and services.

The 2011 Review Update defined what had emerged after Copenhagen as the contemporary international relations reality: there would be no binding Lockean agreement on climate change mitigation for the foreseeable future. The 2011 Review Update observed that effective international action on climate change mitigation was emerging without a legally enforceable



agreement (Garnaut 2011, Chapters 3 and 4). Developments since May 2011 strengthen this perspective. The remainder of this paper describes the emerging international mitigation regime and explains that the foundations have been laid for a concerted increase in the global mitigation effort.

## V. THE EMERGENCE OF A GLOBAL CLIMATE CHANGE REGIME

The international community's work to build a basis for international cooperation on climate change began at Rio de Janeiro, two decades ago. In 1992, there seemed to be lots of time, and the problem seemed to be overwhelmingly that of excessive emissions from the developed countries.

That impression guided the meeting of the United Nations Framework Convention on Climate Change in 1997 and the resulting Kyoto Protocol. By then there had been considerable progress in sharing perspectives within a uniquely ambitious and successful effort in international scientific cooperation, through the International Panel on Climate Change. Understandings were reached on which gases would be covered by efforts to reduce emissions, and on how they should be measured. An agreement was reached that all developed countries would accept constraints on emissions, and that there would be penalties for breaches of commitments. There would be opportunities to reduce the costs of mitigation through Joint Implementation among developed countries (where countries that were falling below their emissions reduction targets would be able to buy entitlements from countries that reducing emissions more than was required by their targets). There would be opportunities for reducing the costs of mitigation in developed countries through a Clean Development Mechanism (CDM), which would certify carbon reduction "offsets" generated in developing countries for sale to developed countries. Developing countries undertook to make efforts to reduce emissions; developed countries to contribute funding to these efforts and also to climate change adaptation in developing countries.

The Kyoto arrangements were damaged when the United States Congress refused to ratify the agreement to which the United States Government was a party. The George W. Bush Government elected in 2000 announced that it would not seek ratification for the agreement. The Australian Government followed the United States lead and continued to do so until policy was reversed in 2007. But both Australia and the United States remained parties to international discussions. Progress was made on some issues in conferences of the United Nations Framework Convention on Climate Change (UNFCCC) in Bali (2007), Copenhagen (2009), Cancun (2010), Durban (2011) and Doha (2012), including on a global objective of holding the human-induced increase in temperatures to two degrees Celsius.

These early efforts in collective action on climate change contained elements of success and failure. It is important to preserve the success (the scientific cooperation, the shared objective, the agreements on how to measure and later to account for and verify emissions, the mechanisms for international trade in entitlements and for transfers of financial resources to developing countries) while correcting the causes of failure.

## VI. TIME HAS PASSED AND TIMES HAVE CHANGED

We no longer have time: the concentrations of greenhouse gases are already approaching levels that are likely over time to generate two degrees increase in average temperatures. Emissions have grown more rapidly since the turn of the century than the most widely used scenarios developed in the 1990s had suggested, largely because growth was stronger and more energy-intensive and energy more emissions-intensive than had been anticipated (Garnaut et al. 2009). If temperature increases are going to be kept to two degrees, there must be an early and large reduction in global emissions trajectories.

In contrast to the world up to the Rio de Janeiro summit, emissions growth in the twenty first century was overwhelmingly concentrated in developing countries. My own calculations on “business as usual” emissions for the Climate Change Review Update (Garnaut 2011a, 2011b) suggested that in the absence of policy action to change established trends, developing countries would account for the whole of the increase in global emissions from 2005 to 2030; developed country emissions as a whole were expected to remain steady between 2005 and 2030. In the absence of policy action, China would account for 41 percent of global emissions in 2030 and developing countries 70 percent. Whatever weight was given to the requirements of historical responsibility and justice, effective global mitigation would require major and early reductions from business as usual emissions in China and other developing countries.

The Kyoto arrangements had envisaged a comprehensive “top-down” agreement in which responsibility for constraining emissions would be allocated across countries and enforced internationally. This ideal would provide a firm basis for international trade in entitlements, to allow reductions in emissions to occur where they could be achieved at lowest cost. Such an agreement would provide each country with assurance that others were contributing their fair shares of the global effort, so that its own emissions reductions would be part of an effective global effort. It would provide each country with assurance that other countries’ emissions-intensive industries were gaining no competitive advantage in international markets against its own as a result of differences in mitigation effort.

The international community has learned slowly and painfully that such an agreement is not within reach for the foreseeable future. This reality came within view at Copenhagen in 2009, and crystallised in Cancun in 2010. It was not possible because the major powers, first of all the United States but also China, were willing to bind themselves domestically to strong mitigation outcomes, but unwilling to enter international agreements to the same end. It was not possible because there were no effective sanctions against breaches of commitments—as demonstrated by Canada walking away without penalty from its Kyoto Protocol pledges.

Subsequent developments raise a question about whether a comprehensive “top-down” agreement is even desirable. In anticipation of a legally binding agreement, Governments settle into negotiating mode and seek to minimise commitments. By contrast, when considering a domestic commitment, Governments are prepared to look more openly at the boundaries of realistic commitments and to go further in defining mitigation targets.

A different approach to setting national targets began to emerge at Copenhagen, took firm shape at Cancun and was elaborated in subsequent UNFCCC meetings in Durban and Doha.

The new approach carries some important features over from the early international discussions. The scientific cooperation remains centrally important to the collective effort. The two degree objective, mechanisms for measurement and verification of emissions, and instruments for international trade in entitlements have been developed or strengthened. Ideas about mechanisms for transferring resources for mitigation and adaptation from developed to developing countries have been given substantive shape (although still little money). It must be said that additional steps need to be taken on verification of emissions: while a case can be made for developing country mitigation targets to be expressed in different ways from developed country targets (intensity rather than absolute reductions), there is no case for differentiation in measurement and verification.

The big departure from the old regime is in the setting of country targets for constraining emissions. It has been accepted that substantial developing countries will make commitments to constrain emissions, in the form of reductions in emissions intensity or “business as usual” emissions. (Intensity targets are strongly preferred to business as usual, as they are capable of objective and unambiguous calculation). It is accepted if only by default that these and developed country commitments to absolute reductions in emissions are voluntary and represent serious domestic undertakings and are not binding under international law. The voluntary targets are set domestically rather than within a comprehensive international agreement. The pressures to make them ambitious come from domestic politics and review and commentary from other countries—a process that is known as “pledge and review”.

I describe the new process as concerted unilateral mitigation.

It is a feature of the Kyoto arrangements carried over into the concerted unilateral mitigation regime that each country is free to use whatever instruments it chooses in meeting its targets. It is free to acquit its commitments through the purchase of international abatement to the extent that it chooses, or not at all. It is free to introduce carbon pricing in the form of an emissions trading system or a carbon tax or not at all. Whether or not it places a price on carbon, it can choose to regulate emissions-intensive activities and subsidise low-emissions substitutes to the extent that it chooses. International comparisons of mitigation effort are made in terms of the outcomes in reductions in emissions below defined baselines, and not in terms of how the emissions reductions are achieved.

For concerted unilateral mitigation to be effective, one major gap in the international regime needs to be filled. The regime needs some framework for guiding assessments of the level of mitigation in each country that amounts to a fair share of an international effort to achieve the agreed global effort. It would be useful and probably necessary for heads of governments committed to strong global mitigation outcomes to appoint an expert group to develop such a framework for allocating the global effort among countries. Within the context of concerted unilateral mitigation, each country would be free to accept or reject guidance provided by such a framework. The framework would become a focus of international review of each country’s effort, and evolve over time in response to discussion and experience.

The Durban conference of the UNFCCC in late 2011 agreed to launch “a process to develop a protocol, another legal instrument or an agreed outcome with legal force”. The process, legal instrument or agreed outcome would be settled by 2015 and come into effect in 2020. Developed and developing countries would all accept obligations, although the form of those obligations could vary across countries.

The Durban decision was sometimes interpreted as a commitment again to seek a binding, tops down agreement, although the words allow other interpretations. At least there is no suggestion that we should return to seeking comprehensive agreement on the allocation of the required global mitigation effort across countries. While there would be advantages in an internationally binding agreement if it were possible to achieve one without reducing mitigation ambition, the practical barriers to a good binding agreement remain as strong as they were at Copenhagen. It is important that we do not allow the search for excellent form to distract the international community from grasping immediate prospects for excellent substance.

To conclude the discussion of the evolution of the global climate change regime, international trade in emissions entitlements has struck some large practical problems. Within the European emissions trading system, the many regulatory and fiscal interventions are forcing much larger reductions in emissions than carbon pricing. These together with slow growth in economic activity and the realisation of unexpected opportunities for low-cost abatement have caused permit prices to fall to levels that are well below the economic cost of emissions and the value of abatement. The low prices raise questions about the effectiveness of the scheme. Although controlled in quantum, use of offsets at very low prices from the Clean Development Mechanism have pushed prices even lower. Low European prices would, if uncorrected, introduce low prices into other emissions trading systems with which Europe is linked, notably Australia from 2015.

It is understood by economists that broadly based carbon pricing achieves more carbon emissions reduction at similar cost, or similar abatement at lower cost, than large numbers of separate regulatory and fiscal interventions. Considerable emissions reductions have been achieved in recent years in many countries through regulatory and differentiated fiscal interventions. However, the cost advantages of general carbon pricing become more important as mitigation targets become more ambitious, and are likely to be essential to achieving the deep reductions in emissions that will be necessary to achieve the agreed global objective. The contemporary problems of uneconomically low prices in domestic and international trading schemes can therefore be seen as a threat to achievement of long term global mitigation goals. A tightening of emissions reduction targets is necessary to restore prices that relate appropriately to the cost and value of abatement in a world that is meeting its emissions reduction targets.

The Clean Development Mechanism (CDM) has emerged as the most important locus for international trade in carbon units, and for a number of years contributed substantially to incentives for investment in emissions reduction in developing countries. As analysed in the recent report of an independent review panel, the CDM is experiencing chronic oversupply of abatement units. Prices have fallen to levels that barely cover transaction costs. With recent and prospective reforms, the CDM is a legitimate offset mechanism with a potentially valuable place in a global system of climate change mitigation (CDM Policy Dialogue, 2012). The review panel concluded that a major tightening of emissions reduction targets and widening of access on the demand side would be necessary to correct the chronic oversupply. I would suggest as well a tightening of access on the abatement supply side, with only least developed countries having unconditional access. Other developing countries would have access if they accepted domestically binding emissions constraints and were living within those constraints without double counting of abatement for which CDM credits had been awarded. If this

approach were adopted by the international community, international mechanisms would need to be developed (perhaps through the established arrangements for Joint Implementation) to monitor double counting of emissions.

## VII. THE CANCUN PLEDGES

Within the framework of concerted unilateral mitigation, all substantial economies placed before the international community pledges that would reduce emissions below business as usual. The sum of the pledges represented a marked departure from established emissions trajectories. At the same time, they were no more than a small first step towards achieving the reductions in emissions that would be necessary to achieve agreed climate change objectives.

The United States pledge represented a large departure from earlier perspectives. President Bush had told a meeting of representatives of large economies in 2007 that United States emissions would continue to rise to a peak in 2025. The Cancun pledge was for emissions to fall from 2005 levels by 17 percent by 2020, corresponding to a 16 percent fall from 2000.

Canada pledged to match a binding commitment by the United States—a substantial undertaking unless the Canadian government had in mind annulling it by saying that the American pledge was not binding even if it were being met.

Some of the pledges contained conditional and unconditional elements—the latter being triggered if other countries took strong action. The European Union pledged to increase its emissions reductions from 20 to 30 percent (both based on 1990) in the context of strong international action.

The Australian pledge was unconditionally to reduce emissions by 5 percent on 2000 levels by 2020, and to increase the reduction to as much as a 25 percent in the context of strong international action. The unconditional commitment represented a sharp break in the trajectory of Australian emissions growth, influenced as it was by the developed world's most rapid growth in population and economic activity and exceptionally rapid expansion of emissions-intensive resource export industries. In 2011, the Australian Department of Climate Change and Energy Efficiency estimated that existing policy, without the new policies legislated in 2011, would see Australian emissions rise by 24 percent.

The Chinese target was to reduce the emissions intensity of economic output by between 40 and 45 percent between 2005 and 2020. This represented the largest departure amongst the community of nations from business as usual in terms of tonnes of emissions avoided. It could have had a galvanising effect on the Copenhagen meeting at which it was revealed to the international community. That its importance was not noticed and brought to account was a failure of diplomacy in China and many other countries.

The various pledges within the context of concerted unilateral mitigation added up to a much larger departure than the notionally binding commitments at Kyoto. However, the pledges left global emissions on trajectories that were far too high for the two degrees objectives unless much more ambitious additional commitments were made for the periods from 2015 and 2020.

Of course, one cannot say now what the Cancun pledges mean for the containment of global warming, as they say nothing about what happens after 2020, and do not allow for the possibility of concerted raising of ambition for what is left of the period before 2020.

### VIII. ENCOURAGING PROGRESS

There is good and bad news in the story of humanity's struggle to find a basis for effective collective action on climate mitigation. The early news was never going to be all good on an issue as complex, difficult and new to the international community as this one.

The best news is of immense importance: emissions generally seem to be on paths to meet or exceed the Cancun targets. They are on track to meet or exceed the pledges even in the cases of China and the United States—the world's biggest emitters of greenhouse gases, the largest and most influential economies, and countries whose pledges represent dramatic reductions in established trajectories. Moreover, the achievement of current pledges is being achieved at less cost than was anticipated by most analysts. Early and widely based progress at surprisingly low cost establishes sound foundations for a large and early increase in national mitigation ambition.

Far from reaching a peak in emissions in 2025 as President Bush foreshadowed in 2007, it now seems that emissions reached their highest level in the year in which the President was speaking, and have been declining since then. It is not a decline in economic activity that dragged emissions down: United States output last year is now around a tenth higher than in 2007.

Two recent private American studies, by Resources for the Future and the National Resource Defense Council, have concluded that the United States is on course to meet its emissions reduction targets despite the defeat in the Congress of the President's proposal for an emissions trading scheme (Scientific American, 2012; National Resource Defense Council, 2012). The Obama Government came to office in the United States in 2009 committed to taking large action on climate change, including through the legislation of an emissions trading scheme (ETS). After the House of Representatives failed to follow the Senate in passing ETS legislation, the Government began to use regulatory powers to achieve its goals. The Secretary for Energy, Stephen Chu, advised me in early 2011 that if the Government could not achieve its mitigation objectives through the most economically efficient means (an ETS), it would seek to realise them through the most cost-effective of alternative means available to it (Chu, 2011). This approach was forcefully endorsed by the President in his second Inaugural Address in January 2013.

Europe has already more or less achieved its Cancun objectives for emissions reductions by 2020. Slow economic growth has subdued demand for emissions-intensive goods and services, but the extent of reduction and the low price of abatement in the emissions trading scheme suggest that emissions reductions have been achieved at lower cost than had been anticipated (European Environment Agency 2012).

In Australia, too, emissions growth has been well below anticipated levels over recent years, tending around zero, despite the continuation of robust expansion of population, output and emissions-intensive resource investment for export. In the electricity sector, stagnant or declining demand has intersected with increased renewable energy production forced by the renewable energy target to cause faster decarbonisation than had been suggested in the official estimates. The introduction of carbon pricing from July 2012 and the use of part of the associated revenue to support renewable energy innovation will extend the reduction in emissions. Preliminary data suggest that emissions from electricity generation in the first six

months of the emissions trading scheme are over 8 percent lower than in the corresponding period of the previous year, with slowing demand growth and the renewable energy target making substantial contributions to reductions.

China's 12<sup>th</sup> Five Year Plan 2011-15 embodies far-reaching measures to constrain emissions within the intensity targets which the Chinese Government has communicated to the international community. In 2011, the first year of the New Plan, emissions continued to grow strongly. This was deeply discouraging for the international mitigation effort. However, policies to give effect to the new Plan began to bite in 2012 and, together with economically driven structural change, changed the emissions trajectory in 2012, to an extent that over-performance against the pledge seems likely.

Within the electricity sector, accounting for over 44 percent of China's emissions in 2010 (IEA 2012), demand growth slowed to 5.7 percent in 2012 after doubling over the previous decade, in response to energy efficiency and structural policies as well as a moderate easing of output growth. The energy efficiency policies and structural change are likely to keep electricity demand growth much lower than in the first decade of the twenty first century.

While early data for 2012 contain some inconsistencies and are subject to revision, they are striking and encouraging. There seems to have been almost no growth in thermal power generation. Output of all low-emissions energy ("clean" energy in the Xinhua terminology) sources of electricity grew rapidly: hydro-electric by 20 percent; nuclear by 17 percent; wind by 36 percent. Solar increased much more rapidly still from a low base. While hydro-electric power generation is affected by climatic conditions which were unfavourable in 2011 and favourable in 2012, it will fluctuate around a rising trend. Nuclear power generation is likely to continue to rapidly increase its share of power generation and wind and solar to do so at an even more rapid rate.

Within thermal power generation, a number of factors led to reductions in greenhouse gas emissions per unit of electricity. A number of Chinese policies will contribute to maintaining the new momentum in electricity decarbonisation that became apparent in 2012. There is still some way to go in replacing high-emissions coal generation in small, inefficient generators with ultra-supercritical plants: the International Energy Agency refers to 68GW of small (less than 100MW) and 138GW of medium (100-300MW) of coal generating capacity remaining in 2010 which is slated for replacement (IEA, 2012).

Policy is focussed on substantially increasing the natural and unconventional gas share of thermal power generation from the current low base.

China is investing more heavily than any other country in technological development for carbon capture and storage from fossil fuel consumption. Major investment in high-voltage long-distance transmission and in storage is leading to more complete utilisation of intermittent renewable energy capacity and to expanding options for new investment in renewables. The 12<sup>th</sup> Five Year Plan greatly increases financial commitments to energy efficiency and for innovation in low-emissions technologies including in the electricity sector.

The electricity supply and demand developments together may have caused stagnation or even an absolute fall in emissions from combustion of coal in electricity generation in 2012. This is a dramatic break from established trends, of historic importance in global terms. It takes us way outside the conventional wisdom on development of the Chinese energy market.

The strengthening of policies and actions to change the trajectory of China's greenhouse gas emissions extend over all major sectors.

Industrial emissions, which are largest in steel production, are experiencing much slower growth as a result of policy-enhanced slowing in the rate of growth of heavy industry, and by innovation to reduce emissions intensity. Forced closure of inefficient plants (32 million tonnes of steel capacity alongside 8,000 GW of coal electricity generation in 2011 alone (NDRC 2012)), higher costs of electricity and other inputs, export taxes and restriction of investment in new capacity have slowed expansion in energy-intensive and emissions-intensive activities. In transport, the heavy investment over the past decade in inter-city and intra-city rail will ease somewhat the growth of automobile traffic. Within the automotive sector, ambitious official targets for electrification are being strongly supported by a range of policies (NDRC 2012). The combination of rapid expansion of public transport led by rail, automotive electrification and decarbonisation of the electricity sector are likely to add up to unexpectedly early peaking of emissions from the transport sector.

In Japan where, despite the nuclear setback following Fukushima, targets for emissions reductions in Tokyo have been achieved much more rapidly than anticipated within its emissions trading scheme. Reducing the emissions intensity of economic activity is proving to be less costly and disruptive than had been anticipated by expert observers.

## IX. CHANCE OF GLOBAL SUCCESS

It is common for commentaries to focus on the failures of international cooperation on climate change. This paper has drawn attention to some successes that could become the launching pad of a strong international effort to achieve the agreed objective of holding temperature increases to two degrees.

This paper has drawn attention to the fact that the major economies including China, the United States, and the European Union (despite the setback to nuclear energy at Fukushima) are making unexpectedly rapid progress towards realising their pledges to the international community.

The paper has noted the importance of international trade in emissions entitlements in reducing the costs of mitigation for the world as a whole. One weak point in contemporary collective action on climate change is the low prices for carbon units in the European Union emissions trading system and in the Clean Development Mechanism. The continuation of low prices would discredit international trade as well as domestic emissions trading systems. The low prices themselves reflect the unexpectedly low cost of reducing emissions.

The remedy for prices that are well below the cost and value of optimal abatement is the same as the remedy for a global mitigation effort that currently falls well short of the requirements of the two degrees objective: an early tightening of targets.

The recent rapid progress towards announced targets on emissions reductions in many countries, and the revelation that costs of reducing emissions have been unexpectedly low, together provide the foundations for an early tightening of announced targets. An international climate change system built around concerted unilateral mitigation provides a favourable context for a renewed international effort to achieve the agreed objective of the international community.



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