

INTRODUCTION

The weight of scientific evidence tells us that Australians are facing risks of damaging climate change.

The risk can be substantially reduced by strong, effective and early action by all major economies. Australia will need to play its full proportionate part in global action. As one of the developed countries, its full part will be relatively large, and involve major early changes to established economic structure.

The work of the Review shows that the costs of Australia playing its proportionate part in an effective global effort, while considerable, are manageable. There is a path to Australia being a low-emissions economy by the middle of the 21st century, consistently with continuing strong growth in material living standards (chapters 11 and 23). By the end of the 21st century, and beyond, more so with each passing decade material living standards would be higher with than without mitigation of climate change.

Scientific opinion and dissent

There is no doubt about the position of most reputed specialists in climate science, in Australia and abroad, on the risks of climate change (Chapter 2). There is no doubt about the position of the leaders of the relevant science academies in all of the major countries.¹ The outsider to climate science has no rational choice but to accept that, on a balance of probabilities, the mainstream science is right in pointing to high risks from unmitigated climate change.

There are nevertheless large uncertainties in the science. There is debate and recognition of limits to knowledge about the times and ways in which the risk will manifest itself. Every climate scientist has views on some issues that differ from the mainstream in detail.

There are prominent dissenters on this matter, gathered under the rubric of 'sceptic'. For the most part 'sceptic' is a misnomer for their position, because these dissenters hold strongly to the belief that the mainstream science is wrong.

In a different category are a small number of climate scientists of professional repute who maintain that the mainstream science embodies misjudgments about quantities. These scientists, who accept the theory of the warming effects of higher concentrations of greenhouse gases, hold the view that these warming effects are relatively or even trivially small in comparison with many other causes of climate variations that are beyond the control of humans.

The dissent took a curious turn in Australia in 2008, with much prominence being given to assertions that the warming trend had ended over the last decade. This is a question that is amenable to statistical analysis, and we asked econometricians with expertise in analysis of time series to examine it. Their response—that the temperatures recorded in most of the last decade lie above the confidence level

produced by any model that does not allow for a warming trend—is reported in Chapter 4 (Box 4.1).

The prisoner's dilemma in international collective action

Effective international action is necessary if the risks of dangerous climate change are to be held to acceptable levels, but deeply problematic. International cooperation is essential for a solution to a global problem. However, such a solution requires the resolution of a genuine prisoner's dilemma: each country benefits from a national point of view if it does less of the mitigation itself, and others do more. If all countries act on this basis, without forethought, communication and cooperation, there will be no resolution of the dilemma. Future generations will judge the outcome to have been insufficient and unsatisfactory.

Resolution of the prisoner's dilemma requires communication, to find a division of costs and benefits of cooperation that is acceptable to all essential participants in a solution. The eventual solution can involve a range of cooperative arrangements, and not only matters related to the division of the mitigation task.

But resolution of the international prisoner's dilemma will take time—possibly more time than we have. The world squandered the time that it did have in the 1990s to experiment with various approaches to mitigation.

A diabolical problem and a saving grace

Climate change is a diabolical policy problem. It is harder than any other issue of high importance that has come before our polity in living memory. Climate change presents 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. Without such action, if the mainstream science is broadly right, the Review's assessment of likely growth in global greenhouse gas emissions in the absence of effective mitigation tells us that the risks of dangerous climate change, already significant, will soon have risen to dangerously high levels.

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 within which effects become evident are too long, and the time frames within which action must be effected too short.

But there is a saving grace that may make all the difference. This is an issue in which a high proportion of Australians are deeply interested. A high proportion of Australians say that they are prepared to pay for mitigation in higher goods and services prices. Most of them say that they are prepared to pay even if Australia is acting independently of other countries. There is a much stronger base of support for reform and change on this issue than on any other big question of structural

change in recent decades, including trade, tax and public business ownership reform. People in other countries, to varying degrees, seem to share Australians' interest in and preparedness to take action on global warming.

Public attitudes in Australia and in other countries create the possibility of major reform on emissions reductions, despite the inherent difficulty of the policy problem.

This report aims to nurture the chance that Australia and the world will manage to develop a position that strikes a good balance between the costs of dangerous climate change and the costs of mitigation. It does this by examining approaches to mitigation in one country within a framework which, if followed elsewhere, would add up to a solution. The Review recognises that other approaches may also add up to a solution. If others were also to develop proposals that add up to a solution to the problem, that would provide the basis for the type of realistic discussion across the international community that will be essential if a basis is to be found for effective global action.

The Australian economy and the challenge of climate change

Australia has a larger interest in a strong mitigation outcome than other developed countries. We are already a hot and dry country; small variations in climate are more damaging to us than to other developed countries. We live in a region of developing countries, which are in weaker positions to adapt to climate change than wealthy countries with robust political and economic institutions. The problems of our neighbours would inevitably become our problems. And the structure of our economy means that our terms of trade would be damaged more by the effects of climate change than would those of any other developed country (see chapters 11 and 23).

At the same time, Australia carries some major assets into this challenge. Australians are facing this new kind of challenge in the best of times. These are the times that earlier generations of Australians had hoped for their country. Australia is fortunate that humanity is enjoying the harvest of modern economic development in Asia and beyond. More people are emerging from poverty more quickly than ever before in human history. Australia's geographic location and economic structure make it a large beneficiary of these historic developments.

Australia is enjoying a double harvest. The internationally oriented market reforms in Australia from the 1980s were put in place just in time to take advantage of the new opportunities in Asia, and more broadly in the developing world. We are now riding the extension of the beneficent processes of modern economic growth into the heartlands of the populous countries of Asia.

In the early years of our federation Australians took pride in having the highest living standards in the world. On the eve of World War I, Australia's output per person was a bit above that of the United States, then and still the benchmark for economic modernity. Then, for seven decades, we turned in on ourselves, and paid the price. For seven decades, we fell further and further behind the global frontiers

of productivity and incomes. The value of our output per person fell to less than two-thirds that of the United States.

Then, a quarter of a century ago, we caught that tide which taken at the flood leads on to fortune. On such a full sea we are now afloat. In recent times, the value of output per person in Australia has again been comparable to that in the United States when both are measured in the national accounts and converted into a common currency at today's exchange rates.

So we have much to contribute and much to lose as we face the diabolical policy challenge of climate change. We would surrender to this challenge if we left climate change unmitigated. We would also surrender if we bungled the attempt to mitigate climate change, which would bring back into the centre of Australian national policy all of the self-interested pressure groups and arbitrary interventions that retarded our progress for so long. It would encumber the international polity with another layer of barriers to and complications of international exchange.

Australians' recent relative economic prosperity has had two direct causes. The first is our decisive rejection and reversal of the mistakes of the early decades after federation at the beginning of the 20th century: our protectionism, xenophobia and bureaucratic trammelling of the market.

The second cause is the Asian economic boom. Australia's resources and human capacities are more closely complementary to those of the densely populated countries of Asia than are those of any other economies on earth. For other developed and many developing countries, the strong growth in industrial production and demand for raw materials and food that accompanies economic growth in China, India, Indonesia and other Asian countries is seen as a competitive and inflationary threat. For Australia, it is an unbridled opportunity. Strong Chinese and other Asian economic growth has been the main factor behind the lift in Australia's terms of trade by about two-thirds over the past six years. This has lifted the average value of Australian output and incomes by more than one-eighth from the effects of increased export prices alone.

The combination of internationally oriented economic reform and opportunities provided by strong growth in the developing countries has so far set Australia apart as the 2008 financial crisis threatens to bring recession to many developed countries.

The increase in concentrations of greenhouse gases in the atmosphere over the last two centuries has generated the climate change that we have experienced to date and will experience over the next couple of decades and beyond. This is the result of economic activity in the countries that are now rich.

The Asian economic boom, half the cause of our prosperity, is also the source of the sharper immediacy of the climate change problem. The rapid increase in concentrations expected over the next several decades is primarily the result of activities that are expected in the developing countries that are becoming rich. The rapid increase in developing country emissions is what makes action to avert dangerous climate change urgent.

The links between Australia's own prosperity and the increase in greenhouse gas emissions in Asian developing countries are rather more direct than the general terms of trade effects would suggest. Fossil fuels have been a major component of increased Australian exports through the Asian boom of the early 21st century. The contribution to the value of Australian exports of the increase in price alone of just one fossil fuel commodity—coal—in 2008–09 is projected to equal about 2 per cent of Australian GDP.

It is neither desirable, nor remotely feasible, to seek to lower the climate change risk by substantially slowing the rise in living standards anywhere, least of all in developing countries. If such an approach were thought to be desirable in some expression of distant and idiosyncratic values, neither Australians, nor people in the developing countries, would accept it. Nor would it be in Australia's interests for Asia's developing countries to accept a dampening of their people's hopes for rising living standards in the interests of climate change mitigation. Their prosperity or its end is translated quickly into our own.

The solutions to the climate change challenge must be found in removing the links between economic activity and greenhouse gas emissions. For Australia, the commitment to the mitigation of climate change can be seen as the reinvestment of a part of the immense gains that have come from accelerated Asian economic growth, in contributing to reduction of an adverse side effect of that growth. In this, we are in a privileged position. We are different from most other countries, and certainly from all other developed countries except Norway.

Vested interests in the public policy process

These realities need to be kept in mind if we are to retain perspective in the domestic debate about mitigation and the introduction of an emissions trading scheme. Some elements of the Australian resources sector have expressed concern about the threat that a price on carbon poses to their competitiveness and to Australian prosperity. Our trade-exposed, emissions-intensive industries have valid concerns. The Review has acknowledged these from the beginning, and sought to accommodate them in its proposals for emissions trading scheme design. The Review proposes arrangements that deal with the valid concerns, without getting in the way of Australia's efficient transition to a low-emissions economy (Chapter 14). Along with some of our farm industries, metals processing would be the most affected, and have the first claims for assistance.

Every element of costs matters, and no increase in costs should be imposed on business without good reason. But when assessments of the reasonableness of arrangements for trade-exposed industries are made, we should be mindful of the wider context. The highest possible obligations under an emissions trading scheme, at the top end of the range of possibilities for permit prices for the foreseeable future, would represent a small fraction of the resource sector's increased revenue from higher export prices in recent years.

It is only to be expected that each firm, industry and sector will argue its own case in its own interests. Senior corporate executives are paid to do exactly that.

But in taking these arguments into the national debate, we must make sure that there is also a strong and independent voice for the public interest in the policy-making process that can keep sectoral claims in perspective.

Public policy in the national interest

The public interest must rely on the clarity of the analysis of the issues, on the dissemination of sound information, and in the end on the judgment of a public that is interested enough in the issue to make the effort to use effectively the information available to it.

Balance, reason and understanding of the premises, information and logic leading to policy conclusions are the keys to Australia and the world using well its last chance to get this difficult policy problem right. The Review's first aim is to lay out the issues for policy choice in a transparent way. The Review will have done its job if Australian governments and the community make their choices in full knowledge of the consequences of their decisions. It is hoped that the approach and analysis communicated in this final report will be helpful to developing transparent approaches to decisions in other countries as well.

No answers to questions as complex and difficult as those introduced here and discussed at length through the report, would seem right, or palatable, to everyone. Perhaps no answers, with their many parts, would seem right or palatable to anyone. Many will disagree with elements or the whole of the conclusions of the Review. Many will disagree with the policy proposals that flow from the conclusions. They would prefer cheaper, more certain, later and less disruptive approaches to reductions in emissions, or higher levels and urgency of mitigation ambition.

The Review would prefer cheaper, more certain, later and less disruptive ways forward—if any were available that were not associated with large risks of damage from climate change. Tempting though it is to do so, it is neither rational nor helpful to reject conclusions because we do not like them. The conclusions will only be wrong if the premises, information or logic leading to them are wrong. The Review has sought to be clear in its premises, information and methodology, so that they can be contested transparently. If the subsequent public policy debate follows these lines, we will improve the chances of Australian and other governments taking good decisions in the year ahead on a sound basis and with widespread community support, and therefore with prospects of policy continuity.

On no issue will this be more important than on the targets and trajectories for Australian mitigation. There has been considerable comment, from people concerned to solve the climate change problem, since the Review's proposals on targets and trajectories were released for discussion in the supplementary draft report on 5 September 2008. The material in this report allows discussion to move beyond expressions of like or dislike for conclusions, into identification of premises, information or logic that may require debate and, if flaws are identified, modification.

Measuring the costs and benefits of mitigation

The Review examines analytically whether and how much mitigation is justified. We do this by comparing the costs of mitigation with the benefits of climate change avoided by mitigation.

The assessment of whether and how much mitigation is worthwhile takes the reader on a long conceptual and quantitative journey. The methodology is new, and can be applied to other countries. Many of the numbers and other facts are specific to Australia.

Mitigation at a given level is justified if the benefits exceed the costs. If the benefits exceed the costs for more than one level of mitigation, the appropriate level is the one that generates the largest excess of benefits over costs. The conceptual framework for assessing whether various levels of mitigation are justified is set out in Chapter 1.

The costs of mitigation are felt through standard economic processes, and can be calculated through computable general equilibrium models.

The benefits of mitigation are the avoided costs of climate change. The assessment of the benefits of mitigation begins with analysis of the costs of climate change with no mitigation and at various levels of mitigation. The benefit of any extent of mitigation is the difference between the costs of climate change with no mitigation, and at the specified extent of mitigation.

There are four types of costs of climate change—and therefore four types of benefits from avoided climate change. Two of these take the form of standard economic costs, felt through markets, from mid-points in the probability distributions of climate change impacts that are derived from mainstream science. These two can, in principle, be assessed quantitatively through general equilibrium models. However, data in the precise form necessary for quantitative analysis through general equilibrium modelling are available for only one of these, Type 1. Type 2 costs of climate change, comprising standard economic impacts for which data are not available in a form that is sufficiently precise for modelling, have to be estimated. Type 3 costs of climate change (and benefits of mitigation) comprise the special and additional costs (value of avoiding) of extreme outcomes, and can be considered as insurance value. Type 4 benefits of mitigation comprise the conservation value related to all of the non-market benefits that would be lost through climate change in the absence of mitigation.

That is not the end of the complications in calculating the costs and benefits of climate change mitigation. The models used for assessing the costs of mitigation and climate change depend critically on the assumptions that are fed into them about structural relationships in the economy. The further we go into the future, and the more we introduce large structural pressures on the models that we use, whether from an ever-rising carbon price or from increasing climate change impacts, the more speculative are the assumptions that make up the model. By the time we get to the end of the 21st century, we have stretched the capacity of the models to the limits of usefulness.

This is not a problem for assessing the costs of mitigation, which will stabilise over time. But it cuts off the costs of climate change and therefore the benefits of mitigation just as they are starting to become large, and long before their peaks.

So what we derive from the quantitative analysis is the net costs of mitigation up to the end of the 21st century, taking into account only the Type 1 and Type 2 benefits of mitigation. The decision that has to be made is whether anticipated Type 3 and Type 4 benefits in the 21st century, and net benefits of all kinds after 2100, justify the calculated net costs of mitigation up to the end of the 21st century.

That is not the end of the conceptual complexity. The costs of mitigation come much earlier than the benefits of avoided climate change. We therefore need to apply a discount rate in comparison of costs and benefits accruing at different points of time.

Perhaps most complex of all is the assessment of the connection between the global mitigation effort, and a single country's contribution to it. The benefits of mitigation come from a global effort, and not from any single country's contribution to that effort. The Review has based its assessments of the costs and benefits of various levels of mitigation on the premise that Australia will make its full proportionate contribution to any global effort. This allows the benefits of a specified global mitigation effort to be associated with the costs of a corresponding Australian mitigation effort.

How can we calculate each country's, in this case Australia's, proportionate share of any global mitigation effort? We have to articulate a set of principles that has a chance of being seen as fair across the international community. Any specified mitigation objective—for example, to hold emissions concentrations to 550 ppm CO₂-e, or 450 ppm CO₂-e with overshooting—will be associated with a global trajectory for emissions over the period leading to the realisation of the objective. How can this emissions trajectory be allocated among countries in a way that can be the subject of an agreement among countries, because it is seen as being fair and practical?

Perceptions and realities of fairness can be influenced by transfers related to technology or support for adaptation, from developed to developing countries. The shape of an agreement could be influenced by the prospect of penalties, for example related to emissions-related restrictions on trade (chapters 8 to 10).

It is unlikely that any allocation of a global trajectory for emissions entitlements will be seen as being fair if it is not based on the idea that, sooner or later, there will be equal per capita rights to use the atmosphere's limited capacity to absorb more greenhouse gases. To be seen as being practical, it will need to allow some time to move from the currently highly unequal assumption of emissions rights across countries, to equal per capita rights. The basis thought to be most likely to be successful is what has become known as 'contraction and convergence', modified to allow faster growth in emissions from fast-growing developing countries for a transition period.

For purposes of analysis, the Review assumed that per capita entitlements would converge to equal entitlements in 2050. The timing of convergence would be a substantive issue in international negotiations on dividing a global emissions entitlements budget among countries.

Note that we are talking about entitlements and not actual emissions. Countries that are able to hold actual emissions below their entitlements will be able to sell their surplus entitlements on international markets. It is not essential for success of the international mitigation effort that every country choose to engage in international trade in permits, rather than to live within its national trajectory. Costs can be reduced by international trade in permits, because trade allows reductions in emissions to occur where they are cheapest. However, the choice to make use of this opportunity to lower costs can be left to individual countries. We can be reasonably confident that enough high-income countries will want to take advantage of opportunities for trade for developing countries to be able to sell surplus permits, and therefore have additional incentives to join the international mitigation effort.

Australia's emissions entitlements within 550 and 450 mitigation objectives were derived from the global emissions trajectories associated with each of them, and from the modified contraction and convergence framework (Chapter 10).

These were the building blocks for the Review's assessment of whether and how much mitigation was worthwhile from an Australian perspective.

Mitigation on the basis of 550 objectives was judged to generate benefits that exceeded the costs. Mitigation on the basis of 450 was thought to generate larger net benefits than 550.

Emissions growth in the Platinum Age

The reassessment of business-as-usual emissions, described in Chapter 3, is a feature of the Review's work. It has large implications for climate change analysis and policy.

The Review has replaced outdated scenarios on emissions growth, embodied in the reports of the Intergovernmental Panel on Climate Change and in earlier studies, by assessments of business-as-usual emissions that are based realistically on growth trends in the early 21st century. These recent years have seen stronger rates of economic growth in the large developing countries than in any earlier period. We call this period of accelerated economic growth the 'Platinum Age', because for most of the world's people it involves stronger growth than the decades after World War II, which economic historians have called the 'Golden Age'. The strong growth is concentrated in countries, first of all China, but also India and Indonesia and others, that, because of their levels of development and economic structure, are experiencing energy-dependent growth. These happen to be countries in which coal is the lowest cost option for increasing energy supply, and coal happens to be the major energy source that is associated with the highest levels of emissions.

None of these realities underlying exceptionally high growth in emissions is going to change at an early date except in the context of climate change policy decisions by governments.

It is a consequence of the reworking of emissions scenarios that the costs of both climate change, and of mitigation to achieve specified concentrations objectives, are higher than had been anticipated by earlier studies. These reworked projections bring forward the critical points for high risks of damaging climate change.

It follows that, if specified mitigation goals are to be reached, it is at once more difficult and more urgent to put in place an effective global agreement. Mitigation efforts that were once thought reasonable now appear to be inadequate.

At the time of presentation of this report to the Prime Minister, state premiers and territory chief ministers of Australia on 30 September 2008, global financial markets are experiencing major instability. Some analysts are suggesting that this will be seriously destabilising for economic growth throughout the world.

Will the positive view of global and in particular of developing country growth, and the associated negative view of greenhouse gas emissions under business as usual (Chapter 3), remain valid in these circumstances?

It is likely that aggregate global growth in 2008 and 2009 will be significantly lower than in the preceding five years or so. However, the acceleration of economic growth in the developing world in the early 21st century has firm foundations. It is unlikely that the current turmoil on financial markets will derail long-term global growth in developing countries permanently from its new and stronger course.

Adaptation

The international community is too late with effective mitigation to avoid significant damage from climate change. So in the best of circumstances, Australians and people everywhere will be adapting to substantial climate change impacts through the 21st century.

The international community may yet fail to put in place effective global mitigation, in which case the challenge of adaptation to climate change will be more daunting. Sound policy on adaptation involves costs, but in many circumstances can later reduce the costs of climate change impacts. Chapters 13 and 15 describe the Review's approach to adaptation policy.

Adaptation to some of the possible consequences of climate change would test humans and their values and preferences in profound ways.

Contemplating the adaptation challenges of people in future times helps to focus our minds on the more difficult dimensions of mitigation choices. We are led to think about how we value future against current generations. We are forced to decide what we would be prepared to pay in terms of consumption of goods and services forgone, to avoid uncertain prospects of possibly immensely unhappy outcomes. We are forced to decide what current and early material consumption we would be prepared to forgo to avoid loss of things that we value, but are not accustomed to valuing in monetary terms.

In making their choices, Australians will have to decide whether and how much they value many aspects of the natural order and its social manifestations that have been part of their idea of their country. In the discussion of the costs of climate change, much is made of damage to natural wonders—to the Great Barrier and Ningaloo reefs, the wetlands of Kakadu, the karri forests of the south-west. We know that we value them highly, and now we will need to think about whether we are prepared to pay for their preservation.

As a changed future approaches, Australians will find themselves thinking about how much they care about other dimensions of our national life that have always been taken for granted. As we will see, with unmitigated climate change, the risks are high that there will be change beyond recognition in the heartlands of old, rural Australia, in Victoria, Western Australia, South Australia, and in the Murray-Darling Basin, which features prominently in our analysis of the possible impacts of climate change. The loss of these heartlands of old Australian identity would be mourned.

Main policy themes

Five general themes that are connected to the Review's policy recommendations run through the report.

Domestic policy must be integrated into global

The first theme is that domestic policy must be deeply integrated into global discussions and agreements. Only a global agreement has any prospect of reducing risks of dangerous climate change to acceptable levels. The costs of achieving any target or holding any trajectory for reducing Australian greenhouse gas emissions will be much lower within the framework of an international agreement. The continuation for long periods of strong Australian mitigation outside a global agreement is likely to corrode the integrity of the Australian market economy. The continuation for long of strong national mitigation in a number of countries without an international framework is likely to corrode the global trading system. It is therefore important to see any period in which an Australian mitigation effort is in place prior to an effective global arrangement as short, transitional and contributing to the achievement of a sound global agreement.

The international dimension of policy is relevant in almost every sphere: in the establishment of targets and trajectories for reduction in emissions; in all dimensions of an increased research and development effort, from climate science to low-emissions technologies; in adaptation to the impacts of climate change; in the importance of equitable distribution of the burden of climate change mitigation.

Strong mitigation must be consistent with prosperity

The second general theme is that global and national mitigation is only going to be successful if reductions in emissions can be made and demonstrated to be consistent with continued economic growth and rising living standards. For Australia, our prime asset in meeting the climate change challenge is the prosperous, flexible, market-oriented economy that has emerged from difficult

reforms over the past quarter century. This gives Australia the resources to join other developed countries in sharing the global leadership responsibility for mitigation and adaptation. It provides a basis for market-oriented domestic approaches to mitigation and adaptation that can reduce their costs. It suggests the primacy of preservation of the integrity of market institutions in designing the approach to mitigation and adaptation.

It is a corollary of the second theme that an effective market-based system must be as broadly based as possible, with any exclusions driven by practical necessity and not by short-term political considerations. This will allow abatement to occur in the enterprises, households, industries and regions in which it can be achieved at lowest cost. We do not know now what those firms and industries and regions will be, or how households will respond. Application of similar incentive structures over as much of the economy as possible allows market processes to guide the emergence of favourable outcomes.

Policies must be practical

The third theme is the importance of practicality. The climate change policy discussion has been bogged in delusion, in Australia and elsewhere. Mitigation targets are defined, and sometimes agreed internationally, without the difficult work being done, to make sure that the separate numbers add up to desired solutions, and to make sure that there are realistic paths to where we commit ourselves to go.

The most inappropriate response to the climate change challenge is to take measures and to reach international agreements that create an appearance of action, but which fail to solve or to move substantially towards a solution to the problem. Such an approach risks the integrity of our market economy and political processes to no good effect. It also weakens the political base for later efforts.

It is delusion for one country to develop its own views on the amount of mitigation that it is prepared to undertake without analysing whether that contribution fits into a global outcome that solves the problem.

It is delusion for people in one or many countries to think that they can commit to reductions in emissions in order to solve the climate change problem, without having in mind steps that can actually be taken to implement that commitment.

Some of the past delusion has arisen out of difficulties of working out how to respond to uncertainty.²

It is an error to think that uncertainty provides good reason for delaying decisions to start with effective mitigation. Uncertainty surrounding the climate change issue is a reason for disciplined analysis and decision, not for delaying decisions. Under uncertainty, knowledge has high value, and this makes the case for increased investment in applied climate science. Rigorous decision-making under uncertainty recognises that options have value, and that option values decay with time. The rate of decay of good options is faster than was thought by the proponents of strong mitigation only a few years ago, because of the 21st century acceleration of growth in greenhouse gas emissions under business as usual.

The acceleration of emissions growth in recent years—itsself the other side of the coin to a beneficent acceleration of growth in many developing countries—has underlined the significance of another delusion: the delusion that this problem can be solved without developing countries playing a major part in the process from an early date.

Policies must be equitable

The fourth theme is that to be practical, any policies on national or international mitigation will need to be and to be seen to be equitable. While there will be no satisfactory solution to the global warming problem without active participation of developing countries from an early date, equity requires developed countries to accept a major part of the costs in the initial years. This was recognised in early international meetings, at Rio de Janeiro and Kyoto, but the recognition so far has been honoured mainly in the breach.

Domestically, in developed and developing countries alike, there is a likelihood that, in the absence of deliberate policies aimed at equitable distribution of the costs of adjustment to a low-emissions economy, the burden would be carried disproportionately by people on low incomes. This reality has the potential for generating resistance to mitigation. As in the international sphere, concerns for equity merge into concerns for practicality.

Good governance is critical

The fifth theme is that there will be no success in mitigation, at a national or international level, without good governance in relation to climate change policies. Proposals that can work on climate change are complex, and cut across strong vested interests of many kinds. These are circumstances in which it is easy, indeed natural, for vested interests to capture policy, and for the national or international interest, and the ultimate reasons for policy, to be forgotten. The only antidote to these tendencies is good governance: the articulation of clear and soundly based principles as a foundation for policy, and the establishment of strong, effective and well-resourced institutions to implement the principles. This is important in both the international and national spheres.

Main policy recommendations for Australia

The main policy recommendations to Australian governments fall within four clusters. One cluster relates to Australia's contributions to the emergence of an effective global agreement. A second relates to efficient implementation of mitigation policies within Australia, and in particular to design of an emissions trading scheme. A third relates to research, and in some spheres development and commercialisation of the products of research. The fourth cluster relates to equitable distribution of the burden. There is obvious overlap across the clusters, but it is useful to introduce them separately.

Australia's commitments in global context

The first is at the centre of the others. The only effective mitigation is global. It is unlikely that the sum of each country's mitigation efforts could add up to effective global mitigation except in the context of an agreement among countries. There will be no international agreement unless each country, and in the first instance each developed country, contributes positively to it. So the first policy issue relates to the contribution that each country, and in this case Australia, makes to an effective global agreement.

Strong mitigation, with Australia playing its proportionate part, is in Australia's interests. In preparation for Copenhagen, Australia should support the objective of reaching international agreement around an objective of holding concentrations to 450 ppm CO₂-e—inevitably with overshooting. It should express its willingness to reduce its own entitlements to emissions from 2000 levels by 25 per cent by 2020 and by 90 per cent by 2050 in the context of an international agreement, so long as the components of that agreement add up to the concentrations objective.

While desirable for Australia and the world, such an agreement will not be easy to reach in one step. It would place constraints on emissions from both developed and developing countries that go beyond what is being contemplated in any but a few countries.

The chances of achieving an effective, soundly based agreement that adds up to 550 are much stronger (chapters 9 and 12). An effective and realistic agreement around a 550 ppm objective would be a major step forward in its own terms. It would also support the beginning of effective international cooperation in emissions reduction and the development and transfer of low-emissions technologies, which would build confidence that ambitious mitigation is consistent with continued economic growth in developed and developing countries. It could therefore be a path towards a subsequent agreement with a more ambitious mitigation objective.

While maintaining its support for the 450 objective, the Commonwealth Government should make it clear that it is prepared to play its full proportionate part in an effective international agreement to hold greenhouse gas concentrations to 550 ppm CO₂-e. This would involve reducing emissions entitlements by 10 per cent by 2000 levels by 2020, and by 80 per cent by 2050.

Consistently with the anticipated content of international agreements at Copenhagen, the offers would relate to binding commitments for 2020, and indicative commitments for 2050. Targets for 2020 are best expressed in relation to the Kyoto Protocol as offers over a base that assumes compliance with the Protocol in the first commitment period (2008–12). In these terms, Australia's offer would be a 17 per cent reduction under a 550 ppm agreement and a 32 per cent reduction under a 450 ppm agreement.

If there were no comprehensive global agreement at Copenhagen, Australia, in the context of an agreement among developed countries only, should commit to a reduction in emissions entitlements by 5 per cent from 2000 levels by 2020 (25 per cent per capita) or 13 per cent from Kyoto compliance in 2008–12. This would be Australia's unconditional offer.

The international agreement would need to go beyond allocation of emissions entitlements across countries. It would need to cover commitments from developed countries to provide support for research, development and commercialisation of low-emissions technologies. Australia should express its willingness to play its full proportionate part in a commitment of a total of US\$100 billion per annum by developed countries, with commitments calibrated to income. Australia's share in current circumstances would be in the order of \$2.7 billion per annum. Details of the proposed International Low-Emissions Technology Commitment are set out in Chapter 10.

Australia should express its willingness to play its proportionate part in a commitment by high-income countries to support adaptation to climate change in developing countries (Chapter 10).

Within its commitment to support the development of low-emissions technologies, Australia should play a leading role in the management and funding of an expanded international effort to develop and to commercialise carbon capture and storage technologies for carbon dioxide.

It is in Australia's interests to work with other countries towards international sectoral agreements to create a level playing field for major trade-exposed, emissions-intensive industries, including metals, international shipping and aviation. A World Trade Organization agreement would support international mitigation efforts by establishing rules for trade measures to be taken against countries doing too little on climate change.

Australia can also take the lead in continuing what it has already begun, in building productive cooperation on climate change issues with its developing country neighbours, first of all Papua New Guinea and Indonesia. An example of successful cooperation between developed and developing countries that was advantageous for development, covering trading in emissions entitlements, transfer of technology, technical assistance on mitigation in the forestry sector, and cooperation on adaptation could be influential beyond Southeast Asia and the South Pacific.

Australia, alongside others who are willing to play this role, could promote the idea that heads of governments with commitments to strong outcomes at Copenhagen could appoint representatives to a group that is given the task of developing detailed proposals that add up to a range of different concentrations objectives. This would increase the chances that discussion at Copenhagen is constructed around practical alternatives.

Above all, Australia can take a lead by putting in place domestic institutional arrangements and policies that are capable of delivering its share of an agreed mitigation objective at the lowest possible cost. An efficient emissions trading scheme and the introduction of supporting arrangements that reduce the costs of adjusting to the carbon constraint will demonstrate that Australia's emissions reduction commitments are credible.

Design of an emissions trading scheme

The second cluster of policy recommendations relate to the Australian system for reduction in greenhouse gas emissions.

An emissions trading scheme will not be the best instrument of greenhouse gas emissions reduction in every country. It is, if designed and implemented well, the best approach for Australia. Chapter 14 describes a simple emissions trading scheme with broad coverage that can be closely integrated into international markets.

Chapter 14 stresses the importance of assisting trade-exposed, emissions-intensive industries to the extent that other countries do not have comparable carbon pricing. It cautions against compensating them for the effects of the introduction of carbon pricing in Australia. This approach supports adjustment towards the structures that are required in a low-emissions global economy.

Chapter 14 also stresses the importance of the administration and long-term stability of the scheme being placed in the hands of an independent authority—an independent carbon bank—working within clear principles established in law.

Trajectories for reductions in emissions over time should be set consistently with Australia's international commitments. All emissions permits should be sold competitively by the independent carbon bank, periodically to deliver the required emissions reduction trajectories. The trajectories would be changed only with five years' notice, and following certification by the federal government that specified international conditions for change had been met.

Australia's emissions trading system should be established at the earliest possible date, in 2010. During the remainder of the Kyoto compliance period, to the end of 2012, permits should be sold at a fixed price, rising over time, as discussed in Chapter 14.

The sale of permits would generate large amounts of revenue. Some of the revenue would be preempted by the issue of credits for trade-exposed industries. It is judged that the application of the principles outlined in Chapter 14 would entail less than 30 per cent of the permit value being preempted by issue to trade-exposed industries, falling over time as other countries adopted comprehensive or sectoral carbon pricing. Actual revenue from permit sales would be allocated either as payments to households (about 50 per cent), as support for research, development and commercialisation of new technologies (about 20 per cent, contributing a major part of Australia's obligations under the International Low-Emissions Technology Commitment), or to business as credits for trade-exposed activities or as cuts in taxes (about 30 per cent).

There is large scope for biosequestration in Australia, and to a lesser extent in other countries. Full realisation of this potential requires comprehensive carbon accounting in relation to land use, and a determined program, policy and research effort.

No useful purpose is served by other policies that have as their rationale the reduction of emissions from sectors covered by the trading scheme. The Mandatory Renewable Energy Target should be phased out (Chapter 14).

There are structural reasons to expect market failure in response to carbon pricing in relation to the information required for optimal use of known technologies; to research, development and commercialisation of new technologies; and to network infrastructure. Policies to correct these failures are discussed in chapters 17, 18 and 19.

Research and application of new knowledge

The third cluster of recommendations relate to research and development. These matters have already been discussed in relation to the International Low-Emissions Technology Commitment. A stronger Australian climate science research effort is required. It is required as a basis for continued readjustment of Australia's contribution to identifying appropriate mitigation targets and trajectories and it is required to provide a stronger Australian basis for adaptation responses (chapters 13 and 15).

There is an important gap in Australia's research capacity, relating to extending and bringing together research related to climate policy. It is recommended that Australia establish a climate change policy research institute, with disciplinary strengths in the physical and biological sciences, economics and other relevant social sciences.

Sharing the burden of mitigation

Finally, the fourth cluster of policies relate to income distribution. Equitable distribution of the burden of mitigation internationally and in each country is at the heart of the practicality of mitigation. This has already been discussed in its international dimension.

Within Australia, the maintenance of full employment and an effective social safety net are the most important requirements for equity in the process of emissions reduction and adaptation to climate change.

The use of revenue generated by the competitive sale of permits is an important instrument of equity. For the most part, the value will have been created by the recoupment from households of the scarcity rents of permits, and passing back proceeds from sales can reduce the effect of mitigation-induced prices on household living standards.

The Review recommends that half the permit revenue be paid to households, with a focus on the lower half of the income distribution. Before and in the early years of the emissions trading scheme, a 'green credit' arrangement should facilitate energy-saving adjustment for low-income households. Other payments to households should be made through the taxation and social security systems (Chapter 16).

There have been demands for compensation of Australian business for loss of income or wealth associated with the introduction of an emissions trading scheme. The most vocal have been coal-based electricity generators. The Review's analysis indicates that such claims must be assessed against other equity claims by people who have been adversely affected by the scheme. The case for business

compensation is weak alongside the claims of low-income Australian households. There is, however, a case for structural adjustment assistance during the transition to low-emissions technologies in coal-based electricity-generating regions, to prevent the emergence of disadvantaged regions in the transition to a low-emissions economy.

Notes

- 1 Issued in a statement by the national academies of science of Brazil, Canada, China, France, Germany, India, Japan, Mexico, Russia, South Africa, the United Kingdom and the United States in 2008 (Joint Science Academies 2008).
- 2 This is not uncommon in the early stages of coming to grips with new problems. The pity is that the analysis of decision making under uncertainty has been taken so far in other contexts that we did not need to learn it all again in a new sphere (Hacking 1990).

References

Hacking, I. 1990, *The Taming of Chance*, Cambridge University Press, Cambridge.

Joint Science Academies 2008, *Joint Science Academies' Statement: Climate change adaptation and the transition to a low carbon society*, joint statement released by the National Academies of Science of the G8 Countries plus Brazil, China, India, Mexico and South Africa.

SYNOPSIS OF KEY POINTS

Chapter 1 A decision-making framework

The central policy issue facing the Review can be simply stated: what extent of global mitigation, with Australia playing its proportionate part, provides the greatest excess of gains from reduced risks of climate change over costs of mitigation?

The mitigation costs are experienced through conventional economic processes and can be measured through formal economic modelling.

Only some of the benefits of mitigation are experienced through conventional market processes (types 1 and 2) and only one is amenable to modelling (Type 1). Others take the form of insurance against severe and potentially catastrophic outcomes (Type 3), and still others the avoidance of environmental and social costs, which are not amenable to conventional measurement (Type 4).

The challenge is to make sure that important, immeasurable effects are brought to account.

The long time frames involved create a special challenge, requiring us to measure how we value the welfare of future generations relative to our own.

Chapter 2 Understanding climate science

The Review takes as its starting point, on the balance of probabilities and not as a matter of belief, the majority opinion of the Australian and international scientific communities that human activities resulted in substantial global warming from the mid-20th century, and that continued growth in greenhouse gas concentrations caused by human-induced emissions would generate high risks of dangerous climate change.

A natural carbon cycle converts the sun's energy and atmospheric carbon into organic matter through plants and algae, and stores it in the earth's crust and oceans. Stabilisation of carbon dioxide concentrations in the atmosphere requires the rate of greenhouse gas emissions to fall to the rate of natural sequestration.

There are many uncertainties around the mean expectations from the science, with the possibility of outcomes that are either more benign—or catastrophic.

Chapter 3 Emissions in the Platinum Age

Greenhouse gas emissions have grown rapidly in the early 21st century. In the absence of effective mitigation, strong growth is expected to continue for the next two decades and at only somewhat moderated rates beyond.

So far, the biggest deviations from earlier expectations are in China. Economic growth, the energy intensity of that growth, and the emissions intensity of energy use are all above projections embodied in earlier expectations. China has recently overtaken the United States as the world's largest emitter and, in an unmitigated future, would account for about 35 per cent of global emissions in 2030.

Other developing countries are also becoming major contributors to global emissions growth, and will take over from China as the main growing sources a few decades from now. Without mitigation, developing countries would account for about 90 per cent of emissions growth over the next two decades, and beyond.

High petroleum prices will not necessarily slow emissions growth for many decades because of the ample availability of large resources of high-emissions fossil fuel alternatives, notably coal.

Chapter 4 Projecting global climate change

As a result of past actions, the world is already committed to a level of warming that could lead to damaging climate change.

Extreme climate responses are not always considered in the assessment of climate change impacts due to the high level of uncertainty and a lack of understanding of how they work. However, the potentially catastrophic consequences of such events mean it is important that current knowledge about such outcomes is incorporated into the decision-making process.

Continued high emissions growth with no mitigation action carries high risks. Strong global mitigation would reduce the risks considerably, but some systems may still suffer critical damage.

There are advantages in aiming for an ambitious global mitigation target in order to avoid some of the high-consequence impacts of climate change.

Chapter 5 Projecting Australian climate change

Australia's dry and variable climate has been a challenge for the continent's inhabitants since human settlement.

Temperatures in Australia rose slightly more than the global average in the second half of the 20th century. Streamflow has fallen significantly in the water catchment areas of the southern regions of Australia. Some of these changes are attributed by the mainstream science to human-induced global warming.

Effects of future warming on rainfall patterns are difficult to predict because of interactions with complex regional climate systems. Best-estimate projections show considerable drying in southern Australia, with risk of much greater drying. The mainstream Australian science estimates that there may be a 10 per cent chance of a small increase in average rainfall, accompanied by much higher temperatures and greater variability in weather patterns.

Chapter 6 Climate change impacts on Australia

The Review has conducted detailed studies of impacts of climate change on Australia. These studies are available in full on the Review's website.

Growth in emissions is expected to have a severe and costly impact on agriculture, infrastructure, biodiversity and ecosystems in Australia.

There will also be flow-on effects from the adverse impact of climate change on Australia's neighbours in the Pacific and Asia.

These impacts would be significantly reduced with ambitious global mitigation.

The hot and dry ends of the probability distributions, with a 10 per cent chance of realisation, would be profoundly disruptive.

Chapter 7 Australia's emissions in a global context

Australia's per capita emissions are the highest in the OECD and among the highest in the world. Emissions from the energy sector would be the main component of an expected quadrupling of emissions by 2100 without mitigation.

Australia's energy sector emissions grew rapidly between 1990 and 2005. Total emissions growth was moderated, and kept more or less within our Kyoto Protocol target, by a one-off reduction in land clearing.

Relative to other OECD countries, Australia's high emissions are mainly the result of the high emissions intensity of energy use, rather than the high energy intensity of the economy or exceptionally high per capita income. Transport emissions are not dissimilar to those of other developed countries. Australia's per capita agricultural emissions are among the highest in the world, especially because of the large numbers of sheep and cattle.

The high emissions intensity of energy use in Australia is mainly the result of our reliance on coal for electricity. The difference between Australia and other countries is a recent phenomenon: the average emissions intensity of primary energy supply for Australia and the OECD was similar in 1971.

Chapter 8 Assessing the international response

Climate change is a global problem that requires a global solution.

Mitigation effort is increasing around the world, but too slowly to avoid high risks of dangerous climate change. The recent and projected growth in emissions means that effective mitigation by all major economies will need to be stronger and earlier than previously considered necessary.

The existing international framework is inadequate, but a better architecture will only come from building on, rather than overturning, established efforts.

Domestic, bilateral and regional efforts can all help to accelerate progress towards an effective international agreement.

The United Nations meeting in Copenhagen in December 2009 is an important focal point in the attempt to find a basis for global agreement. Australia must be prepared to play its full proportionate part as a developed country.

Chapter 9 Towards global agreement

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

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

An initial agreement on a global emissions path towards stabilisation of the concentration of greenhouse gases at 550 CO₂-e is feasible. 450 CO₂-e is a desirable next step. Agreement on, and the beginnings of implementation of, such an agreement, would build confidence for the achievement of more ambitious stabilisation objectives.

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.

Chapter 10 Deepening global collaboration

International trade in permits lowers the global cost of abatement, and provides incentives for developing countries to accept commitments.

Trade in emissions rights is greatly to be preferred to trade in offset credits, which should be restricted.

A global agreement on minimum commitments to investment in low-emissions new technologies is required to ensure an adequate level of funding of research, development and commercialisation. Australia's commitment to support of research, development and commercialisation of low-emissions technology would be about \$2.8 billion.

An International Adaptation Assistance Commitment would provide new adaptation assistance to developing countries that join the mitigation effort.

Early sectoral agreements would seek to ensure that the main trade-exposed, emissions-intensive industries face comparable carbon prices across the world, including metals and international civil aviation and shipping.

A WTO agreement is required to support international mitigation agreements and to establish rules for trade measures against countries thought to be doing too little on mitigation.

Chapter 11 Costing climate change and its avoidance

Type 1 (modelled median outcomes) plus Type 2 (estimates of other median outcomes) costs of climate change in the 21st century are much higher than earlier studies suggested. The Platinum Age emissions grow much faster than earlier studies contemplated.

The modelling of the 550 mitigation case shows mitigation cutting the growth rate over the next half century, and lifting it somewhat in the last decades of the century.

GNP is higher with 550 mitigation than without by the end of the century. The loss of present value of median climate change GNP through the century will be outweighed by Type 3 (insurance value) and Type 4 (non-market values) benefits this century, and much larger benefits of all kinds in later years.

Mitigation for 450 costs almost a percentage point more than 550 mitigation of the present value of GNP through the 21st century. The stronger mitigation is justified by Type 3 (insurance value) and Type 4 (non-market values) benefits in the 21st century and much larger benefits beyond. In this context, the costs of action are less than the costs of inaction.

Chapter 12 Targets and trajectories

Australia should indicate at an early date its preparedness to play its full, proportionate part in an effective global agreement that 'adds up' to either a 450 or a 550 emissions concentrations scenario, or to a corresponding point between.

Australia's full part for 2020 in a 450 scenario would be a reduction of 25 per cent in emissions entitlements from 2000 levels, or one-third from Kyoto compliance levels over 2008–12, or 40 per cent per capita from 2000 levels. For 2050, reductions would be 90 per cent from 2000 levels (95 per cent per capita).

Australia's full part for 2020 in a 550 scenario would be a reduction in entitlements of 10 per cent from 2000 levels, or 17 per cent from Kyoto compliance levels over 2008–12, or 30 per cent per capita from 2000. For 2050, reductions would be 80 per cent from 2000 levels or 90 per cent per capita.

If there is no comprehensive global agreement at Copenhagen in 2009, Australia, in the context of an agreement among developed countries only, should commit to reduce its emissions by 5 per cent (25 per cent per capita) from 2000 levels by 2020, or 13 per cent from the Kyoto compliance 2008–12 period.

Chapter 13 An Australian policy framework

Australia's mitigation effort is our contribution to keeping alive the possibility of an effective global agreement on mitigation.

Any effort prior to an effective, comprehensive global agreement should be short, transitional and directed at achievement of a global agreement.

A well-designed emissions trading scheme has important advantages over other forms of policy intervention. However, a carbon tax would be better than a heavily compromised emissions trading scheme.

The role of complementary measures to the emissions trading scheme is to lower the cost of meeting emissions reduction trajectories, as well as adapting to the impacts of climate change by correcting market failures.

Once a fully operational emissions trading scheme is in place, the Mandatory Renewable Energy Target will not address any additional market failures. Its potentially distorting effects can be phased out.

Governments at all levels will inform the community's adaptation response. More direct forms of intervention may be warranted when events unfold suddenly or when communities lack sufficient options or capacity for dealing with the impacts of climate change.

Chapter 14 An Australian emissions trading scheme

A principled approach to the design of the Australian emissions trading scheme is essential if the scheme is to avoid imposing unnecessary costs on Australians.

The integrity, efficiency and effectiveness of the scheme will require:

- establishment of an independent carbon bank with all the necessary powers to oversee the long-term stability of the scheme
- implementation of a transition period from 2010 to the conclusion of the Kyoto period (end 2012) involving fixed price permits
- credits to trade-exposed, emissions-intensive industries to address the failure of our trading partners to adopt similar policies
- no permits to be freely allocated

- no ceilings or floors on the price of permits (beyond the transition period)
- intertemporal use of permits with 'hoarding' and 'lending' from 2013
- a judicious and calibrated approach to linking with international schemes
- scheme coverage that is as broad as possible, within practical constraints

Seemingly small compromises will quickly erode the benefits that a well-designed emissions trading scheme can provide.

The existing, non-indexed shortfall penalty in the Mandatory Renewable Energy Target needs to remain unchanged in the expanded scheme.

Chapter 15 Adaptation and mitigation measures for Australia

Every Australian will have to adapt to climate change within a few decades. Households and businesses will take the primary responsibility for the maintenance of their livelihoods and the things that they value.

Information about climate change and its likely impacts is the first requirement of good adaptation and mitigation policies. This requires strengthening of the climate-related research effort in Australia. The Australian Climate Change Science Program should be provided with the financial resources to succeed as a world-class contributor to the global climate science effort from the southern hemisphere.

A new Australian climate change policy research institute should be established to raise the quality of policy-related research.

Flexible markets using the best available information are the second essential component for successful adaptation and mitigation policies. It will be important to strengthen markets for insurance, water and food.

Government regulatory intervention and provision of services will be required in relation to emergency management services and preservation of ecosystems and biodiversity.

Chapter 16 Sharing the burden in Australia

Low-income households spend much higher proportions of their incomes than other households on emissions-intensive products. The effects of the emissions trading scheme will fall heavily on low-income households, so the credibility, stability and efficiency of the scheme require the correction of these regressive effects by other measures.

At least half the proceeds from the sale of all permits could be allocated to households, focusing on the bottom half of the income distribution. The bulk could be passed through the tax and social security systems, with energy efficiency commitments to low-income households in the early years.

To assist in early adjustment of low-income households, a system of 'green credits' should be introduced to help with funding of investments in energy efficiency in housing, household appliances and transport.

It is possible but not certain that regional employment issues could arise in coal regions. They would not emerge in the early years of an emissions trading scheme. Up to \$1 billion in total should be made available for matched funding for investment in reducing emissions in coal power generation, as a form of preemptive structural adjustment assistance.

Chapter 17 Information barriers to known technologies

There are potentially large and early gains from better utilisation of known technologies, goods and services, including energy efficiency and low-emissions transport options.

Externalities in the provision of information and principal-agent issues inhibit the use of distributed generation and energy-saving opportunities in appliances, buildings and vehicles.

A combination of information, regulation and restructuring of contractual relationships can reduce the costs flowing from many of the market failures blocking optimal utilisation of proven technologies and practices.

Chapter 18 The innovation challenge

Basic research and development of low-emissions technologies is an international public good, requiring high levels of expenditure by developed countries.

Australia should make a proportionate contribution alongside other developed countries in its areas of national interest and comparative research advantage. This would require a large increase in Australian commitments to research, development and commercialisation of low-emissions technologies, to more than \$3 billion per annum by 2013.

A new research council should be charged with elevating, coordinating and targeting Australia's effort in low-emissions research.

There are externalities associated with private investment in commercialising new, low-emissions technologies.

To achieve an effective commercialisation effort on a sufficiently early time scale, an Australian system of matching funding should be available automatically where there are externalities associated with private enterprise investment in low emissions innovation.

Research in adaptation technologies is required. Existing arrangements are well placed to meet immediate priorities.

Chapter 19 Network infrastructure

There is a risk that network infrastructure market failures relating to electricity grids, carbon dioxide transport systems, passenger and freight transport systems, water delivery systems and urban planning could increase the costs of adjustment to climate change and mitigation.

The proposed national electricity transmission planner's role should be expanded to include a long-term economic approach to transmission planning and funding. The Building Australia Fund should be extended to cover energy infrastructure. A similarly planned approach is necessary to facilitate timely deployment of large-scale carbon capture and storage.

There is a limited case for carefully calculated rates for feed-in tariffs for household electricity generation and co-generation.

The need to reduce the costs of mitigation reinforces other and stronger reasons for giving higher priority to increasing capacity and improving services in public transport, and for planning for greater urban density.

Chapter 20 Transforming energy

Australians have become accustomed to low and stable energy prices. This is being challenged by rapidly rising capital costs and large price increases for natural gas and black coal. These cost effects will be joined by pressures from rising carbon prices, and will be larger than the impact of the emissions trading scheme for some years.

Australia is exceptionally well endowed with energy options, across the range of fossil fuel and low-emissions technologies.

The interaction of the emissions trading scheme with support for research, development and commercialisation and for network infrastructure will lead to successful transition to a near-zero emissions energy sector by mid-century.

The future for coal-based electricity generation, for coal exports and for mitigation in developing Asia depends on carbon capture and storage becoming commercially effective. Australia should lead a major international effort towards the testing and deployment of this technology.

Chapter 21 Transforming transport

Transport systems in Australia will change dramatically this century, independently of climate change mitigation. High oil prices and population growth will change technologies, urban forms and roles of different modes of transport.

An emissions trading scheme will guide this transformation to lower-emissions transport options.

Higher oil prices and a rising emissions price will change vehicle technologies and fuels. The prospects for low-emissions vehicles are promising. It is likely that zero-emissions road vehicles will become economically attractive and be the most important source of decarbonisation from the transport sector.

Governments have a major role to play in lowering the economic costs of adjustment to higher oil prices, an emissions price and population growth, through planning for more compact urban forms and rail and public transport. Mode shift may account for a quarter of emissions reductions in urban passenger transport, lowering the cost of transition and delivering multiple benefits to the community.

Chapter 22 Transforming rural land use

Rural Australia faces pressures for structural change from both climate change and its mitigation.

Effective mitigation would greatly improve the prospects for Australian agriculture, at a time when international demand growth in the Platinum Age is expanding opportunities.

Choices for landowners will include production of conventional commodities, soil carbon, bioenergy, second-generation biofuels, wood or carbon plantations, and conservation forests.

There is considerable potential for biosequestration in rural Australia. The realisation of this potential requires comprehensive emissions accounting.

The realisation of a substantial part of the biosequestration potential of rural Australia would greatly reduce the costs of mitigation in Australia. It would favourably transform the economic prospects of large parts of remote rural Australia.

Full utilisation of biosequestration could play a significant role in the global mitigation effort. This is an area where Australia has much to contribute to the international system.

Chapter 23 Towards a low-emissions economy

Australian material living standards are likely to grow strongly through the 21st century, with or without mitigation, and whether 450 or 550 ppm is the mitigation goal. Botched domestic and international mitigation policies are a risk.

Substantial decarbonisation by 2050 to meet either the 450 or 550 obligation is feasible. It will go fastest in the electricity sector, then transport, with agriculture being difficult unless, as is possible, there are transformative developments in biosequestration.

There is considerable technological upside. This could leave Australian energy costs relatively low, so that it remains a competitive location for metals processing.

Australia's human resource strengths in engineering, finance and management related to the resources sector are important assets in the transition to a low-emissions economy. They will need to be nurtured by high levels of well-focused investment in education and training.

The introductory impact of the Australian emissions trading scheme will not be inflationary if permit revenue is used judiciously to compensate households.

Chapter 24 Fateful decisions

There are times in the history of humanity when fateful decisions are made. The decision this year and next on whether to enter a comprehensive global agreement for strong action is one of them.

Australia's actions will make a difference to the outcome, in several ways.

The chances of success at Copenhagen would be greater if heads of government favouring a strong outcome set up an experts group to come up with a practical approach to global mitigation that adds up to various environmental objectives.

On a balance of probabilities, the failure of our generation on climate change mitigation would lead to consequences that would haunt humanity until the end of time.

