

Garnaut CLIMATE CHANGE REVIEW

DRAFT REPORT

J U N E 2 0 0 8



Garnaut
CLIMATE CHANGE
REVIEW

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ISBN: 978-1-921337-34-5

The dollar amounts in this report are in Australian dollars, unless otherwise indicated.

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All inks used in the printing of this report are vegetable based.

Editorial, design and artwork by WHH Publishing

Printed by Blue Star Print Group

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Preface

The Garnaut Climate Change Review was initiated by the then Leader of the Opposition, the Hon Kevin Rudd, and by the First Ministers of the eight states and territories of Australia. It was commissioned by the First Ministers on 30 April 2007. The Commonwealth joined the Review at the end of 2007.

The Review was required to examine the impacts of climate change on the Australian economy, and to recommend medium- to long-term policies and policy frameworks to improve the prospects of sustainable prosperity.

The Review's secretariat was established in June 2007. Based originally within the Victorian Department of Premier and Cabinet, it includes members from the Queensland, Western Australian and South Australian governments. A secretariat office within the federal Department of Climate Change was established in January 2008. The secretariat has provided invaluable expertise and support to this challenging exercise.

This draft report represents a detailed assessment of the implications of climate change for a single nation. It has built on the existing body of information in the fields of science and economics, and undertaken significant new work to illuminate the potential impacts on, and the most effective course of action for, Australia.

As part of its research and analysis, the Review has consulted widely with a wide range of experts in Australia and overseas: academics, officials, government departments and public bodies, business leaders and representatives, and non-government organisations. The Review thanks all these people and organisations for their generous support under compressed time frames.

The Review has also benefited substantially from interactions with other organisations and the community more generally at five specialist forums and eight public lectures held around the country between August 2007 and June 2008. These forums and lectures were held in almost every mainland capital city, with an attendance of more than 3200 people in the lead up to the release of the draft report.

A lengthy formal submissions process was also conducted, which attracted almost 4000 submissions. Interested stakeholders were encouraged to respond to a series of five issues papers, a discussion paper on the proposed emissions trading scheme and an interim report released in January 2008, all of which stimulated public discussion and debate on some of the most critical issues for climate change mitigation and adaptation in Australia. The submissions assisted in shaping the direction of the Review and a submissions report will be released in July 2008.

Issues of significance not considered in this draft report (such as the results of the economic modelling and the important issues of adaptation) will be further discussed in the supplementary draft report and the final report.

Terms of reference

30 April 2007

To report to the Governments of the eight States and Territories of Australia, and if invited to do so, to the Prime Minister of Australia, on:

1. The likely effect of human induced climate change on Australia's economy, environment, and water resources in the absence of effective national and international efforts to substantially cut greenhouse gas emissions;
2. The possible ameliorating effects of international policy reform on climate change, and the costs and benefits of various international and Australian policy interventions on Australian economic activity;
3. The role that Australia can play in the development and implementation of effective international policies on climate change; and
4. In the light of 1 to 3, recommend medium to long-term policy options for Australia, and the time path for their implementation which, taking the costs and benefits of domestic and international policies on climate change into account, will produce the best possible outcomes for Australia.

In making these recommendations, the Review will consider policies that: mitigate climate change, reduce the costs of adjustment to climate change (including through the acceleration of technological change in supply and use of energy), and reduce any adverse effects of climate change and mitigating policy responses on Australian incomes.

This Review should take into account the following core factors:

- The regional, sectoral and distributional implications of climate change and policies to mitigate climate change;
- The economic and strategic opportunities for Australia from playing a leading role in our region's shift to a more carbon-efficient economy, including the potential for Australia to become a regional hub for the technologies and industries associated with global movement to low carbon emissions; and
- The costs and benefits of Australia taking significant action to mitigate climate change ahead of competitor nations; and
- The weight of scientific opinion that developed countries need to reduce their greenhouse gas emissions by 60 percent by 2050 against 2000 emission levels, if global greenhouse gas concentrations in the atmosphere are to be stabilised to between 450 and 550ppm by mid century.

Consult with key stakeholders to understand views and inform analysis. A draft Report is to be distributed for comment by June 30 2008. The final Report is to be completed and published by September 30 2008. Interim draft reports on particular issues may be released before that time for public discussion. The Report will embody the independent judgments of its author.

1

AUSTRALIA'S CLIMATE CHANGE CHALLENGE

The weight of scientific evidence tells us that Australians are facing risks of damaging climate change. The risk can be substantially reduced by strong and early action by all major economies. Without that action, it is probable that Australians, over the 21st century and beyond, will experience disruption in their prosperity and enjoyment of life, and to longstanding patterns in their lives.

There is no doubt about the position of most reputed specialists in climate science, in Australia and abroad, on the risks of climate change (see Chapter 3). There is strong support for the mainstream science from 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.

There are nevertheless large uncertainties in the science. While there is a clear majority view that there are high risks, there is debate and honest recognition of limits to knowledge about the times and ways in which the risk will manifest itself. Every climate scientist has his or her 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. I exclude from this generalisation a small number of climate scientists of professional repute, who accept the theory of the warming effects of higher concentrations of greenhouse gases, but 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 a 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 5 (Box 5.1).

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 prisoners' 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 and

cooperation, there will be no resolution of the dilemma. We will all judge the outcome, in the fullness of time, to be insufficient and unsatisfactory.

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

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 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.

The most inappropriate response would be to delude ourselves, taking small actions that create an appearance of action, but which do not solve the problem. Such an approach would risk the integrity of our market economy and political processes to no good effect.

We will delude ourselves if we think that scientific uncertainties are cause for delay. Delaying now will eliminate attractive lower-cost options. Delaying now is not postponing a decision. To delay is to deliberately choose to avoid effective steps to reduce the risks of climate change to acceptable levels.

The work of this Review is directed at nurturing the slender 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.

Australia has a larger interest in a strong mitigation outcome than other developed countries. Our location makes us 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 suggests that our

terms of trade would be damaged more by the effects of climate change than would those of any other developed country (see Chapter 9).

However, 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 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 is enjoying a double harvest. The internationally oriented market reforms from the 1980s were put in place just in time. 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 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 now the benchmark for economic modernity. Then, for seven decades, we turned in on ourselves, and paid the cost. 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 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 the first quarter of this year, for the first time since the onset of World War I, the value of output per person in Australia exceeded that of the United States when both are measured in the national accounts and converted into a currency at today's exchange rates.²

So we have much to contribute and much to lose as we face the diabolical policy challenge of climate change. Unmitigated climate change could lose this challenge. Or it could be lost by a bungled attempt to mitigate climate change, which would bring back into the centre of our national policy all of the self-interested pressure groups and arbitrary interventions that retarded our progress for so long.

Australians' recent return to material grace has had two direct causes. First was our decisive rejection and reversal of mistakes of the early decades after federation: the turning away from protectionism, xenophobia and the 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 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 over one-eighth from the effects of increased export prices alone.

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

The links between our own prosperity, and the increase in greenhouse gas emissions in Asian developing countries, is 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 in value 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, Australians would not accept it. Nor would it be in Australia's interests for Asia's developing countries to accept truncation 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.

These realities need to be kept in mind if we are to retain perspective in the domestic debate about mitigation and the emissions trading scheme. Some elements of the Australian resources sector have been especially vocal about the perceived 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. Along with some of our farm industries, metals processing would be the most affected, and have the first claims for special measures. 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, let us make sure that there is also a strong and independent centre for the policy-making process that can keep sectoral claims in perspective.

Balance, reason and understanding of the premises 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.

No answers to questions as complex and difficult as those introduced in this chapter 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 this Review. Many will disagree with the policy proposals that flow from the conclusions. They would prefer cheaper, more certain, later and less disruptive ways forward, or higher levels and urgency of Australian 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 or logic leading to them are wrong. The Review aims to be clear in its premises and methodology, so that they can be contested transparently. If the subsequent public policy debate follows these lines, we will improve the prospects of Australian governments taking good decisions in the year ahead on a sound basis and with widespread community support, and therefore with prospects of policy continuity.

1.1 The context of the draft report in the Garnaut Climate Change Review

This draft report describes the methodology that the Review is applying to evaluation of the costs and benefits of climate change mitigation; to the application of the science of climate change to Australia; to the international context of Australian mitigation; and to Australian mitigation policy. The draft report is a stage in the journey towards the final report at the end of September 2008. It follows the Interim Report in February and the discussion paper on the emissions trading scheme in March 2008.

A supplementary draft report will present the outcomes of all of the joint modelling with the Commonwealth Treasury on the costs of climate change mitigation. The supplementary draft report will also present the results of the Review's modelling of the benefits of climate change avoided. This will allow assessment of the costs and benefits for Australia of varying degrees of mitigation. This, in turn, provides the basis for the Review's recommendations on emissions reduction targets for Australia. Recommendations on targets, consistently with the Review's analysis, will be built around trajectories for emissions reductions over time.

The supplementary draft and final reports will respond to many of the questions to which the Australian community is anxious to have answers. What is the Review recommending about targets and trajectories for emissions reductions in Australia? What does the Review think that this will mean for the carbon price? What effect will this have on petrol and electricity prices?

The answers will have to wait for the completion of the modelling. The Review has avoided speculation on these matters. It would not be helpful to speculate now.

While the draft report does not present the results of modelling the costs and benefits of climate change, it does provide the first public exposure of aspects of the Garnaut–Treasury and Garnaut Review approach to the modelling. It reports some high-level results from the reference case, upon which subsequent economy-wide quantitative analysis will be built: a perspective on growth and structural change in the Australian economy over the 21st century, on the assumption that it is affected neither by climate change nor by climate change mitigation policies.

The draft report also presents the early results of the Garnaut Review's modelling of growth and structural change in the Australian economy over the 21st century in the presence of climate change and the absence of mitigation policies. The difference between the reference case and the case with climate change can be seen as the costs of climate change.

The modelling can cover only some of the benefits of climate change mitigation—those that are amenable to quantitative analysis and for which data were available in the tight time frames of the Review. Comprehensive analysis of the costs of climate change must take account of other factors. Chapter 2 describes the analytic framework that the Review is applying to the integration of all of the anticipated costs and benefits of climate change. While Chapter 2, and the beginnings of its application in Chapter 10, will not satisfy the curious, there is some advantage in discussing the analytic framework in advance of the results of most of the modelling. Like people behind the Rawlsian veil, we can take positions on principle in advance of knowing the precise implications for our own positions (Rawls 1971). The analytical framework presented in Chapter 2 is the essential foundation for public policy choice.

The final report will discuss the way in which the Australian economy responds and changes in the course of progress towards a low-emissions Australian and global economy. There will be separate chapters on the three broad sectors that will be at the centre of the mitigation effort: energy; agriculture and forestry; and transport. There will be an overarching chapter on Australia's transition to a low-carbon economy that brings the sectoral elements together.

These chapters draw in varying degrees on the econometric modelling, and so are left for the supplementary draft and final reports. The draft report does, however, contain a chapter on the energy sector's transformation. This is linked closely to the operation of the Australian emissions trading scheme, so there is value in exposing the Review's perspectives alongside the discussion of its views on the design of the emissions trading scheme.

The draft report generally does not make recommendations, although the tendency of policy analysis is clear. It is closest to recommendations on the design features of the emissions trading scheme, which require business and community discussion of the issues before the completion of the final report at the end of September 2008.

The Review will present in the final report the results of its work on the important question of adaptation to climate change. It is likely that Australians will have to manage difficult climate change, whatever the failure or success of the global mitigation effort from now on. The final report will cover the conceptual framework for looking at adaptation policies; the nature of the Australian adaptation challenge under business as usual and various degrees of effective global mitigation; some important adaptation policy options in key sectors and regions; and water, the central Australian adaptation challenge.

The final report will also present the Review's analysis and recommendations on the appropriate location within the Australian federation of policy and administrative responsibilities for various aspects of climate change mitigation and adaptation.

1.2 Main themes

Some general ideas recur through the draft report, and may be more important than others. They can be taken as central themes, summarised here.

The first theme is that the 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. Uncertainty does not make the case for delay. Rigorous decision making under uncertainty recognises that options have value, and that option values decay with time.

The second theme is that in meeting the climate change contest, Australia's prime asset is the prosperous, flexible, market-oriented economy that has emerged from difficult reforms over the past quarter century. This gives us 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 will be as broadly based as possible, with any exclusions driven by practical necessity and not by short-term political considerations. It will include transport and petroleum products. This will allow abatement to occur in the enterprises and 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, and application of similar incentive structures over as much of the economy as possible allows market processes to guide the emergence of favourable outcomes.

The third 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. 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.

1.3 Main policy tendencies

Some main tendencies in the policy analysis are worth an early mention.

The first is the importance in engaging now in the international dialogue on a global mitigation regime. The good options on mitigation will soon be gone. The extraordinary growth in emissions from the major developing countries, first of all China, means that their early participation in a global agreement on mitigation is essential for success. This conclusion is at odds with the momentum of current international discussions. It may not seem fair to the developing countries, given their stage of development and the history of the international discussions. But it is essential for successful global mitigation.

The nature of the mitigation commitments can vary across countries (Chapter 13). The international community, and Australia, can improve the odds of the major developing countries becoming part of an effective global regime, by defining the terms of developing country engagement with a global regime with the objective of improving the odds. In China's case, cooperation in development and commercialisation of new, low-emissions technologies would be of special importance.

The Review attaches high importance to its proposal for expanding the global research, development and commercialisation effort on low-emissions technologies, because of what it will do for the cost of mitigation everywhere, and for the encouragement that it would provide for developing countries to participate in the global mitigation effort.

The Review's thoughts on the Australian mitigation regime have been much discussed since the release of its Interim Report and the emissions trading scheme discussion paper. It may be worth re-iterating the broad approach to emissions reductions targets and trajectories put forward in those earlier papers. Until 2012, Australia's emissions reduction trajectory is defined by its commitments under the Kyoto Protocol. Its first commitments for the post-2012 period should represent similar adjustment effort to that being made by other developed countries. Recent developments in political discussion in the United States and Japan suggest that the Commonwealth Government's commitments to a 60 per cent emissions reductions may fit this requirement. Beyond that, Australia should be prepared to go further within a comprehensive global agreement, with appropriate commitments from major developing countries. Those general principles will be developed further in the light of the modelling results, and presented in the supplementary draft and final reports. The emphasis on simplicity and credibility in the interim report and discussion paper has, we think, stood the test of public scrutiny.

The discussion has helped to take forward thinking within the Review on some matters raised in those earlier papers. We have been convinced by the evidence that while payments to trade-exposed, emissions-intensive industries

to avoid 'carbon leakage' are justified in principle, their application raises dreadful problems. The danger of a process of allocation of balancing payments descending into a rush for government preferment has been emphasised by behaviour in the political marketplace.

Several implications follow. First, the development of international agreements which establish a more or less level playing field for the main affected Australian industries is an urgent matter. There is no prospect for comprehensive global agreements to play this role in years immediately ahead. The establishment of a special kind of sectoral agreement then becomes a matter of urgency. With priority in policy and diplomacy, it would be possible to establish appropriately structured sectoral agreements for several major commodities in time for the post-Kyoto world of 2013.

In the absence of such an agreement, we suggest that simple rules be established to govern payments to trade-exposed, emissions-intensive industries. General analysis should identify a maximum proportion of permit value appropriate for handling the 'carbon leakage' problem. The ratio would be less than or up to 30 per cent. Simply administered rules of thumb would be constructed around the principles for payments to trade-exposed industries articulated in the discussion paper and in Chapter 15. The rules would define a threshold of loss on an industry basis, with payments being made to offset costs of permits above that point, on a similar basis for all firms in an industry. To the extent that the sum of payments under the rules of thumb fell short of the value of permits under the defined ratio, the difference would be returned as tax cuts to business in some efficiency-raising way, focusing on reduction of distorting input and transaction taxes.

Much anxiety was expressed in consultations about the possibility of an unconstrained emissions trading scheme from 2010 generating high and unstable prices in the early years, and this being disruptive for the economy. The Review recognises that the high fossil fuel prices of 2008, which are likely to continue at least for some time, will force considerable emissions reduction below levels that would otherwise have prevailed in the years of Australia's Kyoto commitments, between 2010 and 2012.

While there are substantial advantages in moving directly to the unconstrained operation of the proposed emissions trading system in 2010, the Review accepts that there is a legitimate second best case for a fixed price for permits in the early years. The advantages and disadvantages of a transition period are discussed in Chapter 15, along with the conditions that would need to be applied in the transition case.

One advantage of such an approach is that, depending on the threshold and the price, it may obviate the need for payments to trade-exposed, emissions-intensive industries in these years of transition. This would allow time for some sectoral agreements to be put in place, perhaps permanently removing the need for such payments.

This would be a large advantage.

Against this, immediate entry into the full regime would see the earlier development of the full range of institutional arrangements to support market exchange of permits. An immediate start-up would remove the chances of industry pressure blocking the eventual movement to an unconstrained system.

The Review proposes that all permits be allocated on a competitive basis. This will generate substantial amounts of revenue. How this revenue is allocated by government will have a large influence on the economic effects of the mitigation effort.

The Review proposes that all of the revenue be returned to households or to business. The modelling that will be reported in the supplementary draft report will provide important guidance into likely amounts of revenue, and into the incidence of the burden of adjustment on various parts of the economy and community.

As a general guide, the Review has formed the view that about half of the permit revenue should be returned to the household sector, mostly as adjustments to the tax and social security systems that enhance efficiency, with some allocations to promote energy efficiency, especially among low-income households.

There are equity and economic management reasons for concentrating the return of permit revenue on the bottom half of the income distribution. This will overcome what would otherwise be regressive income distribution effects of the emissions trading system (Chapter 19). It will also remove pressure for adjustments to wages at the lower end of the wage distribution, that would otherwise introduce risks that what could be a once-for-all price adjustment would be converted into an inflationary spiral.

The Review has formed the view that in the years before there are effective international agreements removing the need for special support for trade-exposed, emissions-intensive industries, up to 30 percent of permit sales revenue could be returned to the business sector as payments to exposed firms, or as a general, efficiency-raising reduction in business taxation (Chapter 15).

The Review has formed the view that about 20 per cent of the permit sales revenue should be allocated to support for research, development and commercialisation of new, low-emissions technologies. This would fund a substantial part of Australia's obligations under the proposed International Low Emissions Technology Commitment (Chapter 13).

1.4 Adaptation: prospects and limits

The international community is too late with effective mitigation to avoid significant impacts. It may yet fail to put in place substantial mitigation, in which case the challenge of adaptation to climate change will be more daunting. Damage from

climate change, perhaps immense damage, is likely to be part of the Australian reality of the 21st century and beyond.

Our final report will analyse the adaptation issues closely.

Adaptation to some of the possible consequences would test us and our values and preferences in profound ways. Contemplating the adaptation challenges of future Australians 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 foregone, to avoid uncertain prospects of thinly defined but possibly immensely unhappy outcomes. We are forced to decide what current and early material consumption we would be prepared to pay to avoid loss of things that we value, but are not accustomed to valuing in monetary equivalents.

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 climate change, much is made of natural wonders—of the Great Barrier Reef, the wetlands of Kakadu, the karri forests. 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.

1.5 Synopsis

The draft report is structured into 20 chapters that address important dimensions of the huge arena on which the assessment of climate change and its interaction with Australian lives is being played out. Some chapters draw inevitably on the language of economics to a degree that may be unwelcome to the general reader. Others contain more detail than the busy person of practical inclination or responsibilities has time to absorb. Thus not everyone who is interested in climate change, its mitigation, its effects on Australia, and the policy issues that it raises will wish to read the draft report from beginning to end. To help readers to discover quickly its main lines of argument as well as the implications that it

draws for policy, and to decide which parts they would like to read in detail, this synopsis provides a summary of key points in each of the following chapters.

The draft report begins by laying out a framework for policy analysis and decision making (Chapter Two). This framework seeks to take full account of uncertainty, risk aversion, and the complex interaction of material consumption, non-market services and time in the assessment of the policy outcomes that serve Australians' interests and values best. The framework seeks to define and, where possible, to quantify for Australians, the consequences of doing nothing about climate change, and of playing our proportionate part in global mitigation efforts of varying ambition.

Chapters 3 to 7 introduce the scientific and economic issues underlying the policy choice. Chapter 3 discusses the basic science of human-induced global warming, focusing on the critical role of atmospheric concentrations of greenhouse gases, the accumulation of which has been accelerating with global economic development.

Chapter 4 has a fresh look at what is happening to emissions, applying a realistic view of the implications of economic development in major Asian developing countries, first of all China, but now more broadly. The Review's work in this area has forced a reassessment of the global challenge: faster, more energy-intensive and more emissions-intensive growth in developing Asia is leading to substantially more rapid growth in emissions than had previously been understood by the international scientific community. The clear and unfortunate implication is that we have less time than previously understood to stem the growth of global emissions, if we are to avoid high risks of dangerous climate change, as defined by mainstream science.

Chapter 5 discusses the probable global climate impacts with no mitigation and with mitigation of varying ambition. Chapter 6 applies that framework to the impacts on Australia. Chapter 7 moves from climate to economic and social impacts, focusing on a limited number of issues of large importance. It provides a taste of the much wider and more detailed work on Australian impacts that has helped to provide the basis for subsequent modelling (Chapter 9) and assessment (Chapter 10). The full studies on which Chapter 7 is based are available on the Review website.

Chapter 8 is the Australian analogue of Chapter 4, looking at the structure of Australian emissions. It asks why Australian emissions are unusually high by global standards, and concludes that it is mainly as a result of our much greater use of coal for electricity generation.

Chapters 9 and 10 bring together the elements of policy choice. The modelling reported in Chapter 9 defines as precisely as possible the general economic effects of the climate impacts that emerge from Chapter 7. In the draft report, the analysis is confined to the costs of climate change—the analysis of the costs and benefits of mitigation raises different and more difficult questions, which will be addressed in the supplementary draft report.

Some important economic impacts of climate change cannot be defined precisely enough for economic modelling. Some involve judgments about the insurance value of avoiding improbable but extremely damaging outcomes. Some impacts are not felt through markets at all, and do not affect consumption of goods and services, but may nevertheless be valued by Australians. Chapter 10 makes a first effort to bring the various influences on value together.

Australian mitigation effort only makes sense as a contribution to effective global contribution. Chapters 11 to 13 discuss the interaction between global and Australian developments. They suggest some ideas on possible ways forward in an international scene that is less than encouraging in all ways except one. That one might just be decisive: the growing concern about global warming in many countries that may encourage governments to be more ambitious on mitigation in future than they have been in the past.

Chapters 14 to 19 discuss Australian mitigation policy in a global context. They propose that a simple emissions trading system of broad coverage be relied upon to achieve the emissions reduction goals of the Commonwealth Government, selected for the role that they can play in supporting the emergence of an effective global mitigation regime. Other measures have a role if, and only if, they remove or reduce the costs of various market failures, the presence of which would otherwise raise the cost of adjustment to the emissions trading scheme. Support for research development and commercialisation of new, low-emissions technologies (Chapter 16), network infrastructure (Chapter 17) and information and agency issues (Chapter 18) are analysed in this context.

The introduction of an emissions trading scheme may have large and regressive effects on the distribution of income. These effects and possible policy responses will be modelled and the results presented in the supplementary draft report. Effective management of this issue is going to be crucial to the success of the emissions trading scheme. Chapter 19 addresses the issues in advance of the modelling results.

The emissions trading scheme and associated mitigation policies will contribute to large structural change throughout the Australian economy. The changes will be most profound in the sectors in which emissions are most important—first of all energy, and then transport, and agriculture and forestry. The draft report presents some preliminary views on the energy transformation that will be triggered by the suite of recommended mitigation policies. This analysis can be taken further in the final report, when the modelling results are in hand. The other economic adjustment chapters will be presented in the final report.

1.5.1 Key points

Chapter 2

The central policy issue facing the Review can be stated simply: 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?

Answering the question draws on our capacity to model conventional economic effects, to measure and to value uncertain outcomes, to value effects that are not felt through markets for goods, services or factors of production, and to value costs and benefits incurred and received by different people at different times.

This chapter puts forward a framework for looking at these issues. It favours transparent reporting of the premises of subsequent discussion, and the introduction of analysis of the sensitivity of outcomes to variables.

The reserves and resources of fossil fuels are finite, which means that their costs are likely to rise over time. This reduces the costs of mitigation, which brings forward an inevitable eventual adjustment away from fossil fuels.

Chapter 3

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 4

Greenhouse gas emissions have grown rapidly in the early 21st century. In the absence of strong mitigation, strong growth is expected to continue for the next two decades and in 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 at, or above, projections embodied in these 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. Under the unmitigated case, developing countries would account for about 80 per cent of emissions growth over the next two decades and more after that.

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

Chapter 5

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

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 means it is vitally important that the current knowledge of these outcomes is incorporated in the decision-making process.

Continued high emissions growth with no mitigation action carries high risks. These risks would be reduced by ad hoc mitigation, but remain high for some elements. Ambitious global mitigation would reduce the risks further, 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 6

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 reduced 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. Average expectations are for significant 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 7

This chapter provides a taste of conclusions from detailed studies of Australian impacts. 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.

These impacts would be significantly reduced with ambitious global mitigation.

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

Chapter 8

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.

The high emissions intensity of Australian energy use is mainly the result of our reliance on coal for electricity. This is a recent phenomenon: Australian and OECD average emissions intensity of primary energy supply were similar in 1971.

Chapter 9

The joint Garnaut–Treasury reference case suggests that, in the absence of climate change or costs from its mitigation, from 2005 to 2100, the Australian population will more than double to nearly 47 million, per capita output will almost quadruple, and economic output will expand by over 700 per cent.

Over the same period, the reference case sees global population increasing by about 40 per cent and stabilising, and then starting to decline late in the second half of the century. Global output increases by about 15 times, mostly in the developing world, led by the large Asian developing economies—China, India and Indonesia.

The median temperature and rainfall outcomes for Australia from climate change with unmitigated growth in global emissions—particularly from impacts on infrastructure, agriculture and international terms of trade—may see GDP fall from the reference case by around 4.8 per cent, household consumption by 5.4 per cent and real wages by 7.8 per cent by 2100.

This would represent significant reduction of economic growth and welfare from what it would have been in the absence of climate change.

These are not the total costs of climate change. Nor can these costs be avoided entirely by mitigation.

Chapter 10

An examination of the range of impacts through market processes with median expectations of climate impacts suggests that the modelling covers 65 to 85 per cent of total market impacts. Non-market impacts of climate change would be valued highly by Australians, but are not quantified in the draft report.

The insurance value of some lower probability outcomes could be extremely costly. An assessment of more extreme low rainfall outcomes for Australia, near the 10th percentile of the distribution, suggests that GDP costs could be in the order of 8 per cent in 2100, with household consumption of around 9.1 per cent in 2100, and reduction in real wages of around 14.8 per cent relative to the reference case.

Extreme economic disruption in developing countries from climate change could exacerbate severe economic effects on Australia.

The extent to which Australian mitigation is justified will be assessed by analysing the benefits of avoided climate change in the modelling and in sectors not subject to formal modelling, the insurance value of mitigation in relation to lower probability but high cost outcomes, and the value to Australians of non-market impacts avoided by mitigation. The application of a range of approaches to discounting for time will be brought into the formulation of advice on whether and how much mitigation is justified.

Chapter 11

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.

Chapter 12

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

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

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

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

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

Chapter 13

International trade in permits lowers the global cost of abatement, allows greater flexibility for developed countries in meeting their commitments, and provides a financial incentive for developing countries to take on 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 up to about \$2.8 billion in 2007—or more than \$3 billion per annum by the time the proposed International Low Emissions Technology Commitment took effect in 2013.

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

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

A WTO agreement is required to support international mitigation agreements and to constrain unilateral action against countries thought to be doing too little on mitigation.

Chapter 14

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

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

The emissions trading scheme is the central instrument of Australian mitigation.

A well-designed, broadly based emissions trading scheme has important advantages over other market-based arrangements (such as carbon taxes and hybrid schemes). In particular, it is able to accommodate more easily international trade to lower mitigation costs and to facilitate developing country participation in international agreements. However a carbon tax would be better than a heavily compromised emissions trading scheme.

The role of complementary measures is to lower the cost of meeting the emissions reduction trajectories of the emissions trading scheme by correcting for 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 naturally as the emissions trading scheme takes up the load of encouraging low-emissions technologies.

Chapter 15

The emissions trading scheme will issue permits for greenhouse gas emissions up to limits and release them in line with the scheme's emissions reduction trajectories. Trade will move permits to entities for whom they have most value. The trajectories will be firm for five years, and indicative through to mid century. Permits should be sold through a competitive process.

The more sectors included in the emissions trading scheme, the more efficiently costs will be shared across the economy. The transport sector should be included.

While there are advantages in moving directly to an unconstrained scheme, 2010–12 could be a transition period. If there were a transition period, the Kyoto Protocol would define Australia's emissions reduction trajectory and permits would be sold at a low fixed price. These years would be used to pursue effective international sectoral agreements, en route to a global agreement.

Unlimited hoarding of permits will be allowed, and the independent regulator, the Independent Carbon Bank, will be able to lend permits within five-year periods. No hoarding of 2010–2012 permits could be allowed if there were price constraints in a transition period.

International linking will play an important role in the scheme, with fewer constraints in later years within an international agreement.

Chapter 16

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 over \$3 billion per annum.

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 grants should be available where private investors demonstrate externalities, low emissions and innovation.

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

Chapter 17

There is a risk that network infrastructure market failures relating to electricity grids and carbon dioxide transport systems could increase the cost of adjustment to a low-emissions economy.

The role of the proposed national transmission planner should be expanded to include a long-term economic approach to transmission planning and funding.

A similar planning approach is necessary to ensure that network infrastructure failures do not unnecessarily delay deployment of large-scale carbon capture and storage.

The Building Australia Fund should be extended to cover energy infrastructure.

There is a case for special feed-in tariffs for household electricity generation and co-generation. The case can be quantified by reference to timing and transmission considerations.

A well-integrated national energy network with the capacity to cope with potentially large shifts in flows will allow for structural change and the smoothing of shocks following the introduction of an emissions trading scheme and recent fuel price volatility.

Chapter 18

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.

Some combination of information, regulation and restructuring of contractual relationships can address many of the market failures blocking optimal utilisation of proven technologies.

Chapter 19

Low-income households spend much higher proportions of their incomes than other households on emissions-intensive products.

The direct price effects of the emissions trading scheme will be regressive. The effects will fall heavily on low-income households, so the credibility, stability, efficiency and longevity of the scheme require the correction of these regressive effects by other measures.

Correction of income effects in the lower half of the distribution is also necessary for anti-inflationary reasons through the early years of the scheme.

Approximately half the proceeds from the sale of all permits could be allocated to households.

Part of the payments to households could assist energy efficiency adjustments. The bulk could be passed through the tax and social security systems, with heavier energy efficiency commitments in the early years. The Henry taxation review could consider these issues.

Chapter 20

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 much larger than the impact of the emissions trading scheme for some years.

Australia is exceptionally well endowed with energy options. Support for research and development and for structural change in transmission infrastructure will allow Australia's natural endowments in renewable energy to be efficiently brought to account.

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

The future for coal-based electricity generation, both domestic and exported, 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.

Specific support for emissions-reducing investment in the coal-based electricity-generating regions is warranted, for smooth energy sector adjustment and established generating regions.

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 In May 2008 the US Bureau of Economic Analysis put seasonally adjusted first quarter US per capita GDP in current dollars at an annualised level of \$US46 716. The Australian Bureau of Statistics put Australian seasonally adjusted first quarter per capita GDP at an annualised level of \$US48 376, when converted from Australian to US dollars at the average exchange rate for the quarter, 0.906143.)

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