REPORT OF THE TASK GROUP ON EMISSIONS TRADING

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Australian Government

Prime Ministerial Task Group on Emissions Trading

ONE NATIONAL CIRCUIT
CANBERRA ACT 2600

31 May 2007

The Hon John Howard MP
Prime Minister
Parliament House
CANBERRA ACT 2600

Dear Prime Minister

I am pleased to present to you the report of the Task Group on Emissions Trading.

In preparing this report, the Task Group has been informed by the views of a wide range of stakeholders. We considered 216 submissions received from interested parties, most of which are available at www.dpmc.gov.au/emissionstrading. We also held lively discussions with 180 representative groups and individuals in Australia and overseas. The broad-ranging expertise of government, industry and environmental organisations has been of significant benefit to the deliberations of the Task Group.

We hope that this report can contribute to the development of policy which will further strengthen Australia's considerable record of achievement in addressing climate change at the domestic and international levels. Our conclusions have been framed to position Australia to take a lead in reducing greenhouse gas emissions while maintaining economic growth and safeguarding our competitive advantage.

On a personal note I would like to thank you for the opportunity to chair the Task Group. I know that my Secretarial colleagues (David Borthwick, Ken Henry, Michael L'Estrange and Mark Paterson) share my views on the value of being able to work alongside our private sector colleagues (Peter Coates, Tony Concannon, Russell Higgins, Margaret Jackson, Chris Lynch, John Marlay and John Stewart). It has been a stimulating exercise.

All of us would like to record our appreciation for the excellent support we have received from the Secretariat to the Task Group, ably led by Martin Parkinson.

Yours sincerely

Dr Peter Shergold
Chair, Task Group on Emissions Trading

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Introduction

Preparation of this report

On 10 December 2006, the Prime Minister announced the establishment of a joint government–business Task Group on Emissions Trading. The terms of reference are set out below. The Prime Minister asked the Task Group to report by 31 May 2007.

Task Group terms of reference

'Australia enjoys major competitive advantages through the possession of large reserves of fossil fuels and uranium. In assessing Australia's further contribution to reducing greenhouse gas emissions, these advantages must be preserved.

Against this background the Task Group will be asked to advise on the nature and design of a workable global emissions trading system in which Australia would be able to participate. The Task Group will advise and report on additional steps that might be taken, in Australia, consistent with the goal of establishing such a system.'

The Task Group consisted of Dr Peter Shergold (Chair), Mr David Borthwick, Mr Peter Coates, Mr Tony Concannon, Dr Ken Henry, Mr Russell Higgins, Ms Margaret Jackson, Mr Michael L'Estrange, Mr Chris Lynch, Mr John Marlay, Mr Mark Paterson and Mr John Stewart. Brief biographical details of the Task Group members are at Appendix A. The Task Group was supported by a joint government–business secretariat.

On 7 February 2007, the Task Group released an Issues Paper which invited public submissions on key issues relevant to the terms of reference. More than two hundred submissions were received from individuals and organisations. In addition, the Task Group undertook extensive consultations with key stakeholders and relevant institutions. Discussions were also held with governments, private sector groups and individuals in the United States, Canada, the United Kingdom, Belgium, France, Norway and Japan.

The Task Group is grateful for the time and effort invested by individuals and institutions in preparing submissions and in participating in consultations. These have helped form the views set out in this report.

The Task Group has also drawn on the extensive research and analysis on emissions trading undertaken in Australia and elsewhere over the last decade.[1] Where information was not available, the Task Group commissioned new research.

Structure of this report

Chapter 1 provides the global context of the report. It outlines the nature of the climate change challenge and describes the current and future profile of global emissions. Chapter 2 outlines Australia's economic structure and competitive strengths and how these influence its current emissions profile. It also describes the steps that government, at both the federal and state/territory levels, is taking to address

climate change. Chapter 3 identifies a range of policy approaches to reducing greenhouse gas emissions and outlines the benefits of market-based responses. Chapter 4 describes the current state of play in international cooperation on climate change and outlines briefly a number of proposed approaches to global climate change architecture beyond the expiry of the initial Kyoto commitment period in 2012.

The nature and design of a workable global emissions trading system is addressed in Chapter 5. The chapter highlights trends in global carbon markets, identifies key principles of a global trading scheme and a possible pathway to that system, together with supplementary measures to promote international engagement.

Chapter 6 considers the question of whether Australia should introduce domestic emissions trading in the absence of global action and how to protect our key national interests. The proposed elements of a domestic emissions trading scheme for Australia are outlined in Chapter 7. Reflecting the fact that a range of policies will be necessary to address climate change, Chapter 8 discusses possible complementary domestic measures that could be implemented in parallel with an emissions trading system.

Chapter 9 outlines possible implementation and governance arrangements.

This report also includes appendices which provide more detail on various aspects of the subject matter.

Key terms

Two terms are used extensively in this report: greenhouse gases (emissions) and emissions trading.

Greenhouse gases

The key greenhouse gases are: carbon dioxide (CO_2); methane (CH_4); nitrous oxide (N_2O); sulphur hexafluoride (SF_6); hydrofluorocarbons (HFCs); and perfluorocarbons (PFCs). Each of these gases has a different capacity to heat the atmosphere, called their global warming potential. Their impact is represented as the index of the global warming contribution due to atmospheric emission of a kilogram of a particular greenhouse gas compared to a kilogram of carbon dioxide (CO_2) (see Table i.1). Although CO_2 is the least potent of the greenhouse gases, it is the most significant in terms of global warming because it is produced in such large quantities. Throughout this report, emissions are referred to as though they were equivalent to a given volume of carbon dioxide and will be referred to as CO_2-equivalent (CO_2-e). Similarly, reference will be made to terms such as 'carbon price', 'decarbonising' and a 'carbon-constrained world', where 'carbon' generally refers to the six major greenhouse gases.

Table i.1 Global warming potentials

Greenhouse gas	Global warming potential (100 years)
Carbon dioxide (CO_2)	1
Methane (CH_4)	21
Nitrous oxide (N_2O)	310
Sulphur hexafluoride (SF_6)	23,900
Hydrofluorocarbons (HFCs)	140 – 11,700
Perfluorocarbons (PFCs)	6,500 – 9,200

Source: Australian Greenhouse Office, 2006b

Emissions trading

Emissions trading schemes were first developed in the 1960s and 1970s in the United States, motivated partly by dissatisfaction with the cost of the regulatory approaches to pollution control. They were first used to price, with a view to reducing, emissions of nitrogen and sulphur oxides (NO_x and SO_x) in the United States

Schemes trading one or more of the greenhouse gases are currently in operation in the European Union, Norway and Australia (in New South Wales); are being developed in a number of states in the United States; and are proposed for introduction in Canada and New Zealand. Emissions credit trading – where emissions reductions in one location or activity are used to offset emissions elsewhere – was also included in the Kyoto Protocol to provide least-cost options for countries to meet their emissions reduction targets. The Protocol allows, but does not require, developed countries to engage in emissions trading to meet their agreed emissions targets.

The most common type of emissions trading systems are known as 'cap and trade' schemes. Under such a scheme, the government determines limits on greenhouse gas emissions (that is, sets a target or cap) and issues tradable emissions permits up to this limit. Each permit represents the right to emit a specified quantity of greenhouse gas (for example, one tonne of CO_2-e). Businesses must hold enough permits to cover the greenhouse gas emissions they produce each year. Permits can be bought and sold, with the price determined by the supply of and demand for permits. Governments can choose how they wish to allocate permits, for example, by auctioning, grandfathering, benchmarking, allocating to meet specific equity objectives, or any combination of these options (a more detailed discussion of these methodologies is included in Chapter 7).

By placing a price on emissions, trading allows market forces to find least-cost ways of reducing emissions by providing incentives for firms to reduce emissions where this would be cheapest, while allowing continuation of emissions where they are most costly to reduce. This underlines the fact that emissions trading is not an objective in itself, but a means of achieving a certain level of abatement at the lowest cost possible.

Note

1 For example, work undertaken by the Australian Greenhouse Office, the Australian Bureau of Agricultural and Resource Economics and Professor Warwick McKibbin, and the more recent work by the states and territories' National Emissions Trading Taskforce, the Business Council of Australia, the Australian Business Roundtable on Climate Change, the Australian Industry Greenhouse Network, the Electricity Supply Association of Australia and the National Generators Forum.

Executive summary

Introduction

The increasing scientific consensus is that human action is contributing to climate change. Many of the activities that have fuelled the world's economic growth and rising living standards emit a range of greenhouse gases that are damaging to the global environment. Without action, there are likely to be increasingly adverse economic, social and environmental consequences. These risks need to be managed. They require an economic solution.

Climate change is a global challenge. Addressing it will not be easy. The actions of any single country cannot mitigate the consequences for itself of carbon emitted elsewhere. The accumulation of greenhouse gases already in the atmosphere means further climate change is inevitable. Remedial action will not have a speedy effect. Global emissions of greenhouse gases will rise significantly in the decades ahead even if concerted international action were to begin at once. Policies will be needed to assist countries to adapt to the detrimental impact of climate change and – the focus of this report – to reduce future emissions.

The Task Group on Emissions Trading has sought to take a balanced view of the challenges presented. While we have had to consider a range of difficult issues, two threshold decisions were needed.

The first was whether Australia, which makes only a very small contribution to the world's emissions of greenhouse gases, should commit now to a longer-term emissions constraint ahead of a comprehensive global agreement.

For Australia to achieve a substantial reduction of carbon emissions will involve the imposition of costs on this generation to manage the risks confronting the next. Inevitably, rates of economic growth will be lower than would otherwise have been the case. Energy, fuel and other costs will be greater for households. It is imperative that Australians fully understand the consequences of significantly changing, over time, the way in which our economy operates.

The global effort so far has fallen short of what is required. As a model for future cooperation, the Kyoto Protocol has fundamental shortcomings. While there is an urgent need for the international community to take effective action, too many countries have not restrained emissions. Too many of those who have announced restraints are well behind their targets. This underscores the problems of achieving deep emissions cuts using the Kyoto model.

A new, more comprehensive agreement is required. Unfortunately, discussions on a post-2012 international climate change framework have been disappointingly slow. An outcome is likely to be some years away. In the meantime, many countries are taking action at the national, bilateral and regional levels. Over time, this fragmented approach may provide the building blocks for a global response.

Australia has a vital interest in the form of any emerging global response. Given our exposure to the impacts of climate change we want an

approach that is effective. At the same time, it needs to be recognised that Australia's natural resource and fossil fuel–energy endowments, and access to cheap energy, have helped underpin our economic growth and prosperity. Australia needs to proceed carefully in taking on emissions constraints ahead of concerted international action.

However, waiting until a truly global response emerges before imposing an emissions cap will place costs on Australia by increasing business uncertainty and delaying or losing investment. Already there is evidence that investment in key emissions-intensive industries and energy infrastructure is being deferred.

After careful consideration, the Task Group has concluded that Australia should not wait until a genuinely global agreement has been negotiated. It believes that there are benefits, which outweigh the costs, in early adoption by Australia of an appropriate emissions constraint. Such action would enhance investment certainty and provide a long-term platform for responding to carbon constraints. Combined with Australia's existing domestic and international work on technology development and cooperation, including the Asia–Pacific Partnership for Clean Development and Climate, it would position us to contribute further to the development of a truly comprehensive international framework.

The second major decision faced by the Task Group concerned the emissions reduction mechanism to which Australia should commit. The Task Group is firmly of the view that the most efficient and effective way to manage risk is through market mechanisms. An Australian emissions trading scheme would allow our nation to respond to future carbon constraints at least cost.

Emissions trading focuses on the ultimate environmental objective: to reduce emissions in the most efficient manner. Other forms of government intervention would impose a far heavier burden on economic activity. It is better to have the Australian Government set a national framework for reducing greenhouse gases and then let the market set the carbon price. Over time, market responsiveness will drive improved energy efficiency and the development and adoption of new and existing low-emissions technologies.

Emissions trading enables the market – not government – to decide which new or existing technologies will reduce emissions at least cost. Favouring particular technologies over others – picking winners – will increase the costs we impose on ourselves. Emissions trading also encourages the development, for trade, of offsets such as forest plantations ('carbon sinks'). It will help new economic opportunities to emerge.

International carbon markets are expanding as countries adopt emissions trading or other arrangements that introduce a carbon price into their economies. Links are likely to develop between these diverse arrangements, but the pace will be uneven. A way will need to be found to engage developing countries in a manner that allows them to balance their economic growth ambitions with the global imperative to reduce emissions.

Australia has a chance now to design a domestic emissions trading system that is sensitive to our particular economic interests, including the determinants of our international competitiveness, and that will provide further opportunities to engage the international community. The Task Group believes that, subject to administrative constraints, the scheme should be as comprehensive as possible. But ambition needs to be tempered with caution. In the period before there is international agreement, an Australian scheme should not prejudice the competitiveness of our trade-exposed, emissions-intensive industries. Australian business should not be lost to overseas competitors with no reduction in global emissions.

Timely and decisive action is warranted. A long-term aspirational goal should be set for reducing Australia's production of greenhouse gases. Australia should commit early to moving its emissions trajectory onto a path to meet this goal. It should plan rigorously to build an effective trading system, ensure transparency in the design of the scheme, and implement the institutional and regulatory arrangements with calm deliberation. It should also maximise the flexibility for the Australian Government to respond to changing circumstances.

The Task Group believes that an emissions trading scheme should form the principal mechanism to achieve emissions-reduction goals. But it is not a panacea. Complementary measures will be required as part of a comprehensive mitigation strategy. A trading scheme combined with a continued focus on technology cooperation and a concerted international strategy would maximise Australia's contribution to global action. It would also address rising uncertainty in our investment environment and prepare Australia for a carbon-constrained future. At the same time, given the extent of climate change under way, action will also be needed to help our society and economy adapt to the reality of climate change.

Key conclusions

Climate change is a global challenge that requires a long-term global solution in order to avoid environmental, social and economic dislocation. Emissions cause damage far beyond the country in which they occur. Once in the atmosphere, their impact is far-reaching and long-lasting. Reducing emissions will require a significant change in both developed and developing economies. It will necessitate a fundamental shift in consumer and business behaviour. The adverse consequences of climate change, and their amelioration, will last for generations. (See Chapter 1.)

Curtailing greenhouse gas emissions will impose a cost both on the global economy and individual nations. Households will pay more for their energy and other products. So will business. Economic growth will be slowed. However, costs can be reduced by the way in which emissions are constrained, the rate at which they are forced below 'business as usual' levels, and success in using energy more efficiently and in making greater use of low-emissions technologies. New economic opportunities will also emerge. (See chapters 1, 2, 6 and 8.)

Addressing climate change is a risk management issue on a global scale. While there are costs in acting now, the consequences of inaction are potentially large for many countries. Given the potential for significant costs arising from climate change in the future, a prudent risk management approach suggests that steps to reduce emissions should be undertaken now. (See Chapter 1.)

The goal of reducing emissions needs to be achieved while maintaining international economic growth and development. Long-term policy solutions need to minimise the cost of abatement. While greater energy efficiency and the more effective use of existing technologies will allow emissions reductions in the short term, new technologies will be the key to achieving an enduring decoupling of economic growth and greenhouse gas emissions. Developed countries should continue to take action to restrain emissions, but they cannot carry the entire burden. Indeed, developing countries are expected to account for more than three-quarters of the projected increase in global emissions to 2030. Global structures need to be found to align the legitimate desire of developing countries to maintain economic growth and energy security with the need to curtail their emissions. (See chapters 1, 4, 5 and 8.)

While a comprehensive global approach to climate change is required, it will be difficult

to reach international consensus in the near future. The current multilateral climate change framework is inherently flawed. It lacks a pathway for developing countries to make substantive emissions commitments and its focus on achieving emissions restraints is too short term. Global emissions in 2010 will be 40 per cent above 1990 levels and rising rapidly, notwithstanding the commitments made by countries under the Kyoto Protocol. Given differences between countries on key issues, negotiations for a post-Kyoto international framework are unlikely to make significant progress unless there is a significant shift in the positions of the major participants. (See Chapter 4.)

In the short to medium term, international action on climate change is likely to be focused on cooperation between countries at the bilateral, regional and plurilateral levels. This is not necessarily a bad thing. The voluntary nature of these arrangements is promoting cooperation on a wide range of issues relevant to energy security, environmental management and economic sustainability. Such arrangements constitute important building blocks for a future global regime, particularly those initiatives that focus on technology cooperation and forest stewardship. Australia has been at the forefront of these efforts through vehicles such as the Asia–Pacific Partnership on Clean Development and Climate, and bilateral agreements such as that recently announced with China on clean coal technology. Australia has also played a major role internationally in seeking to promote initiatives that reduce or offset carbon emissions. Participation in the global effort is enhanced by such arrangements, but there will continue to be significant differences in the scale and type of commitments adopted by individual countries. (See Chapter 4.)

Australia already has an emissions cap that is applicable until 2012. Australia's policy objective has been to meet its Kyoto Protocol target of restraining emissions for the period 2008–12 to 108 per cent of 1990 levels. We are broadly on track to meet that goal. A key contributor has been the impact of reduced emissions from lower rates of land clearing. Policy initiatives implemented by the Australian Government have also contributed, including those designed to promote more efficient use of energy, increase the use of renewable power, and encourage voluntary action on the part of industry. Many Australian businesses have taken a lead in seeking to lower or offset their emissions. As a consequence, Australia is one of the few countries in the world likely to meet its target on the basis of domestic actions alone. (See chapters 2 and 4.)

On balance, there would be benefits in the Australian Government now setting a post-2012 constraint on emissions. Australia accounts for only around 1.5 per cent of world emissions. Any actions to reduce our own emissions will do little to address climate change unless they contribute to developing a global solution. While there is an increasing level of activity within and between nations, at this stage it is unclear what burden-sharing approach will be capable of attracting support from the international community. In the judgment of the Task Group, Australia's commitment to assume a post–2012 constraint would underscore our willingness to help construct a post–Kyoto international framework. We need an approach to climate change that is environmentally effective, economically efficient and equitable, and delivers early and effective engagement between both developed and developing countries, particularly the large emitters. (See chapters 2, 4, 5 and 6.)

Market-based approaches that deliver a price on carbon will achieve greenhouse gas abatement, commensurate with an emissions target, at least cost. The budgetary and economic costs of scaling-up current efforts to achieve more significant reductions in greenhouse gas emissions would be enormous. Regulation places a significant impost on business enterprises. Subsidies risk distorting

economic decision-making. It is better for the Australian Government to establish a long-term aspirational goal and a trajectory to achieve that goal, establish the framework within which the price of carbon will be set, and then allow the market to respond in the most efficient and effective way to the new settings. (See chapters 2, 3 and 7.)

The overriding goal of Australia's efforts should be to lower emissions at least cost. The damage caused by a unit of emissions is the same no matter where it comes from – a uniform carbon price across the economy can harness abatement opportunities wherever they are cheapest. Placing a price on emissions provides an incentive for the discovery and deployment of least-cost abatement opportunities. This should be the key objective. Favouring certain lower-emissions technologies over others places a higher cost on the economy and, consequently, unnecessarily lowers Australian living standards. (See Chapter 3.)

Of the market-based instruments, emissions trading should be preferred to a carbon tax. Emissions trading will ensure that the policy focus remains on the ultimate environmental objective of reducing the output of greenhouse gases. It is also likely to be a central part of the emerging global response to climate change. Incorporating a price cap in the initial phase of the scheme – to limit excessive economic costs – will help build support domestically. But emissions trading – globally or nationally – is not a panacea. Other market failures will persist. There will remain a role for governments in setting regulatory standards, supporting technological innovation and encouraging changes in household behaviour. (See chapters 3, 5, 6 and 8.)

An Australian emissions trading scheme, with a carbon price set by the market, would improve business investment certainty. This is particularly the case for projects with a high degree of carbon risk. There is growing evidence that investments are being deferred due to uncertainty about the future cost of addressing climate change. Without a clear signal on future carbon costs, these investments will not be optimised. There is a risk that a higher carbon profile will be locked in for the life of the capital stock. Emissions trading would improve Australia's business investment environment and strengthen the incentives to develop low-emissions technologies. It would promote the long-term behavioural changes necessary to ensure a smooth transition to a carbon-constrained future. (See chapters 6 and 8.)

For Australia to commit to emissions trading now would place us in advance of most of the world community. Nevertheless, international carbon markets are evolving rapidly. The cost of reducing emissions through regulation and budget-funded programmes has seen an increasing number of governments and businesses seek opportunities to reduce emissions in a more cost-effective manner. European states have adopted full-scale emissions trading and some other national and sub-national governments have announced their intention to do so. Others have introduced carbon pricing through indirect means: in the case of developing countries this has included participation in offsets-based credit trading systems. (See Chapter 5.)

A workable global emissions trading scheme is likely to evolve slowly through a patchwork of linked national and regional schemes. A single comprehensive global emissions trading scheme in which all countries participate under the same rules would deliver least-cost global abatement. Unfortunately, it is unlikely to be achievable in the foreseeable future, not least because of the loss of sovereignty that would be involved. It is more realistic to envisage a global regime emerging through informal and formal linkages between national and regional emissions trading schemes and other arrangements. Engaging developing countries will require a staged approach emphasising flexibility and giving credit

for national efforts to improve energy efficiency or reduce emissions on a sector by sector basis. Recognition of carbon offsets through projects in developing countries will also be important in promoting awareness of future opportunities to reduce emissions. (See chapters 5 and 7.)

It is in Australia's interest to develop a domestic emissions trading scheme that might, over time, be linked to complementary schemes in other countries. Commitment to emissions trading domestically should be used to engage in global policy development in a way that reinforces our objective of a comprehensive global response to climate change, and in a manner that meets our strategic interests. Our early adoption of emissions trading should be accompanied by continuing diplomatic efforts to shape the emerging climate change framework in ways that address both the global challenge and our national interests. We should emphasise the importance of designing emissions trading schemes in a way that will maximise the engagement both of developed and developing countries. (See chapters 5 and 6.)

Deepening the engagement of developing countries in greenhouse gas abatement will require the development of links between emissions trading and a range of other measures consistent with those countries' economic growth and energy security objectives.

We should support an approach that extends recognition of a wide range of activities by developing countries as legitimate contributions to the global climate change effort. We should also seek the development of comprehensive approaches to offsets and carbon sinks, including new approaches to forest stewardship and avoided deforestation. There is considerable scope to integrate such approaches into technology-based and other arrangements, particularly in the Asia–Pacific region. This is a process that will, over time, lead to the knitting together of a comprehensive global regime with a substantive emissions trading component. (see Chapter 5).

An Australian scheme should be tailored to our own needs. It should be national in scope and administration. It should not prejudice the competitive position of our trade-exposed, emissions-intensive industries. It should offer the opportunity to link the Australian scheme to other national or regional schemes as they emerge. (See chapters 5, 6 and 7.)

Introduction of an Australian emissions trading scheme will require careful planning and implementation. The necessary monitoring and regulatory structure must be established. The rules of trade must be unambiguous and transparent. It requires a realistic time frame for adjustment along with a carefully calibrated pathway. It should allow a degree of ongoing flexibility. It should provide the capacity for constraints to be tightened in response to technological breakthroughs or international developments. It should place maximum reliance on market mechanisms to reallocate resources so as to minimise the costs of adjustment and encourage the emergence of new sources of growth and prosperity. (See chapters 6, 7 and 8.)

Australia's medium term emissions trajectory and its long-term aspirational goal must be set with great care while recognising the need for deeper emissions reductions over time. Australia should continue to take a cautious approach to the adoption of targets proposed internationally. This is particularly the case in setting short- to medium-term targets for emissions reductions. Australia has an economic structure and abatement challenge that is different from many other industrialised economies. Australia's natural resource and fossil fuel–energy endowments have helped underpin our economic growth and prosperity. Access to low-cost energy is a source of competitive advantage for Australia, contributing to the development of a range of energy-intensive industries. Inexpensive and

reliable electricity has also been an important component in the high and rising living standards enjoyed by Australian households. The ongoing strength of Australia's economy, and continued population increase, suggest that absolute reductions from current levels may be more costly than for other economies. We need to model carefully the impact of various targets on Australian economic growth and competitiveness before selecting the pathway to long-term emissions reductions. (See chapters 2 and 6.)

An Australian emissions trading scheme needs to take account of the trade-exposed nature of many of our emissions-intensive industries. Many of these industries are already world's best practice in their use of energy and in the management of emissions. They are primarily competing with firms in developing countries that are unlikely to face comparable carbon constraints in the near future. It would be perverse if a poorly conceived domestic policy imposed disproportionate costs on these industries, prejudicing their competitiveness and leading to production shifting offshore without any environmental gain through lower global emissions. (See Chapter 6.)

The inclusion of trade-exposed, emissions-intensive industries in an Australian emissions trading scheme must avoid prejudicing their competitiveness but also provide them with appropriate incentives for abatement. A careful balance needs to be struck. Differential treatment accorded to any sector will increase the aggregate economic costs associated with a given emissions reduction. More of the adjustment burden would be shifted to other industries and to households. The transitional measures necessary to ensure the continued long-term competitiveness of emissions-intensive industries should avoid locking in inefficient abatement choices. (See chapters 3, 6 and 7.)

The key design features of an Australian emissions trading model should be based on a 'cap and trade' model. It should exhibit the following features. (See Chapter 7.)

- **a long-term aspirational emissions abatement goal and associated pathways** to provide an explicit guide for business investment and community engagement
- **an overall emissions reduction trajectory that commences moderately, progressively stabilises, and then results in deeper emissions reductions over time** and:
  - is sufficiently flexible that it can be **periodically recalibrated** by government to changing international and domestic circumstances through regular and transparent reviews
  - provides markets with the ability to develop a **forward carbon price path** to guide business investment decisions and help drive longer-term technology development – markets would be expected to establish a low initial carbon price and a forward price curve that rises over time
- **maximum practical coverage of all sources and sinks, and of all greenhouse gases**
  - with permit liability placed on direct emissions from large facilities and on upstream fuel suppliers for other energy emissions
  - with those sectors initially excluded from the emissions trading scheme subject to other policies designed to deliver abatement
- **initial exclusion of agriculture and land use** from the scheme
  - though agricultural emissions should be brought into the scheme as practical issues are resolved
- **a mixture of free allocation and auctioning of single-year dated emissions permits that:**
  - **provides an up-front, once-and-for-all, free allocation of permits as compensation to existing businesses** identified as likely to

suffer a disproportionate loss of value due to the introduction of a carbon price

  - **ameliorates, through free allocation, the carbon-related exposures of existing and new investments in trade-exposed, emissions-intensive industries** while key international competitors do not face similar carbon constraints, but which also provides ongoing incentives for abatement and adoption of industry best practice
  - **allows for the periodic auctioning of remaining permits**

- **a 'safety valve' emissions fee** designed to limit unanticipated costs to the economy and to business, particularly in the early years of the scheme, while ensuring an ongoing incentive to abate
- **recognition of a wide range of credible carbon offset regimes**, domestically and internationally
- **capacity, over time, to link to other comparable national and regional schemes** in order to provide the building blocks of a truly global emissions trading scheme
- **incentives for firms to undertake abatement in the lead-up to the commencement of the scheme**, including through the purchase of offset credits from carbon plantations, and potentially from other accredited activities
- **revenue from permits and fees to be used, in the first instance, to support emergence of low-emissions technologies and energy efficiency initiatives**
  - the focus might shift more toward households and business as the scheme matures.

Flexibility is vital. The operation of the scheme should be reviewed periodically, initially on a five-yearly basis, to allow calibration of the sequence of short-term emissions caps. Reviews could be more frequent in exceptional circumstances. Before allocation commences, the Government should establish short-term caps and indicative medium-term emissions bands or gateways to provide guidance for the likely path of future caps. At the time of the first review, short-term caps and the gateways might be extended by a further five years. (See Chapter 7.)

Policy towards deployment of low-emissions technologies should be technology neutral, allowing the market to choose the least-cost solutions. Low-emissions technologies – such as clean coal, gas, nuclear, solar, wind, hydro, and geothermal – should compete on an equal basis. The key incentives for commercial deployment of technology will emerge from an emissions trading scheme rather than through additional measures. (See Chapter 8.)

Emissions trading is not a panacea. A comprehensive response will involve complementary measures that address market failures not corrected by the emissions trading scheme. There are strong arguments for complementary policies targeting pre-commercial activities, such as funding for basic and applied research, development and demonstration of low-emissions technology. There will also be a continuing role for policies that improve information, awareness and adoption of energy-efficient vehicles, appliances and buildings. If necessary, households could be assisted to manage better the impact of increased power and fuel costs. (See Chapter 8.)

An Australian approach to reducing emissions must be national and operated by only one level of government. An Australian emissions trading scheme should not be simply added to the current plethora of climate change measures in existence across jurisdictions. Emissions trading represents a fundamental change in the way greenhouse gases are managed. Less efficient government policies need to be phased out. While the Australian Government should implement the emissions trading scheme, a cooperative process across all levels of government to rationalise existing policies will be

critical to achieving maximum effect at minimal cost. A process for rationalising energy policies across jurisdictions needs to be agreed if the costs to Australian businesses and households are to be minimised. (See chapters 8 and 9.)

It will take about four years for Australia to begin full-scale emissions trading. If work were to commence this year, it should be possible to: announce a long-term aspirational goal and to establish an emissions reporting and verification system in 2008; finalise the key design features and establish the legislative basis of the scheme by 2009; establish the first set of short-term caps and allocate permits in 2010; and commence trading in 2011 or, at the latest, 2012. Premature introduction of emissions trading would undermine the stability of the scheme. There are a large number of important steps required before trading should commence. A comprehensive work programme needs to be clearly articulated to adequately prepare business and the community for the changes required. It should focus both on scheme design, including institutional arrangements, and the rationalisation of complementary policies and programmes. Much work remains to be done. It should build on the extensive process of consultation undertaken for this report. (See Chapter 9.)

The challenge of addressing climate change through policies of adaptation and mitigation must not be underestimated. It is highly complex. Prudent risk management is hindered to the extent that the dimensions of global warming, and the adverse impact on future generations, remain uncertain. There are no easy answers. It is clear that there are costs to both action and inaction. Nevertheless, the members of the Task Group have come to a shared conclusion: the adoption of a longer-term emissions constraint and the introduction of an Australian emissions trading scheme offers the least-cost way of reducing the output of greenhouse gases domestically and would make a substantive contribution to a comprehensive solution internationally.

The Task Group believes the key to success is to begin at once, but to proceed with care on the basis of considered and informed decisions.

Climate change – a global challenge

1.1 Overview

This chapter outlines the global context of this report. It acknowledges the scientific consensus that climate change is occurring, while recognising that uncertainty remains about the precise scale and consequences of this change. Key messages are:

- Climate change is a global risk management issue. While there are costs in acting now, the costs of inaction are potentially large for many countries.
- Australia is a small contributor to global emissions, but will be vulnerable to the impacts of climate change. This is because greenhouse gas emissions – irrespective of which country they occur in – add to the global atmospheric concentration and can affect the climate in all parts of the world.
- The climate is subject to powerful inertia. The accumulation of greenhouse gases means that some climate change would continue even if global emissions could be halted immediately.
- This places a premium on policies that protect against the most severe impacts.
- A decisive and timely global response is required. Australia should continue its active efforts to engage all major emitting nations to achieve a comprehensive international framework.
- A decision now by Australia to adopt an emissions cap for the post-2012 period would help prepare the economy for a carbon-constrained future. In adopting a cap, Australia's interests would be served by moving decisively to introduce a domestic emissions trading scheme that carefully manages the consequences for economic growth and living standards.

1.2 The global context

Australia is an active member of the Intergovernmental Panel on Climate Change (IPCC),[1] which represents the most authoritative source of scientific advice on climate change. The latest report from the IPCC confirms that greenhouse gases are damaging the earth's environment and that human activity is at least partly responsible.[2] The IPCC (2007a) found that the world has, on average, warmed 0.7ºC over the past century. It predicts that warming will continue, with an increase in average global temperature of between 1.8 and 4ºC by 2100.[3]

While there remains uncertainty about the precise scale and consequences of climate change, there is general agreement that it poses a threat to global development and living standards as we move further into this century.

> [T]here can be no argument that greenhouse gases are having an adverse impact on the earth's environment.
>
> *Prime Minister, the Hon John Howard MP, 5 February 2007*

The potential impacts of climate change are significant. Changes in rainfall patterns, ongoing water security problems and changes in ecosystems all appear possible. Although

the impacts will vary in scope, intensity and geographical spread, the IPCC (2007b) suggests that average global sea levels will rise and polar ice areas will continue to retreat. Many countries and communities, including in our region, will face particularly severe problems.

In these circumstances, the onus is on the international community to take timely and decisive collective action to avoid the worst effects of climate change.

The problem is truly global in its dimensions. Regardless of their source, emissions add to the atmospheric concentration of greenhouse gases. Given the length of time such gases remain in the atmosphere, the emissions of today will have effects for decades to come. This poses a unique challenge for governments and their citizens – the consequences of their actions are displaced both geographically and in time.

While public concern in Australia about the impact of climate change is relatively recent, the problem is not – the accumulation of greenhouse gases is a by-product of the process of industrialisation and economic development which has delivered immeasurable benefits to society. A larger proportion of the world's population has become better off at a faster pace and by a greater margin than ever before. Increased life expectancy, reduced infant mortality, and a marked decline in world poverty are attributable to the rapid economic growth of the last century.

The important role of emissions-intensive activities in our society means that 'decarbonising' the global economy is a significant challenge. Given the structure of the Australian economy, it is a challenge with direct relevance to our economic prospects. The challenge for all countries is ultimately about risk management on a global scale.

> [T]here does seem to be consensus around the fact that significant levels of global warming imply losses in global GDP over the longer term that should be factored into the policy choices made today.
>
> *Australian Government Intergenerational Report (2007, p. 73)*

Responding to climate change will require societies to adapt to changes that already appear inevitable (adaptation) and take action to reduce the likelihood of still further climate change occurring (mitigation). While adaptation is an important component of Australia's response to climate change,[4] this report focuses on the role of emissions trading as a means of achieving cost-effective reductions in emissions while maintaining robust economic growth.

Curtailing greenhouse gas emissions will impose a cost on the economy. The extent of the cost can be tempered, however, by the way in which emissions are constrained, the rate at which they are forced below business-as-usual levels, and our success in developing and deploying low emissions technologies. But failure to constrain global emissions risks environmental, economic and social dislocation. Sensible risk management requires the weighing up of these costs, and places a premium on policies that provide insurance against the most severe effects.

> Choices about the scale and timing of GHG [greenhouse gas] mitigation involve balancing the economic costs of more rapid emissions reductions now against the corresponding medium-term and long-term climate risks of delay.
>
> *IPCC (2007c, p. 27)*

If the challenge of climate change is to be met, major changes will be required in all countries, yet the prospects for comprehensive global action in the near future look poor. For

a medium-sized country like Australia, with an economic structure built around an extensive fossil fuel and resource endowment, this poses a particular problem.

Australia has moved to cap emissions – its policy objective has been to constrain its emissions to its Kyoto Protocol target of 108 per cent of 1990 levels for the period 2008–12. Were Australia to move now to adopt an emissions constraint for the post-2012 period it would impose costs on the current generation for the benefit of future generations. Adopting a post-2012 cap now is a finely balanced decision.

The Task Group believes that, in adopting a cap, it would be in Australia's national interest to move promptly and decisively to introduce a domestic emissions trading regime that carefully manages the consequences for Australian economic growth and living standards. The Task Group considers that such action should occur in parallel with an active programme to engage all major emitting countries, using all possible mechanisms, to shape an emerging comprehensive climate change framework able to deal with the global challenge in a way that promotes our national interest.

At least in developed economies, reductions in carbon intensity – the amount of CO_2-e produced per unit of production – can be achieved while maintaining economic growth. For example, since the early 1970s, economic growth in both the United States and Japan has increased faster than greenhouse gas emissions. While this is attributable to a range of factors, including industrial restructuring, fuel switching and technology changes, it illustrates that structural shifts in the relationship between economic growth and greenhouse gas emissions are possible, especially given the right policy measures and national circumstances.

New technologies will be the key to decoupling economic growth and emissions. Managing the transition of the Australian economy to a carbon-constrained world will be a long-term challenge. It will involve a fundamental shift in both industry and consumer behaviour and change the nature of much of the economy's capital stock. Short-term fixes disconnected from global efforts are likely to be costly. A smooth and efficient transformation will require a range of policy measures coordinated as part of a long-term comprehensive strategy. It will necessarily involve using existing fossil fuels more efficiently and, over time, making greater use of alternatives as technologies become commercially available and as global efforts take shape.

To date, Australia is one of the few countries likely to meet its Kyoto Protocol target based solely on domestic actions. This is a significant achievement, but it has relied in large part on a reduction in land clearing. An extensive range of other government measures has also been put in place to promote the use of low-emissions technologies and restrain emissions growth. This confirms Australia's preparedness to take action. Achieving greater reductions into the future, however, will be a major challenge. Balancing the need for emissions reductions with ongoing strong economic and employment growth demands both a long-term perspective and coherent, innovative and robust policy solutions.

The Australian Government's 2004 Energy White Paper, *Securing Australia's Energy Future*, recommended a range of policy approaches aimed at lowering Australia's greenhouse signature in the short and long term, while retaining the value of existing resources and maintaining competitiveness. These twin objectives – reducing greenhouse gas emissions while maintaining Australia's competitiveness – are central to the Task Group's terms of reference. The Energy White Paper also emphasised that, to attract the necessary investment in energy assets over the coming years, 'government policies on climate change should set a clear framework for decision making that recognises the long-term nature of

investments and desire for investment certainty' (Australian Government, 2004, p. 149).

The Energy White Paper noted that market-based measures, most notably emissions trading, have the potential 'to lead to better resource allocation and provide industry and individuals with the greatest flexibility in determining how best to respond' (Australian Government, 2004, p. 149). It also noted that the Government would only consider emissions trading if an effective global response to climate change was in prospect.

A truly global emissions trading system – one that treats all firms in the same industry identically, irrespective of their location – has considerable appeal because of its capacity to deliver cost-effective outcomes, with all participants playing by the same rules. Such a scheme would require the participation of all major emitting countries and acceptance of the principle of fair burden-sharing. While governments throughout the world may ultimately adopt some form of collective objective to constrain emissions for the years beyond the initial Kyoto period (that is, after 2012), the prospects in the near to medium term are poor. Many developed countries have signalled varying degrees of reluctance about a rollover of the Kyoto model, while developing countries as a group are strongly opposed to adopting binding emissions reduction commitments.

In any event, a comprehensive, unitary global emissions scheme is unlikely to be realised on any reasonable time scale. But, as the scale of the global challenge has come into sharper focus, there is growing recognition of the role of market-based incentives in global efforts beyond 2012. It seems likely that emissions trading will be a prominent part of the emerging global climate change regime. Global participation in emissions trading may, however, take considerable time and evolve unevenly.

This report considers the nature and design of a future workable global emissions trading system and the prospects for such a system. It addresses the issue of whether Australia should introduce domestic emissions trading in advance of a global system, and the key design features that would be necessary to ensure that Australia's core national interests are preserved in a potentially lengthy transition to a comprehensive global system. It also examines possible complementary domestic policy measures.

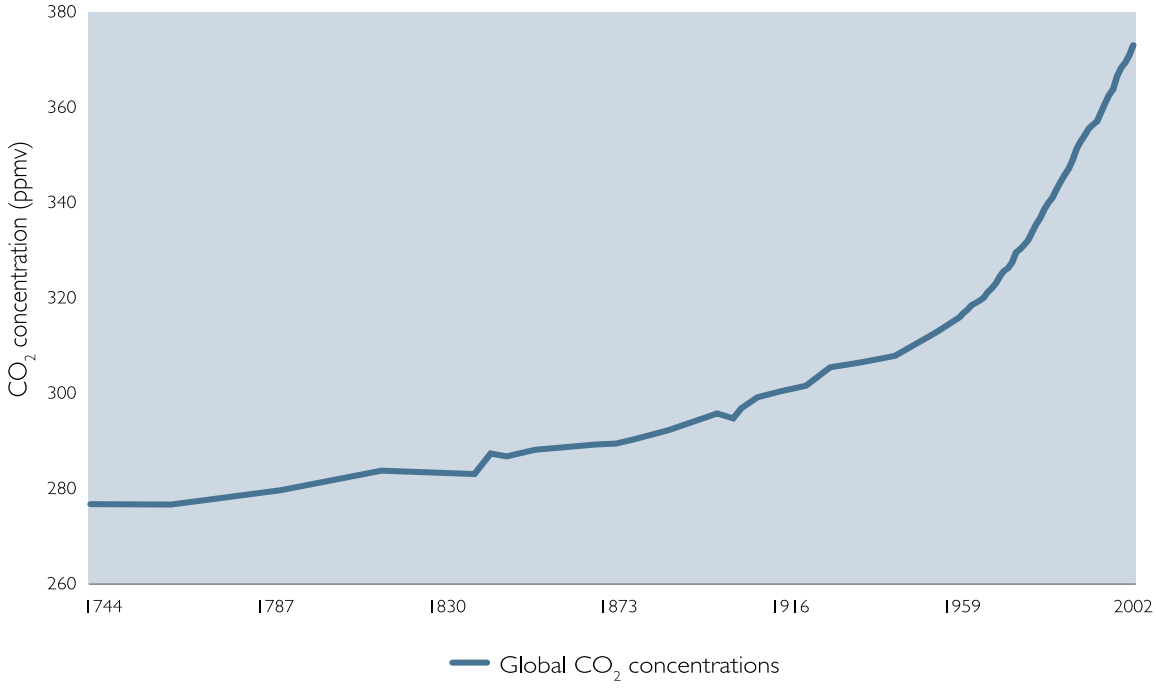
1.3 Global trends in emissions

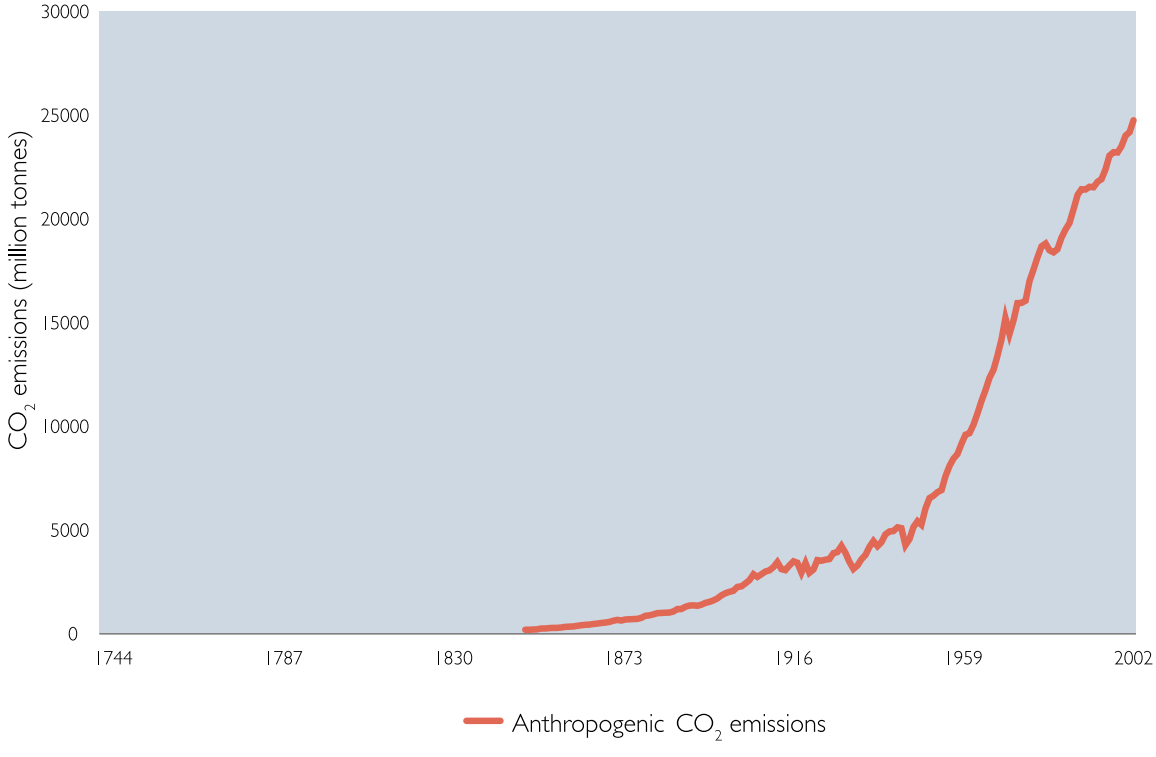
Human-induced (anthropogenic) climate change has been linked to the stock of greenhouse gases in the atmosphere. Since 1750, the atmospheric concentration of the principal greenhouse gas, carbon dioxide (CO_2), has increased from about 280 to 379 parts per million in 2005, and much of this rise is attributed to human activity (IPCC, 2007a). Figure 1.1 shows the extent of the upswing in global emissions from the mid-1900s to 2002. The accumulating impact of greenhouse gases means that the warming effect is subject to powerful inertia. Even if every country stopped emitting greenhouse gases today (that is, the 'flow' of emissions was reduced to zero), it is estimated that global temperatures would still increase by about 0.6°C by 2100 (IPCC, 2007a). In other words, some further climate change is inevitable. At issue is how to minimise the risks of the most serious impacts.

Human activity is estimated to have generated approximately 42 billion tonnes of CO_2-e in 2000 (World Resources Institute, 2005). Figure 1.2 provides a breakdown of global emissions by source, by activity and by greenhouse gas for the year 2000. It shows that the electricity and heating sector is responsible for about one-quarter of total emissions, and that CO_2 is the most significant of the greenhouse gases.

The United States, China, the European Union and Russia accounted for more than 50 per

Figure 1.1 Trends in atmospheric concentrations and anthropogenic emissions[7] of carbon dioxide, 1744–2002





Source: World Resources Institute, 2007

cent of global emissions in 2000. The United States was the largest emitter, contributing more than 20 per cent of global emissions. Rapid growth in energy emissions is expected to result in China becoming the largest single emitting country before the end of this decade. Australia represents about 1.5 per cent of global emissions, and is the world's 12th highest emitting nation (see Table 1.1).

Table 1.1 Shares of global greenhouse gas emissions,[5] 2000 and 2050

Country	Per cent of global emissions in 2000	Per cent of global emissions in 2050
US	20.6%	15.1%
China	14.7%	22.9%
EU25	14.0%	7.8%
Russia	5.7%	2.8%
India	5.6%	9.2%
Japan	3.9%	1.8%
Brazil	2.5%	2.2%
Canada	2.0%	1.3%
Republic of Korea	1.5%	1.0%
Mexico	1.5%	1.7%
Indonesia	1.5%	2.2%
Australia	1.5%	1.0%
South Africa	1.2%	1.1%
Rest of the world	23.8%	29.9%

Sources: World Resources Institute, 2005; Matysek et al., 2006

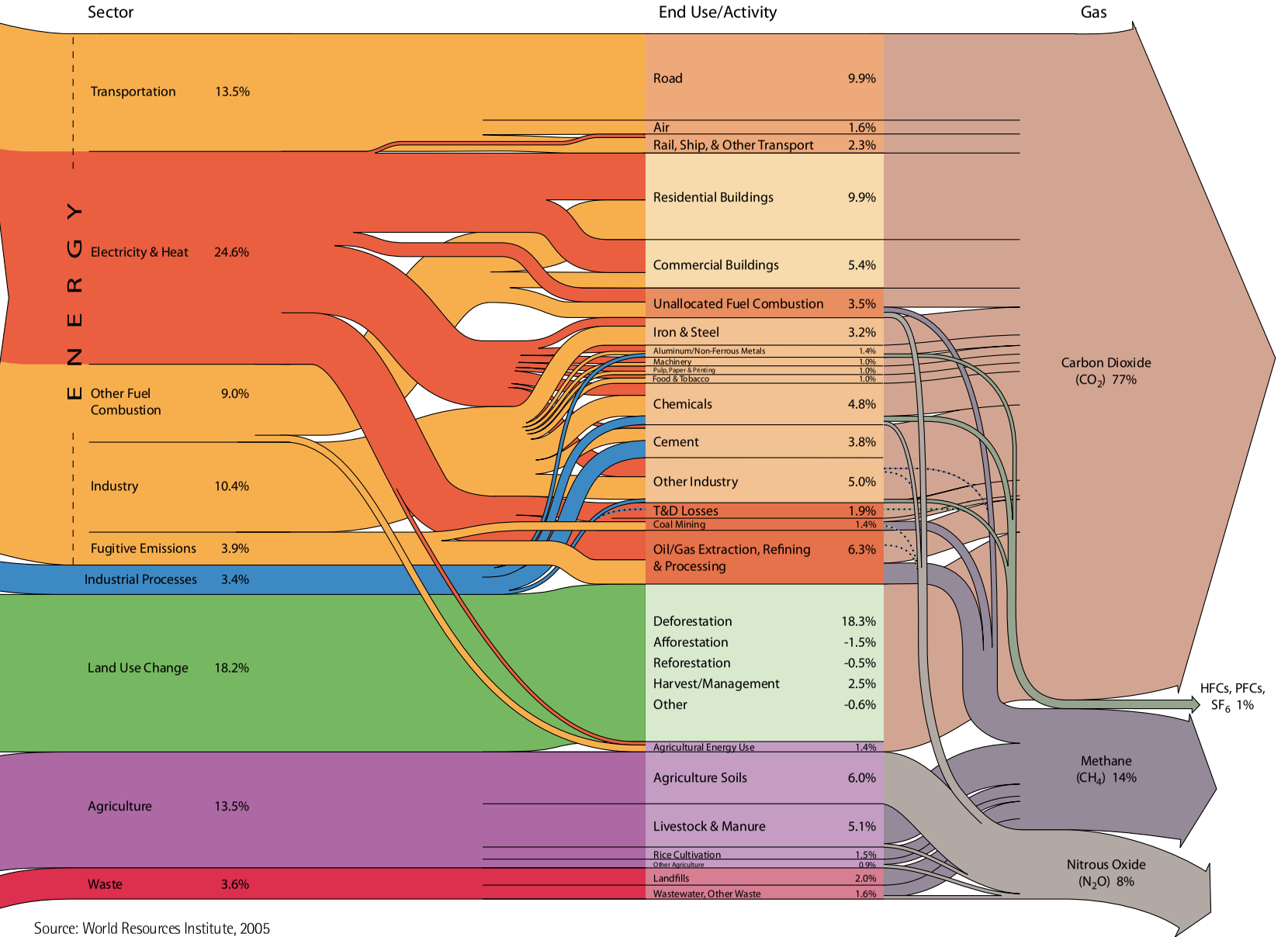
While small in aggregate contribution, Australia is among the highest greenhouse gas emitting countries on a per capita basis (see Figure 1.3). This is largely a result of our high natural endowment of exploitable fossil fuels, economic structure and widely dispersed population. Other countries with similar characteristics have comparable levels of per capita emissions. Figure 1.3 shows that rapidly growing, high-emitting developing countries such as India and China are, at present, relatively low emitters on a per capita basis.

Population and economic growth are the key factors driving global emissions growth. As a result, emissions growth rates are highest among developing countries, where CO_2-e emissions increased by 47 per cent over the period 1990–2002. In contrast, emissions in developed countries (mostly OECD members) in aggregate were unchanged over that period (World Resources Institute, 2005).

Emissions from Russia, Ukraine, and other economies in east and central Europe that were formerly centrally planned, declined significantly following the collapse of their economies after 1990. As activity has recovered, emissions in those countries have also started to rise. In the European Union, declines were registered in the United Kingdom, mainly as a result of the dramatic shrinkage of the coal industry in the 1990s, and in Germany as high-emissions, economically inefficient, activities in east Germany were shut down following the reunification of the country. The United States and Canada recorded significant increases, largely as a result of economic and population growth. In Canada's case, the rapid development of its oil sands industry has also been a factor.

The level, and drivers, of future global emissions are uncertain. Economic and population growth will continue to be influential, but trends in the development of technology and international and domestic policies will have an impact. It is indisputable, however, that global emissions will continue to increase rapidly in the absence of specific action. The IPCC (2007c) notes that, even with current climate change mitigation policies and related sustainable development practices, global greenhouse gas emissions will grow by between 25 and 90 per cent by 2030.[6]

Demand for energy is continuing to rise, primarily driven by growth in developing countries. Rapid industrialisation and urbanisation saw oil consumption in China nearly double between 1995 and 2004 and demand for aluminium, nickel and steel more than triple (Bozon et al., 2007). Electricity generation capacity is increasing rapidly in many developing economies and countries in transition. According to the IPCC (2007c), fossil fuels are projected to maintain their dominant position in the global



Source: World Resources Institute, 2005

Figure 1.2 World greenhouse gas emissions, 2000[8]

energy mix to 2030 and beyond. The International Energy Agency (2006a) has forecast that, based on current policy settings, global energy-related CO_2 emissions will more than double between 2004 and 2030.

The goal of the United Nations Framework Convention on Climate Change, to which Australia is a party, is to achieve 'stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system' (United Nations, 1992). Understanding of the complex environmental, economic and social impacts of climate change is currently not sufficient to identify confidently what this level should be.[9] Table 1.2 illustrates the change in global CO_2 emissions in 2050 required to stabilise atmospheric concentrations at a range of levels (see also Box 1.1 for a discussion of 'sinks' as a means for reducing net emissions).

Table 1.2 IPCC Working Group III stabilisation pathways

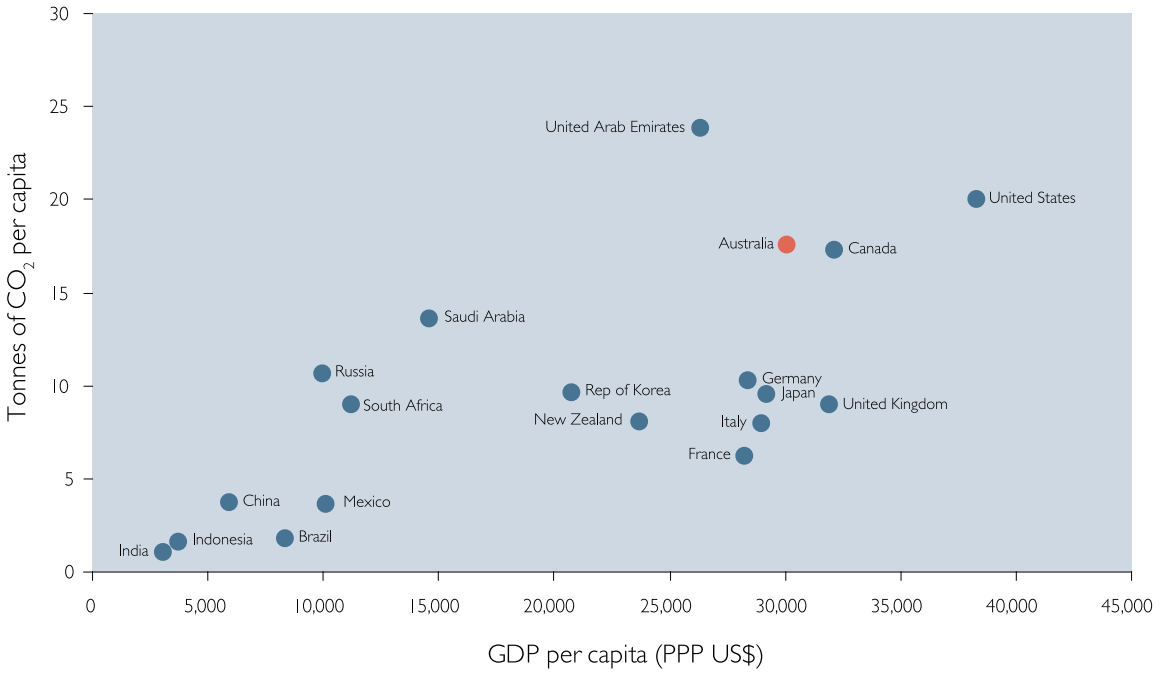
Ultimate CO_2 concentration (ppm)	Global mean temperature increase# (°C)	Peaking year for CO_2 emissions	Change in global CO_2 emissions in 2050* (%)
350 – 400	2.0 – 2.4	2000 – 2015	-85 to -50
400 – 440	2.4 – 2.8	2000 – 2020	-60 to -30
440 – 485	2.8 – 3.2	2010 – 2030	-30 to +5
485 – 570	3.2 – 4.0	2020 – 2060	+10 to +60
570 – 660	4.0 – 4.9	2050 – 2080	+25 to +85
660 – 790	4.9 – 6.1	2060 – 2090	+90 to +140

\# Increase above pre-industrial level at equilibrium

* Percentage of 2000 emissions

Source: Intergovernmental Panel on Climate Change, 2007c

Figure 1.3 CO_2 emissions from fuel combustion and GDP per capita, selected countries, 2004



Box 1.1 Sinks

In addition to action to reduce the volume of emissions from their source, growth in the concentration of greenhouse gases in the atmosphere can be lowered through the use of sinks or carbon reservoirs. The main natural sinks are oceans, plants and other organisms that use photosynthesis to remove carbon from the atmosphere by incorporating it into biomass. The Kyoto Protocol makes some allowance for the use of sinks as a form of carbon offset. Carbon dioxide capture and storage in geological formations (geosequestration) is also being explored as a means to prevent carbon dioxide from entering the atmosphere.

While there remains uncertainty about the level of reductions in greenhouse gas emissions that will be necessary to avoid the most severe impacts of climate change, the potential risks of inadequate global action are becoming clear. The following chapter outlines the relationship between Australia's economic structure and emissions profile, and discusses the steps that government, at both the federal and state/territory levels, is taking to address climate change.

Notes

1 The IPCC is an intergovernmental body that assesses scientific, technical and socio-economic issues relevant to understanding the scientific basis of the risk of human-induced climate change, its potential impacts and options for adaptation and mitigation. It bases its assessments mainly on peer-reviewed and published literature. See www.ipcc.ch for further information.

2. The IPCC Fourth Assessment Report states that 'most of the observed increase in globally averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations' (IPCC, 2007a, p. 10).

3 The IPCC Fourth Assessment Report (IPCC, 2007a) includes best estimates and likely ranges (maximum and minimum) of temperature change between 1980–99 and 2090–99. Estimates and ranges are provided for six emissions marker scenarios. Under the B1 scenario (changes in economic structure toward a service and information economy), the range is 1.1–2.9°C (best estimate 1.8°C). Under the A1 family of scenarios (rapid economic growth, with new technologies introduced at varying rates), the range is 1.4–6.4°C, with best estimates of 2.4°C, 2.8°C and 4.0°C. For a further breakdown of temperature projections, see IPCC, 2007a, p. 13, Table SPM-3.

4 The Australian Government has announced a commitment of up to $26 million to establish and manage the Australian Centre for Climate Change Adaptation and $100 million in programme funding over five years. The aim of the Centre is to provide governments, industry and the community with information on climate change impacts, vulnerability and adaptation options. The Government has also announced a new CSIRO Adaptation Flagship with funding of $44 million to provide more accurate information of localised climate changes.

5 Totals exclude emissions from land-use change and forestry and international bunker fuels. When land-use change and forestry is included, Australia ranks 14th in the world and represents approximately 1.2 per cent of global emissions in 2000. In the same year, counting EU members separately lowers Australia's rank to 15th (without land-use change and forestry) and 17th (with land-use change and forestry).

6 This statement was made with 'high agreement, much confidence'.

7 Excludes emissions from land-use change and forestry and international bunker fuels.

8 All calculations based on CO_2-equivalents. Land-use change includes both emissions and absorptions. Dotted lines represent flows of less than 0.1% of total greenhouse gas emissions.

9 For a more extensive discussion of this issue, see IPCC, 2007c, paragraph 21.

2 Australia's circumstances and current policies

2.1 Overview

Australia's emissions profile is integrally related to its economic structure and prospects, including the competitive position of Australia's resource-based industries. Constraining emissions in Australia will necessarily have a wide impact on our society and economy, particularly in the light of projected strong growth in emissions. The extent of the impact will depend on the policies used to achieve emissions reductions and the time frame chosen to achieve such reductions.

This chapter discusses Australia's economic structure and emissions profile, the suite of existing policies to constrain emissions, and their cost. It highlights the interrelated nature of Australia's emissions profile and the natural resource endowment that has helped deliver the high living standards enjoyed today. Key messages are:

- Australia has an abundant endowment of energy and mineral resources and this is a key component of Australia's economic prosperity. We also have a high endowment of elements expected to be important in a carbon-constrained world, including high-quality geological and biological sequestration sites, significant uranium deposits and renewable energy resources.
- Many of Australia's significant exports are emissions intensive and compete with products from countries unlikely to impose comparable emissions constraints in the near future. Domestic approaches to climate change need to be carefully considered so as to achieve effective least-cost environmental outcomes while maintaining Australia's competitive advantages.
- Based on recent and likely trends in emissions growth rates, Australia may find it more costly than many other industrial economies to adopt targets proposed internationally, suggesting the need for care in target setting.
- Setting a national trajectory for emissions reduction will require careful analysis. It needs to take into account potential abatement options, technological pathways and international developments.
- Australia is a small contributor to global emissions. Any action to reduce our emissions will have a minimal environmental impact unless it contributes to developing a global solution to climate change.
- Reducing emissions has a cost. It is imperative that further reductions in emissions be achieved with policies that achieve the least-cost abatement across all sectors.
- To achieve significant reductions in emissions in the long term, it will be essential to draw on the full range of existing technologies and to bring forward new low-emissions technologies.
- Australia has a plethora of current policies across jurisdictions to achieve both abatement and technological development, with varying degrees of cost effectiveness.
- Abatement policies to date have secured 'low-hanging fruit' that will not be available going forward or will impose excessive economic costs if scaled up.

2.2 Structure of Australia's economy and emissions profile

2.2.1 Australia's economic structure[1]

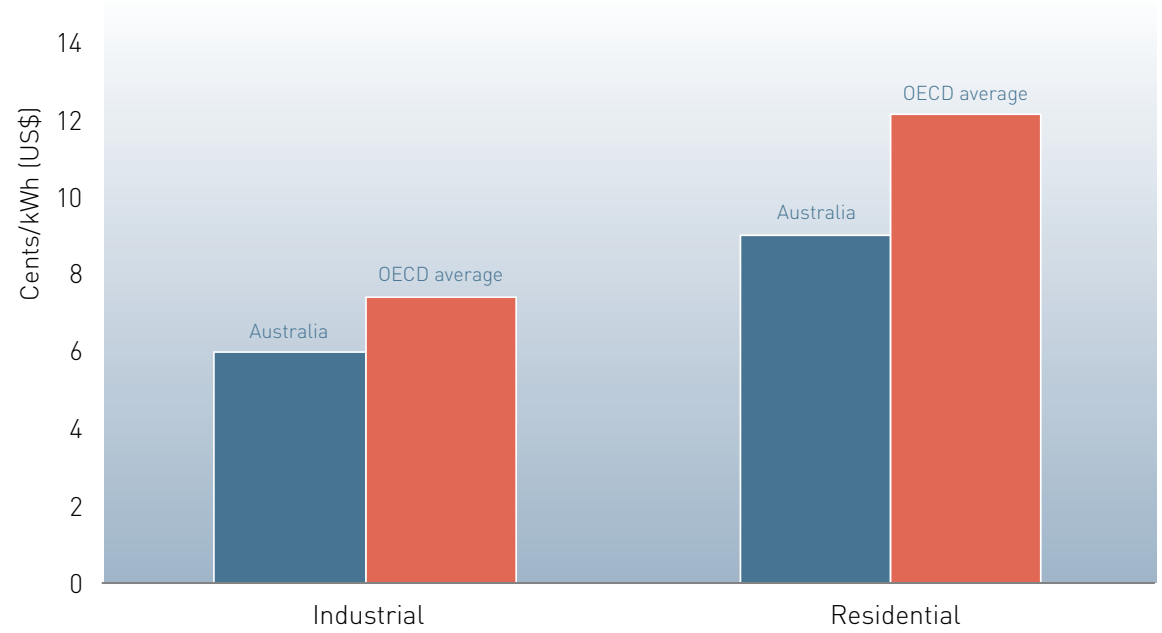
As in most advanced economies, the services sector provides the bulk of Australia's production and employment. This share has been steadily growing over time. It now constitutes around 79 per cent of GDP and 85 per cent of employment.

In contrast to most other advanced economies, however, the Australian economy has a significant reliance on primary (agriculture and mining) and resource-processing industries. These industries are relatively intensive in terms of both energy use and greenhouse gas emissions per unit of output. Agriculture and mining (including services to mining) directly account for 9 per cent of GDP, which is a relatively large share by OECD standards.

In addition, a number of Australia's processing industries are substantially based on our natural resource endowments, either directly (through their use of resources as material inputs) or indirectly (through their use of electricity). These processing industries include food and beverages, mineral products, petroleum and chemicals, and wood and paper products. Together they account for a further 8 per cent of GDP. In total, primary and resource-based sectors employ more than one million people, around 10 per cent of total employment.

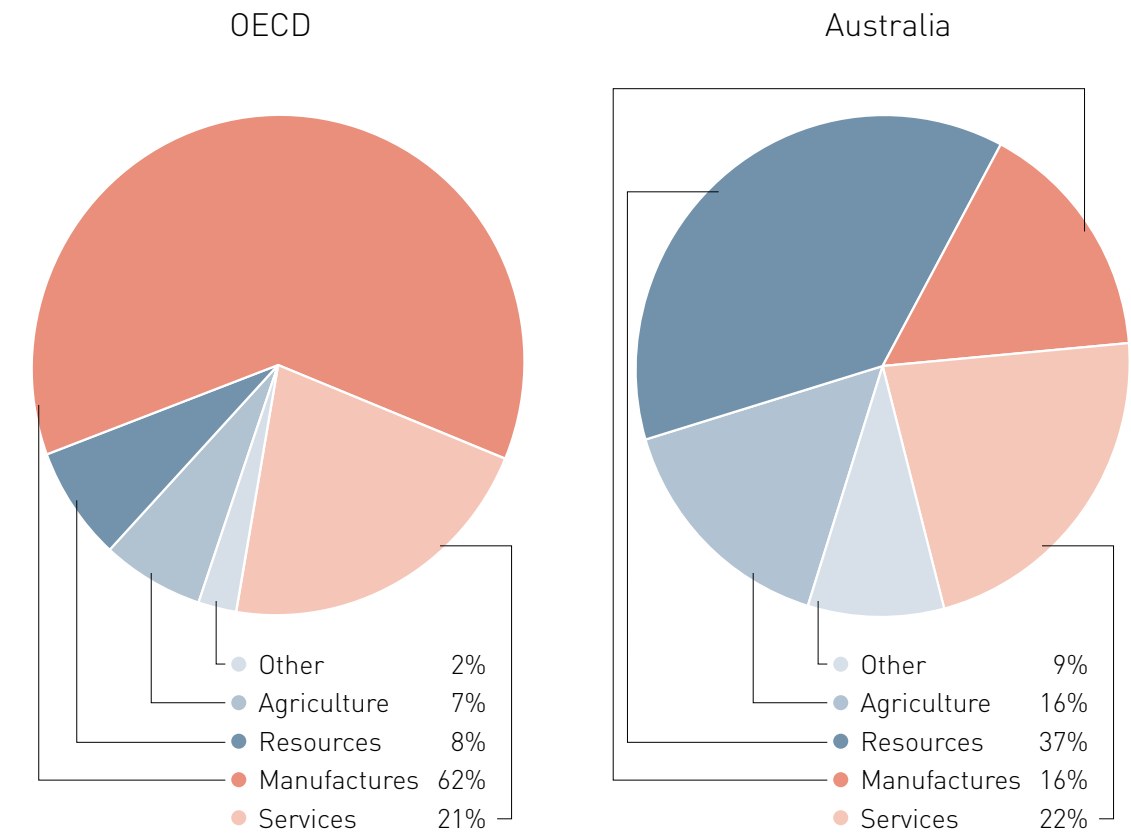
The ability of Australia's natural resource endowments to provide inexpensive and reliable electricity has been a key source of our economic growth and prosperity. It has contributed to the development of a range of energy-intensive industries. Access to low-cost energy is a source of competitive advantage for Australia (Australian Government, 2004). It has also been an important component of the high (and rising) living standards enjoyed by Australian households. Australia's electricity prices for both business and residential use have been among

Figure 2.1 Australian and OECD average electricity prices, 2004



Source: International Energy Agency, 2004b

Figure 2.2 Composition of Australia's exports compared with OECD average



Source: World Trade Organization, 2007

the lowest in the OECD (see Figure 2.1). This is a result of our good fortune in having easy access to large coal and gas reserves located close to markets and our investments in high-quality production and distribution infrastructure. Energy market reforms over the last decade have also contributed.

Primary industries play an even larger role in exports than in production or employment because of Australia's natural resource endowments. Many services are not traded among countries to a significant degree, so our rich endowment of natural resources is a key source of comparative advantage in international trade. The primary sectors provide more than half of Australia's exports, a considerably higher proportion than in many other OECD countries (see Figure 2.2). Furthermore, Australia maintains a substantial trade surplus in primary and resource-based products. Australia's manufacturing exports are also more energy- and emissions-intensive than in most OECD nations, due to a large component of metals processing, including alumina and aluminium production.

In recent years these industries have played a larger role in determining Australian living standards than their share of production alone implies. This reflects the high prices received on export markets. Over the past three years Australia's terms of trade have improved – the price of exports has increased relative to the price of imports – by around one-third, mainly due to rising minerals prices. This has meant that real national income per capita has grown at an average annual rate of 3.3 per cent, which is considerably faster than the 2.0 per cent growth in real GDP per capita.

Table 2.1 Australia's energy resources, 2005

	Australia	Share of world resources (%)	Resources to production years[a]
Coal[b]			
Black coal (gigatonnes)	40	5.4	>100
Brown coal (gigatonnes)	38	23.7	>500
Petroleum			
Oil (gigalitres)	158	0.3[c]	21[c]
Condensate (gigalitres)	301		
LPG (gigalitres)	214		
Natural gas (billion cubic metres)	2,587	1.4	63
Uranium[d] (kilotonnes of U)	731	27	94

a. 2005 rates of Australian production, b. recoverable resources, c. numbers denote naturally occurring crude oil, condensate and liquefied petroleum gas (LPG) combined, d. identified resources of uranium (U) at less than US$80/kg

Source: Australian Bureau of Agricultural and Resource Economics, 2007b; Geoscience Australia, 2007

Australia's natural resource endowments are likely to continue to play an important role in our prosperity into the future. Australia possesses large reserves of energy resources, including abundant and inexpensive supplies of coal and extensive gas and uranium reserves (Table 2.1).

Given this economic structure and resource endowment, Australia will be adversely affected by any action to restrain emissions, whether domestic or international (see Section 2.2.3). However, Australia will also bear increasing economic costs from the impacts of climate change and measures to adapt to climate change if global emissions are not constrained. These adverse impacts include: water shortages, damage to infrastructure, costs to a range of industries (for example, agriculture and ecotourism), negative impacts on human amenity and degradation of the environment.

While Australia's existing areas of economic strength and comparative advantage must be considered carefully in our response to the challenge of climate change, it would be a mistake to believe the structure of the economy is fixed. Sectoral and industry composition is constantly changing in response to shifts in consumer preferences and new technological possibilities. Indeed, the last few decades have seen enormous changes in economic structure, in part due to new products and industries, but also due to significant reforms that have expanded the role of price signals in the economy, particularly in the areas of financial markets, international trade, and labour markets.

A key goal should be to ensure a smooth transition in the economic structure in response to the introduction of policies that constrain emissions. This requires a realistic time frame for adjustment along with a carefully calibrated pathway. There should also be maximum reliance on market mechanisms to reallocate resources. This will minimise the costs of adjustment and encourage the emergence of new sources of growth, employment and prosperity.

2.2.2 Australia's emissions profile

Australia's greenhouse gas emissions profile is a function of our economic structure.

The bulk of Australia's total emissions (559 megatonnes of CO_2-e in 2005 (AGO, 2007a)) is a consequence of energy production. Stationary energy is the largest source of emissions, accounting for approximately half of total

Box 2.1 Emissions sources

Emissions are typically broken down into the following sources:

- **Stationary energy** includes emissions from fuel consumption for electricity generation and petroleum refining, fuels consumed in the manufacturing, construction and commercial sectors and other sources such as domestic heating.
- **Transport** includes emissions from the direct combustion (or end-use emissions) of fuels by road, rail, domestic air transport and domestic shipping.
- **Fugitive emissions** include methane, carbon dioxide and nitrous oxide emitted during the production, processing, transport, storage and distribution of raw fossil fuels (coal, oil and gas).
- **Industrial processes emissions** cover non-energy emissions from mineral processing, chemicals and metal production. These emissions are usually produced during chemical reactions associated with manufacture (for example calcification during cement manufacture releases CO_2).
- **Agriculture emissions** are methane and nitrous oxide emissions sourced from agricultural soils, manure management, rice cultivation and livestock.
- **Waste sector emissions** are primarily methane and include emissions from solid waste disposed to landfill and from the treatment of domestic, commercial and industrial wastewater.
- **Land use, land-use change and forestry emissions** are the result of the burning of removed forest cover, the decay of unburnt vegetation, and emissions from soil disturbed in the process of land clearing. (These are offset to some extent by carbon sequestration due to regrowth of vegetation

emissions, of which electricity generation contributes more than two-thirds. Other energy-related sources include transport and fugitive emissions. Agriculture, changes in land use (mainly land clearing), and forestry are also significant sources (see column 1, Figure 2.3). Box 2.1 provides an explanation of what is covered by each emissions source.

All sectors of the economy, including households, contribute to greenhouse gas emissions either directly or indirectly (see column 2, Figure 2.3). Residential emissions arising from electricity and transport use contribute nearly one-fifth of total emissions. Around half of total emissions in Australia are generated by primary industries and other closely linked industries (agriculture, mining, and segments of manufacturing including mineral and metal processing). This is a consequence of the energy intensity of these industries and/or high levels of emissions related to production processes, which in turn reflects our extensive natural resource endowment of raw materials and energy. Other industries, such as commercial transport, also make a significant contribution.

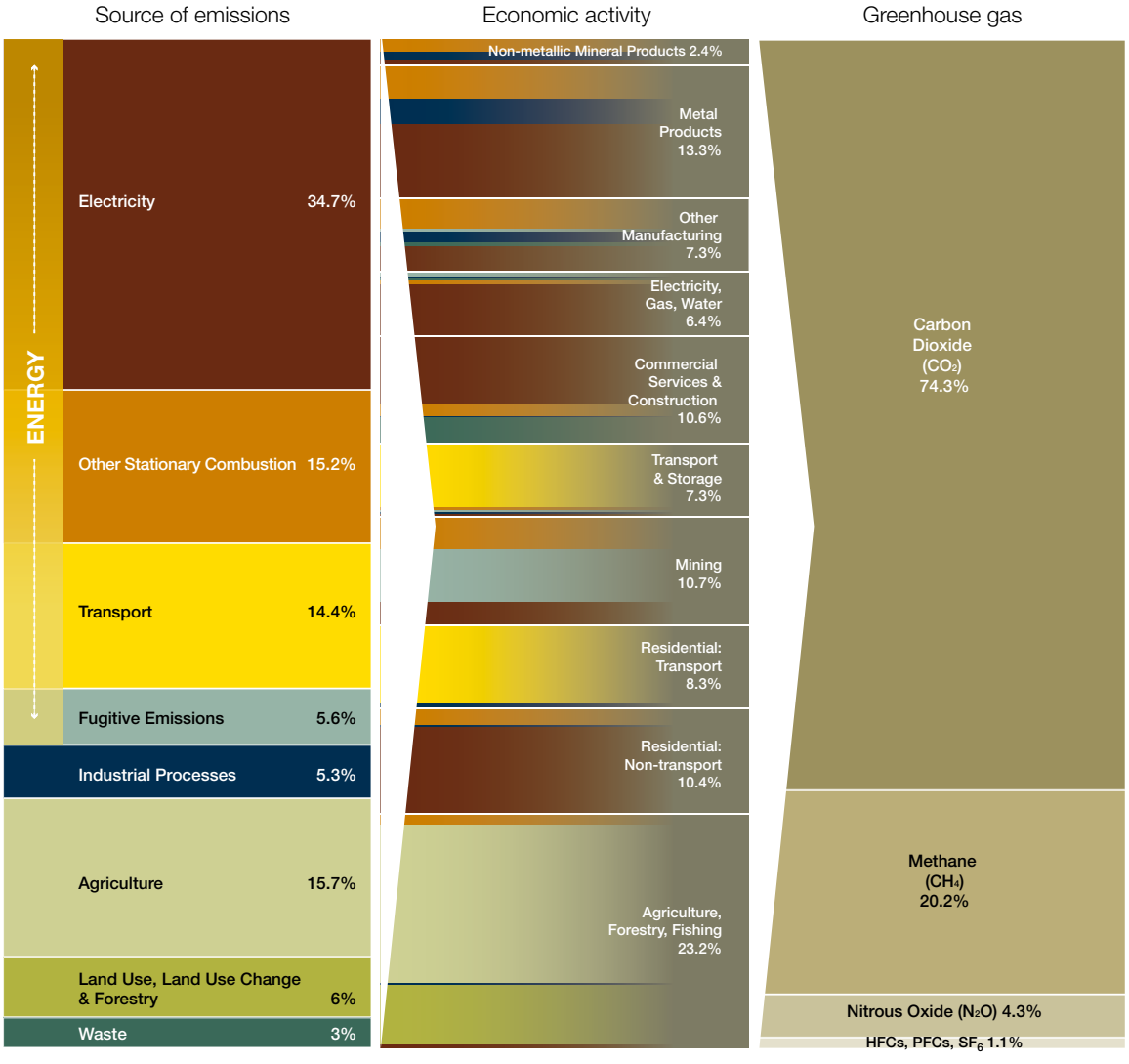
2.2.3 Australian emissions in the global context

Any actions to reduce our own emissions will have minimal impact on climate unless they assist in delivering a global solution to climate change.

Australia has a vital interest in the form of that global response. The domestic economic activity of industries that are based on our favourable resource endowment is a key source of Australia's domestic emissons (see Figure 2.3). Australia will also be affected by the global response through our significant exports of fossil fuels and other energy resources such as uranium. Emissions produced in other countries from the combustion of Australia's

Figure 2.3 Australia's greenhouse gas emissions, 2005

Allocation of greenhouse gas emissions by source, economic activity and greenhouse gas, Australia, 2005



Source: Australian Greenhouse Office, 2007a

fossil fuel exports (particularly coal and natural gas) are of similar magnitude to total domestic emissions.[2] So what other countries do to constrain emissions is of immense significance for Australia's economic prospects. Action to limit carbon emissions by key trading partners will have an impact on the demand for Australian exports. Any shift away from fossil fuel consumption globally will likely affect both the volume and price of exports.

Australia has an important interest, therefore, in ensuring that the burden of international abatement efforts is shared broadly, that all industry sectors contribute, and that appropriate recognition is given to the role of carbon sinks in absorbing atmospheric CO_2-e.

We also have a profound interest in the development of low-emissions technologies, particularly for fossil fuel energy, if we want to maximise the contribution of Australia's fossil fuel exports to our living standards. As

the International Energy Agency (2006a) has pointed out, world energy use will continue to depend on fossil fuels (including Australian coal) for the foreseeable future. Prospects will be enhanced to the extent that clean coal and gas technologies can be developed around the world.

Australia's liquefied natural gas (LNG) and uranium exports have the potential to make a major contribution to global efforts to reduce greenhouse gas emissions if they are used to power electricity generation instead of coal. For example, if Australia's LNG exports were used to replace an importing country's domestic coal-based electricity generation, they could reduce global emissions by around 94 Mt by 2010.[3] Similarly, if Australia's uranium exports were used to replace an importing country's domestic coal-based electricity generation, then by 2010 they could reduce global emissions by around 380 Mt.[4] Growth in both LNG and uranium exports is forecast to continue beyond 2010.

The extraction and processing of natural gas and uranium often involves production of greenhouse gas emissions (for example, through the processing of uranium ore and the natural gas stream). Under international emissions accounting rules, these emissions are attributed to the country where they occur. So, while an expansion of these exports may contribute to a reduction in world emissions, it will likely lead to an increase in Australia's emissions. Therefore any domestic policy response will need to be carefully formulated to ensure continued supply of these resources to Australian and world markets.

If Australia were to take action to restrain emissions in advance of a comprehensive global response, the design of domestic policies would take on added importance. In particular, we would need to take account of the trade-exposed nature of many of Australia's emissions-intensive industries. Many of these industries are already world's best practice in their use of energy and in the management of emissions, but are primarily competing with firms in developing countries that are unlikely to face carbon constraints of similar magnitude in the near future. A poorly conceived domestic policy that imposes disproportionate costs on these industries runs a risk of prejudicing their competitiveness and could shift production overseas without any environmental gain through lower global emissions (see Box 2.2).

2.3 Australia's emissions trajectory

2.3.1 Australia's economic outlook

Australia's future emissions trajectory is closely related to our economic prospects.

The economy is in its 16th year of expansion, with annual GDP growth averaging 3.6 per cent over that period. This expansion has been due primarily to strong underlying economic fundamentals arising from a flexible economy and stable macroeconomic framework. In recent years, rising global demand for resources has contributed substantially to national income and investment growth. Australia's terms of trade are at their highest level in more than 50 years, driving strong investment in the mining sector. Mining has accounted for almost one-third of total business investment growth over the past four years.

With the economy now close to full employment, economic growth over the longer term will depend on growth in productivity, population and workforce participation. The 2007 Intergenerational Report projects that population ageing during the next 40 years will progressively slow GDP growth from an average of 3 per cent in the current decade to 2 per cent in the 2040s (Australian Government, 2007).

Box 2.2 Effects of production and carbon leakage

The imposition of a domestic carbon price in Australia will affect costs and may reduce the competitiveness of trade-exposed, emissions-intensive industries and investments while competitors located in other countries do not face similar constraints. This could lead to 'production leakage' (the loss of activity from Australia to another country), and may also result in 'carbon leakage' (emissions previously occurring within Australia being simply shifted offshore).

- There would be a loss of trade and investment in Australia without any attendant global environmental benefit if an affected firm moved to a new host country and used similar or higher emissions-intensive energy sources or technologies to those previously used in Australia (that is, 'production leakage' would be accompanied by commensurate 'carbon leakage').
- Similarly, there could be adverse impacts on trade and investment, again with no attendant global environmental benefit, if domestic production capacity were to be displaced by imports from a country that does not impose a carbon cost.
- If an affected firm relocated to a host country with no carbon price in response to Australia's decisions to put an explicit price on emissions, there is no reason to expect that the same firm would simply shift production back to Australia if the cost disadvantage were reversed if and when the new host country applied a similar carbon cost. This is because of the high transaction costs associated with relocation (including sovereign risks) and new sunk investments in the host country.

As carbon costs are only one of a range of costs affecting investment decisions, the imposition of a carbon cost in Australia would not automatically lead to movement offshore. There would also be some offset to the deterioration in enterprise-level competitiveness from the likely real exchange rate depreciation that would arise from Australia introducing a cost on emissions before the rest of the world.

It cannot be automatically assumed, either, that production leakage would lead to an equivalent carbon leakage. For example, the displacement of Australian production could result in lower global emissions if the additional production were to occur in jurisdictions with lower emissions profiles (for example, because they use electricity generated by hydro, gas or nuclear power).

Even with this projected slowing of GDP growth, the Australian economy is likely to continue to grow at a faster pace than that of most other advanced economies. The United Nations (2006) projects that the annual rate of Australian population growth over the next four decades will be 0.5 to 0.75 of a percentage point higher than for the developed world as a whole. Other things being equal, this would imply a commensurately higher rate of economic growth.

Over the long term, efforts to mitigate and adapt to climate change, as well as the consequences of climate change itself, could have a significant adverse impact on Australian productivity and production. While this impact is difficult to quantify at this stage, it demands a carefully balanced decision on when, how and in what manner Australia moves forward. Both action and inaction are likely to impose costs on Australia's economy.

Rapid growth in developing countries is likely to generate continued strong world demand for Australian resources and energy-based exports in the decades ahead. This will continue to leave Australia vulnerable to climate change actions

taken elsewhere, in the absence of technological breakthroughs that either directly result in lower emissions from the use of fossil fuels or allow the capture and storage of greenhouse gases released during fossil fuel use.

2.3.2 Emissions projections

Ongoing economic growth is likely to provide considerable momentum to the growth of Australia's greenhouse gas emissions.

The most recent projections of Australia's future greenhouse gas emissions suggest that Australia is broadly on track to meet its Kyoto Protocol target of limiting emissions to 108 per cent of 1990 levels for the period 2008 to 2012 (see Figure 2.4). The suite of climate change policy measures introduced by governments and the actions of industry have played a role in reducing emissions (see Section 2.5.1).

Growth in emissions to 2010 reflect a range of offsetting factors (see Figure 2.5). Strong growth in energy and industrial emissions has been offset by reductions in land use, land-use change and forestry (LULUCF) emissions, in large part due to government regulations phasing out land clearing. This change in land clearing is a one-off factor, meaning that the strong growth in other emissions sources will increasingly drive the ongoing trajectory of emissions.

In the absence of new measures, continued growth in energy demand is projected to lead to national emissions rising to 127 per cent of 1990 levels by 2020 (see Figure 2.4). This growth will be driven primarily by the stationary energy sector, where emissions in 2020 are projected to be 84 per cent higher than 1990 levels. A key factor will be the strong increase in demand for energy by the residential and commercial sectors, associated with growing prosperity and demand for energy-using appliances. Projected growth in energy and resources exports, notably in response to global demand for LNG and alumina, also underpins the expectation of strong growth in emissions from combustion in the stationary energy sector. Other large areas of growth are projected to be transport (62 per

Figure 2.4 Australia's projected greenhouse gas emissions

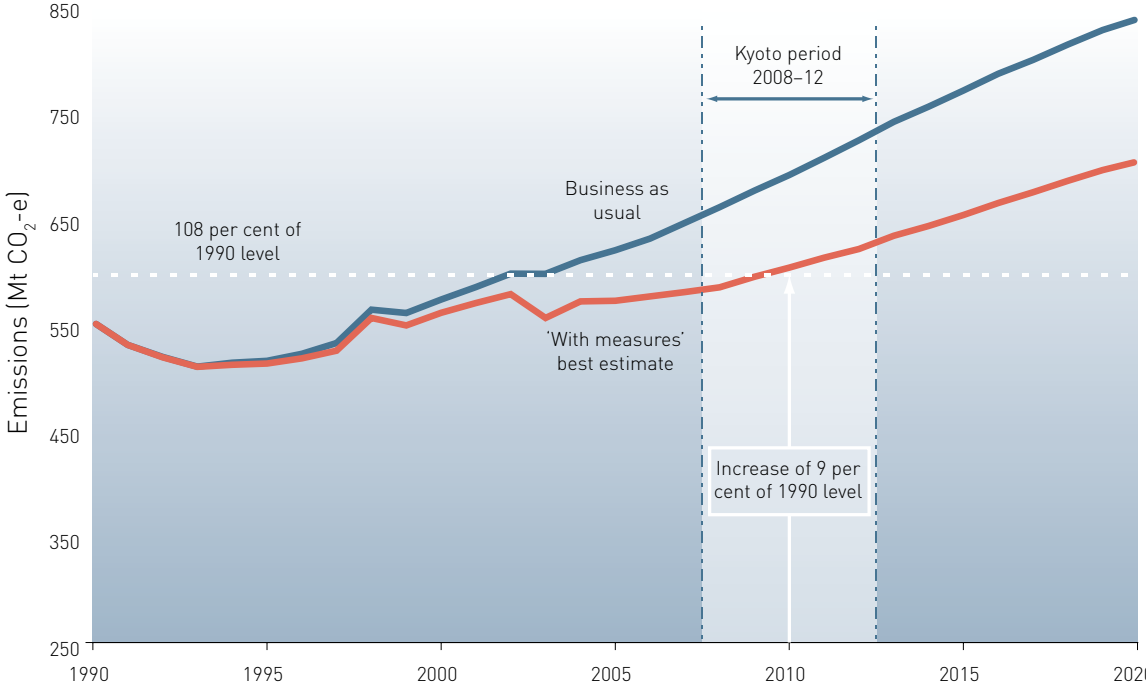
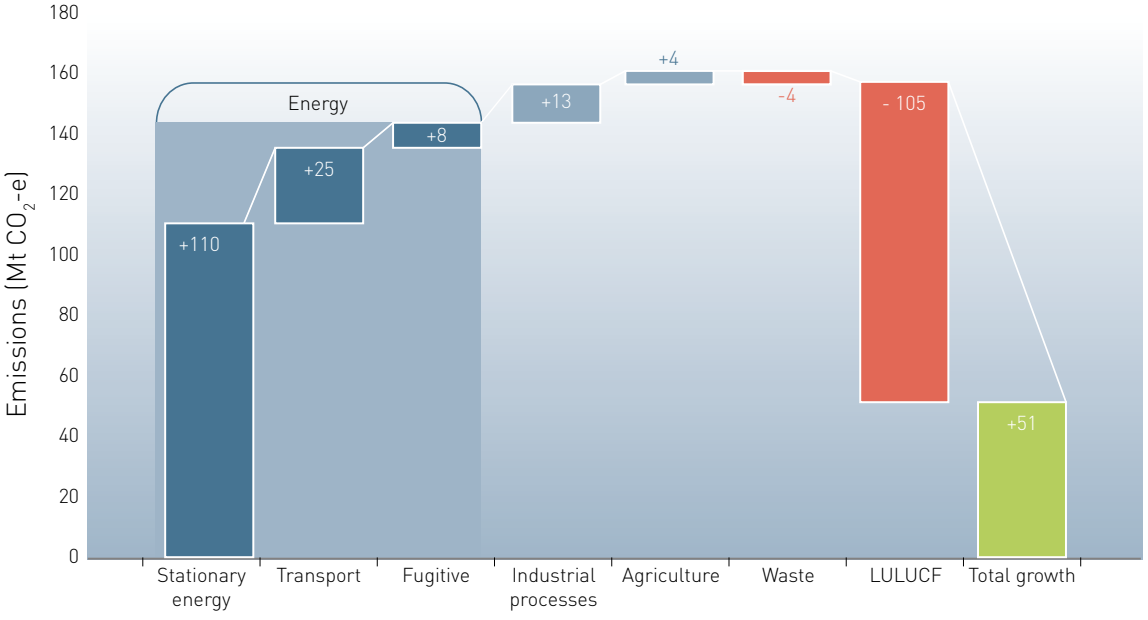


Figure 2.5 Sectoral contribution to Australian emissions growth, 1990–2010



Source: Australian Greenhouse Office, 2006a

cent above 1990 levels), fugitive emissions (an 84 per cent increase, primarily from expansion in the mining and processing of coal, oil and gas) and industrial processes emissions (a 97 per cent increase, primarily from mineral processing and metal production).

2.4 The challenge of reducing emissions

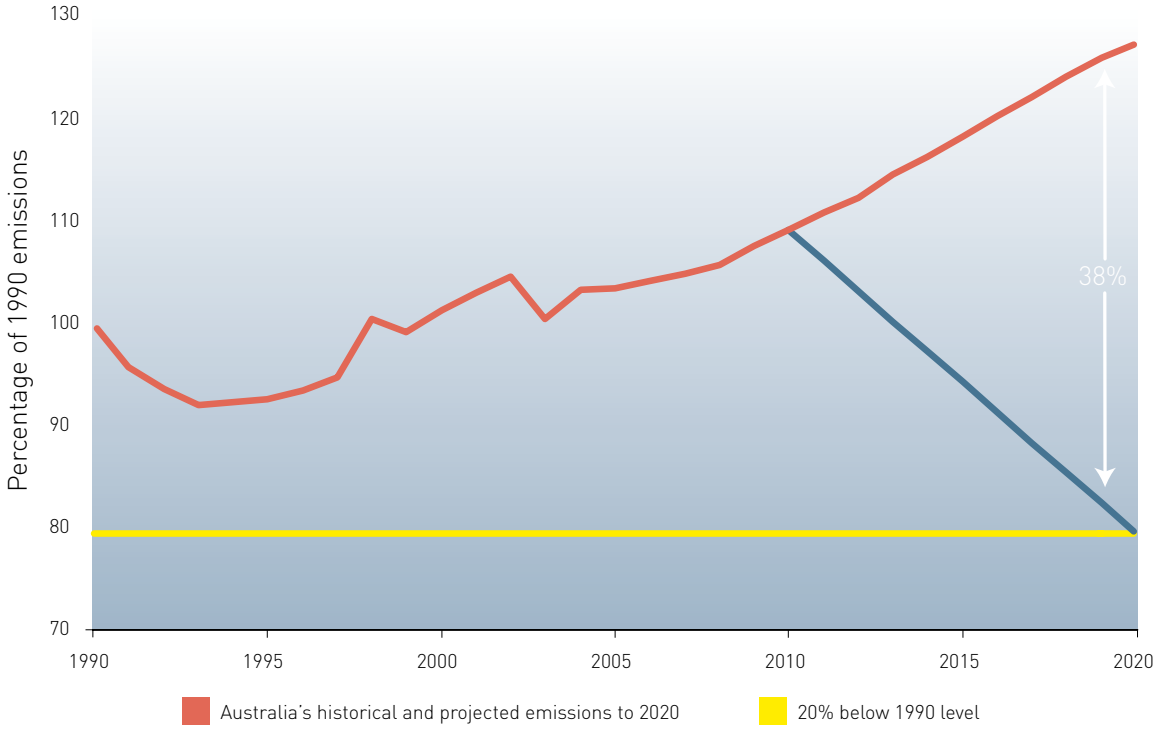
The strong momentum in emissions growth has implications for both the scale and the timing of efforts to stabilise and then reduce emissions.

Reducing emissions over the long term requires a significant 'retooling' of the economy. It requires fundamental changes in consumer and business behaviour. Some reductions in emissions are available at low cost and in the short term, including through households and businesses finding ways to reduce their energy consumption. Large-scale emissions abatement will be dependent on the wider use of existing low-emissions technologies (such as nuclear and wind), the development and diffusion of new and currently immature technologies (such as carbon capture and storage, geothermal and large-scale solar), and widespread take up of energy efficiency and demand reduction opportunities.

Based on recent and likely trends in emissions growth rates, Australia should adopt a cautious approach to the automatic adoption here of targets proposed internationally. The current momentum of emissions growth suggests that absolute reductions from current levels will be very difficult to achieve in the immediate future.

To meet a 20 per cent reduction from 1990 levels by 2020 would require Australia to alter its trajectory from a projected 0.9 per cent per annum increase in the decade 2000 to 2010, to a reduction of 3.2 per cent per year over the period 2010 to 2020. To achieve such a target would require a 38 per cent reduction in emissions (equivalent to 264 million tonnes) from the levels currently projected to prevail in 2020 (see Figure 2.6).

Figure 2.6 Australia's projected emissions relative to 1990 level



Source: Based on data sourced from official Australian Government inventory and projections to 2020 (Australian Greenhouse Office, 2007a; 2006a)

To illustrate the magnitude involved, this is equivalent to, for example, replacing Australia's entire existing fossil fuel–fired electricity generation capacity with electricity from nuclear energy while at the same time removing all existing vehicles from our roads.[5] In the absence of technological breakthroughs, such a reduction would impose a significant cost not only on industry but also on household consumption of energy and transport.

Targets must be realistic. Setting national trajectories will require careful analysis that takes into account potential abatement options, technological pathways, and international developments. As suggested above, any significant reductions in emissions over the longer term would require almost a complete shift of electricity production towards low-emissions generation (see Box 2.3), along with significant changes in emissions from all other major sources. The principles to determine greenhouse gas emissions trajectories over time are discussed in chapters 6 and 7.

Restraining and reducing emissions in Australia is extremely challenging. Yet just as Australia is well endowed with a range of natural resources, we also have a very substantial endowment of the elements expected to be important in a carbon-constrained future.

Australia has substantial low-emissions energy sources, including high reserves of uranium and high-grade renewable energy resources in the form of solar, wind and geothermal. The continent has extensive geological formations that are well suited for sequestering carbon dioxide from fossil fuel emissions, and the large land mass opens up many possibilities for biological sequestration of carbon.

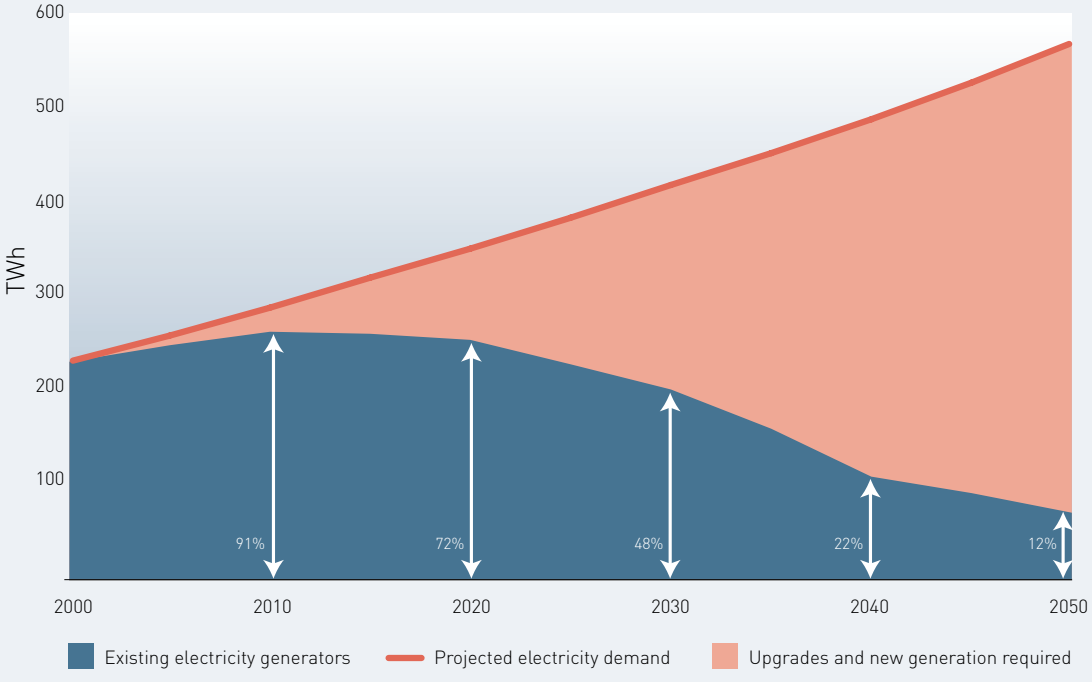
Just as importantly, Australia has a strong research community, particularly in the area of low-emissions technologies, and a good record of adoption of new technologies from outside

Box 2.3 Implications of cuts in electricity sector emissions

The size of potential abatement tasks can be illustrated by considering what is involved in delivering significant emissions reductions in electricity generation, which is responsible for around 35 per cent of total emissions. Demand for electricity is expected to more than double by 2050. Over this period, more than two-thirds of existing electricity generation capacity will need to be substantially upgraded or replaced, and new capacity equivalent to the currently installed capacity will need to be added to meet such a demand outlook (see Figure 2.7).

If emissions from the electricity sector are to be reduced from today's levels, this will require a combination of significant improvements in energy efficiency and conservation and substantial amounts of new generation capacity using low-emissions technology. The Energy Supply Association of Australia has estimated that constraining emissions in this sector at 2000 levels would increase the cost of new investment required by 2030 to $55 billion (from $35 billion if no emissions constraint was imposed). If emissions were constrained at 70 per cent of 2000 levels, the costs would more than double relative to the 'no constraint' scenario (ESAA, 2006).

Figure 2.7 Demand–supply balance for electricity



Source: Uranium Mining, Processing and Nuclear Energy Review, 2006

Australia, opening the prospect for productive increases in effort in this area (see Chapter 8).

2.5 Current policies and measures to reduce greenhouse gases

Constraining emissions will necessarily impose a cost on the economy. However, this cost can be minimised with the right policies. The nature of Australia's emissions challenge suggests two key policy implications for future action:

- attention must be paid to developing and deploying technologies to achieve large emissions reductions in the long term
- ongoing abatement policies need to be broadly based to ensure they are cost effective.

2.5.1 Cost of current abatement policies

Australia's current approach to mitigation encompasses a plethora of policies at the federal and state/territory levels (see Table 2.2). While these policies have helped to ensure that Australia is on track to achieve its Kyoto target, they have varied widely in cost and effectiveness.

> Existing arrangements ... represent a patchwork of highly disparate and fragmented policy measures. These arrangements do not lead to least-cost abatement and this inefficiency is ultimately borne by energy consumers and the community generally.
>
> *Energy Retailers Association of Australia submission to the Task Group*

Some current measures, including land-clearing reforms and voluntary programmes, have provided lower-cost abatement but are unlikely to be available for significant further abatement. Legislation to reduce broadscale land clearing in Queensland and New South Wales will provide emissions reductions in the Kyoto period but cannot be repeated.[6] Similarly, voluntary programmes such as Greenhouse Challenge Plus and Local Greenhouse Action have encouraged businesses and local government to identify and act on low-cost abatement opportunities (see Box 2.4). However, there is a limit on the extent to which voluntary corporate activity can meet a significant proportion of Australia's future abatement challenge.

Grant-based programmes, such as the Greenhouse Gas Abatement Programme, have been reasonably low cost to date, although experience suggests that the cost of abatement is rising over time. The inherent difficulties involved in government assessing whether subsidised action is additional to the effort businesses would have undertaken anyway limit the further expansion of these approaches.

Energy efficiency policies have generally been low cost, in many cases providing net benefits.[7] There is evidence that there remain further low-cost opportunities for improvements to energy efficiency (IEA, 2006c). These are examined in Chapter 8. Nevertheless, given the scale of abatement required, energy efficiency programmes can form only part of the future abatement effort.

Other policies in the current mix impose significant economic costs for relatively modest abatement outcomes. Mandatory targets, such as the Mandatory Renewable Energy Target, are costly because they limit the range of possible abatement activities to more expensive technologies or fuel types. The cost of these policies is hidden in the electricity market, where consumers are forced to cross-subsidise renewable energy generators. As a general rule, it is preferable to make such subsidies transparent by passing them through budget processes at both the federal and state/territory levels.

Table 2.2 Costs of current abatement policies

Programme	Description	Abatement (Mt CO_2-e) in 2010[8]	Cost of abatement (per tonne)[9]
Greenhouse Gas Abatement Programme (GGAP)	Competitive allocation of grants to cost-effective abatement opportunities.	5	Low
Greenhouse Challenge Plus Programme	Voluntary, incentive-based and compulsory partnerships between the Australian Government and industry to abate greenhouse gas emissions (including Greenhouse Friendly and Generator Efficiency Standards).	15	Low
Mandatory Renewable Energy Target (MRET)	Mandatory targets for the uptake of renewable energy.	6.0	High
Energy efficiency standards for residential and commercial buildings	Minimum energy efficiency standards included in the Building Code of Australia.	3.7	Low
National Appliance and Energy Efficiency Programme (NAEEP)	Mandatory comparative energy labelling and minimum energy performance standards (MEPS) for electrical and gas-powered domestic appliances, commercial products and industrial equipment including the recent announcement to phase out inefficient light bulbs.	9.0	Low
Strategic Development of Renewable Energy (outside MRET)	Renewable Energy Commercialisation Programme; Renewable Remote Power Generation Programme.	0.1	High
Ozone-depleting substances and synthetic greenhouse gas replacement from Montreal Protocol industries	Minimise synthetic greenhouse gas emissions, while providing long-term certainty for industry.	4.1	Low
Photovoltaic Rebate Programme (PVRP)	Cash rebates for householders, owners of community-use buildings, display-home builders and housing-estate developers who install grid-connected or stand-alone photovoltaic systems.	Small	High
Renewable Remote Power Generation Programme (RRPGP)	Provides financial support to increase the use of renewable generation technologies in remote parts of Australia that currently rely on fossil fuel for electricity generation.	Small	High
Methane Reduction from Coal Mines	Provides funding for industry action to reduce methane emissions from underground coal mines.	Up to 0.9	Low
Queensland 13% Gas Scheme	Scheme requiring electricity retailers to source 13 per cent of electricity from gas-fired generation.	1.9	High
New South Wales Greenhouse Gas Abatement Scheme (GGAS)	Scheme establishing annual greenhouse gas reduction targets, and then requiring individual electricity retailers to meet mandatory benchmarks based on the size of their share of the electricity market.	5.0	Medium
Victorian Renewable Energy Target Scheme (VRET)	Scheme mandates that Victoria's consumption of electricity generated from renewable sources be increased to 10 per cent by 2016.	1.9 (2020)	High
Queensland and NSW Landclearing Legislation	Reduction of broadscale landclearing.	20.7	Low

The sheer number of abatement programmes across levels of government also imposes compliance costs on industry, with businesses often required to repackage data for several programmes (COAG Greenhouse and Energy Reporting Group, 2006). Regulatory approaches often impose a heavy burden of 'red tape' on industry.

It is unrealistic to expect that the current mix of policies can be scaled up to deliver much larger-scale abatement at a reasonable economic cost. A more sustainable approach to greenhouse gas emissions reductions will be needed in the future, one that minimises government interventions and, in particular, does not attempt to 'pick winners'.

2.5.2 Technology policies

The development and diffusion of low-emissions technologies across all sectors is critical to achieve the large emissions reductions required at the least cost. Governments have a range of measures in place to develop low-emissions technologies, most of which are focused on the electricity sector (see Table 2.3). A number of the measures appear in Table 2.2 and Table 2.3, reflecting their dual roles in achieving abatement and developing technology.

The mandatory target measures are by far the most significant in cost, with the compliance costs of the Mandatory Renewable Energy Target (essentially a cross-subsidy from consumers to renewable generators) estimated to be more than $200 million per year by 2010 (AGO, 2003). The most significant portion of these resources is directed towards relatively mature technologies. Rebate programmes relating to renewable energy, while carrying significant costs, are targeted more tightly on emerging solar and other renewable technologies.

Funding targeted towards the demonstration and deployment end of the innovation cycle is significantly greater than the relatively modest amounts focused on research and development.

Box 2.4 Voluntary action by Australian industry and community

A range of industries and sectors in Australia have already taken voluntary action to reduce greenhous gas emissions. Members of the Greenhouse Challenge Plus Programme are projected to provide a total of 15 million tonnes of abatement in 2010 through improved energy efficiency, energy conservation, use of lower emission energy sources and the purchase of offsets. More than 200 local governments have joined the Cities for Climate Protection™ programme, which provides councils with training and assistance to develop and implement local solutions to reduce greenhouse gas emissions. The following are examples of activity by individual sectors.

- The cement industry joined Greenhouse Challeng Plus in 1997 and has reduced emissions per tonn of product by 21 per cent compared to 1990 levels. The industry achieved these reductions largely through improvements in technology and the use of alternative fuels such as waste tyres, demolition timbers, carbon dust, spent aluminiu pot liners and solvent-based fuels.
- Australian aluminium smelters reduced direct greenhouse gas emissions from 5 tonnes of CO_2-e per tonne of metal produced in 1990 dow to 2.6 tonnes in 2004. Despite strong growth in production, direct gas emissions fell from 6.2 million tonnes of CO_2-e to 4.9 million tonnes over the same period.
- In 2003, the Australian coal industry established COAL21, a partnership of industry, unions, governments and researchers, to identify ways to reduce greenhouse gas emissions from coal-base electricity generation. In March 2006, the industr established a $300 million fund to support the COAL21 programme and increased this to $1 billion in May 2007.

Table 2.3 Costs of technology programmes[10]

Programme	Description	Cost of policy – fiscal or regulatory[11]
Low Emissions Technology Demonstration Fund (LETDF)	This fund supports the commercial demonstration of technologies that have the potential to deliver large-scale greenhouse gas emission reductions in the energy sector and will operate from 2005–06 to 2019–20.	$410 million has been allocated out of the announced $500 million in government funding and these projects will involve total investments worth over $3 billion
Renewable Energy Development Initiative (REDI)	This initiative is a competitive merit-based grants programme supporting renewable energy innovation and commercialisation and it will operate from 2004–05 to 2010–11.	$100 million in government funding to match private sector funding for each project
Solar Cities	This programme is designed to demonstrate how solar power, smart meters, energy efficiency and new approaches to electricity pricing can be combined. The programme will run from 2004–05 to 2012–13.	$75 million; will leverage significant private sector funding
Advanced Electricity Storage Technology	This programme will identify and promote advanced storage technologies in order to increase the ability of renewable energy–based electricity generation to contribute to Australia's electricity supply system.	$20.4 million over five years
Photovoltaic Rebate Programme	This programme provides cash rebates for householders, owners of community-use buildings, display-home builders and housing estate developers who install grid-connected or stand-alone photovoltaic systems.	$201.8 million (including Budget 2007 additional funding). The additional funding will conclude in five years (June 2012)
Renewable Remote Power Generation Programme	This programme provides financial support to increase the use of renewable generation technologies in remote parts of Australia that currently rely on fossil fuel for electricity generation. This is typically a 50 per cent rebate of initial capital costs for eligible projects. Funding will be provided until 2012.	$328.5 million
AGO Strategic Research & Development Investment Plan	This plan aims to facilitate targeted research on greenhouse gas emissions management and climate change responses in the agriculture and land management sectors.	$9.4 million over four years; has leveraged significant private sector funding
Alternative Fuels Conversion Programme (AFCP)	This programme is designed to demonstrate the commercial viability of alternative fuels or hybrid diesel/electric power.	$33.6 million
Mandatory Renewable Energy Target (MRET)	This programme sets mandatory targets for the uptake of renewable energy projects and will operate until 2020.	Cross subsidy costs of $208 million per annum from 2010 (AGO, 2003)
Energy Technology Innovation Strategy (Victorian Government)	This funding aims to assist the commercialisation of coal drying, coal gasification and geological storage (geosequestration) technologies to reduce greenhouse gas emissions from brown coal electricity plants. This funding supports some LETDF projects.	$103.5 million over five years
Victorian Renewable Energy Target Scheme (VRET)	This scheme mandates that Victoria's consumption of electricity generated from renewable sources be increased to 10 per cent by 2016. This scheme will operate until 2030.	Annual or total cost of scheme has not been released by Victorian Government
Queensland Future Growth Fund	This funding supports the deployment of low-emissions coal technologies. This fund will operate separately from the Queensland State Budget.	$300 million

Programme	Description	Cost of policy – fiscal or regulatory[11]
Queensland 13% Gas Scheme	This scheme requires electricity retailers to source 13 per cent of electricity from gas-fired generation. This scheme will operate until 2020.	Cross-subsidy costs of $61–$106 million per annum by 2010 (ERAA, 2005)
Cooperative Research Centre on Greenhouse Gas Technologies (CO2CRC)	This programme is focused on carbon dioxide capture and geosequestration.	$27.9 million in government support over seven years (total funding of $123 million) (DEST, 2006)
Cooperative Research Centre for Coal in Sustainable Development (CCSD)	This programme aims to optimise the contribution of coal to a sustainable future.	$14.5 million in government support over seven years (total funding of $65 million) (DEST, 2006)
CSIRO Energy Transformed Flagship	This research programme is looking at energy technologies that will reduce Australia's greenhouse gas emissions.	$325 million over seven years was allocated by the Australian Government in July 2004 to the six CSIRO Flagships – including the Energy Transformed Flagship (total investment in the six flagships is $1.5 billion) (CSIRO, 2007)
Carbon Neutral Energy Security	The CSIRO Energy Transformed Flagship will be expanded to include research related to coal to liquids, gas to liquids, solar gas to liquids (solar technology to convert natural gas into a high-energy gas for transport fuels, hydrogen and electricity), biofuels and storage of high-density natural gas for transport.	$59.6 million over four years. (CSIRO, 2007)

If reductions in emissions are to be a priority, technology support programmes will need to be focused on areas where government intervention is most warranted, and be well targeted towards Australia's specific technology needs. This issue is discussed further in Chapter 8.

2.5.3 Future policy directions

Given the magnitude of the abatement task facing Australia, it will be critical to rely on broader-based measures that are driven by the market. They should be neutral in terms of technology and fuel. This will allow Australia to achieve abatement at the least cost. There would also be considerable benefit from rationalising the current mix of policies. Well-designed and targeted technology policies, which complement the market signal, will also be necessary to bring on the technologies necessary to make significant reductions in greenhouse gases over the longer term.

Notes

1 Australian economic data used in this chapter has been sourced from the Australian Bureau of Statistics, ‹www.abs.gov.au›.

2 The Australian Coal Association has estimated that the combustion of Australian coal exports would contribute about 1.3 per cent of global emissions. Australian LNG exports would also make a contribution to global emissions, however, if LNG was used to replace coal-based electricity generation then it may result in a net reduction in global emissions. Australia's domestic share is typically estimated to be 1.5 per cent of global emissions. ‹www.australiancoal.com.au/Pubs/ACA_Media_Release_070207.pdf›.

3 Based on the assumption that typical coal generation in China is replaced with combined cycle gas turbine power generation with 50 per cent efficiency. LNG exports in 2010 are projected to be 1049 petajoules (ABARE 2006).

4 Based on the assumption that typical coal generation in China is replaced with typical nuclear power generation running at 90 per cent capacity. Total uranium exports in 2010 are projected to be approximately 10,000 t U_3O_8 (ABARE 2006).

5 In 2005 fossil-fuelled electricity generation was equal to 194 Mt and road transport 71 Mt (AGO, 2007a).

6 However, activities (both domestically and internationally) to avoid deforestation and to promote forest sinks may play a role in future abatement as discussed at Chapter 6.2.2.

7 Net benefits occur where consumers or businesses save money as a result of reduced energy usage which more than offsets any increased costs associated with more energy-efficient appliances and buildings.

8 Abatement figures in this table are presented net of overlaps with other measures.

9 Abatement estimates are sourced from the Australian Greenhouse Office's 2006 Greenhouse Gas Projections. The cost of abatement per tonne is represented by the categories 'low' ($0–10), 'medium' ($10–30) and 'high' ($30+). Estimates of the cost of some of these programmes vary widely – in these cases, the programme is classified according to the lower bound of the estimate. The data used for this analysis has been adapted from COAG, 2002; ERAA, 2005; MMA, 2006a; and Regulatory Impact Statements from the Department of Environment and Water Resources. Given that Greenhouse Challenge Plus is a voluntary programme, it is assumed that the cost of abatement faced by participants is low. The costs of the PVRP and RRPGP are based on internal calculations by the Task Group secretariat.

10 Sourced from Australian Greenhouse Office, ‹www.greenhouse.gov.au›; Victorian Greenhouse Strategy, ‹www.greenhouse.vic.gov.au›; Queensland Government – Department of Mines and Energy, ‹www.energy.qld.gov.au/climate_change.cfm›.

11 Includes government fiscal costs and costs to consumer/private sector where known.

3 Achieving least-cost emissions reductions

3.1 Overview

Achieving significant global and domestic emissions reductions is a major challenge. Properly valuing economic activity (including both production costs and environmental costs) will be critical to addressing this challenge. This chapter considers the variety of ways in which environmental costs can be addressed, including regulatory arrangements, fiscal measures, and market-based policy approaches such as emissions trading and carbon taxes. Key messages are:

- Market-based approaches – where industries choose which abatement opportunities to exploit – are superior in achieving large-scale abatement at least cost to the economy.
- To be fully effective, market-based approaches must be applied comprehensively, which places a premium on wide coverage of industry sectors.
- Promoting comprehensive market-based approaches internationally will help ensure global abatement at least cost.
- Of the market-based instruments, the Task Group considers that emissions trading should be preferred to a carbon tax.
- Emissions trading also provides for linkages to be established with other national schemes, allowing for cross-border trade in permits.
- Complementary policies are still required, such as those directed toward technology development and energy efficiency.
- A desirable model for reducing emissions at least cost incorporates emissions trading with a price cap in the initial phase of a scheme – this combines the best features of a carbon tax with emissions trading.

3.2 Abatement options

3.2.1 Policy choices

Environmental damage from greenhouse gas emissions represents a case of market failure – a negative externality – associated with the production of goods and services. This means that while emissions impose a cost on society through environmental degradation, this cost is not currently reflected in the price of production. Measures are required to ensure business and consumers factor in the impact of environmental damage to their production and consumption decisions.

> Where the use of environmental goods and services is not valued properly, users of the resources have little incentive to recognise the costs of the environmental degradation they impose .... Instead, the focus inappropriately shifts only to the financial growth foregone from addressing [and preventing] the environmental damage.
>
> *Australian Government Intergenerational Report (2007, p. 71)*

There is a range of policy options available to governments to achieve emissions reductions, all of which attempt in some way to make consumers and producers take account of the full cost of their decisions. These include:

- information and education campaigns
- various forms of regulation or standards
- fiscal measures, including grants, subsidies and rebates
- market-based instruments, including carbon taxes and tradable property rights.

In determining the best policy mix for Australia, the overriding objective should be achieving any given level of emissions abatement at least cost.

Information and education campaigns can play an important role in alerting businesses and households to abatement opportunities by providing information that may not otherwise be readily accessible. Such campaigns are typically limited in their scope and impact, but they can play a valuable role in engaging the broader community and help reduce the cost of emissions abatement by changing consumer behaviour. However, to drive large-scale emissions reductions, significant changes in production, consumption and relative prices are needed.

These changes can be achieved by more direct mechanisms – such as prescriptive regulatory approaches and fiscal measures – which can drive larger-scale changes in production and consumption.

Non-market regulatory approaches to abatement generally work by prescribing (that is, requiring) or proscribing (that is, banning) particular technologies or production techniques. Well-conceived environmental regulation can be effective when technologies are relatively standard and their environmental consequences known, as in the implementation of improved fuel standards or the phasing in of new lighting standards. Where technologies and production techniques for achieving environmental outcomes vary widely, however, such regulation will be inefficient in achieving environmental outcomes. It is also likely to impose significant costs on business.

Box 3.1 Example of a 'cap and trade' emissions trading scheme[1]

Two companies, A and B, each emit 100,000 tonnes of CO_2-e each year. The government wants to cut emissions by 5 per cent, and it gives each company an allowance to emit 95,000 tonnes. Each company has the option of either reducing its emissions by 5,000 tonnes or buying up to 5,000 tonnes of allowances from elsewhere. Suppose the market price for the allowances turns out to be $10 per tonne.

Company A can reduce its emissions for half this cost per tonne, so it is reasonable for it to cut its emissions by 10,000 tonnes: if it sells the extra 5,000 tonnes of emissions reductions (for $50,000) it will be able to recover its expenditure.

For company B, making reductions is more expensive, at $15 per tonne. It decides not to reduce its emissions, but instead to buy the 5,000 tonnes of surplus allowances on offer from company A. If company B reduced its own emissions, it would cost $75,000, but if it buys them from company A, the cost is significantly lower, at $50,000.

The end result is that both firms are better off by $25,000 compared to their costs without trading. If they are the only two companies in the country, this means the country's business sector is able to cut emissions by 5 per cent for $50,000 less than if the government forced both companies to reduce their emissions by the same amount. In a scheme with full international linkages, this example could equally apply to trade between companies in different countries.

Regulatory approaches normally require affected parties to achieve specified outcomes irrespective of the individual costs, so there is little incentive to innovate or to do more than is absolutely necessary for compliance. In addition, the price impact of regulation is not immediately transparent to consumers and downstream producers.

An alternative to regulating emissions abatement is subsidising abatement activities from government budgets. For example, government could target specific projects, requiring estimation by government of additional abatement relative to 'business as usual'. However, if not carefully implemented, project-specific approaches can involve high administrative overheads for both government and project proponents.

Financing subsidies and specific project-based interventions also impose costs on society from their use of taxation. If these approaches were to be used extensively to achieve large-scale abatement, the economy would suffer losses in economic and administrative efficiency. In contrast, market-based approaches to emissions abatement involve the explicit pricing of emissions, allowing the market to determine the cheapest source of emissions reduction.

Market-based approaches have the potential to deliver least-cost abatement by providing incentives for firms to reduce emissions where this is cheapest, while allowing the continuation of emissions where they are most costly to reduce. Box 3.1 shows how this works under a 'cap and trade' emissions trading scheme.

> Harness the power of the market – the greatest benefit of emissions trading is the ability of the market to find the lowest cost solution. It follows from this that scheme[s] should have a minimum of rules that limit the type or level of abatement. The underlying principle should be to treat all opportunities equally based on their mitigation impact.
>
> *Australian Plantation Products and Paper*

Market-based approaches also provide a strong ongoing incentive for investment in technology research, development and deployment, and in business efforts to improve energy efficiency.

An emissions price provides incentives for the discovery and deployment of least-cost abatement opportunities. The damage caused by a unit of emissions is the same no matter where it comes from, so a uniform carbon price across the economy can harness abatement opportunities where they are cheapest.

Emissions pricing provides ongoing incentives to all firms and individuals to abate. Market participants have an incentive to abate whenever a unit of abatement is cheaper than the emissions price, which leads to the efficient exploitation of all abatement opportunities.

In contrast, non-price-based policy options (regulations and standards) generally target more obvious sources of abatement and provide minimal incentives to reduce emissions beyond the mandated level. There is, therefore, a risk that the most efficient sources of abatement are not pursued, with the abatement burden spread unevenly across industries and countries (see Box 3.2).

Experience in recent decades across a range of economies and sectors suggests that markets bring dynamic benefits to economic performance. That is, economic outcomes have often exceeded expectations as a result of market-oriented policy changes, as firms have taken up opportunities and incentives to innovate and improve productivity.

The process of 'creative destruction', with opportunities for the emergence of new industries as new technologies and production techniques supplant existing methods, is one of the key ways in which market-based approaches bring broader benefits to society.

Emissions pricing can be a key part of policy responses – domestically and internationally – to the challenge of achieving large-scale

ox 3.2 Modelling regulatory approaches

Australian Bureau of Agricultural and Resource Economics modelling commissioned by the Task Group shows that regulatory approaches can cost the economy substantially more than emissions pricing for the same abatement target (ABARE, 2007).

Application of an arbitrary regulatory approach in Australia – an 11 per cent mandatory renewable target for electricity generation combined with a 27 per cent fuel efficiency improvement in transport by 2030 – resulted in a doubling of the GDP cost in 2030 compared to using a comprehensive emissions trading scheme to achieve the same abatement outcome.

This GDP result is broadly consistent with other research. The Productivity Commission submission to the Task Group noted:

> Australian macroeconomic modelling supports the conclusion that emissions pricing provides lower cost abatement than other measures. Access Economics (2006) and COAG (2002) report results suggesting that replacing some existing measures (such as the MRET scheme, GGAS and Queensland's 13% Gas Scheme) with an economy-wide emissions price signal would reduce costs by 50 to 75 per cent. Evidence from CRA International (2006) modelling supports this level of cost savings from emissions pricing compared with an extended version of the MRET scheme.[2]

emissions abatement. But the lack of a carbon price is not the only market failure in the area of climate change. As a result, emissions pricing alone – whether via emissions trading or carbon taxes – will not constitute a sufficient response to climate change.

The optimal development of new low-emissions technologies requires additional policy interventions. The adoption of energy efficiency measures also warrants policy action beyond getting the right pricing structures in place. These issues are explored in more detail in Chapter 8.

3.2.2 Comprehensive approaches minimise costs

While market-based approaches will, in principle, deliver abatement at least cost, this will only be true in practice when the price mechanism is allowed to operate comprehensively. All countries and sectors need to be engaged in the task of emissions reduction, and all sources of abatement must be pursued, if we are to meet the global climate change challenge. This includes making the full range of offset arrangements available to participants in the market. Carbon sinks and policies to avoid deforestation (including forest stewardship) have a large role to play in this context.

As with a single economy, the use of market-based elements in efforts aimed at global greenhouse gas mitigation will assist in reducing costs. Flexible arrangements will ensure that abatement is focused on least-cost opportunities within and across countries, in a manner that mirrors the outcomes at the domestic level. This will reduce the risk of abatement being loaded onto particular emissions sources, whether within countries or sectors.

It is in Australia's interests to promote a market-based regime at the international level and to try to ensure that any abatement effort is both broadly based and least cost. This allows the price mechanism to operate fully, drawing from both known sources of abatement and new sources yet to be exploited.

In some cases, there may be practical administrative issues which mean that imposing an emissions pricing regime will be too costly. However, even in such cases, techniques for lowering the administrative burden over time may become available. Assistance in building capacity in fundamental market infrastructure

– for example, emissions measurement and techniques in assessing abatement options – can be important building blocks to developing a deeper and more efficient market.

3.3 Comparing market-based approaches

Emissions trading schemes and carbon taxes both impose a price on emissions. Each has its advantages and limitations. A trading scheme sets a price by imposing a quantity constraint on aggregate emissions, while a carbon tax imposes a cost directly on every unit of emissions through the tax system.

Government cannot control both the price and the quantity of emissions reductions at the same time – control over one necessarily affects the other. Therefore, the choice of policy instrument will be guided by the relative importance placed on having greater control over the emissions outcome, or the price (cost) imposed.

3.3.1 Emissions trading schemes

An emissions trading scheme involves the government issuing permits to achieve a measurable emissions reduction task. The number of permits issued (either auctioned or freely allocated) must be less than the amount required under normal 'business as usual' conditions. The scarcity of permits gives them a value.

Firms covered by an emissions trading scheme periodically have to surrender permits to government equal to their emissions. Where firms have different capacities to reduce emissions, they can trade the emissions permits. Firms can improve their capacity to reduce emissions by investing in emissions reduction technologies.

Firms with low-cost emissions reduction options will reduce their emissions until the cost of doing so equals the market price of the permits. Other firms may continue to emit but must buy permits on the market in accordance with their obligations under the scheme, up to the point where the cost of purchasing a permit exceeds the cost of undertaking their own abatement activities.

3.3.2 Carbon taxes

Carbon taxes deliver emissions reductions by setting a price for each unit of emissions, and allowing the quantity of abatement to emerge from the market. This contrasts with an emissions trading scheme, where government sets the emissions reduction task and the market response determines the price of each unit of emissions.

The incentive for firms to abate is similar for a carbon tax and an emissions trading scheme under conditions of certainty. A carbon tax would encourage firms with options for low-cost emissions reduction to reduce their emissions and their tax bill. Remaining firms would continue to emit and pay the tax up to the point where it was no longer profitable to do so.

Where the government has full information, a carbon tax and an emissions trading scheme can deliver similar economic and environmental outcomes (see Appendix D). In practice, however, it is rare that the necessary conditions can be met. The choice of policy instrument therefore depends on an assessment of the relative importance of different considerations, including the value of:

- managing emissions reductions with greater certainty
- managing costs to business consistent with the emissions objective
- providing long-term risk management opportunities to business

- accessing least-cost abatement domestically and internationally
- managing the transition to a carbon-constrained world
- minimising administrative and compliance costs
- modifying or adapting the chosen policy instruments over time.

Appendix D explores the relative advantages of a carbon tax and an emissions trading scheme against these design considerations in some detail.

If the policy objective is to fix the cost of emissions reductions, with less focus on the actual reductions achieved, then a carbon tax can be an effective policy instrument.

It is often argued that this is a desirable outcome from an economic perspective (Weitzman, 1974). That is, efficiency losses to society are minimised when there is greater certainty around the costs of a carbon constraint.

3.4 Preferred approach

The case for using either an emissions trading scheme or a carbon tax in preference to other forms of intervention is very strong. The Task Group is of the view that there are some policy objectives that are best addressed with emissions trading, and therefore considers that this should be the key instrument to deliver emissions reductions over time.

The key benefit of emissions trading is its focus on the ultimate environmental objective – namely, reducing emissions to a point that mitigates the effects of climate change. As such, emissions trading may provide greater long-term policy credibility, as the community can see the direct link between the policy instrument and the desired environmental objective.

An emissions trading scheme also possesses more options to link with global developments in a carbon-constrained environment. It can provide the capacity to access abatement opportunities at least cost internationally. As noted in Chapter 5, the primary policy instrument being used by other countries for carbon pricing is the development of emissions trading schemes. Some countries with carbon levies have moved these into the emissions trading schemes. While a carbon tax can theoretically interact with international emissions trading schemes, it might be more difficult to gain other countries' acceptance of an Australian carbon tax model.

The international landscape is evolving in a way that suggests reductions in global emissions are more likely to develop with linked trading schemes. Against this background, an emissions trading scheme provides the framework that will afford the greatest opportunity for Australian engagement within a global effort.

Emissions trading also provides government with a simple tool to indicate future emissions constraints and thereby provide business with some guidance about expected future carbon prices. Government can issue long-dated permits that businesses can trade directly. Firms can manage their exposure through the purchase of derivative financial products created from these permits.

However, a carbon tax has some clear advantages over an emissions trading scheme, particularly in relation to managing costs to business in the short term. Therefore, a regime that exploits the relative advantages of both an emissions trading scheme and a carbon tax may be potentially superior to a pure emissions trading scheme, particularly in the initial phases of a scheme.

Many policy formulations exist, including the well-known McKibbin–Wilcoxen model (McKibbin & Wilcoxen, 2006), that address the tension between price and quantity control objectives through various 'hybrid' model design features.

These combined form, or 'hybrid', models can provide flexibility to address additional policy objectives, though they necessarily involve trade-offs (for example, cost control is only achieved through reduced certainty about emissions reductions).

In most cases 'hybrid' models incorporate binding short-term price caps. If these arrangements are continually rolled over, they may reduce the capacity of the scheme to secure the full benefits of emissions trading. They may also undermine public confidence in the achievement of the ultimate emissions reduction objective.

Chapters 6 and 7 describe a possible emissions trading scheme for Australia that incorporates elements of a hybrid model in the short term, which maximises the flexibility of the policy framework for government.

The model has characteristics that could be modified in the future, to capture more or less of the key elements of an emissions trading scheme or carbon tax, depending on the way the international community moves over time. These modifications could be calibrated in line with developments in the expected damage associated with climate change, and our understanding of the costs of emissions reductions.

International efforts to build emissions trading are likely to incorporate some features that seek to give greater short-term certainty in terms of price and/or economic cost, at least as a pathway towards controlling quantities of emissions. Some of these ideas are explored in chapters 4 and 5.

Although emissions trading will be the key instrument used to reduce emissions over time, complementary policies will be needed. These policies, including those directed toward the development of new low-emissions technologies and the adoption of energy efficiency measures, are explored further in Chapter 8.

Notes

1 Emissions trading can also take place across borders, subject to certain technical and political conditions. These are outlined in more detail in Chapter 5.

2 Productivity Commission submission to the Task Group, p. 39, citing Access Economics, 2006, *Economic Impacts of a Renewable Energy Target on the Victorian Economy*, Report for the Energy Users Association of Australia and a number of market participants, Melbourne; COAG, 2002; CRA International, 2006, *Analysis of Greenhouse Gas Policies for the Australian Electricity Sector*, Report for the National Generators Forum, Melbourne.

4 The international climate change framework

4.1 Overview

The search for a global solution to ameliorate the impact of climate change has emerged slowly as part of the international agenda over the past 30 years. While there has been some progress, the prospects for the future are clouded. This chapter summarises the current state of play in international climate change negotiations and pinpoints issues that might form part of a future global agreement. Key messages are:

- Future progress in multilateral climate change negotiations will depend on whether it will prove possible to establish an equitable approach to burden-sharing across the international community.
- The fact that developing countries now account for a majority of global emissions, and are the fastest growing component, means that achieving significant reductions in greenhouse gas emissions over the long term will require substantive engagement of both developed and developing countries.
- The absence of a pathway for key developing countries to make commitments is a fundamental shortcoming in the Kyoto Protocol, which undermines its suitability as a model for future cooperation.
- Because of differences over key issues among the key participating countries, it will be difficult to reach consensus on post-Kyoto arrangements in the near term.
- In the short to medium term, progress is more likely to emerge from a 'bottom up' patchwork of actions by individual countries and groups of countries. There is already a wide-ranging agenda. Existing approaches tend to be voluntary in nature, involve developed and developing countries in ways that are shaped by national circumstances, and often focus on practical cooperation in areas such as technology development.
- These approaches are likely to constitute the building blocks of a future global regime as overlapping membership promotes broader agreement on new forms of cooperation.
- This process will take time. In the short term, there will be differences in the nature of commitments made by countries. While some countries will adopt emissions limitation targets, others will prefer non-quantitative approaches.
- In these circumstances, it is a finely balanced judgment as to whether Australia should adopt, in advance of other countries, a domestic emissions constraint for the years beyond the end of the initial Kyoto period in 2012. Adoption of such a target would demonstrate our preparedness to contribute to global efforts, but it would have little impact on total global emissions on its own.
- Australia's focus should continue to be on pursuing an active agenda at the bilateral, regional and plurilateral levels – through arrangements such as the Asia–Pacific Partnership on Clean Development and Climate. Giving particular attention to our region, Australia should seek to promote broad-ranging participation around international efforts that will deliver emissions reductions while maintaining economic growth.

4.2 Multilateral efforts

4.2.1 The United Nations Framework Convention on Climate Change

The first major studies on climate change were undertaken by the United Nations Environment Programme, the World Meteorological Organization and the International Council of Scientific Unions, and were released at the First World Climate Conference in 1979. Established in 1988, the United Nations Intergovernmental Panel on Climate Change is responsible for undertaking scientific and policy assessments of the causes and impacts of climate change.

The conclusion of the United Nations Framework Convention on Climate Change was a defining outcome from the United Nations Conference on Environment and Development (also known as the Earth Summit) held in Rio de Janeiro in 1992. Under the Framework Convention, Australia and 197 other countries agreed to an ultimate objective of stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Some developed countries agreed to voluntary measures to limit their emissions.

The Framework Convention established the architecture and main principles for international cooperation on climate change. In particular, it agreed to a set of 'common but differentiated responsibilities' which established a strict division between the contributions of developed and developing countries. This reflected agreement at that time that developed countries bore responsibility for the largest share both of historical and then current global emissions. The Framework Convention also:

- recognised that the share of global emissions originating in developing countries would grow in the future in line with their social and development needs
- established the principle that developed countries would transfer funding and technology to developing countries for climate-related activities.

The Framework Convention envisioned a series of protocols that would 'operationalise' some of its key features. Not long after the Framework Convention's entry into force in 1994, scientific advances indicated that the impacts of climate change would be longer-lasting and more far-reaching than previously thought. At that stage, a number of scientists and other experts, as well as many governments, began to argue that further, more ambitious action was needed.

A negotiating body, the Conference of the Parties, was established by the Framework Convention to consider the next step in the global effort. The Conference of the Parties proposed the negotiation of a separate treaty with the intention that it would be a more ambitious agreement than the Framework Convention.

4.2.2 The Kyoto Protocol

Successive negotiating rounds resulted in the conclusion of the Kyoto Protocol in December 1997. The Protocol goes beyond the Framework Convention by imposing legally binding targets on the reduction of greenhouse gas emissions.[1]

Like the Framework Convention, most of the provisions of the Protocol apply only to developed countries. The Protocol entered into force on 16 February 2005.[2] At December 2006, it had been ratified by 168 countries and the European Commission.

Australia played a prominent role in negotiations on the Protocol and its implementation, and has worked in concert with a number of countries, most notably the members of the Umbrella Group coalition (see Box 4.1).

The main commitments in the Protocol take the form of individual, legally binding targets that limit greenhouse gas emissions (measured

Box 4.1 Umbrella Group

Australia was instrumental in the formation of the Umbrella Group, an important coalition of non-European Union developed countries that was created following the negotiation of the Kyoto Protocol. The Umbrella Group comprises Australia, New Zealand, Canada, Japan, the United States, Russia, Norway, Iceland, Ukraine and Kazakhstan. As a forum in which members share views and develop common positions on priority issues, the Umbrella Group has been influential in shaping many of the key elements of the Protocol and its implementation. It has played a prominent role in advancing the global debate on many Framework Convention issues.

against 1990 levels). These targets apply both to developed countries and to Russia, Ukraine, and other countries in transition in central and eastern Europe (collectively referred to as the Annex I countries) for the period from 2008 to 2012.[3] Developing countries are not subject to greenhouse gas emissions targets. Annex I country-specific targets (measured in terms of CO_2-e) are as follows:

- -8 per cent: EU15,[4] Bulgaria, Czech Republic, Estonia, Latvia, Liechtenstein, Lithuania, Monaco, Romania, Slovakia, Slovenia and Switzerland[5]
- -7 per cent: United States
- -6 per cent: Canada, Hungary, Japan and Poland
- -5 per cent: Croatia
- 0 per cent: New Zealand, Russia and Ukraine
- +1 per cent: Norway
- +8 per cent: Australia
- +10 per cent: Iceland.

Taken as a whole, the Protocol aims to achieve a total cut in aggregate developed country greenhouse gas emissions of at least 5 per cent from 1990 levels by 2008 to 2012. The Protocol assumes that commitments will be made after 2012, and provides for member countries to begin discussions on future commitments; these commenced in 2005.

The individual targets apply to actual emissions occurring within the national borders of the participating countries. For example, fugitive emissions from coal mined in one country for export would be recorded against that country's target, but emissions resulting from the burning of that exported coal would be recorded in the country of use.

The Protocol specifies that domestic targets should be met primarily through domestic actions, although it is possible for countries to meet their targets by lowering net emissions through the use of carbon sinks in the land use, land-use change and forestry sector. The Protocol applies a strict (and technically complex) set of rules around the eligibility of sinks.

The Protocol also permits developed countries to draw on three 'flexibility mechanisms' to meet their emissions targets: specifically emissions trading, the Clean Development Mechanism and Joint Implementation.

The Protocol established the framework for an international emissions trading scheme and associated measurement, national registry and compliance provisions. The Protocol includes both a 'cap and trade' component, applicable to Annex I countries (Article 17), and the Clean Development Mechanism (Article 12) and Joint Implementation (Article 6), which are offset credit-based systems.

Under the Clean Development Mechanism, projects in developing countries that reduce emissions, and that would not have occurred in its absence (that is, they deliver 'additionality'), are considered an acceptable offset to

emissions that could occur in those developed countries with individual Kyoto targets.

Emissions reductions achieved through projects between Annex I countries are called Joint Implementation. This mechanism was envisaged to encourage projects that would generate emissions reduction credits between developed countries and countries in central and eastern Europe. In practice, however, the rollout of Joint Implementation has been hindered by a lack of clarity regarding its rules and by the accession of most central and eastern European countries to the European Union.

A more detailed description of international carbon trading mechanisms is included in Chapter 5.

4.3 Bilateral, regional and plurilateral initiatives

Since the conclusion of the Kyoto Protocol negotiations, increased activity at the bilateral, regional and plurilateral levels has been a feature of international climate change efforts. These approaches span a wide range of issues and countries. They represent important initiatives from environmental and economic perspectives. They are also potentially significant building blocks for a future global framework.

The wide variation in both content and form of these approaches reflects the diversity of interests and views among countries. Technology development has been a common theme as virtually all countries recognise that technological breakthroughs will be necessary to deliver a long-term solution to climate change. This shared understanding creates a strong incentive for international collaboration on research and development of low-emissions technologies, including through public–private project activity.

The emergence of energy security as a priority global issue has added another dimension to the development of these forms of cooperation. Many countries share the objective of diversifying their supplies of energy to guard against interruptions, and this presents scope for collective action that will also advance climate change objectives. Progress in many of these arrangements has been encouraging to date and has provided a 'push' incentive for the development of new technologies. There is support for the view that a market-based 'pull' mechanism could complement these arrangements and play a role in the future in supporting collaborative action to promote technology development.

The non-binding nature and practical focus of these arrangements are seen by participating countries as important features which should be reflected in a future, more flexible global architecture. Given the difficulties in negotiating and enforcing emissions targets, these arrangements have the potential to enhance significantly national-level efforts and provide a platform for broad-based participation in a global regime that promotes low-emissions technological solutions.

4.3.1 Asia–Pacific Partnership on Clean Development and Climate

The Asia–Pacific Partnership on Clean Development and Climate (AP6) was established by Australia, China, India, Japan, the Republic of Korea and the United States in January 2006. The participating countries account for about half of the world's economic output, energy use and greenhouse gas emissions. AP6 is focused on delivering practical cooperation on technology, emissions management, national pollution reduction and energy security through efforts that also support economic development.

Eight public–private task forces have been established to implement AP6's agenda. These cover the aluminium, building and appliances, cement, cleaner fossil energy, coal mining, power generation and transmission, renewable energy and distributed generation, and steel sectors.

AP6 has already achieved a number of positive outcomes, including:

- assisting in leveraging private sector investment in a major coal mine methane power facility
- providing technical support to China on energy efficiency
- facilitating cooperation on new technologies and processes to reduce emissions in the steel industries in China and India.

The next ministerial-level meeting of the AP6 is expected to be held in 2007 in India.

4.3.2 G8 climate change dialogue

The Group of Eight (G8) launched a 'Dialogue on Climate Change, Clean Energy and Sustainable Development' at its summit in Gleneagles in 2005. In addition to the G8 countries of the United States, the United Kingdom, Japan, Russia, France, Germany, Canada and Italy, the Dialogue involves the five major developing countries of China, India, Brazil, South Africa and Mexico. Other countries with significant energy interests are also involved in the Dialogue, specifically Australia, Indonesia, Iran, Spain, Poland, Nigeria and the Republic of Korea. The European Commission is also represented.

Key areas of focus in the Dialogue so far have been technology development, energy security, energy efficiency, information dissemination and capacity building, particularly on adaptation and climate science. The Plan of Action agreed at Gleneagles included support for a market-based approach to finance the transition to cleaner energy. The International Energy Agency and the World Bank are providing advice on alternative energy scenarios.

The likely outcomes from the Dialogue are not yet clear. While the Dialogue is not part of the Framework Convention negotiations, several participants in the Dialogue envisage that any progress made in this process will ultimately be 'multilateralised' (that is, transferred to the formal multilateral negotiating process under United Nations auspices). The wide diversity of views among participants on key issues has raised doubts about the capacity of the Dialogue process to generate a breakthrough in the near term.

The G8 leaders are scheduled to discuss climate change issues at their annual summit in Heiligendamm, Germany in June 2007, under the economic policy agenda item. A formal progress report on the Dialogue is due at the G8 Summit in 2008, which will be hosted by Japan.

4.3.3 Plurilateral and regional initiatives

A range of plurilateral and regional arrangements, involving clusters of countries with shared interests, have emerged in recent years.[6] Such approaches provide governments with the flexibility to develop policies and measures at the international level that complement and reinforce their national actions, taking into account their environmental, economic and social policy goals. Such arrangements contain a wide range of elements. Some common features are:

- inclusion of voluntary, non-binding measures focused on practical cooperation
- participation from both developed and developing countries
- emphasis on research, technology development and deployment
- promotion of public–private sector linkages and pooling of resources

- incorporation of capacity building and technical assistance.

Appendix E provides a summary of some of these arrangements.

4.3.4 Bilateral initiatives

Similarly, many developed countries have concluded, or are pursuing, bilateral arrangements incorporating climate change and energy-related components. Key features of such arrangements include provisions which are aimed at:

- improving access to finance in the power generation sector
- promoting collaboration on research and development
- tackling deforestation
- promoting policy coherence and the mainstreaming of climate change adaptation and mitigation in developing countries' economic and social programmes.

Australia has concluded a number of wide-ranging bilateral arrangements, known as climate action partnerships, including with the United States, China, Japan, New Zealand, South Africa and the European Union. In broad terms, the aims of these partnerships are to:

- undertake practical actions that achieve or facilitate emissions reductions
- build support for an effective global response to climate change
- improve scientific understanding of climate change
- build capacity to enable implementation of mitigation and adaptation programmes
- facilitate market opportunities for greenhouse technologies, products and expertise from Australia and partner countries
- foster direct involvement by industry, business, scientists and communities in bilateral projects to broaden participation in climate change action.

4.4 Outlook for international cooperation post-2012

In November 2005, as provided for under Article 3.9 of the Kyoto Protocol, the signatories to the Protocol agreed to begin formal discussions regarding a possible second set of commitments in the period beyond 2012. The members of the Framework Convention are also involved in a separate two-year process, known as the 'Dialogue on long-term cooperative action to address climate change by enhancing implementation of the Convention.' This Dialogue is an exchange of views on the international climate policy structure for the post-2012 period. It is not aimed at opening negotiations on new commitments.

4.4.1 Trends in global emissions

A key theme in discussions on post-2012 arrangements will be how to determine the scale of contributions from individual countries to the total global effort. Data on current and projected global emissions define the dimensions of this task. Of particular note are the high rates of emissions growth among developing countries, where collectively CO_2 emissions increased by 47 per cent over the 1990–2002 period. Among the major developing countries, growth during this period was fastest in Indonesia (97 per cent), the Republic of Korea (97 per cent), Iran (93 per cent) and Saudi Arabia (91 per cent). In contrast, aggregate CO_2 emissions in developed countries were unchanged, although there were significant national variations (World Resources Institute, 2005).

This trend of rising emissions in developing countries will continue. The World Resources Institute (2005) has estimated that China's

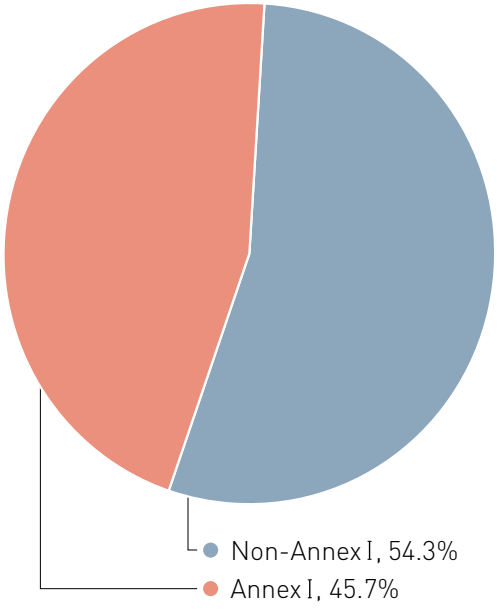
2003 and 2004, accounting for more than half of the worldwide CO_2 increase during that period. The International Energy Agency (2006d) has forecast that China will overtake the United States as the world's largest emitter in terms of energy-related greenhouse gases in the period 2007 to 2009. While China has disputed the claim, the International Energy Agency (2006d) has also forecast that by 2030 China's emissions will be growing twice as quickly as those of all OECD nations combined. Similarly, emissions in Brazil and India in the electricity, industrial, transportation, and household and commercial sectors are projected to more than double from 2000 levels by 2020 (Center for Clean Air Policy, 2006). Per capita emissions in developing countries remain below those of OECD countries, but they are rising rapidly in line with strong energy demand in those countries.

Even if all developed countries were to meet their commitments under the Protocol, this would still represent only very limited progress toward effective global action. Assuming Kyoto commitments are met, it is estimated that global emissions will be approximately 41 per cent higher in 2010 than in 1990; without the Protocol, global emissions are projected to have increased by 42 per cent over the same time frame (Ford et al, 2006). Moreover, developing countries are expected to account for more than three-quarters of the projected increase in global emissions to 2030 (IEA, 2006d). Figure 4.1 shows the share of emissions sourced from Annex I and non-Annex I countries in 2004.

Figure 4.2 highlights the scale of the global challenge in limiting growth in emissions. It shows that achieving progress towards the stabilisation of global emissions over the period 2001 to 2050 will require a major worldwide effort. In a scenario in which developed countries implement a 50 per cent reduction in their total emissions, it will still not be possible to 'flatten' the global emissions curve unless developing countries agree to a substantial reduction in the growth rate of their emissions from 2.3 per cent 'business as usual' to around 1 per cent or less.

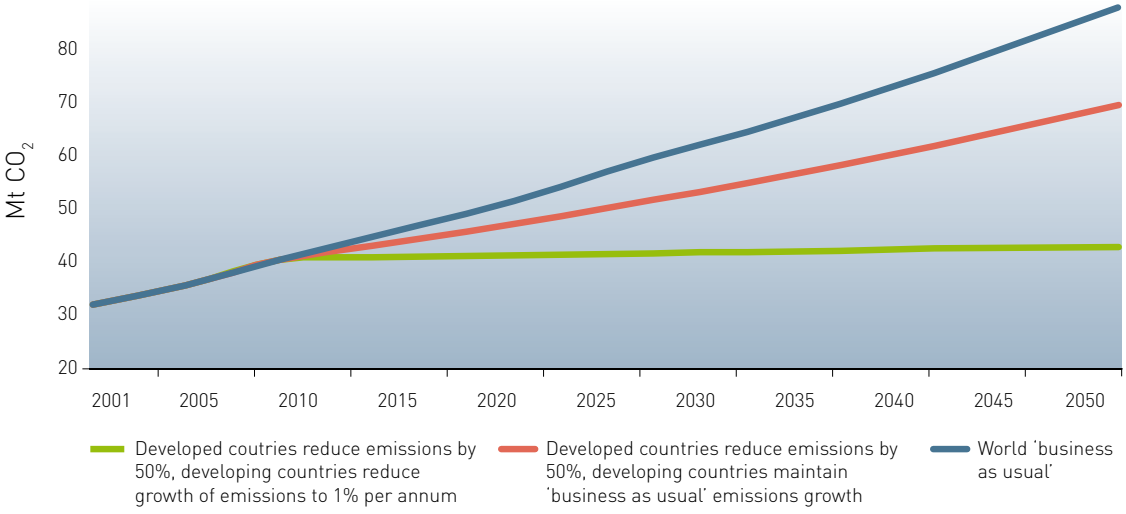
Achieving further reductions in emissions of this magnitude needs to be seen in the context of the significant difficulties facing many governments in Annex I countries in meeting their Kyoto commitments. Table 4.1 shows that Australia is broadly on track to meet its national target as a result of domestic action. With some exceptions, the overall picture on the performance of Annex I countries is that most are tracking well above their targets and face the prospect of purchasing a significant volume of credits from foreign sources in order to comply with their obligations under the Protocol.[7]

Figure 4.1 World emissions, 2004



Source: Intergovernmental Panel on Climate Change, 2007c

Figure 4.2 World greenhouse gas emissions scenarios, 2001 to 2050



Source: Department of Industry, Tourism and Resources; developed from ABARE data

Table 4.1 Change in greenhouse gas emissions, 1990–2004

Country	Per cent change	Kyoto obligation (per cent)
Germany	-17.5 (-21 target in EU)	-8
Spain	+47.9 (+15 target in EU)	-8
United Kingdom	-14.1 (-12.5 target in EU)	-8
Ireland	+22.7 (+13 target in EU)	-8
EU15	-0.9	-8
Canada	+62.2	-6
United States	+21.1	N/A[8]
Japan	+5.2	-6
Australia	+5.2	+8[9]

Source: United Nations Framework Convention on Climate Change, 2006

This data demonstrates that it is simply not possible to achieve the significant reductions in greenhouse gas emissions that are necessary to address climate change over the long term without engaging both developed and developing countries. As time passes, the contributions of developing countries to the global effort will become more important. However, to achieve this degree of participation will require incentives and obligations that will differ according to national circumstances. The Kyoto Protocol's in-built distinction between developed and developing countries, and its focus on individual emissions targets as the form of country-specific commitments, make it ill-equipped as a model to deliver the global effort that is required. There seems little doubt that changes will be necessary in the structure of the current multilateral arrangements to engage the major emitters as a group.

4.4.2 Positions of major participants

United States

The United States has rejected the Kyoto Protocol on the grounds that it would harm its economy and that it does not contain commitments from developing countries. In 1997 the United States Senate voted 95–0 against the Kyoto Protocol or any other international treaty that did not include commitments by all the major emitting countries. The Kyoto Protocol has not been submitted to the United States Congress and, while there are a number of legislative proposals on climate change currently under consideration by the United States Congress, none of them propose the ratification of the Protocol.

A key element of the United States' position has been to emphasise the need for international climate actions to accommodate diverse national circumstances and approaches. It has also underlined the importance of climate actions being considered in tandem with economic as well as sustainable development goals. In 2002 the United States set a goal of reducing the greenhouse gas intensity of the US economy by 18 per cent by 2012.

European Union

The European Union has committed to meeting its Kyoto reduction target and has introduced a domestic emissions trading scheme to that end. In March 2007, the European Union adopted a package of new climate change and energy security measures. The package aims to boost renewables production, support carbon capture and storage projects, cut energy consumption and reform the energy sector. The package includes an undertaking to reduce the EU's greenhouse gas emissions by 20 per cent of 1990 levels by 2020, with the prospect of an increase to 30 per cent if other countries take comparable action as part of a global climate change framework. The package also calls for developing countries to take on emissions commitments by 2020 to 2025. Renewable energy is to have a 20 per cent share of energy supply in the EU by 2020 and biofuels are to make up 10 per cent of EU petrol and diesel consumption for transport by 2020.

The United Kingdom is legislating for a 60 per cent reduction in emissions from 1990 levels by 2050, with reductions in emissions of between 26 and 32 per cent from 1990 levels to be made by 2020.

Germany has set a policy target of a 40 per cent reduction in emissions from 1990 levels by 2020.

Other OECD countries

Other industrialised countries have signalled – with varying degrees of reluctance – their willingness to accept a rollover of the Kyoto model of developed country–specific commitments without substantive changes. Many, if not most, of these countries are currently tracking well above their Kyoto targets. They are concerned about the impacts on the competitiveness of their economies of taking action that is not matched by their major trade and investment partners and competitor nations. There is strong support within this group of countries for a future international climate change framework to deliver emissions reductions by all major emitting countries.

Developing countries

There are differing perspectives among developing countries on many climate issues. As a group, however, developing countries are opposed to taking on legally binding emissions reduction commitments as part of a post-2012 international framework. Reference is made to the principle of 'common but differentiated responsibilities' – embedded in both the Framework Convention and the Protocol – in support of their stance. A recurring theme in statements by many developing country governments is that developed countries should first deliver on their Kyoto commitments and that future emissions targets for those countries should be even more stringent. Not surprisingly, developing countries take the view that economic development and poverty eradication are their key policy priorities and that any action on climate change must not compromise objectives in these areas. The most vulnerable developing countries stress the direct threat of climate change to their future viability. An important focus of developing countries in the climate change debate is on securing the transfer of technology and resources. To

that end, many support the continuation of the Clean Development Mechanism as a vehicle for generating productive inwards investment.

While most developing countries have categorically rejected legally binding emissions limitation targets, there is a growing recognition of the need to ensure that future economic growth is sustainable and not affected by environmental problems, including climate change. A number of major developing countries have taken domestic action, over and above Clean Development Mechanism projects, that have the potential to slow the growth of their emissions. Climate change is not necessarily the driving force. Most of these actions have been taken to increase energy self-sufficiency, improve the reliability of power supplies, enhance economic productivity and international competitiveness, and improve air and water quality.

China introduced a wide range of laws and regulations in 2005 and 2006, including a renewable energy law and a medium- and long-term energy conservation plan. The Chinese Government has conceded that China failed to achieve its energy efficiency and pollution targets in 2006. China's Eleventh Five-Year Plan, released in 2007, has a number of measures to address energy efficiency and environmental issues, including targets of a 4 per cent reduction in energy consumption per unit of GDP per year; a 20 per cent energy efficiency target for energy-intensive enterprises; an increase in vehicle excise duties targeted at large engine sizes; and new goals to reduce the energy intensity of the cement industry.

Recently, Brazil introduced two programmes that are expected to lower its emissions: its Programme for Incentive for Alternative Electric Energy Sources, targeted at reducing electricity sector emissions by 14 per cent below 'business as usual' by 2020; and its ethanol programme, which is projected to reduce transport emissions by 18 per cent by 2020.[10] India's transportation policies are projected to reduce emissions in that sector by up to 15 per cent below 'business as usual' in 2020.

Australia

Given the shortcomings of the Kyoto Protocol, it is more productive for Australia to focus on developing an alternative model for global cooperation beyond 2012 that will deliver genuine and lasting global abatement. Australia's interests will be maximised through an approach that promotes broad-ranging global participation. A post-2012 global regime needs to provide for the recognition of a diverse range of actions by countries over the long term. A multifaceted and flexible policy agenda – which reflects the interconnections between climate change and other economic and social policy objectives – is essential to accommodate the wide range of views and capabilities in the international community.

Considering Australia's future approach to multilateral negotiations, the Task Group favours a continuation of our existing activist agenda. It considers that Australia should continue to seek a global framework that is equitable and effective. The following key elements are critical to that objective:

- engaging the top emitters
- providing flexibility to reflect different national circumstances
- addressing competitiveness issues
- coupling near-term action with a long-term focus
- integrating climate change, energy security and sustainable development policies
- addressing the need for adaptation to the impact of climate change
- delivering a politically acceptable equity formula.

Appendix F includes more information on climate change policies implemented by a number of the major emitting countries.

4.5 Scenarios

A wide range of ideas and proposals have been identified by some governments and non-governmental organisations for a future global climate change regime. Many of these ideas are still under discussion. Nevertheless, the formal government-level negotiating process has not yet reached the point of agreeing that a new framework should be devised. These proposals can be bracketed into two broad categories:

- top–down, multilateral (quantitative)
- bottom–up, pledge and review (non-quantitative).

A number of the individual proposals contain multiple elements and incorporate characteristics of both the top-down and bottom-up models.

4.5.1 Top-down, multilateral approach

The top-down, multilateral scenario implies the need for an approach that quantifies an emissions outcome. Targets adopted under this model can take a number of forms: fixed and binding, indexed, non-binding or sector-specific. The Clean Development Mechanism would be continued, possibly in an enhanced form. Emissions trading and incentive and flexibility mechanisms could be included.

The precise nature of the burden-sharing formula in such a model holds the key to its prospects of success. A simple extension of the existing Kyoto model would be supported by developing countries, but it would likely be firmly opposed by a number of developed countries if it failed to include a realistic pathway for measurable developing country contributions.

To the extent that this model includes modifications to improve its effectiveness and foster global participation – for example, by providing for a more flexible, long-term target; incorporating a broader menu of actions; and recognising particular national circumstances and the capacity to contribute – it could attract support from some, if not most, developed countries. However, developing countries would be likely to oppose firmly any move that would lead to them taking on emissions reduction commitments in the future.

4.5.2 Bottom-up, pledge and review approach

The alternative model – bottom–up, pledge and review – allows countries considerable flexibility to frame objectives and actions in a wide range of different forms. Some of these measures could be semi-quantitative, such as emissions trading or carbon taxes. Others could be performance-based, for example, by linking the take-up of specific technology to a given date or to energy efficiency, research and development, and adaptation objectives.

The objective underpinning the bottom–up, pledge and review approach is to engage climate change actions by a wide range of governments and private sector participants across the broadest possible agenda of actions affecting the level of greenhouse gas emissions. Pledges made by participants would typically be reviewed after a period of time, possibly through a negotiation process, with a view to promoting additional action. This would have parallels to international trade negotiations in which agreements are negotiated through bilateral and plurilateral negotiations and subsequently incorporated in a comprehensive outcome.

This survey of possible post-2012 approaches is drawn from a range of sources, notably the Pew Center for Global Climate Change (Bodansky et al., 2004). Appendix G provides additional details.

4.6 Future action

It is more probable in the near to medium term that a global climate change response will emerge through a series of national approaches. Because these are likely to be characterised by a broad agenda and flexible arrangements, they may offer a practical and effective avenue for promoting wide participation at the global level. Over time, the inclusiveness of these arrangements is likely to promote linkages and connections through overlapping membership. This will have the effect of promoting harmonisation and convergence between approaches. While it is difficult to predict the speed of this 'patchwork' process, it will have a major impact on the design of the next plank in the global climate change architecture.

An active Australian programme of cooperation with our major trade and investment partners and key competitors would maximise the prospects of shaping this global framework in ways that support Australia's economic and environmental objectives. Giving particular attention to the Asia–Pacific region, our engagement could contribute positively to advancing the goal of a comprehensive global effort.

The Task Group believes that, in circumstances where the global effort to address climate change is fragmented and there is no single template for national action, the question of whether Australia should adopt now an emissions constraint for the period beyond 2012 is a finely balanced economic judgment. Such action would demonstrate our preparedness to contribute to global efforts. Adoption of a post-2012 target – together with other policies such as emissions trading to promote flexibility and cost effectiveness – would provide an additional platform for Australia to pursue cooperation at the bilateral and regional levels. It would have a limited impact on total world emissions, however, unless it helped in mobilising an international consensus around a global solution.

Australia has already made a major contribution to the emerging 'bottom–up' agenda and the Task Group believes we should build on, and extend, our existing efforts, including our technology initiatives and bilateral climate action partnerships. An immediate aim should be to identify new opportunities to work with countries that are critically important to the global climate change effort, and to pursue approaches which reflect shared interests in climate change, energy security and sustainable development.

Notes

1 The greenhouse gases covered in the Kyoto Protocol are: carbon dioxide (CO_2); nitrous oxide (N_2O); methane (CH_4); halocarbons (CFCs and HCFCs); perfluorocarbons (PFCs); and sulphur hexafluoride (SF_6).

2 Article 25 of the Protocol states that it shall enter into force 'on the ninetieth day after the date on which not less than 55 Parties to the Convention, incorporating Parties included in Annex I which accounted for at least 55 per cent of the total carbon dioxide emissions for 1990 of the Parties included in Annex I, have deposited their instruments of ratification, acceptance, approval or accession'. The 55-parties clause was reached on 23 May 2002 when Ireland ratified. The ratification by Russia on 18 November 2004 satisfied the 55-per cent clause and brought the Protocol into force.

3 The commitments of Annex I countries are included in Annex B of the Kyoto Protocol.

4 EU15 refers to the number of Member States in the European Union prior to the accession of ten new members on 1 May 2004. The EU15 membership is: France, Germany, the Netherlands, Belgium, Denmark, Italy, the United Kingdom, Ireland, Spain, Portugal, Sweden,

5 The EU15 have redistributed their targets among themselves, taking advantage of a burden-sharing provision for regional entities under the Protocol.

6 Plurilateral agreements in this context are those involving groups of two or more signatories or participants in the Framework Convention or Kyoto Protocol.

7 The joint Russian and Ukrainian surplus has been estimated at 3.7 billion tons of CO_2-e for the 2008 to 2012 Kyoto commitment period. The way in which these credits (sometimes referred to as 'hot air') are deployed is likely to have a major impact on the cost of compliance for developed country Kyoto parties, a number of which will need to rely on these credits to meet their first commitment period undertakings, notwithstanding that the use of these surplus units does not help deliver global abatement.

8 The United States has not ratified the Kyoto Protocol.

9 While Australia has not ratified the Kyoto Protocol, the Government's policy objective has been to achieve greenhouse gas reductions by 2008–12 in line with its 108 per cent Kyoto target.

10 Conclusion 15 of the Report of the Biofuels Taskforce to the Prime Minister (2005) noted that the extent to which use of ethanol represents a low-emissions fuel depends on a number of factors, including the feedstock used and the source of energy used in its production. In some developing countries policies to increase ethanol use may add to pressures to clear land, increasing emissions from deforestation.

The nature of a workable global emissions trading system

5.1 Overview

As the world considers the shape of a post-2012 climate change framework, many governments and members of the private sector are increasingly looking to carbon markets as a way to find cost-effective abatement options and to mobilise investment in low-emissions technologies.

International carbon markets are evolving rapidly but are still immature and fragmented. The market is currently dominated by transactions under the European Union Emissions Trading Scheme, but volumes are growing strongly and that trend is forecast to continue. A number of countries have recently signalled their intention to introduce emissions trading and to explore links with other like-minded countries.

This chapter identifies the key criteria for evaluating a workable global emissions trading system and examines possible pathways to such a system. Key messages are:

- The road to a global emissions trading regime that is environmentally effective, economically efficient and equitable – with full participation of the major emitting countries – will be lengthy, and progress will be patchy.
- The most likely scenario is a 'bottom up' process in which links between national emissions trading schemes are gradually expanded, together with the development of other trading relationships.
- Countries that have adopted emissions trading schemes will have increasing opportunity to establish unilateral and bilateral links to enable the trading of permits and offsets across borders. Such links will require political-level agreement on key objectives.
- As most developing countries, on current policy settings, are unlikely to adopt comparable emissions limitation targets in the near term, their engagement in emissions trading will be limited to being a source of credits for the emissions trading schemes of other countries.
- Over time as countries take on more substantive domestic action to reduce emissions, a wider range of countries will become more involved in the global carbon market and more will move in the direction of adopting emissions trading schemes.
- Promoting more comprehensive participation in emissions trading requires countries to adopt domestic policies to maximise links and promote policy harmonisation at the international level. The key elements for success include: a long-term aspirational emissions reduction target; flexibility in the nature and form of emissions limitation targets; competitiveness mechanisms; and approaches to offsets.
- A decision by Australia to introduce a domestic emissions trading scheme with design features to facilitate links would position us to help shape the emerging international architecture.
- There would be value in Australia working to explore links with other emerging national schemes in parallel with the design phase of any future Australian trading scheme.

5.2 Current carbon market situation

The global carbon market is often taken to refer to the market created under the emissions trading and other flexibility mechanisms in the Kyoto Protocol. In fact, there are a number of carbon markets or programmes emerging at the international level.

While the global market in carbon is relatively fragmented, it is growing. In 2006, the market increased in value to an estimated US$30 billion, three times greater than the previous year. The market was dominated by the sale and resale of European Union Allowances at a value of nearly US$25 billion. Project-based activities through the Clean Development Mechanism and Joint Implementation increased to a value of US$5 billion in 2006. There was also an increase in the voluntary market for reductions by corporations and individuals (World Bank, 2007).

5.2.1 Kyoto Protocol

As noted earlier, the Kyoto Protocol includes both a 'cap and trade' component, which is limited to Annex I countries, and two offset credit-based systems, the Clean Development Mechanism and Joint Implementation.

Under the 'cap and trade' rules in the Protocol, each Annex I country is given an allocation of CO_2-e emissions equal to its national target. These are known as Assigned Amount Units, and are the currency in which government-to-government trading takes place. As the international registry and associated rules for Protocol-based emissions trading have been put in place only relatively recently, no trading has occurred in Assigned Amount Units.

Clean Development Mechanism projects are assessed and credited with 'Certified Emissions Reductions', which can be used by developed country governments to meet their Kyoto targets (to a limit of 5 per cent across 2008–12). Governments that have ratified the Protocol can also allow private companies to use Certified Emissions Reductions to help acquit emissions in their own national emissions trading schemes.[1]

As of 2 May 2007, 176 Clean Development Mechanism projects had been undertaken, providing 45 million tonnes of CO_2-e reductions (Point Carbon, 2007b). A majority of total project activity has been in the renewables and energy efficiency areas. But the 'take off' of the Clean Development Mechanism has not met the expectations of many. Some of the areas of concern are:

- the Clean Development Mechanism's rigorous project assessment and approval regime has generated high transaction costs. While the approvals procedures were introduced to guard against projects without a genuine emissions reduction impact, some criticisms have highlighted the administrative complexity of the process
- the exclusion of some activities from eligibility, notably nuclear energy and carbon capture and storage projects
- the high proportion (58 per cent) of Certified Emissions Reductions concentrated in HFC-23[2] destruction projects in China. While this outcome reflected the relative costs of projects, there have been some criticisms that funding has been diverted from long-term project activity in energy efficiency and renewable energy generation.

5.2.2 European Union

The first phase of the EU Emissions Trading Scheme, which operates between 2005 and 2007, covers around 40–45 per cent of total European Union CO_2 emissions. Under the scheme, EU member state governments prepare National Allocation Plans, which outline how much CO_2 relevant industries are likely to emit as a

basis for requesting permits. The Plans are reviewed by the European Commission – the EU's executive body – which has the authority to determine permit allocation. Key features of the first phase of the EU scheme are as follows:

- **permits** were mainly allocated freely to entities, with 5 per cent auctioning allowed during 2005–07
- **coverage** includes CO_2 from large combustion installations (>20 MWh rated input) from all sectors, plus emissions from oil refineries, coke ovens, and the iron and steel, cement, lime, glass, ceramics and pulp and paper sectors (coverage of these sectors is subject to certain size criteria)
- **banking** from the first to the second trading period is allowed only if it does not lead to an allocation beyond the total approved by the European Commission for the second phase (in practice, banking between the first and second phases will be effectively ruled out)
- **member states** have the flexibility to determine how to provide access to allowances for new entrants.

The second phase of the EU scheme will operate from 2008 to 2012, to coincide with the Kyoto Protocol's first commitment period.

The 60 per cent fall in carbon prices that took place in May 2006 highlighted several problems in the first phase of the EU scheme. In particular, the over-allocation of free allowances to installations generated windfall profits for many, with little corresponding impact on emissions. The European Commission has indicated that it is determined to address these issues in the second phase of the scheme.

The sectoral coverage and scope of the scheme will be widened in the second phase. In particular, EU member state governments will have scope to include other greenhouse gases in addition to CO_2. It has also been proposed that aviation emissions be covered in the second phase. Up to 10 per cent of permits will be auctioned in the second phase.

5.2.3 Norway

Norway was one of the first countries to implement a carbon tax system. It introduced its own domestic emissions trading system for an initial period from 2005 to 2007, covering about 10–15 per cent of its total greenhouse gas emissions. Over the three-year period of the scheme, it is expected to lead to a reduction of emissions by about one million tonnes. Installations already covered by carbon taxes, notably offshore oil and gas, are excluded from the scheme. Norway is scheduled to link its domestic system to the EU Emissions Trading Scheme from 1 January 2008. At that time it proposes to make a range of changes to its system to bring it into line with the EU scheme, including doubling the number of installations and volume of emissions covered.

5.2.4 Japan, Canada and New Zealand

The potential role of emissions trading in Japan's Kyoto compliance policies has been under discussion for some time. The Japanese Government launched a voluntary emissions trading scheme in May 2005 as a small pilot scheme. Sectoral participation in the scheme has been limited, and it is not yet clear whether trading will continue after the pilot scheme period. Japan has already been involved in the global carbon market, mostly through Clean Development Mechanism projects. This involvement is expected to continue given the expectation that Japan will need to purchase a significant volume of international units to meet its Kyoto target.

In May 2007, the Japanese Prime Minister launched a 'Cool Earth 50' proposal, which is aimed at building agreement on a post-2012 international climate change framework. Emissions trading is one of the issues being considered under the proposal.

In April 2007, the Canadian Government announced a major programme of climate change measures. The government's intention is to achieve a 20 per cent reduction in greenhouse gas emissions from current levels by 2020. Under the plan, emitting companies will have access to a range of mechanisms to achieve cost-effective abatement, including an emissions trading scheme with provision for domestic offsets. The Canadian Government has also indicated its intention to explore the scope for future links with emissions trading systems in the United States and possibly Mexico.

The New Zealand Government, which has signalled its commitment to meeting its Kyoto target, has been assessing the feasibility of an economy-wide domestic emissions trading scheme. Recent statements by the New Zealand Government suggest that it is aiming to commence a domestic trading scheme in 2008.

5.2.5 Carbon funds

An increasingly prominent part of the international carbon market has been the growth in carbon funds. These are financial entities which purchase credits, mainly from the Clean Development Mechanism, but also from Joint Implementation projects. The World Bank has been particularly active. It has a number of funds with major investments by public and private bodies, including the European Investment Bank, and is also involved in separate partnership funds with several European governments. Recent analysis indicates that carbon funds are aiming for a total capitalisation of €3.7 billion, of which €3.1 billion has already been committed by fund investors (Point Carbon, 2006).

5.2.6 Non-Kyoto markets

A number of carbon markets in place – or in prospect – are expected to fall outside the Kyoto Protocol framework. Several initiatives have been taken in the United States at the sub-federal level:

- Under the Northeast Regional Greenhouse Gas Initiative, ten north-east states have agreed to introduce a mandatory 'cap and trade' programme focused on the electricity sector by January 2009.[3] The objective of this scheme is to cap emissions at approximately current levels (2007) between 2009 and 2015, and then reduce this level by 10 per cent by 2019.
- In September 2006, California (which, on its own, ranks among the ten largest economies in the world) became the first state of the United States to introduce a state-wide regime to limit greenhouse gas emissions. The state plans to introduce a 'cap and trade' system for the period 2012–20. California has established legally binding targets to reduce emissions by 80 per cent from 1990 levels by 2050, and to have emissions at 2000 levels by 2010 and at 1990 levels by 2020.
- California also reached agreement in February 2007 with four other western states (Washington, Arizona, Oregon and New Mexico) on a Western Regional Climate Action Initiative which commits them to determine a collective emissions cap by August 2007 and to design a regional 'cap and trade' system by mid-2008.
- In May 2007, over 30 states of the United States, accountting for more than 70 per cent of the country's population, announced that they had established a unified greenhouse gas tracking and reporting protocol, a building block for a possible future emissions trading scheme.

Emissions trading has also attracted growing attention at the federal level in the United States. Box 5.1 includes a summary of several proposals for 'cap and trade' schemes that are before the United States Senate or are expected to be introduced in the future.

Box 5.1 Current legislative proposals in the United States Senate on climate change

Several bills have been introduced in the United States Senate proposing the adoption of a domestic emissions trading system in the United States. The proposed schemes have differences in a number of important areas, notably:

- the nature of the long-term target and emissions trajectory
- sectoral coverage
- the inclusion of a safety valve cap on permit prices
- the inclusion of measures to preserve the competitiveness of energy-intensive industries.

The Congressional debate on these proposals is at a relatively early stage. It remains to be seen if and when these, and any future proposals, might be taken forward. Several prominent members of Congress, including Senator Bingaman (D-NM, chair of the Senate Energy and Natural Resources Committee) and Senator McCain (R-AZ), have indicated their support for the United States to adopt an emissions target and to introduce emissions trading.

A feature of the debate on climate change in the United States in recent times has been the intervention of a number of prominent corporations. This includes the United States Climate Action Partnership, a group of business and environmental organisations that supports stronger government action to limit greenhouse gas emissions.[4] The members of the partnership have made statements in support of the introduction of a 'cap and trade' scheme in the United States.

The Australian states and territories have announced their intention to introduce an emissions trading system in 2010 that would cover major power generation sources. The New South Wales Government already has a carbon trading market of sorts under its Greenhouse Gas Abatement Scheme (GGAS). Established in 2003, GGAS is a 'baseline and credit' scheme built around tradable certificates, each representing a notional volume of CO_2-e avoided emissions. After the EU Emissions Trading Scheme, GGAS is the second largest emissions trading system in operation at present.

5.2.7 Voluntary markets

There are also a number of voluntary systems in place. The Chicago Climate Exchange, for example, is a self-regulatory greenhouse gas emissions reduction and trading programme for emission sources in North America and offsets from Brazil. The members of the exchange committed to reduce their emissions by 1 per cent per year over the period 2003–06 relative to a 1998–2001 average. Those members that reduce their emissions below the required level can sell surplus emission allowances on the exchange or bank them. Members unable to meet their targets internally can purchase allowances through the exchange's trading platform or purchase project-based offsets.

In addition, to cater to the interest in offsets from a growing number of government and corporate buyers, several international organisations now offer carbon offsets from project-based forestry and energy initiatives. Examples include Forests Forever, Future Forests and the Emissions-Biodiversity Exchange. In addition, the World Bank's BioCarbon Fund supports projects that do not qualify to generate Kyoto compliance units under the Clean Development Mechanism.[5]

5.2.8 Prospects for the carbon market

The future development of the global carbon market depends on a range of factors. Projections by the International Energy Agency of future energy demand suggest that there could be significant demand for offsets in the future. It is also likely that a number of countries that face significant challenges in meeting their Kyoto targets from domestic measures will need to purchase credits from other countries. As a consequence, there would seem to be good prospects for ongoing market growth. On the other hand, there are a range issues which might affect progress:

- Despite the planned changes in the second phase, the EU Emissions Trading Scheme is still relatively limited in terms of its coverage – less than 50 per cent of total emissions – and its low number of direct links to other trading schemes.
- There are doubts about the capacity of the Clean Development Mechanism, in its current form, to influence a significant proportion of the capital investment in major energy infrastructure that will be required by developing countries in the future.
- There is a lack of clarity over how the proposed emissions trading schemes in the United States and elsewhere might be linked with the international carbon market beyond simply creating additional demand for Clean Development Mechanism–style credits.
- The ongoing uncertainty about the post-2012 international climate change framework has had a dampening effect on market activity.

5.3 Defining a workable global emissions trading system

From Australia's perspective, a workable global emissions trading system needs to be robust in terms of its environmental effectiveness and economic efficiency, and credible from the standpoint of equity and distributional considerations. These criteria are described in Box 5.2.

Participation is a critical issue. The level of international engagement determines environmental effectiveness and has a major impact on economic efficiency. It also goes to the issue of ensuring a fair approach to global burden-sharing. The broader and deeper the level of participation – in terms of the number of countries involved and their share of global emissions – the greater the prospects a regime will meet the test of political feasibility.

But broad participation does not imply a 'one-size-fits-all' approach to contributions. A workable global system would recognise that different countries have different capacities for action, different opportunities for abatement and different vulnerabilities to competitiveness impacts.

> Stability, balanced with ongoing flexibility and a clear long-term direction, will be a key requirement of any international scheme.
>
> *Minerals Council of Australia submission to the Task Group*

5.3.1 A comprehensive, unitary 'ideal'

In theory, the most effective and least-cost outcome at the global level that would meet these criteria would be a unitary global emissions trading system with comprehensive membership by all member governments of the United Nations. Such a system would involve a single 'regulator' that might apply differentiated

Box 5.2 Criteria for evaluating a workable global emissions trading system

Environmental effectiveness – the capacity to deliver long-term reductions in greenhouse gas emissions. Relevant factors would include coverage of gases, sources of emissions (industries and sectors) and removals (using 'sinks', that is carbon-absorbing facilities, such as forests). Environmental integrity would also be affected by the potential for 'carbon leakage', where emissions savings made in one jurisdiction are redistributed globally without any reduction in total global emissions.

Economic efficiency – the capability to achieve emissions reductions in a cost-effective manner, so that the total costs of meeting an emissions target are minimised by using the least-cost means possible, no matter which greenhouse gas is reduced, in which country or sector, or at which point in time. Economic efficiency also requires recognition of the need to minimise distortionary impacts that could limit cross-border trading or bring about changes in competitiveness.

Equity and distributional balance – the recognition of diverse national efforts across different jurisdictions and sectors as comparable in terms of the overall global effort.

national emissions targets, but with identical rules and regulations as to industry coverage, permit issuance and other features across countries. All firms in the same industry would be treated identically regardless of their location. Cross-border trading in permits would also be allowed.

While this model would deliver global reductions in greenhouse gas emissions in a cost-effective manner, it could have drawbacks for individual countries. It might be expected to lead to a realignment of competitiveness based on emissions intensity, although such impacts could be offset to a large degree over the medium to longer term by movements in real exchange rates among the countries in the trading system.

This vision of a unitary system is unlikely to be realised in the near to medium term, however, not least because of the major loss of sovereignty by national governments that is implied in such an approach.

5.3.2 Decentralised, linked arrangements

A more realistic possibility might be the emergence of a global scheme through a system of linked national emissions trading schemes. Under this scenario, countries and/or regions would develop their own emissions trading schemes and other types of carbon pricing arrangements. Over time, links might be developed between individual schemes, and design features might be progressively harmonised, thereby providing the building blocks for a global regime.

Such a model would give countries considerable flexibility to design their own domestic trading systems to accommodate their national policy priorities. It would also allow them to calibrate their approaches to their differing capital investment cycles, the extent of market penetration of energy efficiency technologies, natural resource endowments and emissions profiles.

> Linked national emissions trading systems are more likely than a single global system.
>
> *BHP Billiton submission to the Task Group*

There could also be drawbacks in this approach. Because the treatment of individual industries within each trading scheme would be likely to differ across countries, a linked approach introduces the potential for changes in competitiveness among countries within the system. These changes may be more visible and,

ox 5.3 Linking emissions trading systems

n general, links between emissions trading systems are subject to basic technical requirements such as the compatibility of tradable units and the adequacy of systems for tracking permit trading and acquittal.

Unilateral links occur when permits from trading system A are recognised in system B. The advantage of such an approach is that it increases access to least-cost greenhouse gas reduction opportunities and could help to promote the process of knitting together diverse national-level systems and approaches.

Bilateral links occur when permits from both trading systems are fully usable for compliance in the other country's system. This approach would also deliver lower compliance costs, but it could impact on some sectors depending on the nature of price changes as a result of linking.

therefore, more difficult to address with linked schemes. In circumstances where participation is not universal (that is, if some countries have limited engagement in emissions trading), this could also have a major impact on industry-level competitiveness vis-à-vis direct competitors located in countries outside the trading scheme. A question hangs over the sustainability and longevity of such arrangements given that the long-term wealth transfers implicit in this approach will raise issues of political acceptability unless there is a move toward countries adopting comparable commitments.

5.4 Pathways to a workable global regime

Whether a global emissions trading regime will develop along these lines will depend on the extent to which individual countries see benefit in engaging with the international carbon market. Fundamentally, an effective and workable market will need market demand or 'buyers'. This implies quantitative emissions limitations being accepted by some countries.

5.4.1 Linking emissions trading systems

Links between emissions trading systems could be established unilaterally, or through a process of bilateral mutual recognition. Box 5.3 provides a brief description of the process of linking.

The extent to which links are established between trading schemes will depend on a range of factors, particularly the extent of the differences in the features of the systems. Generally, a high level of compatibility between the design features will enhance the prospects of fully fledged links being established, which would enable trading of emission permits across borders.

Significant diversity in key design features is likely to complicate the task of linking. There are several key design issues where differences could give rise to problems, including:

- **price caps** – a cap in one trading scheme would become the effective cap under both schemes because companies operating in the uncapped scheme would have an incentive to buy permits from the capped scheme. This would compromise the environmental integrity of the uncapped scheme
- **permit allocation** – different methods of allocation between schemes could create differences in the cost burden on

industries, which could increase pressure for harmonisation of approaches or compensatory assistance

- **scope** – differences in sectoral coverage could lead to distortions in investment flows between the two systems, although there is also a risk of such distortions without linking
- **offsets** – different approaches to the acceptability of offsets, such as forestry or nuclear power, could make linking more complex.

Although current experience with direct links between emissions trading systems has been limited, overall the prospects for both formal and informal links between different 'cap and trade' systems appear promising. While there are technical challenges, provided there is sufficiently strong policy common ground on the environmental and economic objectives, it appears feasible to establish workable links between a wide range of different schemes.

5.4.2 Links involving policies and measures-based approaches

Given the status of negotiations on a post-2012 international framework, many countries – and particularly developing nations – are likely to seek to limit their contributions to non-quantitative policies and measures-based approaches. The issue is whether non-quantitative policies could provide a basis for links to be established to national emissions trading systems. If so, it would provide a further element in the 'patchwork' of arrangements described earlier.

A first step would be to design national emissions trading schemes so as to provide explicit recognition of a range of offsets in developing countries. These could, for example, build on the approach of the Clean Development Mechanism, but extend it to include credits for other activities. There are a number of possible options, including, for example:

- sector-specific arrangements with a 'baseline and credit' approach
- technology-based programmes, for example focused on capital development
- voluntary programmes focused on best practice targets at the industry or sectoral level.

Indirect links are already evident in the EU Emissions Trading Scheme, which allows member state governments and firms to meet a proportion of emissions reduction commitments through Clean Development Mechanism projects.

The challenge is to ensure that, in the absence of a quantifiable target, the policies and measures are verifiable and drive emissions reduction that meets the additionality test (reduction that would not have occurred in the absence of the intervention).

Links between non-quantitative policies and measures-based approaches would also be facilitated if such approaches incorporated mechanisms that engage the private sector in the carbon market, directly and indirectly. These connections could emerge through the involvement of governments in cooperative arrangements, as well as through the participation of private sector entities in different systems.

Figure 5.1 depicts the possible steps in the evolution of a global trading system.

5.5 Principles of a workable global system

The creation of a wide range of links between different emissions trading systems and carbon pricing arrangements will be a first step to a more comprehensive global system. As

countries adopt progressively more far-reaching undertakings in concert with others, this is likely to pave the way for the introduction of carbon pricing and emissions trading in a wide range of economies. This process will take some time and, for a possibly lengthy transitional period, involve differences in the nature of the relative contributions made by countries to the overall global effort.

Encouraging wide-ranging global participation in this process will require countries to frame their domestic policies in ways that promote the progressive harmonisation of approaches and maximise the scope for links. Political-level agreement on key principles and objectives will be needed to underpin the process. Otherwise, national-level schemes and approaches will emerge with highly divergent features. This will make linking more difficult and in turn frustrate the objective of a workable comprehensive global emissions trading system.

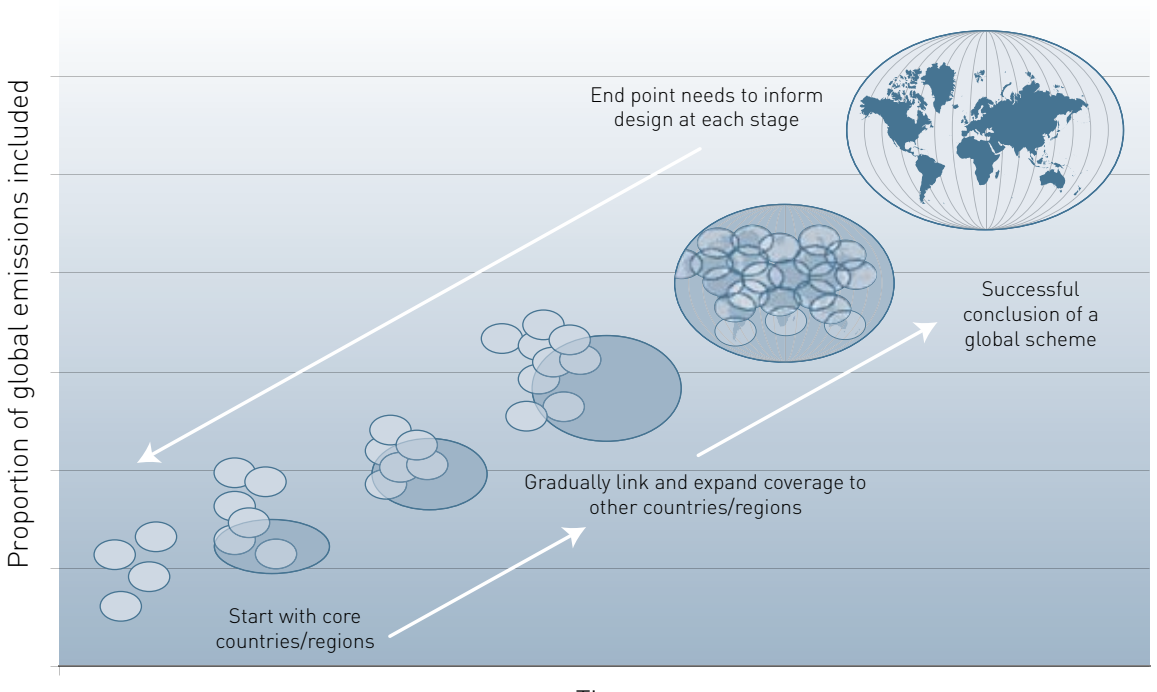
It is possible to identify several issues that, if reflected in national-level schemes and climate change policies and programmes, will facilitate progressively deeper engagement by countries in emissions trading.

5.5.1 Long-term aspirational objective

A global emissions trading system needs to allow countries to frame their mitigation and abatement activities over a longer time frame than the five years adopted in the first commitment period of the Kyoto Protocol. This reflects the reality that governments want to maintain sovereignty in determining their climate change policies, in particular the means and time frame for action. Short-term commitment periods present particular difficulties for economies characterised by high levels of exposure to international markets, high levels of carbon intensity, high economic and population growth, or limited economic or institutional capacity.

A long-term aspirational target at the global level would allow countries to better calibrate

Figure 5.1 Expanding global coverage of emissions trading



their policy response and manage the associated adjustments according to their national circumstances. It would provide an overarching, long-term focus for interaction between countries, both developed and developing, on specific activities to limit emissions.

Given the likely difficulties inherent in reaching agreement multilaterally, a more practicable approach would involve countries working to build consensus on an aspirational target through bilateral, regional and plurilateral interaction.

5.5.2 Flexible targets/caps

Given the likelihood that a global trading system will evolve unevenly, flexibility will be a key issue for countries considering the adoption of national emissions caps or targets as a forerunner to the introduction of emissions trading. Flexibility could take a range of forms.

One issue concerns the way the emissions target is expressed. Indexed targets – for example, those tied to GDP growth – are an example of targets that would allow greater sensitivity to the economic costs of action. Other potential options are for targets to be expressed as a quantity of emissions reductions (either as a percentage of actual emissions at some base period or in tonnes of CO_2-e) or a voluntary 'no penalty' baseline and credit scheme where countries adopt agreed national or sectoral emissions baselines. If they secure sufficient reductions to take their total emissions below the baseline, countries could earn tradable credits.

Sectoral approaches could also offer flexibility, as could voluntary and/or industry-based schemes. By generating deviations from a baseline, these arrangements could balance sector-specific circumstances with the introduction of carbon pricing to promote abatement. Box 5.4 describes some possible approaches to sector-specific models.

Box 5.4 Sectoral approaches

Sector-specific models are envisaged as a 'bottom up' method for encouraging sector-wide actions with reference to what is technologically feasible and economically cost-effective in each sector. An example of such an approach would involve developing countries pledging to achieve a carbon intensity level for a given sector. If they exceeded the target, they would be rewarded by being able to generate credits that could be sold, but they would not face any penalty for falling short.

Various incentive packages could be constructed to accompany such an approach, for example on technology. The actions undertaken by developing countries might link sectoral benchmarks to the target-setting process on the basis of a more level playing field in those sectors. The most likely sectors are those whose competitiveness is vulnerable to emissions penalties such as electricity, iron and steel, chemicals and petrochemicals, motor vehicles, aluminium, cement, and pulp and paper. Firms within these sectors, and in different countries, often use different technologies or are dependent on totally different inputs, notably in respect of energy supplies. The prospect for workable sectoral approaches, with industry agreement, is accordingly limited, and will probably involve agreements or benchmarks matching like with like.

Another approach would be to allow countries the scope to calibrate their targets in certain circumstances without penalty, for example, in response to changes in scientific knowledge or major or unforeseen economic problems.

5.5.3 Competitiveness issues

The capacity to preserve competitiveness is critically important in circumstances where global emissions trading is emerging from a decentralised system of linked national arrangements. The challenge in such circumstances is to promote harmonisation of approaches over time so that they deliver environmental outcomes while reducing competitiveness impacts. The process of harmonisation is likely to take some time.

In the transitional period, there are a range of ways in which countries may seek to address competitiveness concerns, including a price cap – a 'safety valve' – aimed at ensuring the continuity of investment against the risk of fluctuations and unpredictable movements in the permit price. Other options for dealing with competitiveness include exemption of sensitive industries from a trading system.

Moving beyond the initial transitional phase, these mechanisms are likely to generate complexity in developing links. Accordingly, a more viable basis for a globally harmonised approach could focus on transitional free allocation of permits. This would appear to be a more workable option that would simultaneously deal with competitiveness issues, provide no barrier to linking with other national schemes, and be readily calibrated to take account of international developments – for example, as participation in emissions trading expands to key trade and investment partners and competitor countries.

5.5.4 Offsets and credits

While the Clean Development Mechanism is the established mechanism at the multilateral level, there is no reason why it should be the exclusive vehicle for offsets trading. Any interested country has the capacity to work with others to incorporate offsets elements in their domestic emissions trading systems in ways aimed at driving wider country participation in emissions trading.

Assuming sound management and implementation, offsets systems could generate significant demand for credits and provide a framework for the recognition of such measures as undertakings by developing countries. To the extent that this approach would introduce broader-based incentives into developing country economies, or in selected sectors such as forestry, it might lead to their accepting 'baseline and credit' and other more stringent undertakings.

Some countries have suggested the need for reform of the Clean Development Mechanism to give it a more 'programmatic' approach and move away from the project-by-project focus. A redefinition along these lines would potentially allow credits to be generated from a broader range of activities in a larger number of countries. Areas such as energy efficiency and agriculture/land use would appear to be a logical focus for attention in this respect.

5.6 Supplementary efforts to promote engagement

The inclusion of the features outlined above would promote the involvement of all major emitting countries in trading at the global level. It is unlikely, however, to be sufficient in isolation to ensure widespread participation. A range of complementary parallel policies and approaches will be needed. Several categories can be identified.

5.6.1 Capacity building

The effective integration of climate-related technology into the national economic growth strategies of key developing countries is an

important factor in their engagement in global efforts to address climate change. It requires a substantial commitment by developed countries in the form of capacity building, technical assistance and the transfer of technology and know-how.

The fundamental aim is to promote policy settings in developing countries that are capable of bringing about a convergence of sustainable development, energy security and climate change goals. Such settings would ensure that domestic measures are mutually reinforcing and take into account the longer-term global objective of addressing climate change.

This approach seeks to tackle the emissions reduction challenge at its source, specifically by influencing the energy-generation and industrial energy-use choices being made by rapidly growing developing countries. A high priority should be given to targeting clean energy options through assistance to establish governance and policy frameworks that will favour such options in the future. There is a wide range of possible activities that could be identified for direct assistance.

Technology development

The Task Group believes that there is considerable scope for enhanced cooperation with regional developing countries on technology development, building on the AP6 model. Such approaches would have the potential to span the related issues of climate change, energy security and sustainable development. They also provide a basis for identifying projects and activities that could generate credits in emissions trading schemes.

There is also scope to develop enhanced cooperation and dialogue in our region in the areas of energy efficiency and conservation, including developing new, greenhouse-friendly standards. Work in these areas is already embedded in many technology arrangements, including AP6. There is also an opportunity for Australia to explore action in our region, including through the Asia–Pacific Economic Cooperation forum. There may also be scope for supplementary bilateral efforts to explore sector-specific energy efficiency initiatives.

Technical assistance

Many developed countries, including Australia, have programmes for delivering capacity-building and technical assistance aimed at promoting satisfactory legal, regulatory and institutional arrangements in developing countries. These programmes range from ensuring that basic greenhouse gas accounting measures are put in place and operating effectively, to addressing issues of policy development and implementation.

There is potential for the continuation and reinforcement of such actions. The involvement of international institutions such as the World Bank and the United Nations Environment Programme provides avenues for maximising the impact of individual country contributions. Australia is well positioned to use its bilateral channels of assistance to continue to support capacity-building and related activities aimed at preparing countries for engagement in carbon trading activities.

5.6.2 More flexible multilateral and bilateral agreements

A more flexible and multifaceted approach to the entire international climate change agenda is necessary to achieve broader participation, particularly from key developing countries. There is a range of possibilities.

Bilateral, sectoral and regional arrangements – 'bottom up' arrangements – provide participating countries with the flexibility to frame the agenda and the nature of their involvement in line with

their interests and areas of sensitivity. Such an approach has the potential to act as a stepping-stone to broader engagement because it yields fewer competitive concerns than an economy-wide target approach. It enables developing countries to combine greenhouse-friendly measures and their sustainable development policy goals.

Another possibility could be to devise new approaches, applicable only to developing countries, which would enable them to receive credits for actions funded by multilateral agencies, and for such credits to be 'counted' as contributing all or part of their involvement in a multilateral regime during a set transition period. This would help developing countries engage substantively in multilateral efforts without a negative impact on their pursuit of economic prosperity.

5.6.3 Policy integration and adaptation

A successful regime of global actions would involve strengthening the links between mitigation efforts and the achievement of related goals including adaptation, poverty alleviation, energy security and maintaining biodiversity. The effective treatment of these links is important because it reflects the wide-ranging economic and political implications of climate change policies for all countries.

At the political level, these issues are central to creating the right conditions for deeper developing country engagement in emissions reduction. But there are difficulties in addressing some of these issues in a coherent way, particularly in measuring progress and in drawing concrete links with abatement activities.

To maximise international ownership by developing countries, a future global strategy needs to integrate climate change policy into the overall development policy agenda of individual countries. The aim of such efforts is to establish enduring policy frameworks that will favour clean energy options and energy efficiency initiatives for both development and energy security reasons.

While the focus of this report is on abatement, many developing countries, particularly those in the least developed category – a number of which are in our region – are the most vulnerable to the impacts of climate change and face the most significant challenges in mobilising the resources necessary to implement adaptation measures. Such measures cover a potentially wide range of activities, such as waste disposal, and water and coastal management strategies. There is scope for adaptation activities to be accorded a higher priority in the climate-related activities of developed countries' development assistance programs and in multilateral funding mechanisms.

5.7 A way forward

Given the unlikely prospects of a comprehensive unitary emissions trading system emerging from international negotiations, the Task Group believes the most likely scenario in the near to medium term is for a decentralised set of arrangements involving carbon trading. The building blocks of such an approach could involve:

- some countries introducing domestic trading systems based on the 'cap and trade' model
- other countries introducing a range of policies and measures with elements of a 'baseline and credit' approach or other mechanisms that would engage their private sectors in the global carbon market
- links between different trading systems, and between participants in different systems and approaches, through various formal and informal mechanisms, gradually introducing carbon pricing to a range of markets.

The process of knitting together these disparate national-level systems and arrangements is likely to be uneven and constrained by various political and socio-economic factors. A key issue will be the extent to which individual countries implement domestic policies that promote links and interconnections.

The Task Group believes that a decision by Australia to introduce a domestic emissions trading scheme would help to shape a future global system.

In considering links between a possible future Australian domestic emissions trading system, and systems and approaches by other countries, the Task Group considers that Australia's future approach should focus on potential candidates that share our political-level objectives in relation to climate change and that have broadly similar policies in the following areas:

- aspirational long-term emissions target
- flexibility in relation to target-setting
- recognition of offsets
- transitional competitiveness-related mechanisms.

As the process of engaging developing countries in emissions trading will take time, a range of supplementary policies will be necessary to build systems and structures that will prepare them for global emissions trading – specifically capacity building, more flexible international agreements and policy integration.

Notes

1 Certified Emissions Reductions can only be assigned to countries and entities that have ratified the Kyoto Protocol. They can be exchanged at the private level between non-parties, but these would not be registered under the Protocol.

2 HFC-23 is a greenhouse gas generated as a by-product in the production of a refrigerant, HCFC-22.

3 US states participating in the initiative are Connecticut, Delaware, Maine, New Hampshire, New Jersey, New York, Vermont, Rhode Island, Massachusetts and Maryland.

4 Details on membership and objectives of the United States Climate Action Partnership are available at ‹www.us-cap.org›.

5 They fall outside the 'only Afforestation and Reforestation' rules in the Protocol.

6 Positioning Australia in a carbon-constrained world

6.1 Overview

This chapter begins by exploring actions that could be part of Australia's response to the climate change policy challenge, regardless of whether a domestic emissions trading scheme is implemented.

There are two distinct policy questions in deciding whether to go beyond these actions:

1. whether to announce a cap on post-2012 domestic emissions ahead of a more comprehensive post-Kyoto global agreement; and if so
2. whether to implement a domestic emissions trading scheme in order to achieve that cap.

The Task Group has no doubt that emissions trading is to be preferred as an approach to deliver least-cost abatement. The questions before us are why adopt a cap, and why move to implement emissions trading now? Key messages are:

- Australia should take immediate steps to strengthen monitoring and reporting of emissions nationally, take action to preserve and develop forest sinks, and invest in low-emissions technology and energy efficiency.
- Australia should announce a domestic emissions constraint for the period beyond 2012 as soon as possible and move at once, but with care, to introduce an emissions trading scheme. Effort should be carefully calibrated in light of detailed analysis of economic costs and developments internationally.
- Taking action would improve business investment certainty, increase Australia's influence on emerging international approaches to climate change, and strengthen incentives to develop low-emissions technologies.
- Improved understanding of the costs of emissions trajectories will be important in the development of specific short-term emissions constraints and a long-term aspirational goal – hence further development of economic modelling capability is a high priority.
- Trade-exposed, emissions-intensive industries should be included in any emissions trading scheme, with features to ensure that a good balance is struck between achieving low-cost abatement and not prejudicing their competitiveness.
- The scheme will need to build over time towards the higher carbon prices that are necessary to achieve significant long-term abatement and hence provide maximum incentive for the development of low-emissions technology.

6.2 Preparing for global emissions trading

There are a number of initiatives Australia should adopt irrespective of the view on an emissions trading scheme in the near term. These measures would make a valuable contribution to positioning the Australian economy for eventual participation in any future

global emissions trading scheme. Some of these measures would help establish the necessary infrastructure for future emissions trading while others would complement any eventual emissions trading scheme by helping deliver future abatement opportunities.

Such measures include:

- strengthening our capability to measure Australia's emissions
- action to preserve and develop forest sinks
- improving energy efficiency
- strengthening prospects for the breakthrough technological changes that are needed to allow deep emissions reductions over the long term
- informing the public on how to reduce energy consumption and take up low-emissions technology.

6.2.1 Strengthening emissions measurement

A comprehensive system of emissions measurement, reporting and verification is essential for the credibility of efforts to constrain emissions.

Australia is well placed in this area, being widely recognised internationally for its strong knowledge base in national emissions measurement and the high quality of its emissions inventory, including in the area of measuring emissions from land clearing and other land-use change. Many Australian companies have measured their own emissions for several years – indeed, under the Australian Government's Greenhouse Challenge Plus Programme, firms responsible for 50 per cent of total national emissions report their own emissions. However, there is a plethora of mandatory and voluntary programmes across jurisdictions that require companies to measure and report emissions and energy use. This leads to increased reporting costs for business and may impair the overall reliability of the data.

Extending data collection to cover more sectors and installations on a standardised basis would assist continuing efforts to improve the quality and reliability of historical and projected data on emissions and energy. High-quality data is essential, both to inform the development of good policy and to assist business in evidence-based decision making.

The regular reporting and verification of high-quality, standardised data on emissions is critical for the operation of emissions trading markets. Indeed, any system of permit trading will fail unless a transparent and reliable reporting and verification framework is in place.

Mandatory reporting for large entities will be necessary to ensure good data coverage while minimising any increased regulatory and 'red tape' burden, and to improve measurement and verification standards across firms to the levels required to support both policy development and emissions trading (see Box 6.1).

Any mandatory emissions and energy reporting system should be purpose-built to support the potential needs of an Australian emissions

Box 6.1 COAG agreements on energy and greenhouse gas reporting

On 14 July 2006, the Council of Australian Governments (COAG) agreed that a single system for reporting on energy and greenhouse gas emissions is the preferable course of action, and agreed to develop a proposal for a streamlined reporting system.

On 13 April 2007, COAG further agreed to establish a single, mandatory national greenhouse gas emissions and energy reporting system, with the detailed design to be settled after the completion of this report.

trading scheme. The reporting system should be developed and implemented by the Australian Government to ensure maximum alignment with the design needs of a single national emissions trading scheme. It should also provide a single streamlined national reporting point for emissions and energy data for all programmes across jurisdictions. Agreement by all levels of government on the benefits of a single Australian Government-run scheme is critical to reduce the regulatory costs on business.

6.2.2 Avoiding deforestation and promoting forest sinks

Emissions abatement can occur either by direct action to reduce the amount of greenhouse gases being released into the atmosphere (reducing gross emissions), or by actions to remove greenhouse gases from the atmosphere using carbon sinks (reducing net emissions).

Forests figure prominently on both sides of the challenge of reducing carbon in the atmosphere. Deforestation is one of the major contributors to global greenhouse gas emissions. Reductions in land clearing are, therefore, an important priority. The establishment of new forests has the potential to significantly reduce the quantities of carbon in the atmosphere and is a way of engaging the agricultural sector.

Avoiding deforestation, creating new carbon sink forests, and implementing more effective land management practices, have particular value in that forests not only contribute to reducing emissions but also have the potential to contribute to more sustainable natural resource management, including salinity management. There needs to be a long-term commitment to such approaches – it generally takes considerable time to deliver maximum carbon abatement and other environmental benefits.

The Task Group believes that undertaking low-cost measures to reduce deforestation and promote carbon sinks, both within Australia and internationally, should be an immediate priority. Early development of carbon sink forests would also provide a means to assist firms to build familiarity with offset credit mechanisms and assist in achieving least-cost abatement if emissions trading is introduced.

6.2.3 Investing in technology and energy efficiency

Measures to boost the development and demonstration of low-emissions technologies and improve energy efficiency have formed the cornerstones of the Australian Government's climate change response in recent years. These efforts will continue to be relevant in the period ahead, and would also complement any eventual emissions trading scheme.

In the case of low-emissions technologies, the Energy White Paper (Australian Government, 2004) emphasised that new technologies had the potential to reduce the cost of adopting carbon constraints if an effective global response to climate change were to emerge. This has led to a range of programmes to develop and demonstrate breakthrough technologies in Australia and internationally, under which funds have been committed to a number of major projects.

Improved energy efficiency in many cases provides a 'double dividend', in terms of net economic benefits and lower emissions, which should be pursued regardless of progress in developing a global emissions trading scheme. In addition to the introduction of cost-effective measures to enhance take-up of beneficial energy-efficient activities, there is an important role for government in providing information on private opportunities to secure both environmental and economic benefits.

Continued efforts to promote low-emissions technologies and energy efficiency will be

required whatever decisions are made about adopting emissions trading, though the form of this support might change over time with the introduction of an emissions trading scheme in this country (see Chapter 8).

6.3 Should Australia implement emissions trading domestically?

This report has already highlighted the fact that it will take time for a global framework on tackling climate change to emerge. Realistically, the prospects are poor in the near term. To reiterate, this framework is likely to evolve organically through a patchwork of linked national, bilateral, plurilateral and multilateral initiatives that cover an array of issues and areas. Almost certainly an increasing role will be given to emissions trading as a mechanism to achieve least-cost abatement.

At the same time, it appears that the uncertainty and associated costs surrounding the future policy framework in Australia have risen in recent years. This is having an impact on investment in key emissions–intensive industries and energy infrastructure. As argued in chapters 2 and 3, scaling up the extensive suite of existing, predominantly non-market, interventions to a level that would support long-term, sustained deep cuts in emissions is unlikely to be viable from either an economic or environmental perspective and would be unlikely to resolve investment uncertainty.

There are two distinct policy questions here for the Government:

1. whether to announce a cap on post-2012 domestic emissions ahead of a more comprehensive post-Kyoto global agreement; and if so
2. whether to implement a domestic emissions trading scheme in order to achieve that cap.

On balance, the Task Group believes that it is appropriate for the Australian Government to set an explicit constraint on Australian emissions beyond 2012. The Task Group considers that an emissions trading scheme is necessary to achieve such a cap at least cost.

The costs of unilaterally imposing a cap on domestic emissions are direct and obvious. Adoption of an emissions cap ahead of a comprehensive global response risks Australia taking on a disproportionate burden in reducing world emissions. Depending on the timing of implementation, imposing a carbon price within Australia that is not matched by similar action overseas could also place key Australian industries at a competitive disadvantage, for potentially little global environmental benefit. As noted earlier, governments around the world have been uncertain about the shape of a post-2012 framework and what that might imply for burden-sharing and industry competitiveness (see Section 4.4.2). These concerns have been particularly acute in Australia given the role of natural resources in the economy, and the world-class, trade-exposed, emissions-intensive industries that have developed based on this endowment.

On the other hand, a number of emerging considerations suggest that adopting an Australian cap, and an emissions trading scheme, ahead of comprehensive global action may also bring important national benefits. These factors include the need to improve the long-term business investment environment, to increase Australia's influence on the emerging international patchwork of emissions reduction approaches, and to build on incentives to develop low-emissions technologies. These arguments are outlined in more detail in the sections below.

In addition, failing to use available market mechanisms to address mitigation could add to general fiscal pressures over coming decades

arising from the ageing of the population and the potential calls on the public sector to assist in adaptation to climate change (see Australian Government Intergenerational Report, 2007, p. 71).

The Task Group believes that the adoption now of emissions constraints for the period beyond 2012, and the measured implementation of emissions trading domestically, is a prudent course of action – the key design elements necessary to deliver overall national benefits, and deal appropriately with the direct costs discussed above, are outlined in Section 6.4.

6.3.1 Improving signals for business investment

Any action by Australia to constrain emissions will impose costs on the economy.

What is less well understood is that delaying action can also result in economic costs beyond those arising from the impact of climate change itself. These costs arise because of business uncertainty about future policy frameworks. They are larger when there is a widespread perception that action will eventually occur, but the timing and magnitude of action remain uncertain. These costs are rarely transparent but they are real. They may be:

- opportunity costs, which occur due to investment lost or deferred due to ongoing uncertainty, or
- potentially higher future adjustment costs that are locked in due to inappropriate investment decisions today in long-lived emissions-intensive assets.

It has become increasingly apparent to Australian business during the last year that the costs of uncertainty are significant and rising.

> ERIG [Energy Reform Implementation Group] was struck by the significant concerns raised by market participants about market uncertainty in relation to possible future greenhouse gas abatement initiatives.... [G]reenhouse risk constitutes one of the most important barriers to investment in the energy industry, particularly to new base load coal investments. ERIG notes that most market participants desire a coordinated and sustainable policy approach to greenhouse and are already pricing greenhouse risks into their future investment plans.
>
> *ERIG (2007, p. 27)*

Continued policy uncertainty, along with the absence of mechanisms to price and manage future carbon risks, is increasingly likely to impede investment in Australia and in other developed economies. This is especially the case in industries with long-lived operations that are emissions intensive, such as baseload electricity generation and minerals resource processing, where investment planning horizons extend decades beyond 2012.

> Without a clear greenhouse gas emissions policy framework there is a risk that investment in baseload capacity may be deterred.
>
> *Energy Supply Association of Australia submission to the Task Group*

Extensive consultations during the course of preparing this report highlighted a range of business concerns stemming from uncertainty about whether Australia would adopt an explicit price on carbon, and the timing and magnitude of such a decision. The two concerns most frequently cited were that:

- there is increasing pressure for further policies and measures at the sub-national level, such as the proposed state- and territory-based national emissions trading scheme and state-based renewable energy

targets. These measures impose costs on businesses and consumers that are additional to those that would be incurred under a nationally consistent approach

- the absence of clear medium- to long-term carbon prices or policy signals and incentives to reinforce the stated importance of new low-emissions technologies is impeding business investment in the research, development, demonstration and deployment of these crucial technologies.

> The current greenhouse policy uncertainty is already affecting Australian businesses. They are being adversely affected by the current disparate and often poorly formulated policy responses from governments to date... It is not just current policies that are a concern. Greenhouse-specific regulatory hurdles for particular projects are also occurring with growing frequency.
>
> *Business Council of Australia submission to the Task Group*

There is some evidence that investments with a high degree of carbon risk are currently being deferred. The direct and short-term economic costs of this uncertainty are difficult to quantify, but international analysis suggests carbon price uncertainty can contribute to increases in electricity prices and the creation of investment cycles that exacerbate short-term peaks and troughs in generation capacity (IEA, 2007, p. 11).

Policy uncertainty is only one of the many factors that can impact on Australian power investment and electricity prices. Nevertheless, illustrative analysis commissioned by the Task Group suggests that a hiatus in investment in baseload power can result in temporary electricity price increases without achieving any emissions reductions. Such price rises can involve significant wealth transfers from users of electricity to producers of electricity (see Box 6.2).

The longer this uncertainty persists, the more likely it is that some investments in critical infrastructure, such as power generation, may need to be made regardless of their longer-term consequences. Without a clear signal on future carbon costs, these investments will not be optimised, with a consequent risk that a higher than otherwise carbon profile is locked in for the life of the capital stock. The scale and type of investment required to significantly reduce emissions in the electricity sector (outlined in Box 2.3) suggests this latter risk can have important long-term consequences.

While Australia remains an attractive location for resource-based investments because of its stability and energy cost base, some stakeholders have indicated that investment decisions will need to be made in coming years in relation to a number of large-scale, long-lived investments that are highly affected by carbon risk. In addition, large increments of baseload power generation will be required in the next decade.

Unless these matters are resolved soon, there is a risk that the ongoing uncertainty about future policy could begin to impose a higher cost on the economy through lost or stalled investment than would a well-calibrated policy response. Delaying further action in order to safeguard Australia's competitive advantage will increasingly become a less effective approach if it increases investor uncertainty in the very industries the strategy is designed to assist. Declaring that Australia will not adopt emissions trading is unlikely to reduce uncertainty unless accompanied by widespread community support, particularly in light of the announced intention by states and territories to introduce their scheme from late 2010 and the burgeoning of inefficient and poorly targeted policy interventions.

These considerations suggest that Australia would be well served by developing, as a matter of urgency, a clear and coherent national framework for dealing with carbon constraints

Box 6.2 The impact of policy uncertainty on investment

Companies routinely invest in an uncertain environment. Electricity generators, for example, need to manage uncertainty in relation to their fuel costs, technology developments, and demand for electricity. A lack of clarity regarding the framework through which carbon prices will be set in the future is a further source of uncertainty, which can increase the riskiness of investment.

The Task Group commissioned ACIL Tasman to provide stylised scenarios to illustrate how ongoing uncertainty around climate change policy might impact on investors and consumers in the national electricity market (see Appendix H for details).

This analysis shows that consumers of electricity (including businesses) could face substantially higher electricity prices if existing uncertainty stifled investment in baseload generation capacity. Under these scenarios, wholesale electricity prices could rise by up to 25 per cent during the period from 2012 to 2017. This amounts to additional costs of between $1.9 billion and $3.5 billion in net present value terms compared to scenarios where carbon prices were known with certainty.

Investors in new capacity could lose $137 million in net present value terms if they invest in gas-fired baseload generation in anticipation of a high carbon price only to find that no carbon price eventuates. Conversely, investors could lose $153 million in net present value terms if they invest in coal-fired generation in anticipation of no carbon price but find that a high carbon price eventuates.

Much of the additional cost to consumers represents a transfer to existing generators that benefit from higher prices and capacity utilisation. Indeed, long-term contracts for the supply of electricity are being regularly established, and uncertainty on the policy regime could result in windfall winners and losers.

No climate change policy framework can remove carbon-related risks, many of which are beyond the control of individual governments. However, governments have the opportunity to ameliorate some of the climate change policy risks. This can reduce the likelihood of investments being deferred unnecessarily or of inappropriate investments being made. Governments can also provide a framework within which investors can develop better instruments to manage climate change policy risks and to hedge against carbon price risk.

Transparency in the policy framework – including criteria and processes guiding the government's climate change policy response and clear indications regarding permit allocation methodologies – is essential to provide firms with opportunities to manage climate change policy risk (IEA, 2007, p. 17).

to improve the business environment. Given the lead times involved in many investment decisions, it would be valuable to have such a framework in place on a definite time frame, so that business has maximum opportunity to make its own investment decisions based on assessments of carbon price risks going forward. Such a framework would also begin to transition Australia's economy to a low-carbon footprint over the medium to long term. Early and measured steps would allow a smoother adjustment path than alternative approaches and reduce risks of higher adjustment costs in moving at a later date. An Australian emissions

trading scheme would establish short-, medium- and long-term price signals, which would help business assess and implement the best possible abatement strategies (including the development and deployment of low-emissions technologies) and manage their long-term carbon risks.

In addition to the direct impact of a national emissions trading scheme on business behaviour, the Task Group also considers that a carbon price would have important, less tangible, impacts on business practice and outlook that would prepare Australia well for a carbon-constrained global economy. A carbon price, however low it might be initially, would provide a clear signal to industry that managing greenhouse gas emissions will need to be an integral part of future business practice.

6.3.2 Positioning Australia for international developments

Given that global emissions trading is likely to develop initially through a range of linked national and regional arrangements, the Task Group considers that a decision now by Australia to limit future emissions is appropriate. Establishing a domestic emissions trading scheme to manage post–2012 emissions would ensure we are well positioned to advance our interests as international events unfold:

- It would allow Australia to contribute to the global response to climate change by managing our national emissions in a sustainable way.
- It would demonstrate to the international community Australia's commitment to a long-term national contribution to the overall global response.
- It would underscore Australia's national interest in supporting market-based, flexible models for responding to climate change concerns.
- It would provide the economy with a low-cost, calibrated policy instrument that could respond flexibly to the broad range of possible international developments.
- It would allow Australia to develop and evolve a national response specifically tailored to our particular national circumstances and objectives:
  - this would allow us to capitalise as a 'fast follower' by building on the lessons learned from the European Union and other trading approaches
  - such a scheme would enable Australia to engage early with major emitters and key developing countries and influence the international debate on emissions trading in a direction consistent with our national interests
  - a comprehensive and inclusive approach would provide a basis for Australia to engage with a wide range of key emitters and trade and investment partners, including in undertaking joint activities
  - specifically incorporating the capacity to link our national scheme to other national or regional initiatives would enable Australia to influence the international debate in key areas such as targets, competitiveness issues, and comprehensiveness in relation to coverage of sectors, gases, and the use of sinks and offsets.

Australia has an interest, for example, in leading the way in the development of approaches that maximise the potential of carbon sinks to contribute to the abatement task. Current methodologies in international emissions accounting assume that all carbon within a tree is emitted upon harvest. However, carbon remains locked in the timber until it decays. Australia should make it a priority to explore and demonstrate more rigorous methodologies for plantation offsets, which take into account the carbon contained in harvested wood products.

Current international rules neither create nor recognise international trade in credits for avoided deforestation, reducing scope for market-based incentives to play a role in reducing land clearing. Australia has a broader interest in pioneering approaches to develop international cooperation to avoid deforestation, including methodologies that may become part of future global emissions trading systems. This may be one of the approaches to climate change that could be explored within the Asia–Pacific region.

6.3.3 Incentives to develop low-emissions technologies

Australia is at the forefront of international efforts to develop low-emissions technologies, a position that is clearly consistent with our national interests as a major energy exporter, and our objective of finding low-cost ways to reduce domestic emissions in an increasingly carbon-constrained world. While many key low-emissions technologies are some distance from commercialisation at present, it is becoming increasingly clear that these technologies will require a carbon price signal to make them competitive with current production methods.

> The introduction of a credible emissions constraint or price signal would also have an important signalling effect about the likely long-term future demand for low-emissions technologies. This is a key factor influencing expected returns on investment in low-emissions research.
>
> *CSIRO submission to the Task Group*

The prospect of an appropriate carbon price will provide an important financial incentive to business efforts to develop low-emissions technologies. The introduction of a well-designed domestic emissions trading scheme, particularly one that pays due regard to building long-term price signals, can play an important role in motivating those involved in existing technology efforts and hence contributing to Australia's climate change policy objectives. Many stakeholders also consider that an emissions trading scheme needs to be part of a broader suite of measures to develop low-emissions technologies.

> [T]he objective of a climate change policy is to direct capital within the market towards low and zero carbon emissions investment. Capital allocation within our economies needs to shift for this to happen. As industry is constantly building new energy infrastructure, the fastest way to achieve the necessary outcome is to directly channel that capital by offering an incentive (for example, in the form of a price of carbon through a trading system).
>
> *Shell Company of Australia Limited submission to the Task Group*

6.4 Ensuring an emissions trading system protects Australia's national interests

The Task Group believes that it is possible to reconcile the priorities of fair burden-sharing and retaining competitiveness with the policy advantages outlined above. This requires the adoption of a well-calibrated policy response that includes the introduction of a single, Australia-wide, emissions trading scheme – so long as we can design appropriate built-in safeguards to ensure we do not prejudice the competitiveness of our trade-exposed, emissions-intensive industries.

6.4.1 Carefully assessing the costs

The economic cost of an emissions trading scheme depends critically on the cap placed on emissions (see Box 6.3 on interpreting economic

Box 6.3 Interpreting estimates of the economic costs of climate change action

Estimates of the economic costs of emissions abatement policies, including emissions trading, need to be interpreted with care.

Estimated economic costs of policy action are commonly reported as deviations from a baseline scenario. For example, a relatively ambitious abatement target may be reported as involving a 5 per cent cost to Australian GDP by 2050. It is important to recognise that this does not mean that GDP in 2050 is 5 per cent lower than today. Rather, it represents forgone growth, and means that the level of GDP in 2050 is 5 per cent lower than it would otherwise have been. Such impacts are significant and policy should be directed at minimising costs.

Nevertheless, impacts of this magnitude can be consistent with ongoing strong economic growth and rising living standards. For example, if GDP is assumed to grow by an average 2.2 per cent per year to 2050 without the policy intervention, a 5 per cent reduction in GDP by 2050 would convert to a reduction in average annual growth of 0.1 percentage points, to 2.1 per cent per annum. While a seemingly minor change, this slowing in growth means that it takes an extra two and a half years (to 2052) for GDP to reach the same level as it would otherwise have attained in 2050 – but in both cases, real GDP is still 2.3 times the level of today.

In most cases, economic costs are also calculated relative to a baseline that does not involve any climate change action. However, other measures to address climate change are already in place in many countries, including Australia, and such measures are likely to continue. Therefore, when weighing up the costs of an emissions trading scheme, it is important to keep in mind that emissions trading may be replacing some other climate change measures that impose their own costs on the economy. If so, the net addition to cost is likely to be less than reported in the modelling.

Most economic estimates of climate change action, including the ones referred to in this report, provide useful insights into the likely costs of abatement but remain silent on the benefits of such action. This facilitates understanding of how various considerations (such as the extent of international participation, the pace of technology development and policy design) can affect the costs of intervention for given environmental benefit but does not constitute a cost–benefit analysis of potential policy responses which, for relatively small emitters such as Australia, involves a complex assessment of links between Australian mitigation actions and Australian environmental outcomes.

Modelling the economic impacts of emissions abatement requires forecasting a myriad of complex relationships over long time horizons, where these relationships are based on a large degree of conjecture (there being little observable experience of carbon pricing). The results of such exercises are necessarily, therefore, subject to a degree of uncertainty – that is, costs may be over- or under-stated. More fundamentally, economic models are built around existing relationships and trends, reducing the extent to which they can fully account for innovation potential and the propensity for markets to exploit new growth opportunities. Accordingly, while such exercises can illustrate a number of impacts, and the relative importance of different issues, the negative impacts of market-based emissions abatement action in the longer term may be over-estimated in general.

On the other hand, claims made that are not backed by rigorous modelling, and which suggest that undertaking sharp emissions reductions will result in faster GDP growth than otherwise, need to be treated with a great deal of scepticism. In addition, large and rapid reductions in emissions can involve economic disruption not fully captured by overall economic modelling results.

Box 6.4 Uncertainties surrounding the costs of climate change mitigation

All climate change action involves cost, though a 'slow start' emissions trading scheme with relatively low initial carbon prices is likely to have only modest impacts on the economy. The more stringent the target, the higher the costs.

The Australian Bureau of Agricultural and Resource Economics (ABARE) has previously estimated that a 39 per cent cut in global emissions (relative to baseline) by 2050 by a global coalition, involving a cut in Australia's emissions of 39 to 43 per cent, would reduce Australian GDP by 2.5 to 3.1 per cent (depending on the level of emissions abatement and the availability of carbon capture and storage and nuclear technologies) (Ahammad et al., 2006). If Australia unilaterally increased its abatement to 68 per cent, this would have virtually no impact on aggregate global emissions but would reduce Australian GDP by 10.7 per cent.

An alternative set of stringent scenarios was modelled by the Allen Consulting Group (2006a) using the Monash University Centre of Policy Studies MMRF-Green model. It shows that if Australian emissions were cut by 80 per cent by 2050 relative to baseline, GDP would be 6 per cent lower by 2050.

The differences between the ABARE and Allen Consulting Group modelling results are mainly due to different assumptions regarding the availability of abatement opportunities, technological change, international policy settings and abatement targets. Such differences in modelling results are by no means restricted to Australian modelling. For example, the IPCC (2007c) has reported abatement cost estimates from 139 studies that model the economic effects of global emissions reductions that achieve global CO_2-e concentrations of between 535 and 710 parts per million. Removing the most extreme top and bottom 10 per cent of results leaves abatement cost estimates that range from -1 per cent to 4 per cent of global GDP by 2050.

cost estimates). To an important extent the cost of any such scheme can easily be adjusted over time by appropriately setting the cap – indeed, that is one of the benefits of an emissions trading scheme relative to other less efficient policy instruments.

Estimates available both domestically and internationally suggest that the costs of restraining emissions through a price signal can be kept modest and can also be consistent with ongoing strong economic growth, though the total costs rise with more ambitious levels of abatement (see Box 6.4). These estimates also serve to underline the significant uncertainty that currently exists in the range of predicted impacts on economic growth, suggesting that further analysis is needed before a final decision is taken on any short-term emissions cap or long-term

Priority should therefore be given to further developing Australia's analytical modelling capabilities, particularly given the long-term economic significance of policy choices facing Australia in setting emissions trajectories. This work should examine not only the macroeconomic impacts but also the potential impact on key industries and sectors.

> Rio Tinto supports the development of an integrated independent modelling capability with the ability to model more realistic treatment of the technology development pathway and more accurate assumptions about emissions reduction opportunities and the abatement cost curve.
>
> *Rio Tinto Limited submission to the Task Group*

Given the inherent limitations of modelling, a

is that it allows the community to observe actual responses to emissions pricing without imposing excessive costs on the economy. Building on observed behavioural and technology responses to emissions pricing, modellers and analysts can improve the accuracy of their predictions, giving policy makers and the community more confidence in setting emissions targets in the future.

Both the time frame and pathway over which emissions are reduced below 'business as usual' levels will determine the cost of an emissions constraint. Requiring a large reduction in emissions over a short time frame will impose a higher cost than steadier action over a longer period, other factors being equal. In light of the risks and costs associated with higher than expected prices, it may also be prudent to cap scheme costs initially, through design features that place a ceiling on permit prices in the early stages of implementation.

Another key factor affecting cost is the availability of abatement options. Imposing a hard emissions constraint in the absence of cost-effective technological solutions will impose a higher cost on the economy than taking action at a level commensurate with the technological options available. On the other hand, a scheme which maximises the availability of cheaper abatement options, including from international sources, and allows firms to optimise abatement over time through 'banking' of credits, will help to lower the costs to the economy.

Design features that limit cost should be combined with the ability to periodically review and recalibrate the emissions constraint after consideration of international developments, macroeconomic costs, technological advances and competitiveness impacts.

In advance of any broader effective global response, it is important that any self-imposed cap does not result in a disproportionate burden on the Australian economy. The bigger the coalition of countries seeking emissions reduction, the more effective are responses in achieving global outcomes relative to economic cost (see Box 6.5). Hence, the Task Group believes it is essential that Australian domestic action be combined with efforts to build a comprehensive global response and be calibrated to reflect progress in developing such a response. Any emissions trading scheme adopted domestically needs to allow sufficient flexibility to adjust to international developments.

6.4.2 Competitiveness

The Task Group has interpreted its terms of reference as requiring that future action on climate change taken by Australia should not only contribute to an effective global response but also preserve the competitive strengths drawn from Australia's large reserves of fossil fuels and uranium. These world-class natural assets, and the access they provide to reliable low-cost sources of energy, form the basis of the viability of the highly profitable resource and minerals processing industries that Australia has developed over the last several decades (see Chapter 2).

The introduction of a market price for carbon in Australia would result in the following cost increases (with a resultant loss in trade competitiveness) for trade-exposed, emissions-intensive industries and firms:

- an explicit cost for their 'own emissions' – the direct cost
- two types of higher indirect costs – namely higher energy input costs (primary pass-through), and higher costs for a firm's other carbon-intensive production inputs (secondary pass-through of higher embodied emissions costs in inputs such as process feedstocks).

It would be perverse if, in deciding to act in advance of the rest of the world, Australia's own policies to reduce domestic emissions inadvertently forced these industries, in part or whole, to migrate offshore, without any

Box 6.5 Ensuring a proportionate contribution to global abatement

The costs and benefits of action by countries to reduce emissions depend critically on the extent to which this is part of a comprehensive effort.

To achieve the same level of global abatement, all members of a smaller coalition would have to cut their emissions by more than if they were part of a more comprehensive effort. This is illustrated by analysis undertaken by ABARE (Ahammad et al., 2006) for the Energy Futures Forum. In one scenario, Australia is part of a global coalition which cuts global emissions by 39 per cent by 2050 – Australia's emissions are reduced by 43 per cent while GDP is around 2.5 per cent lower than the baseline by 2050. In contrast, when the coalition is smaller, Australia's emissions reduction has to rise to 64 per cent and GDP is 8.3 per cent lower in 2050, relative to the baseline levels.

This highlights that deep cuts to global emissions will be very costly to achieve without involving a large proportion of world emitters. However, as described in Chapter 4, a comprehensive global coalition is unlikely to emerge in the near future and countries will move at different paces depending on their specific circumstances.

The Task Group commissioned ABARE to model illustrative scenarios examining the impact of building progressively larger international coalitions to reduce greenhouse gases. The scenarios kept abatement targets in coalition countries constant while assessing the effects on global abatement and economic activity (see Table 6.1; more detail is provided in Appendix H).

Table 6.1 Impact of different international emissions reduction coalitions, 2030

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Country coalition	Developed and 'transition' countries[a]	Top 20 emitters minus key competitors[b]	Top 20 emitters	All countries
Australian emissions	-22%	-22%	-22%	-22%
Global emissions	-9%	-20%	-22%	-25%

a. This coalition approximates the group of countries with targets set out in Annex B of the Kyoto Protocol, including most developed economies and ex-Soviet Bloc transition economies. b. As for Scenario 3, but excluding some key competitors to Australian industry: Brazil, Indonesia, South Africa, Commonwealth of Independent States, and the Middle East.

The scenarios show a large improvement in environmental effectiveness when a majority of key emitters joins in the abatement task, and burden-sharing broadens to include rapidly growing developing economies. Global abatement in 2030 is more than doubled (from 9 per cent in Scenario 1 to 20 per cent in Scenario 2) when the coalition of countries is broadened from developed and 'transition' countries to include a majority of key emitters. The amount of global abatement is further increased progressively as the coalition is broadened to include all the largest 20 emitters (Scenario 3) and all countries (Scenario 4).

Global environmental outcomes from a given Australian abatement effort unambiguously improve as more countries contribute while costs to Australia remain relatively constant in these scenarios (see Appendix H). Overall, this analysis suggests that a strategy based on building a coalition from the 'bottom up', combined with efforts to make multilateral arrangements more inclusive, holds a prospect for reasonable outcomes for Australia even in the likely event that progress is uneven.

environmental gain through lower emissions (see Box 2.2 and associated discussion in Chapter 2).

It is important, therefore, that the introduction of an Australian emissions trading scheme not prejudice the competitiveness of our trade-exposed, emissions-intensive industries.

Efforts to avoid prejudicing the competitiveness of these industries, however, risk moving the economy away from its least-cost abatement pathway through time. This is because anything less than complete coverage and equal treatment across industries would force a greater burden of adjustment onto the sectors included in the emissions trading scheme. Differential treatment accorded to any sector, whether it is one that is trade exposed and emissions intensive or any other, will increase the economic costs associated with a given emissions reduction and shift more of the adjustment burden to the other industries and to households (see Box 6.6). An alternative approach is to adjust the aggregate cap to prevent a shift in adjustment burden to other sectors, resulting in reduced achievement of Australian and (to a lesser extent) global abatement.

Care is also needed to ensure that measures to avoid prejudicing current competitiveness do not prevent Australia from developing an efficient and competitive industrial structure that is adapted to a carbon-constrained world.

> [I]nternational competitiveness is only at significant risk, and special treatment under emissions trading therefore only warranted, in cases where...
>
> - The industry is particularly emissions intensive;
> - The industry is particularly trade exposed; and
> - This trade exposure is in particular to competition from countries that do not have to meet emissions caps under the Kyoto Protocol.
>
> *WWF–Australia submission to the Task Group*

These varying policy considerations suggest to the Task Group that any domestic emissions trading scheme should:

- include transitional provisions to substantially ameliorate any competitiveness impact arising through the imposition of direct and indirect carbon-related costs, but that these only be provided while broadly comparable carbon constraints are not in place in key competitor economies
- ensure, in the meantime, that trade-exposed, emissions-intensive firms have ongoing incentives to abate their emissions through inclusion in the scheme
- include in the design of any transitional measures features that avoid locking in inefficient abatement choices and so reduce the economic costs from shifting the burden to other sectors and build the long-term competitiveness of these industries.

Experience in the first phase of the European Union trading scheme demonstrated that excluding trade-exposed, emissions-intensive operations from carbon liability under the scheme failed to shield them from the pass-through of indirect carbon-related costs imposed by upstream suppliers (such as electricity generators). It also removed any incentive for abatement of direct emissions. As such, excluding trade-exposed, emissions-intensive industries from an Australian trading scheme would be likely to increase pressure for alternative – and perhaps more costly and arbitrary – abatement measures to be imposed (for example, through environmental approval processes). Such alternative measures may not only be more costly but also fail to afford the competitiveness protections offered within a well-designed trading scheme.

Hence, the Task Group considers that trade-exposed, emissions-intensive industries should be covered as part of the emissions trading scheme, which should include appropriately calibrated measures to ensure that a good

Box 6.6 The economic welfare and carbon leakage impacts of climate change policy

The Task Group commissioned ABARE to model a set of scenarios to illustrate the effects of an arbitrarily chosen carbon price differential between Australia and the rest of the world on trade-exposed industries to illustrate the effects of leakage. These scenarios assume an almost complete shielding of trade-exposed industries, rather than the policy approach proposed in Chapter 7.

Table 6.2 Illustrative abatement scenarios, 2030

	Scenario A	Scenario B	Scenario C
Abatement relative to the reference case	-11.8%	-11.8%	-7.9%[a]
Carbon price per tonne of CO_2-e	capped at $15	rises to $31	rises to $18
Coverage	all sectors (other than land-use change and forestry)	as for A but natural gas, iron and steel, non-ferrous metals and agriculture shielded	as for B
Leakage	12.8%	3.6%	3.8%
Effect on GDP levels	-0.7%	-1.1%	-0.6%

[a] Non-shielded sectors abate the same as under Scenario A.

Scenario A illustrates that, in the case of Australia introducing a carbon constraint ahead of the rest of the world, a substantial proportion of Australian abatement (12.8 per cent) is offset by increased greenhouse emissions overseas. This 'leakage' is concentrated in a small number of industries and scenarios B and C highlight the impact of efforts to reduce such leakage.

Scenario B shows that shielding trade-exposed industries can cut leakage from around 13 per cent of Australian abatement to about 4 per cent. Leakage is undesirable for two broad reasons: (1) it reduces environmental outcomes flowing from Australian action, reducing its cost-effectiveness; and (2) it provides an additional incentive for other countries to postpone their contribution to global abatement.

However, shielding trade-exposed industries also has the effect of redistributing the abatement burden to the non-shielded sectors within Australia, roughly doubling the carbon price required to achieve the same abatement and leading to an additional 0.4 percentage point reduction in GDP (relative to Scenario A). Precise impacts are dependent on the specific industries shielded – for example, removing shielding from agriculture significantly reduces the GDP impact. However, a number of other trade-exposed, emissions-intensive industries are not included in the broad industry categories shielded in the scenario.

In a situation where the global abatement effort is not sufficiently broad, government may choose to both shield trade-exposed sectors and adjust the overall abatement task to ensure the rest of the economy does not carry an additional burden. This possibility is illustrated in Scenario C, where the non-shielded sectors abate the same amount as they were abating under Scenario A. Thus, in Scenario C the abatement achieved is reduced (from 12 per cent to 8 per cent) but so is the GDP impact (from 0.7 per cent of GDP in 2030 to 0.6 per cent).

These trade-offs highlight the careful judgments needed to strike a balance between achieving low-cost abatement and not prejudicing the competitiveness of trade-exposed sectors. The approach proposed by the Task Group for dealing with trade-exposed, emissions-intensive industries would be expected to achieve good abatement outcomes in these industries (in contrast to the complete shielding modelled in

balance is struck between achieving least-cost abatement and not prejudicing their competitiveness.

6.4.3 Providing incentives for technology

Adoption of an Australian emissions trading scheme that sets a clear forward trajectory for emissions reductions (and thus a rising cost of carbon into the future) – along with the creation of liquid forward carbon markets – will allow the creation of a forward price curve for emissions permits. This anticipated long-term price path will send strong signals to business about the importance of investment in low-emissions technologies.

By populating this forward curve with expected future prices – at least as far out as the most credible government commitment to reduce emissions – trading schemes allow business to undertake appropriate risk management similar to their use of existing financial derivatives. That is, using forward prices for permits and their own internal investment frameworks, businesses can optimise their investment decisions in relation to carbon risk, including decisions about research and development in low-emissions technologies, abatement opportunities and energy efficiency.

There is currently a significant cost gap between existing high-emissions technologies and existing and prospective low-emissions technologies (see Appendix I). This suggests that a relatively high medium-term forward price from the outset of the scheme will be necessary to induce commercial deployment of the new technologies.

A distinction needs to be drawn between the current (spot) and future or forward prices. A low spot price is desirable in the early days of any scheme in order to avoid excessive dislocation. This must be accompanied by a market-established rising forward price of sufficient magnitude to induce behavioural change, accelerate the uptake of existing low-emissions technologies, and provide an incentive for additional research and development on breakthrough technologies.

A price signal provides a weaker incentive in the earlier stages of the technology cycle, where technical risks predominate over financial risks. It is for this reason that the Task Group believes that complementary measures would still be required to support early and mid-stage research and development of new technologies (see Chapter 8).

6.5 Principles for domestic policy

The Task Group believes that the following set of principles could form the basis of a future response by Australia that incorporates an emissions trading scheme as a core policy instrument. In the view of the Task Group, any future long-term greenhouse gas abatement framework should:

1. be part of an overall comprehensive and multifaceted policy response that represents a credible national effort and contributes to achieving a robust global framework
2. provide a smooth adjustment path to a low-carbon economy that can be calibrated to international and domestic circumstances and expected technological developments
3. form a sound basis for long-term domestic policy that promotes greater long-term operating and investment certainty for business
4. feature a single, comprehensive and national well-designed Australian emissions trading scheme that
   - » delivers sustained long-term greenhouse gas abatement

- includes appropriate long- and short-term incentives for the commercialisation and deployment of the widest range of technologies at least regulatory cost
- minimises the overall cost to the economy and limits the impact on long-term economic growth
- does not prejudice the competitiveness of key trade-exposed sectors

5. ensure that all sectors of the economy make an equitable contribution to the national abatement effort, either as part of an emissions trading scheme or through alternative abatement measures.
6. ensure appropriate contributions from government and industry towards the research, development and demonstration of new step-change low-emissions technologies and improvements in energy efficiency both domestically and internationally
7. maximise access to least-cost abatement opportunities across the economy through comprehensive domestic and international offsets regimes, including for avoided deforestation and carbon sinks
8. draw on high quality and streamlined data collection systems, and efficient supporting infrastructure, such as registries
9. include rationalisation of the existing suite of greenhouse-related measures at all levels of government
10. provide appropriate government information and support to households to better manage their energy consumption.

These principles are developed further in chapters 7 and 8.

Elements of an Australian emissions trading scheme

7.1 Overview

This chapter outlines the principles and key operational details for the development of an Australian emissions trading scheme. In some areas where further analysis is necessary, the merits of different options are discussed.

If it were decided to pursue a scheme along the lines proposed here, considerable further work would be needed on the detailed design. This work will take some time, and the scheme will need extensive scrutiny to ensure its soundness before trading begins. Building on the consultation and design work already undertaken will assist in this regard. Excessive haste carries great risk, particularly given that the comprehensiveness of the scheme outlined here exceeds that of both the EU Emissions Trading Scheme and the scheme proposed by the states and territories.

The Task Group is of the view that a commitment to an emissions trading scheme should be made in the near future. Implementation will still require some years of careful preparation. That should not delay action. It is possible to provide powerful incentives to reduce emissions – such as ensuring no disadvantage or providing credit for action taken after the date of announcing an intention to adopt emissions trading – while the work of building the necessary infrastructure for the scheme takes place.

7.1.1 Key features of the proposed scheme

The Task Group has concluded that any future Australian scheme should be based on a 'cap and trade' model with the following features:

- a long-term aspirational emissions abatement goal and associated gateways to provide a context for community efforts
- an overall emissions trajectory that:
  - commences moderately below 'business as usual' projections (so that the market establishes a low initial price for carbon), but which progressively stabilises and then allows for deeper emissions reductions over time
  - is sufficiently flexible that it can be periodically recalibrated by government to changing international and domestic circumstances through regular transparent reviews
  - provides markets with the ability to develop a forward carbon price path to guide business investment decisions and help drive longer-term technology development
- maximum practical coverage of all sources and sinks, and of all greenhouse gases
  - with permit liability placed on direct emissions from large facilities and on upstream fuel suppliers for other energy emissions
  - practical considerations suggest initially excluding agriculture and land use emissions

- a system of permit allocation and issuance that:
  - is based on time-dated single-year emissions permits
  - provides an up-front, once-and-for-all, free allocation of permits as compensation to existing businesses identified as likely to suffer a disproportionate loss of value due to the introduction of a carbon price
  - ameliorates, through free allocation, the carbon-related exposures of existing and new investments in trade-exposed, emissions-intensive industries until key international competitors face similar carbon constraints, but which also provides ongoing incentives for abatement and adoption of industry best practice
  - allows for the periodic auctioning of the remaining permits, with revenues used, in the first instance, to support the emergence of low-emissions technologies and measures to improve energy efficiency
- a 'safety valve' emissions fee designed to limit unanticipated costs to the economy and to business, particularly in the early years of the scheme, while ensuring a continuing incentive to abate
- recognition of a wide range of credible domestic and international carbon offset regimes
- capacity, over time, to link to other national and regional schemes in order to provide the building blocks of a truly global emissions trading scheme.

A discussion of possible governance arrangements and a timeline to implement the emissions trading scheme follows in Chapter 9.

> As part of Australia's risk management policy it should develop a domestic emissions trading scheme which can be linked globally and increase business certainty.
>
> *Business Council of Australia*

7.1.2 Australian emissions trading in operation

Figures 7.1 and 7.2 illustrate how this scheme might operate. It is premised on the assumption that trading could commence in 2011, and that a purpose-built mechanism to monitor, report and verify emissions data would already be in operation.

Government would establish a long-term aspirational goal for emissions reductions. It would also set a series of short-term annual quantity caps for overall emissions for, say, ten years into the future – initially to 2020.

Emitters covered under the scheme would need to acquit permits equivalent to their annual emissions, or in the event they produced more emissions than are covered by their permits, to pay an emissions fee. This fee would be set somewhat higher than the expected market price of permits but low enough to prevent the imposition of seriously damaging costs. It would be adjusted up over time.

Annual permits, each dated for a given year, would be issued free of charge to compensate firms for a disproportionate loss in asset value from the introduction of the emissions constraint. These permits would have a range of dates that could extend well beyond 2020.

Other permits would be provided to trade-exposed, emissions-intensive firms to ameliorate the bulk of the competitiveness impact of the emissions cap. Allocations to these firms could continue for as long as other key nations did not impose comparable carbon constraints on their firms.

Permits would be provided to these firms for five years at a time, conditional on actual levels of production; decisions about whether to continue free provision of permits would be made as part of periodic reviews of the operation of the scheme. Residual permits for the period 2011 to 2020 would be progressively auctioned.

Figure 7.1 Illustrative emissions trajectories

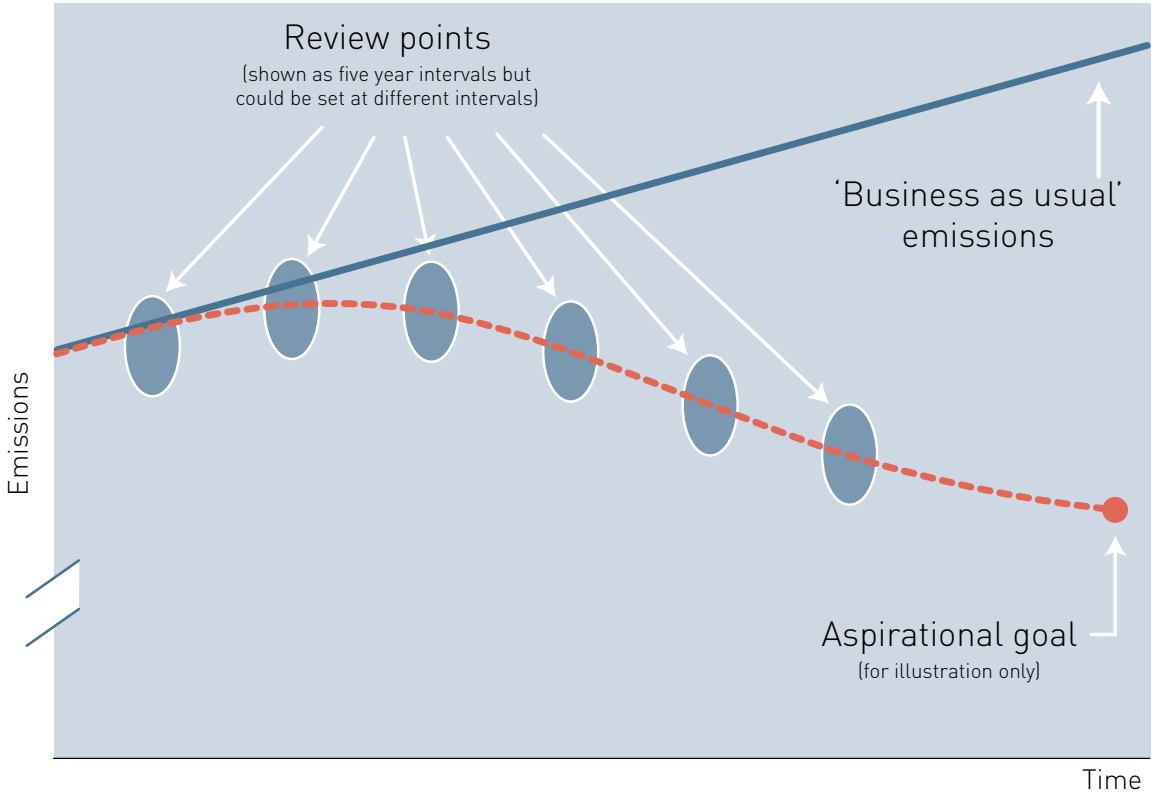
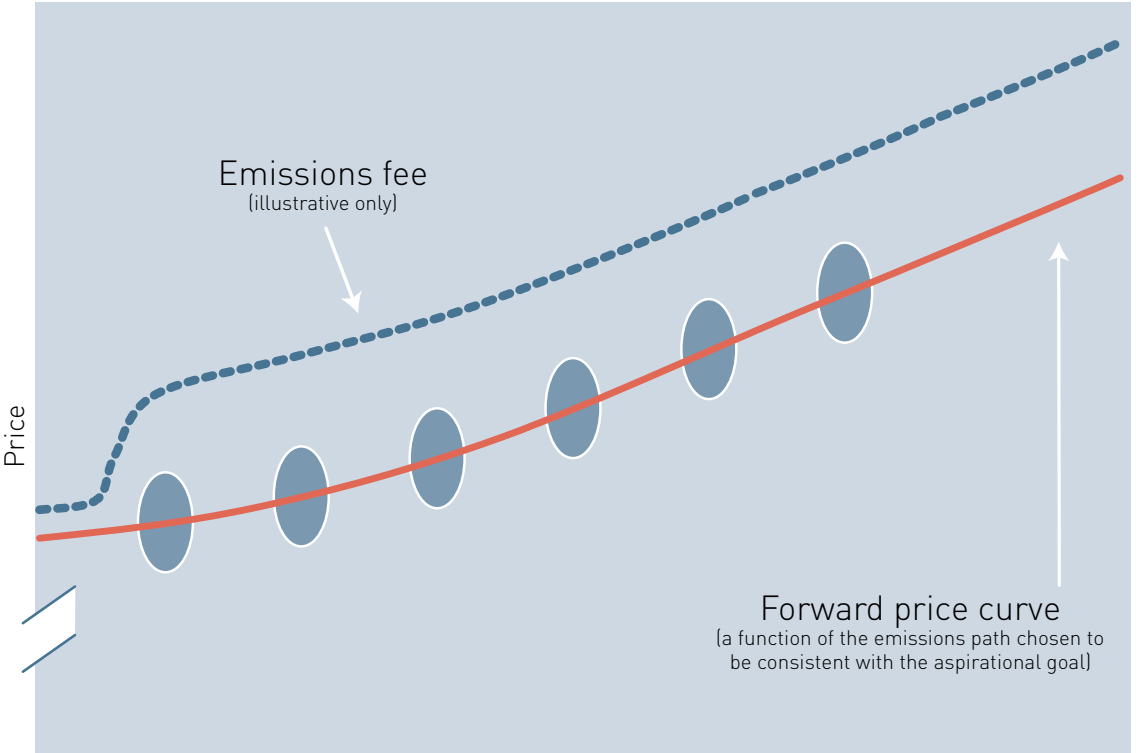


Figure 7.2 Illustrative price paths for carbon permits and the emissions fee



A small number of future-dated permits, beyond 2020, would also be periodically auctioned in order to promote the establishment of liquid forward markets.

Flexibility is vital. The operation of the scheme would be reviewed periodically, initially on a five-yearly basis, to allow calibration of the sequence of short-term emissions caps. Reviews could be more frequent in exceptional circumstances. When the scheme begins, government could establish short-term caps to 2020 and indicative medium-term emissions bands (or gateways) to provide guidance for the likely path of future caps for the period 2021 to 2030. At the time of the first review in 2015, short-term caps might be extended to 2025, and the gateways to 2035.

The indication of tighter future emissions constraints would produce an expected rising price of carbon over time (as shown in Figure 7.2). The use of an initially low emissions fee (or compliance incentive – shown by the dashed line in Figure 7.2), which increased as the scheme matured, would form an effective safety valve to protect against unexpected price shocks.

Firms with a relatively higher cost of abatement would be able to trade permits with firms with a lower cost of abatement. This would equalise the marginal cost of abatement across firms and sectors within the scheme. Markets and businesses would use the expected future price path for carbon to inform their decisions on investment, abatement activity and technology choices. The development of an effective forward market and derivative instruments to hedge risk would offer business risk management options that are currently unavailable.

Recognition of credible offsets (international and domestic) and links to other schemes would allow maximum access to low-cost abatement opportunities elsewhere. Domestically, inclusion of offsets from agriculture and forestry would help lower the cost of meeting any given emissions target. It would also provide an opportunity to further develop methodologies relevant to a range of global circumstances. This is particularly important given the need to engage developing countries in efforts to restrain emissions.

The following sections provide a more detailed description of these key features.

7.2 Ensuring a sustainable national contribution

The Task Group firmly believes that the key goal is to reduce emissions. Decisions to favour specific technologies, or to exclude alternatives, will raise the cost of achieving any reduction in Australia's own emissions. An unwillingness to use all available least-cost technologies makes the task of meeting the long-term aspirational goal even harder and risks undermining both the goal and, ultimately, the domestic emissions trading scheme itself. The market should drive the choice of technology if global emissions reductions are to be achieved at least cost.

7.2.1 Setting a long-term goal

Adopting a credible long-term aspirational goal for national emissions reduction is critical. It sets the framework for Australia's overall abatement efforts. Such a goal could be described in terms of the percentage reduction in emissions from a particular point in time, or in terms of the maximum number of tonnes of CO_2-e that Australia is aiming to emit by a particular year. An easily understood objective, set sufficiently far into the future, allows business and government to make better-informed decisions now.

By providing long-term clarity about the extent of the challenge, this goal will give households and business additional certainty about the need to change their behaviours. It will also help markets to establish prices for carbon emissions well into the future. Having a forward

price signal is a key incentive to help accelerate the technological innovations needed to achieve significant reductions in CO_2-e emissions.

The nature of any aspirational goal needs to be specific. However, the goal will be more effective if it is based on well-understood and accepted policy objectives and explicit criteria, and is able to evolve in response to new information. This policy approach involves fundamental social objectives, and needs to be environmentally and economically robust.

The Task Group believes Australia should examine all the issues necessary to determine a long-term aspirational goal – the abatement opportunities available today, including the scope for greater use of existing low-emissions technology; the technological breakthroughs necessary to deliver deep emissions cuts into the future; the policies required to promote greater use of existing technology and the development of new technologies; and the costs involved.

Without a strong analytical basis, there is a risk that any particular goal will lack credibility. If markets assess that the goal is not achievable, unnecessary additional risk will be factored into the price of emissions permits in anticipation of future changes to policy.

Given the importance of providing clarity about Australia's commitment to sustained emissions abatement, the Task Group sets a high priority on undertaking the necessary modelling and analysis to allow the early identification of a prudent and robust long-term aspirational goal.

7.2.2 Setting the emissions trajectory

Once a long-term aspirational goal is set, it will be necessary for government to establish a series of shorter-term emissions caps and to provide guidance on the shape of possible trajectories to move from the cap to the goal. Setting a sensible, well-calibrated trajectory is the principal way to constrain overall cost while ensuring Australia makes a fair contribution to the global effort.

In the same way as the aspirational goal defines the magnitude of the long-run abatement task, the caps define the extent of short-term abatement needed. The caps set a limit on the total number of tonnes of CO_2-e that can be emitted in any given period. As Figure 7.3 shows, a series of caps would be established for 2011 to 2020 and each year every emitter would need to hold a permit for each tonne of CO_2-e released or pay an emissions fee.

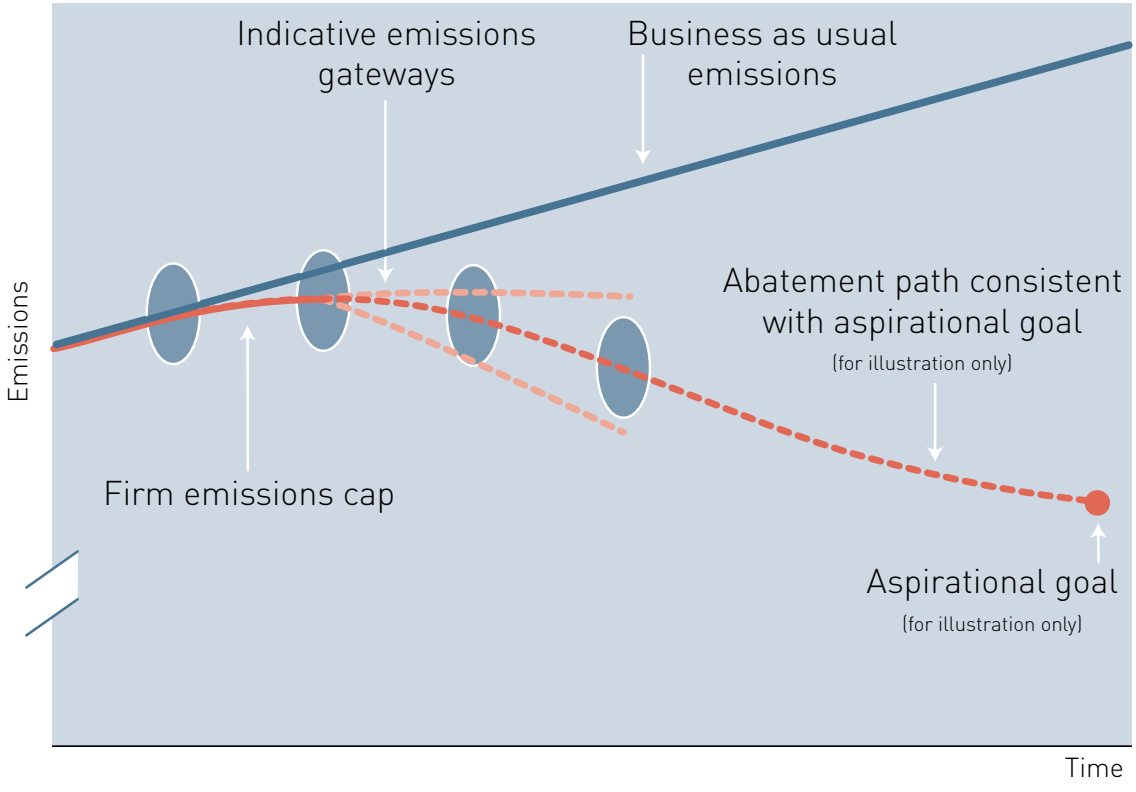
Providing guidance on how the economy might make the transition from the annual caps to the long-term goal is essential. The objective should be to pursue a trajectory from the caps to the goal that facilitates a smooth transition to a low-carbon world. A trajectory 'geared to the rate at which the economy can adjust would ensure that any costs to the economy in the short to medium term were manageable' (National Emissions Trading Taskforce, 2006, p. 37).

Considering the range of possible trajectories involves weighing up:

- the need to balance certainty about the emissions-reduction path with the opportunity for Australia to respond to the evolving nature of the global climate change framework
- the likelihood of further improvements in science and technology
- the accumulation of experience with the domestic economic costs of mitigation.

At the outset it is hard to be definitive about which of the multitude of possible emissions reduction paths might be most appropriate. There is a need to balance the understandable desire of firms for investment certainty with the need to retain some flexibility for government to recalibrate the emissions objective as new information becomes available. To this end, government should provide firm signals on the trajectory in the short and medium term,

Figure 7.3 Short-term fixed emissions targets and medium-term emissions gateways



with some flexibility to adjust the level of effort through time.

There is also considerable merit in allowing for a series of periodic reviews, combined with a mix of firm short-term caps and medium-term gateways for future caps (see Figure 7.3).[1]

Reviews could be conducted every five years. Given the importance of calibrating the cap and gateways to the experience with emissions trading, the pace of international developments, improvements in technology, and emerging science, both the caps and the gateways could be reset at five-yearly review points. While there would always be an opportunity to bring forward reviews in exceptional circumstances – for example, because it was apparent that the economic costs of a particular cap were significantly higher than expected – the period between reviews could itself be reassessed on the basis of experience.

While further work is needed to specify a definitive set of review criteria, these progressive recalibrations of the level and timing of emissions reductions should take account of the extent to which:

- Australia's domestic emissions trading system has become, or could be, linked to other systems
- Australia has entered into agreements with key partner countries, particularly developing countries, with tangible emission reduction outcomes (this would include a new multilateral response framework)
- the ambition of the emissions constraint is commensurate with international commitments and emerging developments in climate change science
- major economic partners, or competing countries in sensitive sectors, introduce carbon constraints or prices into their economies

- emerging low-emissions technologies are expected to become commercially deployable over time.

Shaping the trajectory, and setting the gateways, needs to take account of what can reasonably be achieved over different time frames. Because the capital stock is broadly fixed in the short term, the faster the pace of the reduction, the more the costs of capping emissions rise. In addition, while there is likely to be a wide range of abatement possibilities available now, technological breakthroughs will be needed to deliver sustained deep cuts in emissions without damage to living standards. In the absence of similar action by key trading partners and competitors, it is also important to ensure that short-term economic costs are kept modest.

This suggests the need for a staged initial movement away from 'business as usual', with a gradually accelerating pace of emissions reduction. In this way firms have time to adjust the mix of existing technologies and techniques used in production (including the application of existing technologies used overseas but not currently widespread in Australia). Providing time for this initial switching may mean that emissions continue to rise for a period, although at a significantly slower pace, before they stabilise and then fall.

In the medium term, the use of new and presently immature low-emissions technologies (along with the more widespread use of existing technologies) will be needed to deliver deep emissions reductions. The progressive rollover of the capital stock will make it more feasible to introduce lower-emissions technologies at reasonable cost. This will depend on having sufficiently strong price signals from the early days of the trading scheme – the longer the time for adjustment, and the stronger the price signal about the need for future adjustment, the lower will be the likely cost.

It would be a mistake, however, to set the emissions trajectory on the basis of the actual emergence of technologies. If the emissions constraint were only to be tightened after new technologies had already emerged, this would:

- depress the price of permits for future emissions significantly
- reduce the incentives for development and diffusion of new technology
- discourage embodying new technologies in replacement capital investment.

Market expectation of higher prices in the future, reflected in the rising forward price curve, is the key lever by which to pull forward new technology. The medium-term gateways should, therefore, ensure that sufficient pressure is applied to accelerate the expected pace of technology development. Tighter constraints on the quantity of emissions will induce higher permit prices. This, in turn, will help accelerate the development and diffusion of new technologies. The further one looks into the future, the more realistic it is to aim for significantly deeper cuts.

Setting the range for possible future caps provides important medium-term information for new firms while ensuring that government does not take on excessive risk by committing to a single emissions-reduction pathway.

The upper bound of the gateway could be interpreted as the emissions reduction Australia is prepared to undertake unilaterally to:

- help the economy make the transition to an emissions-constrained future
- ensure that adverse economic impacts are manageable
- establish a credible international negotiating strategy for moving towards a workable global scheme.

The lower bound of the gateway could be interpreted as the maximum contribution Australia would be prepared to make based on sufficient progress towards an effective international agreement and the expected

commercial deployment of known and anticipated low-emissions technologies.

> With careful planning and analysis, it would be possible to design an emissions trading scheme for Australia that can support a pathway to emission reductions without harming the competitiveness of Australian industries.
>
> *Rio Tinto Limited submission to the Task Group*

7.2.3 Coverage and providing for comprehensive action

The efficiency and fairness of a national abatement effort will be increased to the extent that all sectors contribute to greenhouse gas reductions. The broader the opportunity to identify and implement abatement opportunities, the lower will be the cost to the economy of meeting any given abatement task. In addition to achieving abatement efficiently, comprehensive coverage has an important equity dimension: it ensures the abatement task is shared broadly across sectors of the economy, as well as bringing benefits in terms of increased liquidity in the Australian emissions trading scheme.

Exclusions should only be considered in light of compelling practical considerations, particularly the lack of accurate and cost-effective ways of measuring and verifying emissions (or appropriate proxies). The lack of reliable measurement methodologies may suggest that some activities be excluded from an emissions trading scheme, at least until measurement issues can be resolved.

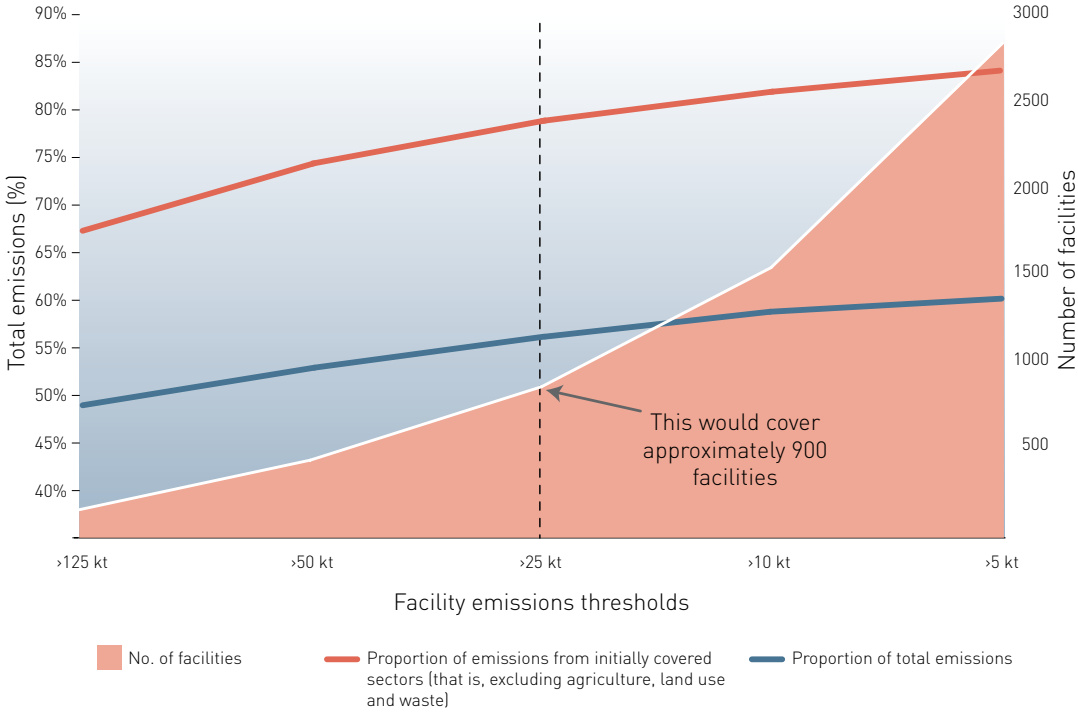
For some processes such as fuel combustion, emissions can be measured or estimated at relatively low cost with a high degree of accuracy. For a limited number of emissions sources (waste, fugitive emissions and agriculture) there is higher complexity and uncertainty at the facility level at present. The practicality of inclusion in the scheme is also affected by cost-effectiveness considerations. Where emissions must be measured from a large number of small sources, the compliance costs of inclusion increase.

Consideration of these factors (see Appendix J) suggests that there is a strong case for all energy, industrial and fugitive emissions to be included in the scheme from the beginning. However, measurement uncertainties and compliance cost issues suggest that agricultural and land use emissions be initially excluded. For a small number of additional activities, including waste, the practicality of inclusion should be further investigated during the detailed design phase.

The number and size of facilities captured by an emissions trading scheme will be a key determinant of compliance costs. If permit liability is based on direct emissions from facilities, the number of facilities covered by the scheme would increase rapidly below a certain size threshold, for little gain in emissions coverage (see Figure 7.4). This suggests that direct liability for the acquittal of emissions permits should only be imposed on facilities above an emissions threshold. Details should be determined in the design phase, but a threshold of around 25 kt CO_2-e per annum would appear to strike a good balance between high direct coverage and cost effectiveness. On this basis around 900 relatively large facilities would be included in any Australian scheme. Emissions from these facilities amount to around 80 per cent of total emissions outside of agriculture, land use and waste, or around 55 per cent of total emissions.

Allocating permit liability to direct emitters above a specified threshold should be accompanied by an approach that covers the energy emissions of other entities by imposing liability on their upstream fuel suppliers. This would be a cost-effective way of covering smaller individual sources of emissions – particularly from residential and commercial transport and

Figure 7.4 Coverage based on permit liability at point of emissions



energy use in other sectors such as agriculture – as fuel is a highly accurate proxy for energy emissions, and would require relatively few facilities to participate in the scheme. Except for the agriculture and waste sectors, almost all emissions for small entities relate to fuel combustion, which suggests that allocation of permit liability to upstream fuel distributors could ensure broad coverage for the scheme.

The Task Group's preferred approach is to combine coverage of direct emissions from large emitters so they can directly manage their entire emissions liability, with upstream coverage of fuel suppliers (principally non-industrial coal, gas and liquid fuels) for other energy emissions. Such a mix of permit liability arrangements would provide a scheme that was broader in coverage and scope, increasing its efficiency. The proposed scheme would cover almost 100 per cent of industrial process, energy and fugitive emissions and 70 per cent to 75 per cent of total emissions, depending on final coverage of sectors such as waste. In particular, these arrangements would ensure that fuel use in the agriculture and transport sectors was included within the Australian scheme – an important point, particularly given the significant size and growth of transport emissions.

The preferred approach reduces the risks of economic distortions both within and between sectors, by ensuring that all activities face a similar carbon price. This could be important in some sectors where large facilities cover only a moderate proportion of total production and emissions (see Appendix J). Variants of this approach could be explored during the design phase, including the voluntary 'opt in' for energy emitters not captured by the threshold (which would allow companies to include all emissions regardless of facility size).

This approach strikes a balance between ensuring a broad coverage of direct emissions and minimising compliance costs for business. In particular, an emissions trading scheme along these lines will achieve very high coverage levels while limiting the number of facilities

Box 7.1: Abatement policies for agriculture

The scope for implementing alternative abatement policies to agricultural emissions appears limited in the short term. Many of the factors that suggest initial exclusion of the agricultural sector from an emissions trading scheme also suggest that a carbon tax is also currently impractical

- that is, the lack of reliable measurement methodologies at the farm level and the complexity and cost of verifying emissions.

The scope for new cost-effective regulation also appears to be limited. Land clearing – one of the key sources of emissions from the sector – has already been regulated in most states to achieve both improved natural resource management and greenhouse gas mitigation. There are few obvious additional regulatory options available.

Proposals to cover only a subset of agricultural activities with alternative price or regulatory measures (say because practical measurement issues are resolved earlier) need to be carefully considered, given the potential for economic distortions to be introduced between related activities in the sector (for example, between intensive and extensive livestock, or between livestock and cropping). On the other hand, different agricultural activities and products have very different carbon profiles. There may be capacity for significant abatement in response to policy measures. The agricultural sector should be engaged to develop realistic options.

The main focus for the agricultural sector at this stage in emissions trading is to increase its capacity to achieve low-cost abatement, initially via the provision of offsets. This suggests the research effort should be enhanced to develop greater understanding of practical abatement opportunities for the sector, and to improve enterprise measurement of agricultural emissions. Announcing the intention to include agriculture within the scheme on a defined timetable would provide an important incentive for research and development activities and their piloting at farm level. Early results from such efforts (before application of a price signal) would produce returns to the sector in the form of greater opportunities for the sale of offsets into the sectors covered by an emissions trading scheme.

directly involved in scheme administration (emissions measurement and permit acquittal). Importantly, such an approach will not impose any additional administrative compliance costs on small business (although all businesses and households will be indirectly affected as carbon prices flow through the economy).

7.2.4 Abatement policies for excluded sectors

In keeping with the principle of comprehensive coverage, the agriculture and waste sectors, which are initially excluded from the scheme, should face the prospect of future inclusion when practical measurement issues – including compliance cost – are resolved.

> Many Australian farmers are...well positioned to undertake actions on farm land that should be able to be recognised in a national emissions trading scheme as an eligible offset credit... Australian agriculture also has the potential to provide a very important contribution to the national effort to reduce net greenhouse emissions.
>
> *National Farmers' Federation submission to the Task Group*

Even from the beginning, they have a key role to play. Excluded sectors are likely to have access to a range of low-cost abatement opportunities. Allowing these sectors to provide certified offsets will reduce the cost of achieving a given scheme cap, and lower the cost of greenhouse gas reductions for the economy as a whole.

To the extent possible, though, efficiency and burden-sharing principles suggest sectors not covered by the scheme for any length of time should be subject to equivalent alternative policy instruments. That is, the voluntary and project-based nature of offsets means that the national abatement effort would remain concentrated on a smaller group of sectors and products. Eventual inclusion of all sectors in the emissions trading scheme, or imposition of alternative policies, should therefore remain a fundamental policy principle.

An analysis of the particular situation facing agriculture (see Box 7.1) suggests that at present there are few options for imposing equivalent carbon constraints through other policy instruments (although energy emissions in the sector would be covered via the upstream arrangements outlined in Section 7.2.3). The need to improve understanding of emissions measurement and abatement options in this sector suggests an immediate priority for increased research and development.

> While agriculture has not been included in any emissions trading system developed yet, its emissions profile in Australia could make it a candidate for inclusion in any newly developed national emissions trading system which seeks to reduce national emissions in a cost-effective manner.
>
> ...
>
> The exploration of a phased approach to incorporating agriculture fully into a national emissions trading system highlights the need for research to identify low-cost mitigation options for Australian agriculture, the development of industry standards for mitigation and offsets, the verification of methodologies, and the accreditation of management practices. This will require industry, government and the research community working together.
>
> *Rural research and development corporations submission to the Task Group*

7.3 Minimising the economic cost

7.3.1 Capping the cost

The overriding objective of emissions trading is to limit emissions at least cost. There should be sufficient permits acquitted to match actual emissions, with the market price of permits indicating the cost of abatement. However, there may be times when firms cannot acquire sufficient permits due to limited market liquidity or where the cost of doing so would be regarded by government as excessive. In these circumstances there needs to be a flexible way to redress the shortfall while maintaining an economic incentive for firms to develop cheaper abatement and permit-purchase strategies.

The Task Group believes that the use of an emissions fee – a pre-set fee for every tonne by which emissions exceed the permits held by a firm – could satisfy this objective at least cost and with little distortion of abatement incentives. As a permanent feature in the trading scheme, this would not only provide a compliance incentive but also act as a permanent safety valve or cost control mechanism, ensuring the aggregate or macroeconomic costs of the scheme did not become excessive.[2]

It is not possible, however, to control both the price of emissions permits and the quantity of emissions reductions, so the use of an emissions fee as a safety valve comes at the cost of some short-run loss of control over aggregate emissions.[3]

It would, therefore, be necessary to consider carefully what might constitute a reasonable emissions fee, balancing the desire to restrain costs with the potential credibility issues if the short-term caps are regularly breached.

It is the view of the Task Group that during the initial, or settling in, phase of the scheme the emissions fee should be set at a relatively low level. Beyond that, the level of the fee should move further away from expected permit prices in order to reinforce the abatement incentive and ensure tighter compliance with the desired emissions cap (see Figure 7.2).

Setting a binding fee for a significant period of time would also reduce the ability to link with other schemes. In the initial period, while the permit price was constrained by a low emissions fee, it would also be necessary to consider limitations on the ability of firms to 'bank' permits for use in subsequent periods. Otherwise, firms could have an incentive to pay the fee and 'warehouse' permits for when they are expected to be more valuable.

The Task Group considers that the imposition of a 'make good' provision – whereby firms with permit shortfalls are required to both pay an emissions fee and cancel an equivalent number of permits in the next period – would effectively represent a double penalty and would be undesirable, especially at the outset of the scheme. It may be useful to revisit this issue after experience has been gained with the scheme. There would be some merit in considering a short 'true up' period after each acquittal period, before the emissions fee was applied. This would allow firms that record a shortfall to voluntarily purchase additional permits and avoid the fee.

7.3.2 Banking and borrowing

The Task Group believes that, in order to lower overall cost and provide additional flexibility for individual firms, provision should be made for them to be able to 'bank', or carry forward, dated emission permits for use against future emissions liabilities. On the other hand, it should not be possible for firms to 'borrow', or bring forward, future permits to retire against current liabilities.

Climate change is a problem reflecting the build up of greenhouse gases over time rather than a function of emissions in any given year. 'Banking' of an emissions permit means that a unit of carbon is not issued into the atmosphere in that year. As long as integrity over emissions is maintained through time (that is, emissions are matched to permits), the banking of permits against future emissions will lead to the same cumulative emissions reduction and impact on atmospheric greenhouse gas concentrations.

Banking also allows firms to manage emissions profiles more smoothly from year to year to reflect production variations and the business cycle.

In theory, 'borrowing' should result in the same outcome, but there may be an incentive to borrow from the future to cover current emissions in the hope that any serious shortfall between available permits and underlying emissions will be offset

by intervention. This would increase the pressure on a future government to weaken the credibility of the scheme through an opportunistic additional issuance of permits in order to avoid sharp increases in the cost of permits.

As noted in Section 7.3.1, if a low emissions fee is used as a de facto cost cap during the initial years of the scheme, firms that access the emissions fee in any given year would need to be prohibited from banking or selling permits relating to that year.

7.3.3 Providing for offsets

Earlier chapters of this report have highlighted the potentially important role of offsets in any emissions trading scheme, particularly their capacity to reduce the costs of greenhouse gas abatement. At the global level, the recognition of offsets created in developing countries can be an effective way of promoting their involvement in global efforts to limit emissions. Domestically, inclusion of offsets from sectors not covered by the emissions trading scheme will reduce the cost of meeting the scheme cap, and assist in preparing those sectors for eventual inclusion in the scheme. In the view of the Task Group, an approach that recognises a wide range of offsets is highly desirable.

Domestically, offsets from the forestry and agricultural sectors could play an important role in achieving abatement. There are a number of well-established standards for the recognition of credits from carbon sink forests, suggesting that credits from this source could be created and 'banked' ahead of the commencement of permit trading (see Section 7.5.3). This would provide further immediate incentives to this area, building on changes in tax treatment announced in the 2007–08 Budget.

Given the shortcomings in the existing international methodologies for offsets, there is clearly scope to improve on these approaches. By establishing and demonstrating sink and offset methodologies that work and are relevant to a range of global circumstances, Australia would be well positioned to influence the evolution of international rules in this area in a direction that would provide a positive incentive for engagement by developing countries. Of particular importance would be inclusion of international trade in avoided deforestation. The development of rigorous methodologies and governance in this area should be a priority. The Government's recently announced 'Global Initiative on Forests and Climate' could assist in such an approach.

An integral part of Australia's international climate change strategy should be to develop the elements of a future Australian approach to international offsets. It would need to be informed by discussions with a range of international partners. A programmatic model (see Chapter 5) is preferable – one that would lead to greater investment certainty, drive transaction costs lower and promote a longer-term perspective. Simplified approaches to offset recognition could be considered, provided that they could demonstrate robust abatement outcomes. Inclusion of land use, forestry and wood products and the recognition of credits for carbon geosequestration should be priorities. This would help to promote more flexible models for greater global participation.

7.3.4 Linking with other schemes

Chapter 5 suggested that any global emissions trading system in the near to medium term is likely to be a decentralised set of arrangements involving a range of national and regional schemes. The resulting variations in scheme design will have an impact on the capacity to link different schemes, although links are likely to evolve over time.

As a supporter of the development of a global system, Australia has a direct interest in promoting links between comparable schemes. Any Australian domestic trading scheme should

be designed to enhance the scope for links, both formal and informal, with as many different systems as possible.

Australia's basic approach should be to promote links where there is assurance of the integrity of the partner system and the linking mechanism. Whether or not other parties wish to link formally to an Australian trading scheme, Australia should consider recognising quality credits from other official or unofficial (including voluntary) schemes.

> In the absence of a timely international program CSR Limited is supportive of a suitable national scheme, designed to link with other markets as they evolve.
>
> *CSR Limited submission to the Task Group*

Provided these foreign permits or credits deliver a tonne of emissions abatement and if there is sufficient assurance that they cannot also be used in the overseas jurisdiction (that is, that they cannot be used multiple times), recognition will assist in seeking out abatement opportunities at least cost and optimising the timing of exploitation. Any of these links will provide a conduit for the transmission of emission abatement prices and serve to enhance efficiency globally. While this system would not require explicit linking through mutual recognition, these links would still contribute to knitting together the different national and regional schemes.

Price conduits can be expected to operate in both directions – not only allowing Australian emitters access to least-cost abatement opportunities globally, but also allowing non-Australian emitters access to Australian permit prices. These links would promote harmonisation in emission abatement prices worldwide, though it is unlikely that complete harmonisation would be realised for many years.[4]

A range of design features could still present a barrier to formal bilateral linking (see Chapter 5). These include issues such as differences in targets and scope, and divergent approaches to safety valves and price caps. In most cases, such differences would make linking more complex, although they should not necessarily be seen as absolute impediments if there is an opportunity to reduce global emissions.

7.4 Smoothing the transition

In any emissions trading scheme, the allocation of permits can be used as an instrument to share the cost of the emissions constraint more fairly across the economy, promote the development of efficient markets, and help avoid prejudicing the international competitiveness of trade-exposed, emissions-intensive industries.

7.4.1 Permit allocation

A transparent method for allocating permits is critical to the credibility and stability of any emissions trading scheme. It is also one of the most complex design issues. This is a key reason why any early commitment to emissions trading should be accompanied by a period of careful planning before trading commences. For example, see Box 7.2 for a discussion of tax considerations.

Placing a cost on emissions results in a wealth redistribution throughout the economy by reducing profitability for some firms,[5] providing benefits to others (such as renewable energy generators) and raising the cost of consumption for households.

Box 7.2 Tax considerations

Appropriate tax treatment for emissions permits needs to balance efficiency, equity and simplicity considerations. Some broad principles relevant to these considerations follow. The actual tax treatment will depend on the specific details of an Australian emissions trading scheme and judgments about the appropriate balances. Further examination of tax issues will need to be built into any future design work for the scheme.

To maximise efficiency in emissions abatement, the tax system should not introduce distortions between the purchase of emissions permits and other options for meeting emissions targets. Ideally, the tax outcome should be neutral as between purchasing a permit, undertaking capital expenditure to reduce or sequester emissions, undertaking current expenditure to reduce emissions, investing in research and development or reducing production. The tax treatment should not bias decisions by businesses between holding a permit or holding a derivative of that permit. It also would be desirable not to have stamp duty on the trade of emissions permits, to avoid creating non-neutralities with similar assets.

A key equity issue is the tax treatment of the proposed compensation. Compensation should be based on the post-tax amount of any losses, since the tax system already provides some mechanisms to mitigate the impact of policy announcements on asset prices (see note 7 at the end of this chapter for examples). The post-tax compensation payment should be equivalent to the appropriate proportion of post-tax losses.

The tax arrangements for an emissions trading scheme should be as simple as possible. Experience shows that it is better to accommodate new products, such as emission permits, within existing tax arrangements than to create special treatments that add to the complexity of the tax law and may open tax arbitrage possibilities. As the design of the scheme proceeds, there will be greater scope to determine if it can be accommodated within existing tax law in a way that meets the policy intent of least-cost emissions abatement.

Further details of the appropriate taxation treatment of emissions permits would depend on the other design characteristics of the scheme. GST and international tax implications would also require further consideration.

> The economic burden imposed on a particular firm or industry sector under a greenhouse gas trading program is not a direct function of its emissions or fossil-fuel throughput. Rather the burden depends on a number of factors, including ability to pass through costs, emission reduction opportunities, and [the reaction] of consumer demand for the firm's or sector's output in response to higher prices.
>
> *US National Commission on Energy Policy (2007, p. vii)*

The extent to which individual firms experience an unexpected loss of asset value will be determined by two factors:[6]

- the cost of the firm's carbon exposures, both direct (that is, its own emissions) and indirect (that is, what is embedded in its inputs)
- its ability to pass on these costs to its customers, whether in Australia or in global markets.

The method adopted to allocate permits could introduce further arbitrary wealth gains and losses, or it could be used to partly redress the initial wealth redistribution.

After considering the merits of different approaches to the issuing of permits, the Task Group believes that the methodology chosen should satisfy three criteria:

- it must avoid creating disincentives for early abatement
- it must not provide ongoing incentives for 'rent seeking', or opportunities to overturn or undermine the scheme
- it must minimise ongoing transaction costs for business and government and promote market efficiency.

The methodologies available to allocate permits include:

- free allocation to businesses to redress all or part of the loss in asset value
- free allocation based on historical emissions (grandfathering)
- free allocation based on benchmarking against industry averages or best practice criteria
- auctioning.

Each of these methodologies is potentially complex, imperfect and imposes some degree of administrative burden (see Appendix K).

In considering who, and how much, to compensate we must emphasise once again that the introduction of an emissions trading constraint imposes an unavoidable cost on the whole economy. Households will face higher costs and some firms a loss in the value of their assets.

For firms, it seems desirable to use permit allocations as a means of providing compensation. Administrative complexity argues, though, against attempting to compensate explicitly all firms within the scheme.

> Giving away allowances won't shield firms or consumers from [the] price signal...
>
> But allowances can be used for a variety of productive purposes: to compensate those who bear a disproportionate burden under the policy, to advance other public-policy objectives (such as supporting energy R&D), or to provide broad societal benefits (for example, making it possible to cut taxes on income or investment).
>
> *US National Commission on Energy Policy (2007, p. viii)*

For firms, an approach that focuses on redressing disproportionate (that is, significantly larger than average) losses in asset value strikes a reasonable balance between equity and administrative simplicity. All other allocation methodologies, apart from complete auctioning, have administrative complexity. None of the alternative approaches provides redress for loss of value. Over time, and having provided effective compensation, the auctioning of residual permits provides an economically efficient and transparent means of permit allocation (Bovenberg & Goulder, 2000).

A compensatory approach would provide a one-off allocation of permits with various dates of effect. The permits would have a collective value broadly equivalent to the excess loss of value – that is, the amount by which the loss exceeds a benchmark loss (see Box 7.3 for a worked example of how this could be applied). The one-off nature of the allocation ensures that there are no ongoing incentives for 'rent seeking', while the auctioning of residual permits reduces transaction costs and contributes to price discovery and market efficiency.

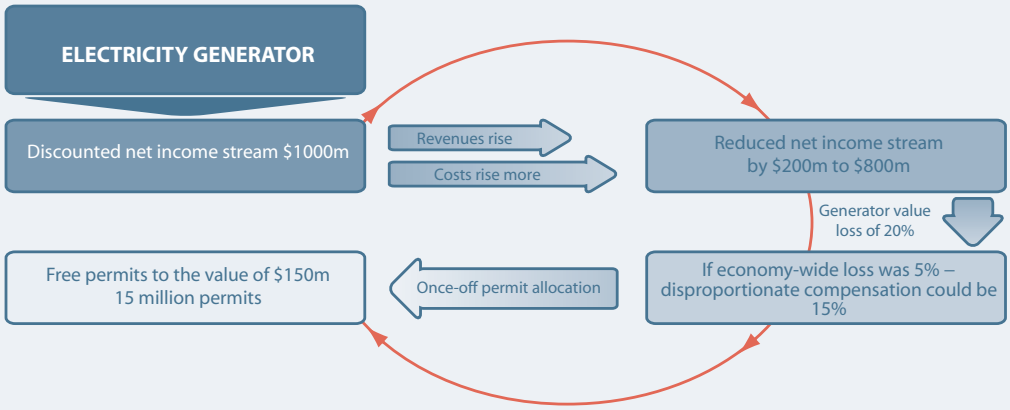
While the bulk of any remaining permits for the period of the short-term cap (2011 to 2020 in our example) could be auctioned up front, regular auctions of a proportion of those remaining could assist in promoting market liquidity and price discovery. Accordingly, there would be benefit in progressively auctioning the remaining permits

Box 7.3: Permit allocation methodology

This worked example outlines a possible free permit allocation process to compensate an electricity generator for a disproportionate loss in asset value (in post-tax terms). In the example, an electricity generator owns assets with a market value of $1 billion – the present value of expected future net income flows.

After the introduction of an emissions trading scheme, these net income flows are reduced. The generator suffers a net loss in income even though it can pass much of its increased carbon costs onto electricity consumers. In this example, the net income loss over time amounts to $200 million – a 20 per cent reduction.

If modelling were to show that economy-wide losses amounted to 5 per cent, free permits could be allocated to compensate for any proportion of loss in excess of this amount. In the example, free permits (at an assumed price of $10 per tonne of CO_2-e) compensate for the disproportionate loss of 15 per cent (that is, 20 per cent minus the 5 per cent economy-wide impact). This amounts to 15 million permits with a total value of $150 million. The one-off compensation could also be delivered using a combination of differently dated (and, hence, differently valued) permits. Permit allocation would be designed to address disproportionate losses in post-tax terms.



over the period 2011 to 2020, combined with possibly less frequent auctioning of a small amount of permits dated beyond 2020.

By calculating a one-off asset loss at a particular date and providing appropriate recognition for early action (see Section 7.5.3), the incentive to abate is not adversely affected. After the date of announcement of an intention to proceed with emissions trading, decisions to invest would be taken in the knowledge of the impending introduction of a price on carbon. Such investments should not be eligible for compensation.

The transitional nature of support for trade-exposed, emissions-intensive industries warrants a different approach. This is discussed in detail in the next section. Further detail on how the compensatory approach to permit allocation might work is provided in Appendix K.

The Task Group recognises, however, that this compensatory approach potentially involves significant complexities. It has not been possible in the time available to work through all the practical implications of the proposed approach. After further investigation, government

may decide that an alternative approach is administratively simpler. If so, it will be important to ensure that the chosen methodology does not distort incentives to abate.

7.4.2 Trade-exposed, emissions-intensive industries

> An emissions trading scheme should be part of a phased, certain and comprehensive suite of policies to tackle greenhouse emissions across the Australian economy...Any scheme would need to address export-exposed industries and not be designed in a way that damages Australian industry's international competitiveness.
>
> *Minerals Council of Australia submission to the Task Group*

In order that the competitiveness of Australia's trade-exposed, emissions-intensive industries not be prejudiced, the Task Group has focused on developing transitional arrangements for these industries.

On balance, the Task Group believes that the approach most likely to avoid damaging the competitiveness of these industries would be one that:

- allocated free permits every five years to existing investments in the trade-exposed, emissions-intensive sector equivalent to the carbon costs flowing both from their direct (industrial process) and indirect (energy and embodied production inputs) post-tax costs. Over time, allocations to offset direct emissions could be calculated as if firms were using world's best practice low-emissions technologies
- allocated free permits for any new investments in trade-exposed, emissions-intensive sectors to offset direct emissions as if the investments were using world's best practice low-emissions technology.

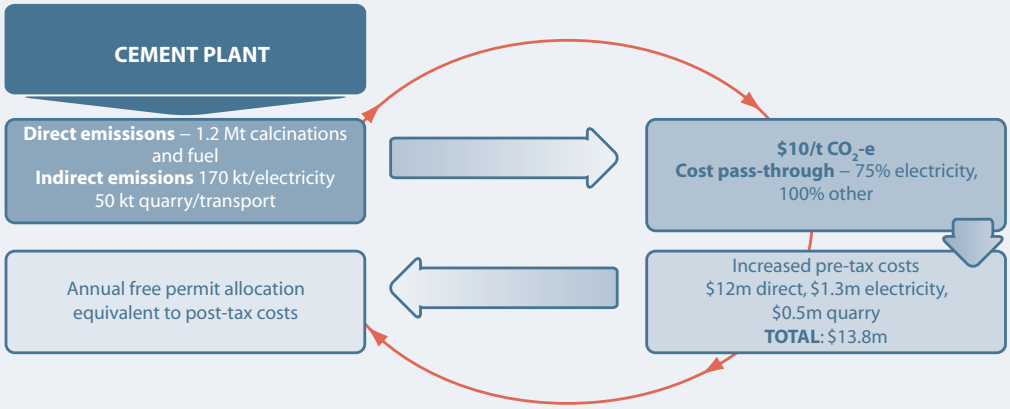
In order to provide incentives for abatement during this transitional period, it would be important to ensure that all firms in trade-exposed, emissions-intensive industries are treated, over time, as if they were using world's best practice low-emission technologies. In the event that a firm was using a higher-emissions technology, it would need to purchase permits in the market.

> 'Insulating' trade-exposed, emissions-intensive industries should:
>
> - be a transitional arrangement and be open to regular review in light of new international policy developments such as competing countries taking on carbon pricing
> - be conditional on industries demonstrating they are meeting world's best practice standards in greenhouse intensity and technology development. This should be open to regular review in light of global technological developments
> - also only be based on the actual 'trade-exposed' elements of a company's operation and should not be applied if the company can pass on any additional costs to customers.
>
> *The Climate Institute of Australia submission to the Task Group*

To minimise the welfare implications on other sectors of the economy, the emissions cap under the scheme could be adjusted upwards to account for emissions as a result of new investments in the trade-exposed, emissions-intensive sector. Given the time lags involved between decisions to invest and initial production, it is likely that there would be sufficient room to accommodate these upward adjustments within the gateways or emissions bands.

Given the transitional nature of these arrangements, allocation of free permits should

Box 7.4 Permit allocations for trade-exposed, emissions-intensive industries



This worked example outlines a simple case of cost amelioration for a generic cement plant that is trade exposed due to import competition. The plant releases 1.2 million tonnes of CO_2-e annually from calcination and from fuel combustion – its direct emissions.

It also purchases electricity, which contains embedded emissions equivalent to 0.17 million tonnes of CO_2-e. In this example it has been assumed that the electricity supplier passes 75 per cent of its emissions costs onto end users such as the cement plant. The plant also faces higher costs for emissions attributable to upstream quarrying and transport. These costs are assumed to be fully passed forward.

At an assumed permit price of $10 per tonne of CO_2-e, the plant faces higher pre-tax direct costs of $12 million and indirect costs of $1.8 million (that is, $1.3 million from higher electricity costs and $0.5 million from other indirect inputs).

These costs would be tax deductible business expenses. Sufficient free permits would need to be issued to the cement plant each year, to cover the plant's costs in post-tax terms. The best method for delivering 'post-tax' cost amelioration should be given priority in any subsequent work on emissions trading.

be: for fixed periods, say five years; conditional on continued production in Australia; and be subject to regular reassessment as to whether they continued to be warranted. The timing of these reassessments might coincide with the periodic review points already proposed for the scheme. It will be important that trade-exposed, emissions-intensive firms are assured of:

- continuing transitional support while circumstances remain unchanged
- a phased adjustment period in the event circumstances warrant the withdrawal of transitional arrangements.

When transitional arrangements are withdrawn, trade-exposed, emissions-intensive firms would be eligible for compensation for any resultant disproportionate loss of value in respect of assets in existence at the announcement of the scheme. This would be the same as the treatment received by other firms at the outset of the trading scheme.

More detailed discussion of the treatment of trade-exposed, emissions-intensive firms, and a discussion of criteria for their definition, is provided at Appendix L.

While advice to the Task Group suggests that such transitional arrangements would not be inconsistent with Australia's World Trade Organization obligations, this advice would need to be reviewed when the transitional arrangements were finalised.

7.4.3 Use of revenues

The emissions trading model outlined here would generate revenue from the auction of permits and emission fees from firms unable to acquit sufficient permits to meet their obligations. It is likely that annual revenue flows from emission fees will be variable and, if the fee is set appropriately, highly uncertain. Revenue flows from permit auctions will depend upon the structure of compensatory allocations (which influences the residual amount of current period permits available for auction) and decisions on the timing and number of short and long-dated permits to be released in any one year.

Given the uncertainty about international progress on climate change frameworks and climate change science, emissions caps settled now may turn out to be too high. There could be a case for holding back part of auction revenues in case it is necessary for the government to re-enter the market to purchase permits.

Putting this possibility aside, revenue could potentially be directed to the following areas:

- expanded investment in research and development and pre-commercial demonstration of low-emissions technologies
- measures to address other significant market failures that impede the transition to a lower-emissions intensity economy, for example the take-up of energy efficiency measures
- assistance to households
- funding co-operative action on climate change with developing countries
- managing the overall business tax burden by recycling revenues to reduce other business

Given the importance and magnitude of the emissions reduction challenge, the Task Group encourages the Government to accord the highest priority for the use of revenue to the support of the first two tasks.

In doing so, it recognises that it is not necessarily desirable to link these revenue flows directly (that is, hypothecate) to expenditure programmes. Annual revenue flows may be low in the early years but, as the scheme matures and the bulk of permits are auctioned, may eventually exceed requirements by a considerable margin. Linking revenues directly to spending programmes could undermine the quality of projects that receive support. However, there is merit in the broad principle that revenues raised are best directed to meeting the abatement challenge that has prompted Australia to consider adopting emissions trading.

The use of a market mechanism to place a price on carbon will have equity implications – someone has to meet the costs imposed on the economy. In the case of business, this has been reflected in the proposed compensatory approach to permit allocation for firms suffering disproportionate loss in value.

Acquiring permits, whether through free allocation or by purchase, will become a cost of doing business. The incidence of that cost – the ultimate distribution of the cost – will be determined by the market environment confronting individual firms. Some firms will be able to pass on costs wholly or partly to households in the form of higher prices. Other firms, especially those producing products whose prices are set in global markets, could see demand and profits fall if their competitiveness is eroded. This will impact detrimentally on shareholders and workers in those industries, at least for a transitional period.

Regardless of how permits are allocated, much of the cost from imposing a constraint on emissions will ultimately be borne by Australian

households (and some offshore investors in Australian firms). They will face higher prices for electricity, petrol and other CO_2-e intensive products, and their income from returns on capital may also be reduced, at least for a period. Box 7.5 outlines some possible impacts on households.

While the household sector should not be shielded from the price changes arising from a decision to impose a carbon constraint on the economy – this would act counter to price-based incentives to change consumer behaviour – the impact on low-income households in particular may lead government to consider ways in which households might be assisted. Government may wish to consider helping households to constrain costs through better management of their consumption of carbon-intensive products.

As the scheme matures government may also wish to consider directing part of the increasing auction revenues generated by the scheme to households and business.

7.5 Developing well-functioning markets

The development of well-functioning markets is essential to achieving a least-cost outcome and drives the best possible decision-making by business and other stakeholders over time. As shown by the early experience with the EU Emissions Trading Scheme, the design of the scheme can affect the functioning of markets, particularly its ability to promote accurate short-, medium- and longer-term price discovery. Well-functioning markets depend critically on liquidity (volume of trade), systems to ensure the integrity of market behaviour, and high quality and timely information.

Box 7.5 Some estimates of household impacts

Consumers will be affected by the introduction of a carbon price through a rise in the cost of electricity and petrol, and through increases in the carbon cost embodied in consumer goods. The impact will depend on both the size of the carbon price and each household's consumption pattern. Under the states and territories proposed national emissions trading scheme (National Emissions Trading Taskforce, 2006), a scenario with the carbon price rising from $6 to $17 per tonne in years 2010 to 2020 is associated with an average increase in household electricity bills by between $25 and $80 per year depending on the jurisdiction (or less in some jurisdictions because of the use of gas instead of electricity for cooking and heating). Another scenario with carbon prices averaging around $30 per tonne between 2021 and 2030 is associated with an increase in average bills by between $70 and $200 per year. The full impact would also depend on embedded costs in other areas of household consumption.

There are many actions consumers can take to reduce, or even avoid, the impact of higher electricity prices. For example, choosing energy-efficient products when purchasing replacement appliances, can deliver significant energy savings over the life of the product.

7.5.1 Creating markets

Australia has well-developed financial markets, which already provide much of the necessary infrastructure to support a domestic emissions trading scheme with international linkages. These include registries, mechanisms for monitoring and verifying trades, and clearing and settlement services. Important experience has already been gained through trading Renewable Energy Certificates, NSW Greenhouse Gas

Abatement Certificates, and Queensland Gas Energy Certificates.

A key lesson learnt from these domestic and offshore schemes (such as those of the European Union and the Chicago Climate Exchange) has been that, once the principal legal provisions and permit allocations are established, the ongoing role for government should be minimised. Government should maximise the use of existing financial market infrastructure (including registries) wherever possible.

However, to develop a fully fledged carbon trading market, some minimum requirements need to be met. In particular it is important that government provides a 'strong and unambiguous signal to industry about the likely nature of an [emissions trading scheme]' (Baker & McKenzie, 2007, p. 8).

Government guidance is needed on:

- the time frame and coverage of the trading scheme
- scheme caps in the short term
- indicative ranges for the medium term
- an aspirational goal for the long term.

Decisions about permit allocation methodologies and offset regimes will also assist in the full development of the market over time (Baker & McKenzie, 2007, p. 8).

To facilitate these developments, the determination of the scheme parameters and infrastructure arrangements should be given priority in any subsequent work on emissions trading.

Once the key principles of the scheme are established, the financial market can play its role by:

- reducing transactions costs (the cost of buyers and sellers finding each other)
- facilitating price discovery and the transfer of risk (underpinning investment decision making)
- minimising the prospect for counter-party and settlement default (which assists the market's credibility and provides security for market participants).

7.5.2 Promoting price discovery, market liquidity and risk management

Previous chapters in this report have highlighted the importance of price information, and the role that expected future carbon prices play in encouraging the development and deployment of new and existing low-emission technologies. Well-developed financial markets and instruments are essential tools in the discovery of spot and forward prices for carbon in an emissions trading scheme.

Aside from the actual permits that can be traded, related products will emerge in the market. Warrants, futures and options contracts will develop rapidly after the Government provides clear signals of its intent to establish an emissions trading scheme.

These related products (and other more exotic formulations) will form the basis of the derivative markets that will support the emissions trading scheme. Derivative markets have two central roles: risk transfer and price discovery (Australian Securities Exchange, 2007, p. 5). For market participants, the primary purposes of derivatives markets are:

- to transfer the risk of adverse changes in prices from those who wish to reduce risk to those willing to accept it
- the revelation of price information that reflects the consensus of real bids, offers and trades
- bids, offers and trades in futures and option markets are publicly disseminated – as a

result, they often become the primary source of price discovery.

The significance of derivative markets in relation to the efficiency of an emissions trading scheme is highlighted by the experience of the EU scheme. Up to 95 per cent of the total volume in this market has occurred in derivative trades (forwards, futures and options), with the remaining in spot trades.

This demonstrates the important role that derivatives markets play in providing market participants in an emissions trading scheme with information about future permit prices, and the capacity to manage price risk efficiently.

> Forward and secondary markets ... enable market participants to manage the risks inherent within their businesses and compete with each other at the lowest possible cost to consumers.
>
> *Australian Securities Exchange submission to the Task Group*

Market liquidity is also important in the development of the market and associated risk management products. Government can support a liquid market by providing clear and transparent guidance regarding the major scheme features and rules.

Liquidity will also be enhanced by a phased issuance of permits with varying dates. This will provide derivatives markets with guaranteed access to an underlying instrument (namely the emissions permit) in the future. Auctioning (or freely issuing) a small number of longer-dated permits will also help to underpin the forward markets and provide investors with confidence of the scheme longevity.

In addition, auctioning permits with different maturity dates may reduce the consequences from some businesses holding on to their allocations, particularly in the early phases of an emissions trading scheme.

7.5.3 Encouraging early abatement

Any announcement and design of a trading scheme must include provision that ensures continued take up of low-cost abatement actions in the lead-up to the commencement of trading. Many companies have already undertaken voluntary abatement activity for a variety of motivations (commercial value, corporate social responsibility and capacity building). Decisions to undertake further activities such as these should not be impaired.

Maintaining incentives for firms to undertake abatement in the period prior to commencement of trading ('early abatement') can be achieved in a number of ways:

- ensuring that firms undertaking such action do not suffer a disadvantage when permit allocations are made
- crediting early abatement from offset activities that are additional to current measures
- crediting early abatement from activities that would be covered within the emissions trading scheme.

Design of the allocation process is particularly critical in this regard. A poorly conceived allocation process could lead to strong incentives to delay abatement and, at worst, could artificially inflate emissions in the lead-up to allocations. The rejection of grandfathering as an allocation methodology would go some way towards reducing these risks. The preferred approach to allocation – to compensate for disproportionate losses – necessarily requires base emissions data from which to calculate permit allocation. In some cases this will only be available after the new mandatory monitoring and reporting arrangements are in place. But firms should not be disadvantaged because measurement systems are not yet in place if they undertake additional abatement after the announcement of a decision to adopt emissions trading.

There is also a case for encouraging abatement before the trading of permits begins, particularly by providing incentives for early investment in carbon sinks. Recognition of abatement action could provide companies with valuable opportunities to build familiarity with carbon credits and manage risk in the lead-up to trading. It could also provide additional liquidity in the early stages of scheme operation.

Consideration should be given to recognising credits from sectors not covered by the scheme, principally from the establishment of biological carbon sinks within Australia (including carbon sink plantations), and international carbon credits. Consideration should also be given to providing an early signal that new abatement activities accredited to existing standards (for example, certain classes of Clean Development Mechanism, or under the Australian Government's Greenhouse Friendly programme) should be able to generate credits for the scheme. This would provide immediate opportunities to undertake abatement, and ensure maximum continuity with emerging voluntary markets.

The provision of credits for early abatement for activities covered by the emissions trading scheme should be considered in the design phase. Any approach needs to be administratively simple (given the short time available to put in place an approval process prior to the commencement of trading). It must not undermine the integrity of the scheme – if credits are provided for activities that do not in fact provide additional abatement, this will impact on both the abatement outcomes for the scheme and equity between firms. Such action needs to be coordinated with any complementary measures put in place in the lead up to the scheme (for example, initiatives to encourage energy efficiency) to ensure that there is no 'double dipping'.

One approach could be to provide a fixed pool of credits which are allocated on a 'first come, first served' basis for verified emissions abatement activities that are additional to current abatement efforts. Consideration would need to be given to the quantum of available credits, the basis of translation (one-for-one or scaled) and the range of eligible activities. Other options exist, including a voluntary early trial of trading for companies with high-quality measurement and verification of data. Incentives to participate could include limiting credit for early action to participants. To maintain the integrity of the overall abatement effort, credits awarded for early abatement would need to be taken into account in setting first period caps (that is, overall caps would need to be reduced by an equivalent amount, although this could be spread over the full period to minimise the impact on available permits in any given year).

The Task Group does not consider that credits should be provided for abatement activity undertaken before any policy announcement. Such firms would have undertaken early action voluntarily on the basis it made good business sense. Crediting action requires introducing criteria that are in some sense arbitrary (even in cases where abatement is verified using established frameworks). It could produce a windfall gain for some companies, and would load greater adjustment to any cap onto other firms in the system.

7.5.4 Monitoring, compliance and trading infrastructure systems

The ability to monitor, report and verify business emissions data accurately is essential to judging compliance and maintaining the environmental and financial integrity of the trading system. Emissions markets, like other markets, require a sound base of publicly available information to operate efficiently.

The Task Group recognises that Australia has developed relatively good but dispersed energy and emissions data collections. However, these

are not yet of sufficient standard to underpin an Australian emissions trading scheme. A new 'fit for purpose' monitoring, reporting and verification system will be required.

The Task Group acknowledges the in-principle decision by the Council of Australian Governments to establish a national energy and emissions reporting mechanism along with its commitment to reduce the 'red tape' imposed on business.

A single national reporting system needs to be established in a way that is consistent with the monitoring, reporting and verification needs of the trading scheme and the commitment to streamline the reporting burden across all jurisdictions.

There is also a need for further transaction account and inventory infrastructure to be developed. These systems must be transparent and involve regular public disclosure of information about any accepted commercial-in-confidence requirements.

Notes

1 The National Emissions Trading Taskforce has also proposed combining firm short-term caps with medium-term gateways.

2 While not part of the model proposed here, it may also be worthwhile to consider the development of a floor price whereby government acts as a purchaser of permits if the market price falls sufficiently. This could provide an incentive for firms to undertake more extensive abatement without the risk that their efforts would be stranded by a future fall in permit prices, say due to a future technology breakthrough.

3 It is for this reason that the McKibbin–Wilcoxen approach comprises both a short-term carbon tax and a long-term emissions trading scheme. See, for example, McKibbin & Wilcoxen, 2006.

4 The Government may wish to consider limiting the export of Australian permits other than to countries with which we have mutual recognition arrangements.

5 The value of an asset is simply the discounted present value of the stream of profits it is expected to generate. Changing the stream of profits results in a change in asset value and hence redistributes wealth across the community.

6 To the extent that markets have accurately factored in a future carbon constraint, these losses will already have been capitalised into asset prices.

7 The tax system will ameliorate some of the impacts on changes in wealth. This creates a difference between the pre-tax and post-tax measures of any loss or gain. The mechanism creating this difference varies according to the nature of the asset and the timing of any sale of the asset. For example, firms experiencing a windfall loss in assets subject to depreciation under the tax system may continue depreciating their assets at historical costs (under safe harbour arrangements) rather than the new, lower, market value. Alternatively, these firms could immediately sell the asset, with the full loss in value immediately recognised, thereby reducing their current income tax obligations. In terms of the firm's shareholders, where any loss is reflected in a lower share price, that loss will reduce any capital gains tax obligations which may otherwise have arisen when sold. For a firm or shareholder experiencing a windfall gain the opposite would generally apply.

8 Supporting policy measures to achieve abatement

8.1 Overview

A well-calibrated cap, supported by an emissions trading scheme, will address the central market failure relating to climate change by pricing greenhouse gas emissions. It is, however, only one part of the comprehensive suite of policies needed to effectively reduce emissions over time.

In the short to medium term, significant abatement will be available from relatively low-cost activities that improve energy efficiency and through adjustments to production techniques using existing technology (for example, fuel switching). In the longer term, achieving sustained abatement without dramatic impacts on living standards will require a significant rethink of current production techniques and the diffusion of low-emissions technologies. This chapter outlines the broad nature of policies to encourage low-emissions technology development and improve energy efficiency. It also deals with the potential to rationalise existing policies over time. Key messages are:

- Well-designed and well-targeted low-emissions technologies and energy efficiency policies can reduce the economic costs associated with a carbon constraint.
- There are strong arguments for increasing funding for basic and applied research and development of low-emissions technologies.
- Significant public resources could be required to demonstrate low-emissions technologies in the lead up to, and in the early stages of, an emissions trading scheme.
- It is critical that the policy towards deployment of low-emissions technologies be technology-neutral and fuel-neutral, allowing the market to choose least-cost solutions.
- The key incentives for technology deployment should emerge from an emissions trading scheme that has maximum 'pull forward' through a credible and rising carbon price signal.
- Australia should continue to place a high priority on international technology cooperation initiatives – the inclusion of scope for international offsets in a domestic emissions trading scheme will provide further incentives for these efforts.
- There will be a continuing role for initiatives that improve information, awareness and adoption of energy efficient vehicles, appliances and buildings – this will help households and businesses manage carbon costs.
- While there is a role for well-focused complementary policies, programmes should be abolished or phased out unless they are directed efficiently at clearly demonstrated market failures not addressed by the emissions trading scheme.
- All levels of government will need to rationalise the existing plethora of complementary policies in order to achieve maximum effect at minimum cost, with least imposition of red tape on business.

Box 8.1 Implications of technology development and energy efficiency for the cost of an emissions trading scheme

Numerous modelling results show that faster technology development or enhanced uptake of energy efficiency opportunities can lower carbon prices and the economic cost of an emissions trading scheme considerably. Conversely, if fewer technology and fuel options are available then this will increase the cost.

- The Task Group commissioned the Australian Bureau of Agricultural and Resource Economics to assess the effects of accelerated technology development and improved energy efficiency (Appendix H, Scenario 5). A scenario that brought forward implementation of a range of technologies by six years ahead of 'business as usual' assumptions, showed that the economic costs of achieving a given abatement target could be reduced by one-third.
- Modelling for the states and territories' proposed national emissions trading scheme concluded that, by 2020, enhanced energy efficiency, demand-side 'induced technical change' and increased forestry biological sequestration reduce the economic cost of achieving a given level of abatement by around one-quarter (Allen Consulting Group, 2006b).
- The Energy Supply Association of Australia (2006) found that to achieve a reduction of 30 per cent of electricity-related emissions from 2000 levels without nuclear and carbon capture and storage technologies would approximately double total electricity production costs compared with the scenario where these technologies were available.
- Modelling by the Australian Bureau of Agricultural and Resource Economics (Ahammad et al., 2006) for the CSIRO's Energy Futures Forum found that the availability of carbon capture and storage in power generation would reduce global carbon prices by more than 50 per cent, while the economic cost in terms of forgone GDP would be reduced by around one-quarter.
- Analysis in the United States for the Regional Greenhouse Gas Initiative (Prindle et al., 2006) showed that a doubling of the outcomes from energy efficiency measures would reduce carbon prices by about one-third.
- Two separate modelling studies undertaken in the United Kingdom into the macroeconomic effects of energy efficiency found strong positive macroeconomic effects associated with energy efficiency policies (Cambridge Centre for Climate Change Mitigation Research, 2006; Allan et al., 2006).

8.2 Driving innovation and technology development

8.2.1 Rationale for technology measures

The scale of the global abatement task is such that it will require the development and deployment of currently immature and new breakthrough low-emissions technologies for all sectors of the economy. By their very nature, we cannot at this stage know which of these technologies will be successful. Attempts to 'pick winners', or to rule out any particular approaches, carry high risks and add to the cost of achieving the needed abatement.

The energy sector is an obvious area in need of technology breakthroughs, given that Australia's demand for electricity and transport energy is expected to experience continued strong

growth. While some low-emissions technologies currently exist, they either are not yet at a scale to meet this demand or are currently unused in Australia.

It is critical that efforts to reduce emissions are phased in over time in line with what can realistically be achieved. Too rapid a reduction will result in significant adverse economic impacts and risk losing public support. Too slow a global reduction will risk environmental, social and economic damage from unrestrained climate change. It is essential, therefore, that governments around the world take action to accelerate the development of low- and zero-emissions technologies – and that access to all technologies is available to market participants.

A well-designed emissions trading scheme with a long-term price path, and transparent governance and review, will provide incentives to progress research, development and demonstration of low-emissions technologies. However, such 'technology pull' needs to be complemented by an active 'technology push'.

> While a market-based solution is the primary vehicle, other supporting policies and initiatives will be required to ensure the research and development necessary to identify technology solutions including low emissions technologies...
>
> *Business Council of Australia submission to the Task Group*

Economic modelling suggests that cost-effective technology policies will have an important role to play in contributing to significant reductions in emissions at acceptable economic cost (see Box 8.1).

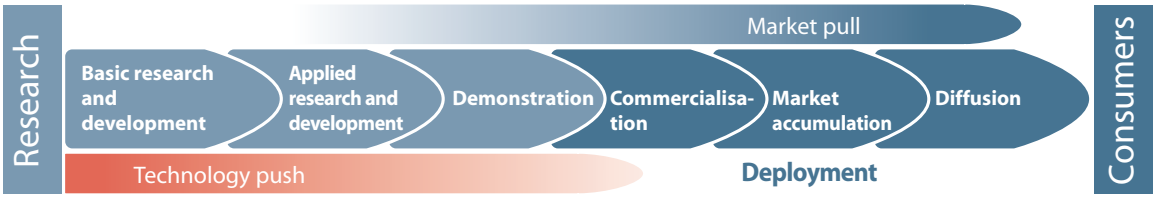
8.2.2 Role of government in the innovation cycle

Government has a key role in encouraging research and development (R&D). This role arises because the market under-invests in basic R&D due to the inability of individual companies to capture the full economic benefit of their investments. This market failure is experienced to some degree in all R&D, but appears to be particularly apparent in zero- and low-emissions energy technologies (Stern, 2006, pp. 352–5).

While government and the private sector both have a part to play in bringing forward new technology, their roles differ over the innovation cycle (see Figure 8.1). The need for 'technology push' policies is greatest in the earlier stages of the innovation cycle – particularly basic and applied R&D. As a technology moves through the innovation cycle, the role of the market becomes increasingly important and government's role is to ensure the existence of appropriate market frameworks, rather than to support individual projects. The right amount of market 'pull' will send a signal to the private sector (and attract new investors, such as venture capital) to bring forward low-emissions technologies, and the market will ultimately identify the most successful of these.

A clear long-term price signal can help in providing incentives for demonstration and deployment. Given the inherent risks associated with government funding processes, establishing maximum credibility for the long-term carbon price should be a key plank of the strategy to encourage investment in the development of

Figure 8.1 The main steps in the innovation cycle



low-emissions technologies. Nevertheless, there will necessarily be limitations on the credibility that investors in low-emissions technologies can attach to long-term price signals in the early stages of a scheme. This would suggest that government should consider additional measures (that is, beyond the R&D phase) during the early stages of a trading scheme.

8.2.3 Low-emissions technology priorities

It will be critical for the world to have available the widest possible array of deployable low-emissions technologies. Australia cannot, however, be a leader in all areas. Technological innovation is increasingly global – Australia accounts for only a small portion of global population and production, so it is sensible for us to focus on areas that are unique to our needs and natural advantages. For other areas, it makes sense for Australia to be a fast adopter of technologies developed elsewhere, a role that has historically been a key element of Australian economic success.[1]

Given Australia's resource endowment – with abundant reserves of coal, solar energy resources and geothermal potential – resource-related technologies should be our R&D priorities.

Carbon capture strategy (CCS) is a low-emissions technology of great importance to Australia and the world. Despite its significant contribution to greenhouse gas emissions, the global distribution of coal means it will inevitably continue to play a major role in energy production in many countries for the foreseeable future, if only because of energy security considerations. If this energy security imperative is not to be at odds with the global environmental imperative, a way needs to be found to reduce greenhouse gas emissions from using coal. The development of technologies that enable the retrofit of existing electricity generation stock will be important to allow the maximum utilisation of CCS technologies (see Box 8.2).

Australia's coal industry is so extensive that capture and storage of fossil fuel emissions has an added importance – not only will it allow Australia to reduce its own emissions but it also has the potential to allow importers of Australian coal to continue to use it while reducing emissions. The role of CCS in reducing global emissions is also recognised by the International Energy Agency (2006c), which estimates that CCS technologies could account for between 20 per cent and 28 per cent of total CO_2 emissions reductions by 2050.

8.2.4 Supporting basic and applied research and development

Given the global abatement task and Australia's national interest in key low-emissions technologies, provision of significant funding for basic and applied R&D will remain an ongoing priority. Support is needed both to lower the cost of existing and promising technologies and to develop breakthrough low-emissions technologies. In addition to effective prioritisation, R&D efforts need to be sufficiently resourced. Expenditure on energy R&D has fallen worldwide in recent decades in both the public and private sectors, despite the increased prominence of energy security and climate change. A number of international analyses suggest that world investment in energy research and development is insufficient given the scale of the challenges the world now faces (see, for example, IEA, 2006c; Stern, 2006).

In Australia, significant investments in R&D into low-emissions technologies have been made including through the CSIRO's Energy Transformed National Research Flagship (including increases in the recent Budget to develop lower-carbon transport fuels), the establishment of a number of Cooperative Research Centres focusing on low-emissions

technologies and support for private sector development efforts through measures such as the Renewable Energy Development Initiative. This has complemented efforts to increase resources for demonstration through such measures as the Low Emissions Technology Demonstration Fund.

Given the importance of developing new technological options for future deployment, there is a strong case for further increasing the level of resourcing for Australian R&D in low-emissions technologies. Concern regarding the adequacy of public investment in energy R&D was raised in a number of submissions to the Task Group and in domestic consultations.

> The development of low emissions technologies required to achieve cuts in emissions is under-resourced both domestically and internationally. While a carbon price may encourage some technology development, a major boost to funding for low emission technology is essential if technologies are to be developed and deployed commercially at the scale required in the near future.
>
> *Rio Tinto Limited submission to the Task Group*

As outlined in Chapter 7, the introduction of an emissions trading scheme will generate revenues from permit auctioning and emissions fees – these revenues could be used to support low-emissions technology R&D. However, assessments of the benefit to the Australian public from the range of expenditures related to emissions abatement, as well as 'value for money' and rigorous scientific scrutiny of the merits of R&D funding, must form the basis of any decisions to expend these revenues and, possibly, other public funds.

Similar prioritisation of R&D is also needed for other sectors that have the potential to reduce emissions significantly. An obvious area where Australia has strong interests is agriculture, where technologies are highly specific to local factors. The discussion in Chapter 7 relating to the eventual inclusion of the agricultural sector in an emissions trading scheme suggests a high priority for increased research on abatement in that sector.

Box 8.2 Post-combustion capture

One example of a CCS technology is post-combustion capture. Potentially, post-combustion capture technologies will be able to be retrofitted into existing electricity generation capacity. If this occurs then the cost of the abatement task would be substantially reduced. While the development of CCS technologies continues, the development of 'capture ready' power stations that are more easily fitted with post-combustion capture technology may be one means for both developed and developing economies to introduce flexibility in meeting future carbon constraints. This suggests Australia has a strong interest in building on its existing investments in this technology by the CSIRO and through projects developed under the Asia–Pacific Partnership on Clean Development and Climate.

8.2.5 Policy relating to demonstration and deployment of low-emissions technologies

Government support for technology beyond the R&D stage needs to be carefully targeted and designed to ensure it builds on, and does not conflict with, price signals provided by an emissions trading scheme or other market frameworks (for example, energy market reforms).

Demonstration funding

There is a case for government involvement in sharing the high risks involved in demonstrating low-emissions technologies, particularly in the early stages of a trading scheme. Market demonstration of technologies shows potential purchasers and users that the technology works in real-world applications under Australian conditions, and tests and demonstrates its performance, viability and potential market (Grubb, 2004).

The Australian Government and some state governments have already committed considerable funding for demonstration support to a range of projects in areas of strategic significance for Australia; further support should be focused on these areas. Rigorous assessments of the public benefit of projects, including 'value for money' and technical scrutiny is necessary – these assessments would benefit from business input, given that the private sector will be the ultimate commercial user of these technologies.

The scale of future assistance required for demonstration could be significant. Many of the relevant technologies are unlikely to be available for commercial use for some years and will require considerable further 'proving up' over the intervening period.

Policy beyond the demonstration stage

A key role for government at the deployment end of the technology cycle is to ensure there are no artificial constraints to the deployment of low-emissions technologies.

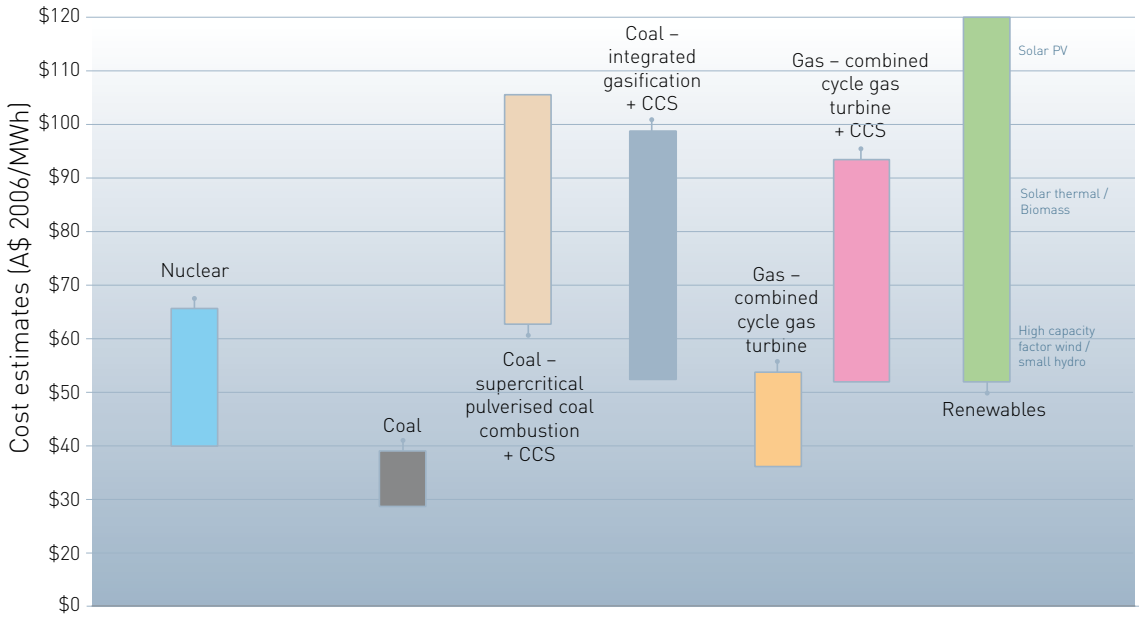
While there is a necessary element of priority setting in technology research, development and demonstration measures, it is critical that policies addressing deployment be technology-neutral, allowing least-cost solutions to emerge. Figure 8.2 illustrates estimates of future costs for a range of energy generation technologies (see also Appendix I). Modelling suggests that having the full range of technologies available, including nuclear power, has the potential to reduce the cost of a cap on emissions (see Box 8.1). Measures to build community confidence in low-emissions technologies, founded on sound science and good consultation processes, are also critical to ensure that practical constraints to the rollout of technologies are minimised.

Deployment encompasses commercialisation, market accumulation and diffusion. Measures to positively assist deployment of low-emissions technologies require particularly careful assessment, given the central role of the emissions trading scheme in providing incentives at this end of the innovation cycle. That is, additional policies encouraging deployment run a danger of interfering with the market signals emanating from a trading scheme, thereby reducing the critical role of private sector risk capital winnowing out less attractive approaches. Government assistance to deploy high-cost technology will not provide cost-effective abatement and, by its nature, will involve larger regulatory or budget costs than more targeted support provided earlier in the innovation cycle.

A number of submissions have argued that there is a need for technology deployment policies alongside the introduction of an emissions trading scheme to ensure ongoing improvements and cost reductions in high-cost but promising technologies. The objective is to make these technologies readily available for more widespread use as the emissions cap becomes progressively more stringent. Different methods of deployment support are outlined in Box 8.3.

A well-designed emissions trading scheme, involving forward signalling of progressively more stringent emissions caps, will, however, provide incentives to move technologies towards deployment and encourage investment in low-

Figure 8.2 Cost ranges for various technologies



Source: Uranium Mining, Processing and Nuclear Energy Review, 2006, p. 56

emissions technology by investors. Additional deployment measures introduce significant risks in attempting to 'pick winners' and generally involve some risk of political and policy lock-in. The Task Group considers that the focus of technology deployment policy in the period ahead should, therefore, be on developing an emissions trading scheme with maximum 'pull through' of technology through the market creation of a credible and rising carbon price signal, rather than on instituting further measures that provide deployment support.

> Business leaders expressed the view that governments should not attempt to pick technology winners, but allow the market to determine the most cost-effective abatement
>
> *Australian Davos Connection Limited, Business Leaders Forum on Climate Change*

In addition, there are questions about the extent to which broad low-emissions technology deployment policies will achieve technological goals. Many low-emissions technologies of strategic significance for Australia, where commercialisation within Australia will produce significant 'learning by doing' benefits, still require significant 'proving up'. This suggests that policy interventions earlier in the innovation cycle should be the priority in the period ahead. Increments to baseload electricity generation required in the next decade will increasingly focus on likely carbon prices in the 2020s and beyond, and a rising carbon price will be critical in assisting business to make the right technological choices.

Market participants should make their own judgments about investments in response to emerging carbon price signals, suggesting there is not a strong case for government support for major climate-related infrastructure (for example, CO_2 pipelines and transmission lines to new low-emissions power generation facilities). It is critical, too, to ensure that the provision of capital subsidies for demonstration do not significantly impact on business confidence and planning by unpredictably adding new capacity to the market, and, in doing so, foreclosing commercial decisions to bring forward new investments that incorporate low-emissions technologies. That is, funding is best directed at demonstration-scale plants, which generally

ox 8.3 Policies to encourage deployment of low-missions technologies

Six broad approaches can be identified for government to assist in deployment of new low-emission technologies:

- Tax credits and/or concessions. These provide preferential tax treatment to certain technologies and/or projects, either by giving rebates for operating expenses or concessional treatment of capital expenses.
- Rebates or subsidies for deployment of technologies. Examples include the Photovoltaic Rebate Programme and the Renewable Remote Power Generation Programme.
- Technology target schemes. Examples include the Mandatory Renewable Energy Target and the Queensland 13% Gas Scheme, with some submissions arguing this concept be broadened to include all low-emissions technologies.
- Feed-in tariffs. These are a fixed-price support mechanism that can be imposed on electricity market participants (and funded via cross-subsidies), or subsidised by government.
- Tender policies. Government provides funding support to deployment of projects that meet set criteria.
- Guaranteed 'top-up payments' to technology investors. Government provides these payments to ensure a given carbon price at some time in the future for a low-emissions plant.

have a low impact on aggregate production capacity.

If government considers that further technology policy interventions are necessary, these should meet very high thresholds of policy justification. In particular, proposals for support beyond the demonstration phase need to be critically assessed to determine whether they are likely to drive significant cost reductions for subsequent Australian applications of the technology. 'Industry development', broadly defined, is rarely a good policy justification. Australia's economic history is littered with the problems of addressing unsustainable industry structures that had been justified on 'infant industry' grounds.

Any deployment support, if it were to be contemplated, would need to be targeted on technologies of particular interest to Australia. Schemes that mandate achievement of a deployment target for given technology classes should be open to both renewable and non-renewable technologies, both to reduce costs and to achieve the widest range of technological options. Any technology target policy, though, would carry the fundamental risk that support would accrue to the most 'market ready' technologies, not those of greatest strategic interest for Australia. This would suggest that more targeted support measures (such as feed-in tariffs or carbon price top-up arrangements) could better achieve technology objectives. Nevertheless, any of these measures involves the significant risk that is always inherent in governments 'picking winners', reinforcing the preference of the Task Group for maximum reliance on the emissions trading scheme to provide incentives for technology deployment.

8.2.6 International technology cooperation

Although Australia is only a small player in the global innovation process, we can leverage our contribution and reduce duplication of effort through our participation in cooperative international initiatives in technology development. Such cooperation allows Australia to build on those areas where we are technological leaders, and to maintain close familiarity with international developments in the other technology categories.

The Australian Government has already invested considerably in building international partnerships. Australia is a founding member of the Asia-Pacific Partnership on Clean Development and Climate. We have developed a number of bilateral climate change partnerships with key trading partners and large emitters, including China, the United States, Japan, New Zealand and the European Union. Australia is also actively involved in a range of plurilateral initiatives on technology and policy to mitigate the effect of greenhouse gas emissions, including the Methane to Markets Partnership, the Carbon Sequestration Leadership Forum, the International Partnership for Hydrogen Energy, and the Renewable Energy and Energy Efficiency Partnership (see Appendix E).

Allowing the use of international market-based offsets in a domestic emissions trading scheme would spur further action in international technology cooperation as Australian companies seek out low-cost abatement opportunities overseas to meet their domestic liabilities. In particular, such linkages would provide further incentives and opportunities for technology sharing between Australia and developing countries, and provide a key plank for efforts to engage developing countries in global abatement initiatives.

8.3 Achieving improved energy efficiency and demand management

8.3.1 The case for additional energy efficiency and energy demand policies

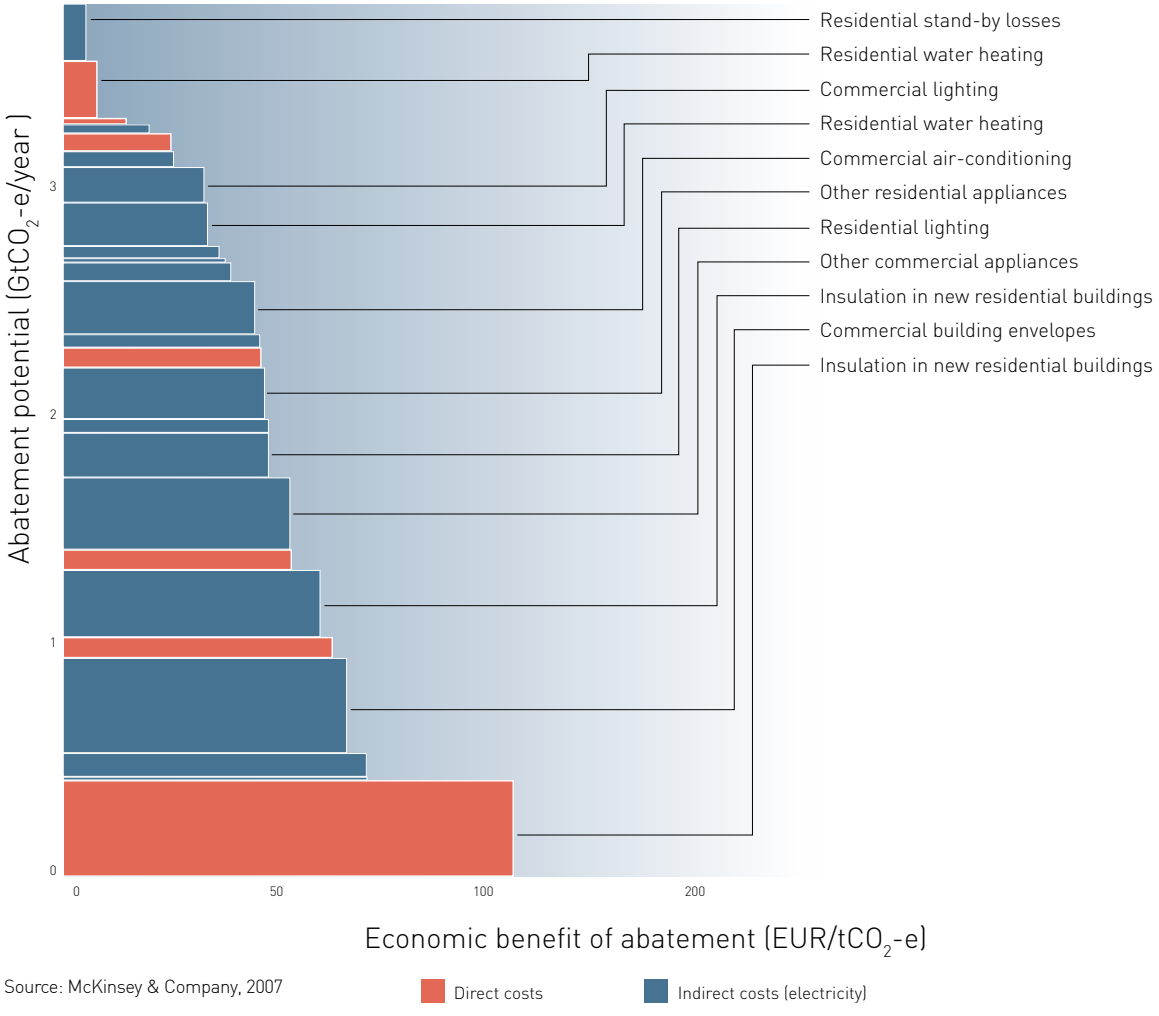
Improvements in energy efficiency globally appear likely to provide some of the lowest cost abatement opportunities, with many of these opportunities apparently available at net economic benefit (IEA, 2006c). Energy efficiency opportunities include the use of more efficient appliances and improvements in energy use in buildings, which are estimated to provide significant potential for abatement in the period to 2030 (see Figure 8.3). Opportunities also exist to procure economic benefits in the transport sector, through private sector investment in improved vehicle fuel efficiency and broader policy reforms to improve the efficiency of transport systems (IPCC, 2007c; Enkvist et al., 2007).

> Energy efficiency, both at the enterprise and domestic level, will be an important contributor to emissions reduction.
>
> *Business Council of Australia submission to the Task Group*
>
> [A] sound greenhouse policy focussed on achieving abatement at the lowest possible cost requires energy efficiency measures as well as a price on greenhouse [gas emissions].
>
> *Australian Business Council for Sustainable Energy submission to the Task Group*

In 2004, the Australian Government's Energy White Paper indicated that implementing a limited range of energy efficiency opportunities could reduce greenhouse gas emissions by around 10 million tonnes a year. Effective exploitation of economically sensible energy efficiency opportunities will help minimise the permit price emerging from an emissions trading scheme and help reduce the aggregate economic cost of any given greenhouse gas constraint (see Box 8.1).

Placing a price on carbon will provide an incentive for households and businesses to reduce their energy demand. Consumers will be able to either reduce how much energy they use (energy conservation) or use less electricity

Figure 8.3 Global abatement opportunities for the building sector, 2030



Source: McKinsey & Company, 2007

to produce the same amount of output (energy efficiency).

While pricing emissions will lead to some improvements in energy efficiency, there is evidence that households and firms do not always take up opportunities for seemingly cost-effective improvements in energy efficiency. It appears there are significant non-price barriers including lack of information, information asymmetries, split incentives (the benefit from undertaking energy efficiency measures does not flow through to those incurring the cost), and other behavioural factors (Stern, 2006, p. 378). This suggests a role for well-targeted energy efficiency policies that would complement the introduction of an emissions trading scheme.

8.3.2 Possible energy efficiency measures

Chapter 2 outlined the existing range of measures across Australian jurisdictions to promote energy efficiency. These cover consumer information, regulation of minimum standards, incentives, and mandatory energy auditing (and in some cases mandated implementation of certain activities). An immediate priority is to streamline existing energy efficiency policies, given that a number of measures across jurisdictions directly overlap.

In line with the overall approach outlined above, policies relating to energy efficiency should

be designed to complement the price signal generated by an emissions trading scheme to the maximum extent possible.

There will be an increased role for programmes that improve information and awareness, and assist consumers to understand the energy and emissions implications arising from their use of products. Australia has a range of effective information programmes relating to energy appliances; these should be continued and improved. Measures to improve access to information about energy use will also play a key role. The introduction of 'smart meters' (which show users in real time their energy use and costs), already underway in Australia as part of energy market reform, will assist here.

Beyond information-based policies, energy efficiency policies could target areas where market barriers are likely to be more fundamental and enduring. This is likely to be in areas where consumers make infrequent decisions and where it is difficult to judge the energy and emissions implications. There is a good case for continuing the development of well-designed and consistent regulated minimum energy standards for buildings and household appliances. Purchases of energy-efficient products can have a large impact on aggregate emissions over time, and reduce the impact on household budgets of any rise in carbon prices.

Current approaches to mandatory standards should be improved to ensure they achieve their objectives at minimum cost. While appliance standards are well coordinated nationally, the national building code has not been adopted by all jurisdictions, which increases compliance costs and reduces effectiveness. The adoption of a national building code by all jurisdictions should be a priority, with ongoing development to ensure that implementation of higher energy standards delivers cost-effective savings (Productivity Commission, 2004).

Some apparent market barriers will be reduced over time as households and businesses change their behaviour following the introduction of a carbon price, so some energy efficiency policies could be withdrawn as the emissions trading scheme matures. Energy efficiency audit programmes may have a key role to play leading up to the implementation of the emissions trading scheme by increasing awareness by large businesses of energy savings within their operations. The need for such programmes, however, could be reviewed as the presence of an explicit market price for carbon itself raises consciousness of the need to better manage energy use.

Most current policies target new appliances and buildings and hence have only a gradual effect on overall energy efficiency and emissions as additions are made to the stock of appliances and buildings. Improving the energy efficiency of existing buildings, however, offers some cost-effective opportunities for abatement, and investments in this area are subject to many of the behavioural and information barriers discussed above (see Figure 8.4) (IPCC, 2007c).

There is a role for targeted measures to provide incentives for such energy efficiency investments on the part of households and other affected groups where investment constraints may be greatest (Stern, 2006, p. 389), although investments should involve private capital. These would help minimise exposure to energy price increases in ways that reinforce the underlying objectives of the emissions trading scheme – to achieve abatement in a cost-effective way. Such measures could be integrated with other climate and energy-related information measures.

8.3.3 Transport

Many of the issues already discussed in the context of non-price barriers to the uptake of energy efficiency opportunities by end users also extend to transport energy use. Hence there may be a case to complement the price signal

introduced as part of the emissions trading scheme with a range of policies that, if effective, will reduce the cost of a given emissions cap. Potential measures include:

- improved information for consumers on vehicle emissions, building on current labelling requirements
- policies to achieve lower vehicle emissions over time[2]
- research to develop lower-carbon fuels
- policies to influence travel demand behaviours, including choice of transport mode and car pooling
- congestion pricing, which has other economic benefits
- urban design and public transport planning, taking into account likely future carbon constraints.

Most of the above measures cross-current jurisdictional and policy boundaries, and many are currently being examined jointly by the environment and transport councils under the Council of Australian Governments.

8.3.4 International cooperation on energy efficiency

A cooperative approach with major international producers to source energy-efficient appliances could produce significant low-cost abatement outcomes (Stern, 2006, p. 532). Australia is generally a 'technology taker' for major household appliances. By working with overseas appliance manufacturers, Australia can reduce costs and increase the effectiveness of performance standards and labelling schemes. Australia is already engaging with partner countries on energy-efficient appliances and buildings standards though the Asia–Pacific Partnership on Clean Development and Climate.

8.4 Rationalising existing policies to achieve least-cost abatement and clear carbon price signals

As discussed in Chapter 2, the current multiplicity of policies imposes economic costs on Australia. This burden will increase significantly if the current approach is scaled up to attempt to achieve the greater abatement levels necessary in the future. Indeed, a key rationale for introducing an emissions trading scheme is to minimise the cost of abatement policies over time. It would therefore be counterproductive to add an emissions trading scheme on top of the current plethora of policies – such an approach would mean that any given abatement effort costs more than necessary, or that a given economic cost is not achieving maximum abatement.

> There is an urgent need to rationalise Australia's greenhouse policy to encourage ongoing investment in the energy sector.
>
> *Energy Retailers Association of Australia submission to the Task Group*

This suggests that the design and introduction of the emissions trading scheme should be complemented by a concerted effort to rationalise the policies of the federal, state and territory governments (see tables 2.2 and 2.3). The Task Group recognises that some policies may have multiple objectives, though questions remain about the cost effectiveness of many of these in achieving industry and technology development objectives.

In general, the Task Group strongly believes the default position should be that programmes should be abolished or phased out unless they are directed efficiently at clearly demonstrated policy gaps, or are necessary to build capacity in the lead up to the introduction of an emissions trading scheme.

8.4.1 Rationalising existing interventions

The NSW Government has already announced that it would transition its Greenhouse Gas Abatement Scheme into a domestic emissions trading scheme if one were introduced, given the direct overlap in objectives, design and participants (NSW Department of Energy, Utilities and Sustainability, 2006). Details for achieving this would need to be developed further in the design phase of any trading scheme, and due regard given to those participants that had invested on the basis of the current expiry date of 2020.

All Australian schemes that set mandatory targets for deployment of particular technologies should be wound up over time, and new ones forestalled. There is a case for letting current legislated commitments run out given the cost, complexity and potential sovereign risk issues associated with compensating market participants that have taken positions on the basis of current legislation. This would suggest that the Australian Government's Mandatory Renewable Energy Target and the Queensland 13 per cent Gas Scheme should be wound up in line with the time frame set out in current legislation. The potential to abolish the Victorian Renewable Energy Target Scheme should be examined given that the recent commencement of the scheme means less investment has been undertaken, while the recently announced NSW, WA and SA schemes should not proceed.

> Under no circumstances should such [an emissions trading] scheme merely be added to the hotchpotch of existing measures.
>
> *Australian Petroleum Production and Exploration Association submission to the Task Group*

As part of any implementation of an emissions trading scheme, the Australian Government should seek a moratorium on proposals by state and territory governments to introduce new abatement measures or expand existing ones. The overlap in reporting requirements across jurisdictions, should be reduced. Governments should also identify other grant-based policies within their jurisdictions that could be removed with the introduction of an emissions trading scheme.

8.4.2 Importance of clear price signals

The key mechanism by which an emissions trading scheme achieves abatement is by providing price signals to change behaviours, and reduce demand for carbon-intensive products. It will be critical that other market frameworks and policies do not mute price signals and hence reduce the effectiveness of an emissions trading scheme. Ongoing energy market reform is particularly important. Existing market features such as retail price caps for energy can mute the transmission of carbon costs to retail customers, resulting in lower abatement and a greater cost burden being placed on non-retail customers. An important part of scheme design (and ongoing progress in energy market reform) will be to ensure these elements of energy pricing arrangements work effectively together.

> A comprehensive, national approach to greenhouse gas abatement is required if Australia is to avoid unnecessary economic dislocation and inequitable abatement burden shifting between sectors.
>
> *Energy Supply Association of Australia submission to the Task Group*

8.4.3 A coordinated national approach

Effective streamlining of existing policies and implementation of a cost-effective suite of policies will require action across all levels of government. Given the importance of developments determining the appropriate level of international action, the Australian Government must necessarily play the lead role in developing and implementing key national abatement measures such as the emissions trading scheme. However, other responsibilities and policies currently cross jurisdictional boundaries, suggesting that a cooperative approach to national greenhouse policy is essential.

If a cooperative approach does not produce the necessary level of rationisation and coherence in ongoing climate change policy, the Australian Government should consider other options to ensure ongoing national abatement policy is implemented effectively and at lowest cost.

Notes

1 The OECD has attributed Australia's rapid adoption of information and communication technology as a key factor in driving labour productivity growth between 1996 and 2002 (OECD, 2004).

2 There is currently a voluntary agreement in place with the Australian car industry that sets vehicle fuel efficiency standards to 2010. Regulatory measures to achieve emissions reductions are being proposed in a number of other jurisdictions, such as the United States and the European Union.

Implementation

9.1 Overview

Australia faces a threshold decision. While policies pursued to date have made us one of the few countries in the world likely to meet its greenhouse gas reduction target based solely on domestic actions, there is little likelihood of existing programmes being scaled up in a cost-effective way to meet the demand for future action to address climate change.

The decision as to whether to now adopt a greenhouse gas limitation target beyond the initial period of the Kyoto Protocol to 2012 is a finely balanced one given the disappointingly slow progress in discussions on a post-Kyoto international climate change framework. However, after careful consideration, the Task Group believes that adoption of an appropriate cap on emissions is the correct long-term decision in terms of further advancing our international interests, addressing uncertainty in the investment environment and preparing Australia for a carbon-constrained future.

The Task Group believes that adoption of a post-2012 cap should be accompanied by timely and decisive action to introduce an Australian emissions trading scheme as a key measure to enable us to meet future constraints on emissions at the least cost.

The Task Group notes that the scheme proposed in this report is more comprehensive than both the existing European Union Emissions Trading Scheme and the emissions trading scheme proposed by the Australian states and territories. It would, at present, be the most innovative example of such a scheme in the world. Implementation will, therefore, need to be undertaken systematically through a comprehensive nationwide programme.

The Task Group believes it should be possible to commence trading in 2011 if a decision to establish an emissions trading scheme were to be taken in 2007. However, there would be value in providing for the potential to defer trading to 2012 if global developments or other issues suggest there is clear benefit to Australia in doing so.

This chapter outlines a series of indicative steps to be taken in preparing for the commencement of trading:

- foundations (years 0–1), including finalising the design of the scheme, establishing emissions reporting systems, determining a long-term aspirational target, deciding on complementary programmes and policies, and engaging international partners on emissions trading offsets
- establishment (year 2), including passing legislation to introduce the scheme, establishing governance structures, and deepening and broadening international cooperation focussing on countries considering emissions trading
- trading (years 3–4), including setting short-term targets and allocating permits, commencing trading and exploring linkages with other emissions trading schemes.

9.2 Governance aspects

The Task Group considers that a single national scheme implemented by the Australian Government is the most effective policy governance model. This would allow the scheme to be implemented with the maximum link with Australia's international climate change strategy and in a manner consistent with broader economic instruments. State-based nationally consistent or linked legislation would lead to potential delays in decision making, risk possible disparate outcomes between jurisdictions, and add to the complexity of the scheme and uncertainty for business.

The experience of the European Union Emissions Trading Scheme – and closer to home with other reform processes – suggests a unitary administrative, legislative and decision-making structure would be desirable for such a critical national market policy instrument. Nevertheless, implementation of an emissions trading scheme should be coordinated with other complementary measures across jurisdictions.

9.3 Implementation timetable

The Task Group believes that a dedicated team should be appointed with the appropriate skills and resources necessary to finalise the design features of the scheme, consult with stakeholders and make recommendations to the Government within the time frame suggested. While further design work is necessary, the Task Group cautions against 'reinventing the wheel' – the next phase of work should build upon the extensive consultation process with business and other stakeholders undertaken by the Task Group and, where possible, draw on the work of the states and territories' National Emissions Trading Taskforce.

The following timetable is based on the assumption that a decision to proceed is announced in 2007.

Phase I: Foundations (2007–08)

Work in this phase would concentrate on establishing the systems and structures required for implementing the strategy outlined in this report, specifically:

- putting in place legislation to underpin national mandatory reporting of emissions and energy use, and commencing reporting
- determining a long-term aspirational goal for reducing emissions
- finalising the detailed design elements of the emissions trading scheme
- establishing mechanisms to generate credits from sinks that can be banked until trading commences
- determining the detail of additional Australian Government measures that would complement emissions trading
- information campaigns to assist businesses and households to identify abatement opportunities
- initiating discussions focused on rationalising existing approaches at both the federal and state/territory levels
- beginning dialogue and action at the international level, particularly in the region.

Table 9.1 Phase 1: Foundations (2007–08)

Scheme design	Parallel action
Key outcomes and actions	**Key outcomes and actions**
• Commence analysis and modelling of the implications of national greenhouse gas targets and trajectories (2007)	**Domestic**
• Passage of legislation to provide for comprehensive national mandatory emissions and commencement of energy reporting (2008)	• Determine Australian Government measures that would complement emissions trading (end-2007) • Information campaigns to assist business and households to identify abatement opportunities
• Announcement of a long-term aspirational goal for reducing greenhouse gas emissions (mid-2008)	• Discussions on rationalising existing federal, state and territory climate change programmes (2007–08)
• Decisions on detailed scheme design, including: » coverage, permit allocation procedures and rules, compliance mechanisms, approaches to early action, offsets and safety valve functioning (2008) » broad aspects of governance and institutional frameworks (mid-2008)	**International** • Focus on clean energy issues at APEC (Sept 2007) • Advance activities under the Asia–Pacific Partnership on Clean Development and Climate and the Global Forestry initiative
• Creation of credits for early action and offsets for subsequent use when trading commences, including carbon forest sinks (2008)	• Contribute to UNFCCC discussions on post-2012 international framework (2007) • Commence dialogue with like-minded countries on emissions trading focussing, for example, with Canada and New Zealand (2007–08) • Engage key partner countries on offsets (2007–08)

Phase 2: Establishment (2009)

Work in this phase would concentrate on:

- passage of legislation for the emissions trading scheme
- establishing the independent regulatory body and the panel to conduct reviews
- assessing the outcomes of the first year of mandatory reporting
- testing structures and systems
- broadening and deepening international cooperation, particularly with a view to developing common approaches on emissions trading and offsets.

The Task Group believes that governance and institutional arrangements will be critically important to the integrity of the scheme. They should ensure a single and effective national scheme. It would be highly desirable to ensure clear lines of responsibility and accountability between the Government and the new regulatory body to ensure clarity for the market. A key issue is the separation of the policy function from the operational aspects.

The Task Group believes that the Australian Government should have responsibility for establishing goals and targets, and for major decisions surrounding scheme design. The Task Group suggests that the Government may wish to consider establishing an independent panel to participate in regular reviews and to advise on appropriate settings for short-term targets and gateways. The findings of the advisory panel could be made public to promote transparency and predictability and improve public awareness and understanding.

The independent regulatory agency would be responsible for:

- issuing advisory notes to provide guidance on the application of the legislation to enable a smooth transition for industry in the lead-up to the commencement of trading under the scheme
- allocating permits consistent with the methodology contained in legislation
- certifying offsets so that they are credible and can be traded domestically and internationally
- establishing robust registry arrangements to record ownership changes and acquittal of permits and offset certificates
- ensuring compliance with the emissions trading scheme, including monitoring and verification
- collecting revenue from the auctioning of permits and use of the emissions fee
- meeting public accountability requirements through annual reporting and other mechanisms.

Legislation would need to embrace the key aims and principles of the scheme and be prepared following consultation with stakeholders.

An important focus would be on cooperation between the federal government and state/territory governments to rationalise existing policy interventions and ensure that true, well-targeted, complementary measures were introduced. Such an approach must produce coherent policy outcomes rather than build on the current plethora of overlapping and inconsistent climate change measures. Progress in this task should be reviewed by the Australian Government in 2008 so as to assess whether alternative strategies are required to achieve an effective and efficient suite of climate change mitigation policies by the time trading commences.

Table 9.2 Phase 2: Establishment (2009)

Scheme design	Parallel action
Key outcomes and actions	**Key outcomes and actions**
• Passage of legislation (2009)	**Domestic**
• First year outcomes of mandatory reporting and development of strategy to ensure quality data systems in place during 2010 (2009)	• Review progress with states and territories on complementary measures and rationalising (2008)
• Establish the independent regulatory body and make key appointments (2009)	• Implement agreed timetable with the states and territories for rationalising programmes and policies and introduction of complementary programmes (2009)
• Establish any advisory panels and outline their functions and roles: these could include technological and consumer issues (2009)	**International**
	• Advance discussions with selected partner countries on principles and practices on offsets (2009)
• Conduct trials of information systems and structures (2009)	• Explore linkages between other countries' emissions trading schemes (2009)
	• Advance APEC climate change agenda (2009)
	• Advance activities under the Asia–Pacific Partnership on Clean Development and Climate and the Global Forestry initiative
	• Enhance programme of bilateral climate action partnerships (2009)
	• Continue engagement in UNFCCC discussions on post-2012 international framework (2009)

Phase 3: Trading (from 2010)

Work in this phase would concentrate on:

- setting the short-term caps for the trading scheme and issuing permits
- assessing the results of trials and the capacity of data monitoring and verification
- introducing full-scale trading
- establishing links with other emissions trading systems.

The Task Group considers that trading under the scheme should aim to commence in 2011. This would provide the flexibility to take into account global developments; allow the scheme to begin with a broad coverage; and ensure two full years of monitoring and verification of emissions data before the commencement of trading. However, in the event of compelling international developments or difficulties in establishing domestic systems, consideration could be given to deferring trading until 2012.

Table 9.3 Phase 3: Trading (from 2010)

Scheme design	Parallel action
Key outcomes and actions	**Key outcomes and actions**
• Announce short term cap (2010)	**International**
• Assess the results of trials and the capacity of data monitoring and verification (2010)	• Establish links with other emissions trading schemes (2010) » an assessment of progress in concluding links would be valuable to inform a decision on the precise start date for trading under an Australian emissions trading system
• Announce methodology for calibrating the scheme (2010)	• Continue to explore upgraded and new bilateral climate action partnerships (2010)
• Allocate or auction permits (2010)	• Advance activities under the Asia–Pacific Partnership on Clean Development and Climate and the Global Forestry initiative
	• Continue engagement in UNFCCC discussions on post-2012 international framework (2010)
• Commence full-scale trading (2011)	

Appendices

Appendix A
Membership of the Task Group

Dr Peter Shergold, Chairman

Dr Shergold has been Secretary of the Department of the Prime Minister and Cabinet since February 2003. He joined the public service in 1987 and has since served as the Secretary of a number of Australian Government departments and agencies. He received a PhD in Economics from the London School of Economics and has twice been a Fulbright Scholar. Dr Shergold was appointed a Companion of the Order of Australia on Australia Day 2007.

Mr David Borthwick

Mr Borthwick is Secretary of the Department of the Environment and Water Resources. Previously, he was a Deputy Secretary in the Department of the Prime Minister and Cabinet responsible for economic, industry and environmental issues. From 1991 to 1993, he served as Australia's Ambassador to the OECD in Paris. Mr Borthwick holds a degree in economics with first-class honours from Monash University. In 2002, Mr Borthwick received a Public Service Medal for outstanding public service in the development and progression of the Australian Government's economic policies.

Mr Peter Coates

Mr Coates is Chief Executive of Xstrata plc's global coal business, Xstrata Coal, and a member of the Xstrata Group Executive. In addition to his considerable coal industry experience, gained in Australia and South America, he has also occupied senior positions in companies involved in other commodities including nickel, iron ore and bauxite. Mr Coates is the current Chairman of the Minerals Council of Australia, a past Chairman of the NSW Minerals Council and the Australian Coal Association and a current Director of both of these industry bodies.

Mr Tony Concannon

Mr Concannon is the Managing Director of International Power, Australia's largest private generator of electricity, and was appointed to the board in January 2004. He joined the industry in 1982 and has worked in a number of business areas including power station operations, trading and international business development (based in Asia). Mr Concannon is a chartered engineer.

Dr Ken Henry

Dr Henry was appointed Secretary to the Treasury in 2001. Prior to his appointment, he was a Deputy Secretary in The Treasury, responsible for macroeconomic policy and international issues. In 1992, he was appointed Minister (Economic and Financial Affairs) in the Australian Delegation to the OECD in Paris following a five-year period as senior adviser to

the Treasurer. He received a first-class honours degree in economics from the University of New South Wales. Dr Henry was appointed a Companion of the Order of Australia on Australia Day 2007.

Mr Russell Higgins

Mr Higgins is an Independent Non-executive Director of the Australian Pipeline Trust. He is also the Chairman of the Cooperative Research Centre for Coal in Sustainable Development and Chairman of the CSIRO Energy Transformed Flagship Advisory Committee. He is a Director of Ricegrowers Limited and Australian Biodiesel Group Limited. Among his many previous roles, Mr Higgins was Secretary of the Department of Industry, Science and Resources and Chairman of the Australian Government's Energy Task Force. Mr Higgins was appointed an Officer of the Order of Australia on Australia Day 2006.

Ms Margaret Jackson

Ms Jackson has been the Chairman of the Qantas Board since 2000. She is a Director of Australia and New Zealand Banking Group Limited and Billabong International Limited, and Chairman of Flexirent Holdings Pty Limited. She is a Member of the Business Council of Australia Chairman's Panel, a Fellow of the Institute of Chartered Accountants in Australia and a member of the Foreign Affairs Council. In June 2003, Ms Jackson was appointed a Companion of the Order of Australia.

Mr Michael L'Estrange

Mr L'Estrange is Secretary of the Department of Foreign Affairs and Trade. Prior to this appointment, he served as Australia's High Commissioner to the United Kingdom. He has also served as Secretary to Cabinet and Head of the Cabinet Policy Unit. Mr L'Estrange is a Rhodes Scholar and has degrees from the University of Sydney and Oxford University. Mr L'Estrange was appointed an Officer of the Order of Australia in 2007 for service to the development and implementation of public policy in Australia.

Mr Chris Lynch

Mr Lynch is a Director of BHP Billiton Limited. He joined BHP Billiton as Chief Financial Officer of the Minerals Group in 2000. He was appointed Chief Financial Officer in September 2001 and Group President of Carbon Steel Materials in April 2006. Previously, he held positions at Alcoa, including Vice President and Chief Information Officer, and Chief Financial Officer, Alcoa Europe. Mr Lynch is a Director of the Minerals Council of Australia.

Mr John Marlay

Mr Marlay is the Chief Executive Officer and an Executive Director of Alumina Limited. He has held senior management roles with Hanson Plc, Pioneer International Ltd, James Hardie Industries Limited, and Esso Australia Ltd. He is also a Non-executive Director of Incitec Pivot Limited. Mr Marlay has extensive resource sector experience operating in international management roles, including capital-intensive joint ventures.

Mr Mark Paterson

Mr Paterson was appointed Secretary of the Department of Industry, Tourism and Resources in January 2002. Prior to this appointment, he was the Chief Executive of the Australian Chamber of Commerce and Industry. He has also headed the Retailers Council of Australia and the Retail Traders Association of New South Wales.

Mr John Stewart

Mr Stewart was appointed Managing Director and Group Chief Executive Officer of National Australia Bank in February 2004. Prior to this appointment, he was Group Chief Executive of Woolwich plc, a UK bank. After the acquisition of Woolwich by Barclays Bank PLC, he became Deputy Group Chief Executive of Barclays Bank PLC and a main Board Director. Mr Stewart is a board member of the Business Council of Australia.

Secretariat

The Task Group was supported by a joint government-business secretariat located in the Department of the Prime Minister and Cabinet.

The secretariat was headed by Dr Martin Parkinson, who is Executive Director (Deputy Secretary) in The Treasury with responsibility for domestic and international macroeconomic issues.

The secretariat also included:

Mr Justin Brown, First Assistant Secretary, Department of Foreign Affairs and Trade

Mr Barry Sterland, First Assistant Secretary, Department of the Environment and Water Resources

Mr Bruce Wilson, General Manager, Department of Industry, Tourism and Resources

Mr Mark Gibbs, Department of the Prime Minister and Cabinet

Mr Russ Campbell, Treasury

Mr Salim Mazouz, Department of the Environment and Water Resources

Mr Ross Lum, Department of Industry, Tourism and Resources

Mr Alex Park, Department of the Prime Minister and Cabinet

Ms Bev Sims, Treasury

Ms Carole van Eldik, Department of the Prime Minister and Cabinet

Private sector members

Mr John Daley, Australian Industry Greenhouse Network

Ms Maria Tarrant, Business Council of Australia

Appendix B
Consultations

Members of the Task Group and Secretariat met with the following organisations.

Australian organisations

ABB Australia Pty Ltd

Adelaide Brighton Ltd

AGL

Alcoa of Australia

Alinta

Alumina Limited

Amcor Limited

Australia and New Zealand Banking Group Limited (ANZ)

Australian Aluminium Council

Australian Business Council for Sustainable Energy

Australian Chamber of Commerce and Industry

Australian Coal Association

Australian Conservation Foundation

Australian Emissions Trading Forum

Australian Energy Alliance

Australian Financial Markets Association

Australian Gas Association

Australian Industry Greenhouse Network

Australian Industry Group

Australian Institute of Petroleum

Australian Institute of Refrigeration, Air Conditioning and Heating

Australian Liquefied Petroleum Gas Association Limited

Australian Petroleum Production and Exploration Association

Australian Pipeline Industry Association

Australian Plantation Products and Paper Industry Council

Australian Securities Exchange

Australian Trucking Association

Auswind

Baker & McKenzie

Bayard Group

BHP Billiton

Blue Circle Southern Cement Limited

BlueScope Steel Limited

BOC Limited

Boral Limited

BP

Business Council of Australia

Caltex Australia Petroleum Pty Ltd

Cement Australia

Cement Industry Federation

Chamber of Commerce and Industry of Western Australia

Chamber of Minerals and Energy of Western Australia

Climate Action Network Australia

Climate Institute (Australia)

Coles Myer Ltd

Commonwealth Bank Group

CS Energy

CSR Limited

DuPont

EnergyAustralia

Energy Networks Association Limited

Energy Retailers Association of Australia

Energy Supply Association of Australia

Energy Users Association of Australia

Environment Business Australia

Ergon Energy

Ford Motor Company

Freehills

GM Holden Ltd

Hydro Aluminium Kurri Kurri Pty Ltd

Hydro Tasmania

Insurance Council of Australia

International Power Australia

Investor Group on Climate Change Australia/ New Zealand

Jones Lang LaSalle

Leighton Holdings Limited

Loy Yang Power

Macquarie Generation

Major Energy Users

Mallesons Stephen Jaques

Minerals Council of Australia

National Association of Forest Industries

National Australia Bank

National Electricity Market Management Company Ltd

National Generators Forum

New South Wales Minerals Council Ltd

Nufarm Limited

O-I Asia Pacific

OneSteel

Orica Limited

Origin Energy

Pacific Hydro Pty Ltd

Plastics and Chemicals Industries Association

PricewaterhouseCoopers

Property Council of Australia

Qantas Airways Limited

Queensland Resources Council

Renewable Energy Generators of Australia Ltd

Rio Tinto Limited

Shell Company of Australia Limited

Simcoa Operations Pty Ltd

Snowy Hydro Limited

Solar Systems

Stanwell Corporation Limited

Tomago Aluminium Company Pty Limited

Transurban Limited

TRUenergy Australia Pty Ltd

VENcorp

Visy R&D Pty Ltd

Western Australian Sustainable Energy Association Inc.

Westpac Banking Corporation

Woodside Energy Limited

WWF–Australia

Xstrata Plc

Zinifex Limited

International organisations

Belgium

Alcan

BP plc

BHP Billiton

Business Europe (formerly UNICE)

CEMBUREAU – The European Cement Association

Centre for European Policy Studies

Enterprise and Industry Directorate-General, European Commission

Environment Directorate-General, European Commission

EURELECTRIC – Union of the Electricity Industry

International Emissions Trading Association

RWE

Vattenfall AB

Canada

Canadian Council of Chief Executives

Department of Foreign Affairs and International Trade Canada

Environment Canada (Department of the Environment)

Finance Canada (Department of Finance)

International Institute for Sustainable Development

National Round Table on the Environment and the Economy

Natural Resources Canada (Department of Natural Resources)

Privy Council Office

Standing Committee on Environment and Sustainable Development

France

EDF

Gaz de France

International Energy Agency

Ministry of Ecology and Sustainable Development

Ministry of Industry, Economy and Finance

Organisation for Economic Co-operation and Development

Union of Industrial and Employers' Confederation of Europe

Japan

Ministry of Economy, Trade and Industry

Ministry of the Environment

Norway

Bellona

Centre for International Climate and Environmental Research – Oslo

Ministry of the Environment

Ministry of Finance

Ministry of Foreign Affairs

NORFUND – Norwegian Investment Fund for Developing Countries

Norwegian Pollution Control Authority

Point Carbon

Singapore

Ministry of the Environment and Water Resources

United Kingdom

BHP Billiton

British Energy

Carbon Trust

CEMEX Europe

Centrica

Climate Change Capital

Confederation of British Industry, Climate Change Task Force

Corus

Department for Environment, Food and Rural Affairs

Department of Trade and Industry

Foreign and Commonwealth Office

HM Treasury

International Power plc

Rio Tinto P.L.C.

Shell

UK Emissions Trading Group

United States

American Enterprise Institute for Public Policy Research

Center for Clean Air Policy

Chevron Corporation

Chicago Climate Exchange

Congressional staff

Council on Environmental Quality

Department of Energy

Department of the Treasury

Edison Electric Institute

Energy Information Administration

Environmental Defense

Environmental Protection Agency

Johns Hopkins University

Natural Resources Defense Council

Pew Center on Global Climate Change

Resources for the Future

U.S. Chamber of Commerce

U.S. Department of State

World Bank

World Resources Institute

Appendix C
Submissions received

The Task Group thanks the many individuals and organisations who responded to the call for submissions. All non-confidential submissions to the Task Group are available in Portable Document Format (PDF) on the Secretariat website at ‹www.pmc.gov.au/emissionstrading/submissions.cfm›.

Submissions received from organisations

Abatement Solutions – Asia Pacific Pty Ltd

AGL

Alcoa of Australia

Alinta

ATA – Alternative Technology Association

Alumina Limited

Anglo Coal Australia

Association for the Advancement of Sustainable Materials in Construction

Association of Consulting Engineers Australia

AustElec Pty Ltd

Australasian Compliance Institute

Australasian Emissions Trading Forum

Australasian Institute of Mining and Metallurgy

Australian Academy of Technological Sciences and Engineering

Australian Aluminium Council

Australian Automobile Association

Australian Business Council for Sustainable Energy

Australian Chamber of Commerce and Industry

Australian Climate Exchange Ltd

Australian Coal Association

Australian Conservation Foundation

Australian Dairy Industry Council Inc.

Australia and New Zealand Banking Group Limited (ANZ)

Australian Financial Markets Association

Australian Forest Growers

Australian Industry Greenhouse Network

Australian Industry Group

Australian ITER Forum

Australian Labor Party, Geelong West Branch

Australian Network of Environmental Defender's Offices Inc

Australian Nuclear Science and Technology Organisation

Australian Petroleum Production and Exploration Association

Australian Plantation Products and Paper Industry Council (A3P)

Australian Pork Limited

Australian Securities Exchange

Australian Sugar Milling Council Pty Ltd

Australian Trucking Association

Australian Vinyls Corporation Pty Ltd

Auswind

Babcock & Brown Environmental Investments Limited

Babcock & Brown Power Limited

BHP Billiton

BlueScope Steel Limited

Boral Limited

BP

Brattle Group

Brian J. O'Brien & Associates Pty Ltd

Brotherhood of St Laurence and National Welfare Rights Network

Business Council of Australia

Caltex Australia Petroleum Pty Ltd

Cambiar Pty Limited

CANwin

Carbon Planet Pty Ltd

Carbon Pool Pty Ltd

CarbonShift Ltd

Cement Australia Pty Limited

Cement Industry Federation Limited

Chamber of Commerce and Industry of Western Australia

Chamber of Minerals and Energy of Western Australia

Chevron Australia Pty Ltd

Climate Action Network Australia

Climate Action Newcastle

Climate Institute (Australia)

CO2 Group Limited

Commonwealth Bank of Australia

Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Country Energy

Crucible Carbon

CRC on Greenhouse Technologies (CO2CRC)

CS Energy

CSR Limited

Cumpston Sarjeant Pty Ltd

Easy Being Green

Ecofibre Industries Limited

Edentiti Pty Ltd

Energetics Pty Ltd

EnergyAustralia

Energy Bulletin

Energy Developments Limited

Energy Networks Association Limited

Energy Retailers Association of Australia

Energy Supply Association of Australia

Energy Users Association of Australia

Engineers Australia

Environment Business Australia

Environment Institute of Australia and New Zealand

Environmental Defender's Office (Ltd) NSW

Exigency Management Pty Ltd

ExxonMobil Australia Pty Ltd

Finlaysons

Flinders Power

Ford Motor Company of Australia Ltd

Future Generations Trust

Goulburn Broken Catchment Management Authority

Great Barrier Reef Foundation

Green Building Council of Australia

Griffin Group

HRL Developments Pty Ltd

Hyder Consulting Pty Ltd

Hydro Aluminium Kurri Kurri Pty Ltd

Hydro Tasmania

Inquit Pty Ltd

Institute of Actuaries of Australia

Insurance Australia Group Limited

Insurance Council of Australia

Integral Energy

International Power Australia

Investor Group on Climate Change Australia/New Zealand

J Sabine International

Landholders Institute Inc.

Law Council of Australia

LMS Generation Pty Ltd

Loy Yang Power

Major Energy Users

Make Poverty History

Mallesons Stephen Jaques

Middle Way Pty Ltd

Minerals Council of Australia

Monash Energy Holdings Ltd

Motor Trades Association of Queensland

National Association of Forest Industries

National Association of Testing Authorities, Australia

National Australia Bank

National Electricity Market Management Company Ltd

National Farmers' Federation

National Generators Forum

National Parks Association, Southern Highlands Branch

National Stock Exchange of Australia

Nature Conservation Council of NSW

NSW Business Chamber

New South Wales Minerals Council Ltd

O-I Asia Pacific

OneSteel

Origin Energy

Pacific Hydro Pty Ltd

Plastics and Chemicals Industries Association

Power and Water Corporation

Productivity Commission

Property Council of Australia

Qantas Airways Limited

Queensland Farmers' Federation

Queensland Magnesia Pty Ltd

Queensland Resources Council

Refrigerants Australia

Renewable Energy Generators of Australia Ltd

ResourcesLaw International

Rio Tinto Limited

Rural research and development corporations*

South Australian Water Corporation

Santos Ltd

Shell Company of Australia Limited

Simcoa Operations Pty Ltd

Stanwell Corporation Limited

Sustainable Forestry Management Australasia Pty Ltd

Synergy

*Land & Water Australia submitted an Issues Paper to the Task Group on behalf of Australian Pork Limited, Cotton Research and Development Corporation, Forests and Wood Products Research and Development Corporation, Grains Research and Development Corporation, Horticulture Australia Council, Land & Water Australia, Meat and Livestock Australia, and Sugar Research and Development Corporation.

TecEco Pty Ltd

TEPCO Forests Australia Pty Ltd

Thiess Pty Ltd

Timber Queensland Limited

Tomago Aluminium Company Pty Limited

Total Environment Centre Inc.

TRUenergy Australia Pty Ltd

Urban Ecology Australia

Victorian Association of Forest Industries

Victorian Employers' Chamber of Commerce and Industry

Victorian Government

Visy R&D Pty Ltd

Wesfarmers Limited

Western Australian Sustainable Energy Association Inc.

Westpac Banking Corporation

Woodside Energy Limited

WWF–Australia

Submissions received from individuals

Hope Ashiabor

Riley Ashton

Bryan Beudeker

Ann Birrell

Richard Bomford

Lyndal Breen

Bishop George Browning

V.D. Burnett

Stephen Choularton

Liam Cranley

Ian T. Dunlop

Nicola Durrant

Ian G. Enting

Peter Evans

Mark Fleming

Kim Frawley-Major

Joshua Gans and John Quiggin

Tom Gordon

D.J. Hamilton

Mick Harewood

Kate Holmes

Frank Jotzo

Tim Kelly

Philip Laird

Peter Lawrence

Gillian Lord

Keith McIlroy

Warwick McKibbin

Frank Muller, Hugh Saddler and Clara Cuevas

John Newlands

Carol O'Donnell

Jack Pezzey

Ben Quin

Peter N. Rampling, Ian A. Eddie and Monir Z. Mir

B. Vijaya Rangan

Alex Robson

David Tongue

David Tranter

Riejet Van de Vusse

Larry Whitehead

Peter Wood

Appendix D
Comparing carbon taxes and emissions trading

Chapter 3 briefly noted that, on balance, of the market-based instruments available an emissions trading scheme is likely to be superior to other instruments such as carbon taxes. This conclusion relies upon the assessment that emissions trading appears to provide greater flexibility in terms of:

- more readily accessing opportunities for least-cost abatement through easier linking with emerging international efforts to restrain emissions
- signaling future carbon prices.

While a carbon tax can address these issues, its greatest advantage is its ability to more effectively manage carbon costs, particularly over the short term. This appendix compares the relative strengths of carbon taxes and emissions trading against particular key design criteria.

Where the government has full information, a carbon tax and an emissions trading scheme can deliver similar economic and environmental outcomes (see Box D.1).

In practice, however, it is rare that the necessary information conditions can be met for carbon taxes and emissions trading to be equivalent policy instruments. The choice of policy instrument depends, therefore, on an assessment of the relative importance of various considerations, including the value of:

- managing emissions reductions with greater certainty
- managing costs to business consistent with the emissions objective
- providing long-term risk management opportunities to business
- accessing least-cost abatement domestically and internationally
- managing the transition to a carbon-constrained world
- minimising administrative and compliance costs
- modifying or adapting the chosen policy instruments over time.

D.1 Managing emissions reductions and costs to business

It is unlikely that it would ever be possible for government to possess full information regarding abatement costs, and the damage associated with climate change.

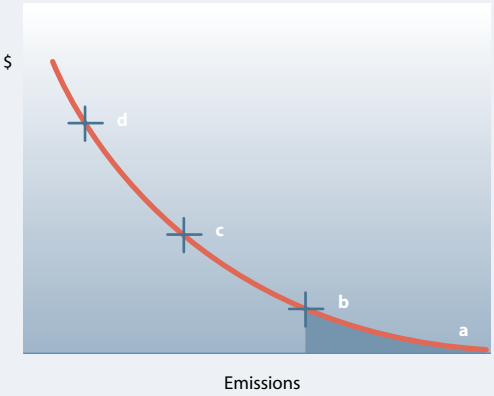
Carbon taxes and emissions trading both need to be able to adjust to refined emissions targets as the scientific understanding of the carbon cycle and its impacts are better understood. A carbon tax involves additional uncertainty as the extent to which businesses and individuals would change their emissions behaviour for any given tax rate is unknown. Government would be expected to have to change the carbon tax rate over time to deliver any specific emissions reduction.

If the policy objective is, instead, to make fixed the cost of emissions reductions to business, with less immediate focus on actual reductions achieved, then a carbon tax is an effective policy instrument. Moreover, it can be argued that a carbon tax is superior to emissions trading from an economic perspective (particularly in the short run) because it more efficiently deals with uncertainties regarding the likely costs of abatement relative to the benefits from abatement (Stern, 2006, p. 313; Hepburn, 2006; Weitzman, 1974).

For example, in a world of uncertainty, a tax is preferable where the benefits of reducing pollution are likely to change less with the level of pollution than the costs of the pollution reductions. This is likely to be the case in the short run. The benefits of reducing emissions

Box D.1 Comparing emissions trading and carbon taxes

Marginal costs of emissions reduction



The curve represents the marginal cost of abatement. It describes the additional cost firms would incur to achieve the next unit of emissions reduction. The cost of each unit of additional abatement increases as there will initially be simple, low-cost opportunities for firms to abate, but these will gradually be used up, forcing firms to access more costly abatement measures as the size of the emissions reduction increases.

However, as the abatement task increases, more expensive changes or technology will be required. In the absence of policy to reduce emissions, emitters will freely emit up until the point where there is no further private benefit in doing so – that is, point (a).

Where there is certainty as to the marginal cost of emissions reduction, the contribution to global emissions reduction implied at point (b) can be achieved either through an emissions trading scheme that permits the quantity of emissions implied by the vertical line at point (b), or through a carbon tax where the tax rate is that implied by the horizontal line at point (b). Under either approach, the economic cost is the sum of the marginal costs of emissions reduction, indicated by the shaded area.

Similarly, the emissions reductions implied by points (c) and (d) can be achieved through either an emissions trading scheme or a carbon tax.

The choice between the emissions reductions implied by points (b), (c) and (d) ideally should be informed by the marginal cost of emissions.

Total costs (that is, the costs of emissions plus the costs of emissions reductions) are minimised where the marginal cost of emissions reductions matches the marginal cost of emissions – that is, the environmental and economic costs caused by an additional unit of CO_2-e.

in any single year are unlikely to have very significant impacts (as climate change is dependant on the total stock of carbon equivalent emissions rather than the annual flow of emissions). However, the costs of abatement are likely to increase significantly as firms with fixed capital stock and technology find it harder to reduce emissions.

Conversely, in the longer run a permit system is likely to be superior. The longer-term marginal benefits of reducing the stock of emissions are large, as the cost of climate change increases with the size of the stock. The marginal cost of abatement in the long run is also likely to be lower because there is additional flexibility in the capital stock and in technology. In this case, in the long run the benefits of further reductions increase more with the level of pollution than the costs of delivering these reductions.

Ultimately, adopting emissions trading or a carbon tax rests on a choice about the overriding policy objective. If managing costs is given greater immediate weight, a carbon tax can be particularly effective. However, if the focus is on achieving longer-term specific emissions reductions, there are advantages to emissions trading. Short-term policy instruments should be consistent with achieving long-term goals.

D.2 Providing risk management opportunities to business

Policy frameworks that impose a carbon price to reduce emissions must provide some guidance about expected future carbon prices in order to be fully effective. However, this guidance, particularly over the longer term, will be limited by current assessments of climate change science, meaning there will always be some uncertainty as to the future restrictiveness of government policy.

Future policy uncertainty represents a business risk. Governments can limit the risk by providing clear rules and guidelines about how and when policy changes will be decided. Even with such guidance, business will require tools to manage future carbon price risks.

Business may face higher carbon prices due to policy change from higher tax rates under a carbon tax, or reduced permit issuance under emissions trading.

Emissions trading can incorporate design features to help business manage this risk. The government can issue long-dated permits, which businesses can trade directly, or they can manage their exposure through the purchase of derivative financial products created from permits. This enables those investing in emitting industries to gain greater certainty as to the carbon price they may face over the life of their investment by hedging – in effect, 'locking in' a future carbon price.

A carbon tax can only achieve similar outcomes if tradable tax offsets are available. However, such offsets would be unusual – there are currently no markets established for trading in future tax rates. Like banking provisions for emissions trading, tradable tax offsets would add to compliance and administrative costs.

The announcement of tax rates applying over the longer term is not an established practice in taxation. It also presumes a clear understanding of the changing relationship between carbon prices and emissions quantities, and the influence of technological change and structural shifts in the economy on this relationship.

Given these factors, emissions trading provides government with a more established and familiar mechanism to help business manage future carbon price risks.

D.3 Accessing least-cost abatement domestically and internationally

A key policy objective for Australia is to ensure that our emissions reduction task is comprehensive in its scope, with access to all abatement opportunities. Australian firms should be able to pursue abatement opportunities at least cost domestically and internationally.

Emissions trading and carbon taxes both offer robust frameworks that provide Australian firms with access to domestic offsets and carbon sinks as a means of meeting their emissions reduction obligations. Under emissions trading, permits are available for certified emissions reductions from domestic offsets and carbon sinks. The same outcome can be achieved under a carbon tax by providing tradable tax credits or grants equivalent to the tax rate.

Under any global emissions reduction framework, decisions would need to be made as to the extent, if any, of transfers between Australia and the rest of the world, and the extent of harmonisation of the implicit emissions price.

In advance of a harmonised emissions price globally, there are still considerable benefits to providing Australian firms with access to offshore abatement. Australia may also be able to provide abatement to other economies.

Such international transfers are more likely to be available for Australian companies under emissions trading rather than a carbon tax regime.

The international community appears to be heading towards greater use of emissions trading. Although theoretically there should be scope for gaining recognition of a carbon tax system – it could be based on very similar measurement and verification arrangements to emissions trading schemes – it is likely that the differences in such schemes would complicate international negotiations for mutual recognition.

Other countries may not readily accept an Australian carbon tax regime. This could limit the access of Australian firms to lower-cost abatement opportunities, or limit other countries' ability to tap into lower-cost Australian abatement opportunities or techniques.

D.4 Managing the transition to a carbon-constrained world

Ensuring a smooth transition to a carbon-constrained world is an important design feature of any policy framework, from both an economic and equity perspective. Transitional tools can be regulatory in nature, though they will typically involve explicit financial transfers. Revenue generated from emissions trading or a carbon tax can provide a financing source for these transfers. Revenue would be generated annually under a carbon tax whereas emissions trading will generate revenue whenever permits are sold rather than freely allocated.

Revenue can be reinvested to support low-emissions technology development through research and development funding. Such measures must be rigorously assessed to minimise the risk that the expenditure does not displace private investments that would otherwise have occurred. Where these measures are effective, they will reduce the cost of transition to a carbon-constrained world over time.

It may also be desirable to direct revenues to industry and households. This could be done through the free allocation of permits. The free allocation of permits would entail the transfer of a financial asset, which, in the case of an emitting firm, would not affect their marginal cost of production, thus retaining the price incentive to reduce emissions.

Similar outcomes could be achieved under a carbon tax by setting a tax-free threshold on existing emissions or through grant payments.

In either case, measures must be carefully considered to ensure that no windfall gains accrue to entities that have the capacity to pass part, or all, of their carbon costs on to customers and suppliers.

D.5 Minimising administrative and compliance costs

The use of market-based mechanisms such as emissions trading or a carbon tax will create explicit costs for business and government. Both mechanisms require decisions to be made regarding:

- the firms required to measure emissions
- where in the supply chain emissions would be required to be acquitted
- who would check and record the payment of tax or the surrendering of permits
- who would penalise non-compliance
- what those penalties might be.

Policy trade-offs in each of these areas will imply variations in the administrative and compliance cost burden. An emissions trading scheme would require higher start-up costs (the creation of a market) relative to a carbon tax. In addition, emissions trading is likely to have additional ongoing costs as trade needs to be monitored. That said, given that well-established commodity markets and regulatory infrastructure already exist, the ongoing costs might be expected to be low.

A carbon tax would be based on well-established taxation arrangements. However, to the extent that a carbon tax regime is adjusted to capture or mimic benefits achievable under emissions trading, the compliance costs are likely to be similar.

In practice, the administrative and compliance costs of emissions trading or a carbon tax will be determined by the complexity of the design features adopted. The introduction of permits with varying maturities, tradable tax credits, included and excluded sectors, incentive arrangements imposed on excluded sectors, and international linkages, will all add to a scheme's complexity and total administrative and compliance-cost burden.

This complexity will often be a necessary price to pay for an effective, efficient and equitable carbon-price regime. Both emissions trading and carbon taxes will reflect these costs in a broadly similar manner.

D.6 Modifying or adapting policy instruments over time

The case for using either an emissions trading scheme or carbon tax in preference to other forms of intervention is very strong. While a strong case can be made for a carbon tax, it appears that there are some policy objectives that are more easily addressed with an emissions trading scheme.

The key benefit of emissions trading is its focus on the ultimate environmental objective – namely, reducing emissions to a point that mitigates the effects of climate change. An emissions trading scheme also possesses easier options to link with global developments in a carbon-constrained environment.

The international landscape is evolving in a way that suggests reductions in global emissions are more likely to develop with linked trading schemes. Against this background, an emissions trading scheme provides the simplest framework for Australian engagement in a global effort.

However, a carbon tax has some clear advantages over an emissions trading scheme, particularly in relation to managing costs to business in the short term. Therefore, a regime that exploits the relative advantages of both an emissions trading scheme and a carbon tax may be potentially superior to a pure emissions trading scheme in the initial phases of a scheme.

These combined form, or 'hybrid', models can provide flexibility to address additional policy objectives, though they necessarily involve trade-offs (for example, cost control is only achieved through reduced short-term certainty about emissions reductions).

In most cases 'hybrid' models incorporate binding short-term price caps. If these arrangements are continually rolled over, they may reduce the capacity of the scheme to secure the full benefits of emissions trading. They may also undermine public confidence in the achievement of the ultimate emissions-reduction objective.

Therefore, a model that incorporates elements of a hybrid model in the short term, with an underlying emissions trading model at its heart, can maximise the flexibility of the policy framework for government.

Appendix E
Selected plurilateral arrangements

Plurilateral arrangements – in which several countries engage in cooperation, usually on a non-binding, voluntary basis – have emerged in recent years as a prominent feature of international cooperative efforts on climate change. Many of these arrangements involve the participation of both developed and developing countries, and have focused on the development, transfer and uptake of climate and energy technologies. The following is a summary of several such arrangements.

E.1 Asia–Pacific Partnership on Clean Development and Climate (AP6)

AP6 is a collaboration between six developed and developing countries (Australia, China, India, Japan, the Republic of Korea and the United States) to address energy, climate change and air pollution issues. It was established in January 2006. Partnership countries account for about a half of the world's GDP, population, energy use and greenhouse gas emissions.

AP6 focuses on practical action to develop and deploy low-emissions technologies. Its charter recognises that climate change actions should complement, and not frustrate, economic development and energy security goals. AP6 focuses on developing and deploying new technologies that will put economies on low-emissions trajectories. It aims to complement other international activities, including the UNFCCC and the Kyoto Protocol, G8 climate activities and regional initiatives such as in APEC.

Eight public–private task forces have been established to implement the AP6 agenda. The task forces cover the aluminium, building and appliances, cement, cleaner fossil energy, coal mining, power generation and transmission, renewable energy and distributed generation, and steel sectors. The task forces have developed action plans that feature over 90 project proposals, reflecting the AP6's vision of delivering greenhouse emission management, national pollution reduction and energy security benefits through efforts that also support economic development. The Australian Government has provided in-principle funding for 41 of the 90 projects, with a focus on cleaner fossil energy and renewable energy and distributed generation. Further information is available at ‹www.ap6gov.au›.

E.2 Carbon Sequestration Leadership Forum (CSLF)

Established in 2003, the CSLF is focused on the development and dissemination of technologies for capture and storage of carbon dioxide through coordinated research and development. The technical, political and regulatory environment for the development of such technology is also considered. The CSLF comprises 22 members:

- Australia, Brazil, Canada, China, Colombia, Denmark, the European Commission, France, Germany, Greece, India, Italy, the Republic of Korea, Japan, Mexico, the Netherlands, Norway, the Russian Federation, Saudi Arabia, South Africa, United Kingdom and the United States.

The CSLF charter was agreed at the first ministerial-level meeting of the Forum at Washington DC in June 2003. The charter established a broad outline for cooperation between governments, industry, researchers and non-government organisations. The charter will remain in force until 2013. The

second ministerial-level meeting took place at Melbourne in September 2004. The activities of the CSLF are conducted by:

- a Policy Group, which governs the overall framework and policies of the CSLF – Australia is currently Vice Chair of the Group
- a Technical Group, which reviews the progress of collaborative projects and makes recommendations to the Policy Group.

The most recent meeting of the Policy and Technical Groups, held at New Delhi in April 2006, resulted in finalisation of a CSLF Strategic Plan.

E.3 Global Initiative on Forests and Climate

In March 2007, Australia announced its intention to work with like-minded developed and developing countries and with relevant international organisations to support new forest planting, limit deforestation and promote sustainable forest management. The countries in South-East Asia and the South Pacific are a particular focus of the Initiative. Projects under the Initiative will be aimed at:

- building technical capacity to assess and monitor forest resources and develop national forest management plans
- putting in place regulatory and law enforcement arrangements to protect forests
- promoting the sustainable use of forest resources and supporting economic diversification
- encouraging reforestation of degraded areas
- piloting approaches to provide financial incentives to countries and communities to promote sustainable development.

E.4 International Partnership for the Hydrogen Economy (IPHE)

Established in 2003, the IPHE coordinates international research, development, demonstration and commercial utilisation activities related to hydrogen and fuel cell technologies. There are 17 members:

- Australia, Brazil, Canada, China, the European Commission, France, Germany, Iceland, India, Italy, Japan, the Republic of Korea, New Zealand, Norway, the Russian Federation, the United Kingdom and the United States.

The specific aims of the IPHE are to:

- identify and promote potential areas of bilateral and multilateral collaboration, including by leveraging resources
- analyse and recommend priorities for research, development, demonstration, and commercial utilisation
- analyse and develop policy recommendations on technical guidance, including common codes, standards and regulations
- foster implementation of large-scale, long-term public-private cooperation
- address emerging technical, financial, legal, market, socioeconomic, environmental, and policy issues.

E.5 Methane to Markets Partnership (M2M)

M2M is aimed at advancing cost-effective methane recovery and use as a clean energy source, focussing on agriculture, coal mining, landfills, and oil and gas systems. Twenty countries are members, accounting for more than 60 per cent of global methane emissions:

- Argentina, Australia, Brazil, Canada, China, Colombia, Ecuador, Germany, India, Italy, Japan, Mexico, Nigeria, Poland, the Republic

of Korea, the Russian Federation, Ukraine, the United Kingdom, the United States and Vietnam.

The aims of M2M are to:

- identify and promote areas of bilateral, multilateral, and private sector collaboration on methane recovery and use
- develop improved emissions estimates and identify the largest relevant emission sources to facilitate project development
- identify cost-effective opportunities to recover methane emissions for energy production and potential financing mechanisms to encourage investment
- identify and address barriers to project development and improve the legal, regulatory, financial, institutional, technological and other conditions necessary to attract investment in methane recovery and utilisation projects
- identify and implement collaborative projects aimed at addressing specific challenges to methane recovery, such as raising awareness in key industries, removing barriers to project development and implementation, identifying project opportunities, and demonstrating and deploying technologies
- foster cooperation with the private sector, research organisations, development banks, and other relevant governmental and non-governmental organisations
- support the identification and deployment of best-management practices in the recovery and use of methane
- work to improve scientific understanding and certainty in relation to the recovery and use of methane.

E.6 Renewable Energy and Energy Efficiency Partnership (REEEP)

Established in 2004, REEEP is a global partnership of governments, businesses, development banks and non-government organisations. Its goals are to:

- reduce greenhouse gas emissions by accelerating the integration of renewable energy into the energy mix
- deliver social improvements to developing countries and countries in transition by improving the access to reliable clean energy services
- bring economic benefits to nations that use energy in a more efficient way and increase the share of indigenous renewable resources within their energy mix.

REEEP is funded by a number of governments, including:

- Australia, Austria, Canada, Germany, Ireland, Italy, Spain, the Netherlands, New Zealand, Norway, the United Kingdom, the United States and the European Commission.

E.7 International Energy Agency Implementing Agreements

Since its creation in 1974, the International Energy Agency has provided a structure for international cooperation in energy technology research, development and deployment. Under the auspices of the International Energy Agency, there are currently some 40 active programmes, known as Implementing Agreements, in which experts from governments and the research community are brought together to share expertise and resources on technologies for fossil fuels, renewable energies, efficient energy end-use and fusion power.

The aims of the Implementing Agreements are to:

- improve energy efficiency and technology reliability
- enhance access to up-to-date assessments of energy technology performance
- reduce environmental impact of energy-sector activities
- cooperate with non-member countries.

Australia participates in 15 Implementing Agreements, including:

- clean coal science
- bioenergy
- geothermal energy
- photovoltaic power
- solar heating and cooling
- wind turbine systems
- energy conservation in buildings.

Appendix F

Climate change actions by selected countries

Country	Kyoto target	Other actions	Emissions performance	Attitude to Kyoto-style targets/ timetable approach
United States	Not applicable – the United States has not ratified the Protocol	Objective of a reduction in greenhouse gas intensity by 18 per cent from 2002 to 2012. Strong proponent of plurilateral technology arrangements, including AP6 Increased mandatory fuel standard to 35 million gallons of renewable and alternative fuels by 2017 (announced in 2007 State of the Union, but not yet legislated) Increased fuel efficiency for cars Incentives for R&D in alternative fuels (ethanol, biomass) Tax rebates on clean coal power stations	+21.1 per cent (1990–2004). Energy-related CO_2 emissions increased by 1.7 per cent between 2001 and 2004	The US has not stated an explicit position on the post-2012 international framework. It has highlighted its opposition to a continuation of Kyoto, and has outlined its view that the future framework should be addressed by both developed and developing countries; be discussed within the context of energy security, climate change and economic growth; and reflect the critical importance of developing low-emissions technology and deploying it on a cost-effective basis around the world.
European Union	-8 per cent (applies to EU15; significant variations among member states)	Measures under the European Climate Change Programme (ECCP) set up in 2000, including establishment of the EU Emissions Trading Scheme, its second phase to operate from 2008–2012 with wider sectoral scope and more gases; energy efficiency standards for buildings; measures on fluorinated gases. Second phase of ECCP (2005) focussing on CCS, transport sector emissions and renewables. EU objectives for post-2012 include: binding renewables target of 20 per cent by 2020; improving energy efficiency by 20 per cent by 2020; supporting carbon capture and storage demonstration projects; and alternative fuels support. EU has proposed a 20 per cent reduction in emissions by 2020, increasing to 30 per cent if matched by actions by other developed countries as part of an international agreement.	-0.9 per cent for EU15 (1990–2004). Member state performance: Germany -17.5 per cent; Spain +47.9 per cent; UK -14.1 per cent; France -0.8 per cent; the Netherlands +1.6 per cent.	Supports continuation of Kyoto, but is seeking commitments by other developed countries. It is also seeking action by developing countries by 2020–25 subject to graduation criteria. It also supports streamlining of CDM; improved access to finance for electricity generation in developing countries; sectoral emissions trading in certain sectors; and a future international agreement on energy efficiency.

Country	Kyoto target	Other actions	Emissions performance	Attitude to Kyoto-style targets/ timetable approach
Japan	-6 per cent	Kyoto Protocol Target Achievement Plan includes: measures to improve fuel efficiency in motor vehicles; promote biofuels; cooperate with China and east Asian countries on energy efficiency; a plan to expand the utilisation of nuclear power. A voluntary emissions trading scheme is in place but is limited to a small number of sectors and it is not clear if it will be continued. Revised national strategy expected in June 2007. Programmes to improve efficiency of household appliances. In May 2007, the Japanese Prime Minister launched a national campaign to achieve Japan's Kyoto target. Strong proponent of plurilateral technology arrangements including AP6; supports technical exchanges to improve energy efficiency in bilateral and multilateral fora. Reporting and accounting procedures in place. Examining seabed carbon capture and storage and coal-seam CO_2 storage. Developing advanced capture technologies. Examining possible carbon tax, but no fixed plan. Concluded joint statement with the United States in April 2007 that provided for joint action on energy security, clean development and climate change.	+ 5.2 per cent (1990–2004)	Supports continuation of Kyoto, but subject to action by developing countries.

Country	Kyoto target	Other actions	Emissions performance	Attitude to Kyoto-style targets/ timetable approach
Canada	-6 per cent	New plan announced in April 2007 that commits the government to reducing emissions by 20 per cent of 2006 emissions by 2020. Emitters will have access to domestic emissions trading, offsets, and use of CDM credits. Exploring possible future linkages with emissions trading in the United States and Mexico. Established technology fund. Fixed emission cuts for non-greenhouse gas pollutants. Improved energy efficiency including for appliances.	+ 62.2 per cent (1990–2004)	Supports a comprehensive global approach with participation from all major developed and developing countries.
New Zealand	0 per cent	Considering an economy-wide 'cap and trade' emissions trading system. An announcement is expected in 2007. Biofuels target of 3.4 per cent of fuel consumption by 2012	+ 21.3 per cent (1990–2004)	Supports a comprehensive global approach with participation from all major developed and developing countries.
China	No emissions commitment	Renewable energy law and 10th five-year plan expected to reduce electricity sector emissions by 5 per cent below BAU in 2020 Medium- and long-term energy conservation plan estimated to reduce cement emissions by 15 per cent below BAU in 2020 and iron and steel sector emissions by 9 per cent below BAU in 2020 Fuel efficiency standards for motor vehicles estimated to reduce transport emissions by 5 per cent below BAU in 2020	+ 47 per cent (1990–2004)	Supports continuation of Kyoto on the condition that developing countries do not take on emissions limitation commitments.
India	No emissions commitment	Transport policies are estimated to reduce transport emissions by up to 15 per cent below BAU in 2020 Electricity emissions expected to increase	+ 55 per cent (1990–2004)	Supports continuation of Kyoto on the condition that developing countries do not take on emissions limitation commitments.

Appendix G
Summary of post-2012 international climate change approaches

The following draws on two major summaries of proposals that have been put forward by a number of organisations and individuals for advancing the international climate change effort beyond 2012:

- International Climate Change Efforts Beyond 2012: A Survey of Approaches, Bodansky, Chou and Jorge-Tresolini for the Pew Center, 2004
- Approaches for Future International Cooperation, Philibert, International Energy Agency, 2005.

There are wide variations in the proposals. Some are comprehensive in scope, outlining a complete picture of the elements of a future global regime. Others address particular aspects of the negotiations – for example, the type of target. Many proposals can be viewed as complementary rather than mutually exclusive.

G.1 Form and forum

Most proposals assume that the next global framework will be negotiated in much the same way as the Kyoto Protocol – that is, among governments on a global basis under the auspices of the UNFCCC. A few proposals, however, suggest alternative approaches:

- the 'orchestra of treaties' proposal envisions a variety of activities undertaken outside the UNFCCC by like-minded countries, including on emissions trading, technology development and funding
- a portfolio approach, in which like-minded or significant countries would pursue a variety of approaches
- a 'converging markets' approach, which envisages a multi-stage regime, starting with bottom-up, bilateral negotiations to integrate national emissions trading schemes and then developing into a broader regime as other countries seek to join
- parallel climate policy, which suggests that the United States engage China and other major developing country emitters in a new regime, parallel to Kyoto, which could include gradual emissions reduction pathways involving modest targets and full use of international emissions trading.

G.2 Mitigation commitments

It is possible to group proposals on mitigation and types of commitment under two headings:

- quantitative approaches – in which action is driven by some overall aggregate goal or target in relation to emissions outcomes, or by other objectives such as temperature increase or atmospheric concentrations
- non-quantitative approaches – in which action is not driven by a specific target but rather aims to engage a wide range of participants, for example, using a 'pledge and review' approach where participants make pledges of action, often in the form of specific policies and measures that include provision for future review.

The following provides a summary of proposals grouped under these headings.

G .3 Quantitative approaches

G.3.1 Fixed and binding targets

The following are proposals on participation/ allocation issues:

- 'multi-stage' – a pathway to a new global regime in which developing countries

participate in a commitments regime in several stages, involving progressively more stringent commitments

- 'contraction and convergence' – specifying a global emissions pathway that leads to an agreed long-term CO_2 concentration level, with country-specific emissions limits aimed at achieving convergence in per capita emissions
- 'common but differentiated convergence' – allocation of national emissions targets on a per capita basis; differentiation between developed and developing countries in the period up to 2025; developing country targets determined on a per capita basis, allowing increased emissions for most. Developed country targets would be set for 2010 and 2025, with provision for adjustments up and down based on a country's carbon intensity vis-à-vis the Annex I average
- 'global triptych' – in which technological opportunities to reduce emissions in various sectors would be calculated taking into account different technological starting points of countries. The 'triptych' reflects the original proposal's focus on emissions in the sectors of power generation, energy intensive industries and the domestic sectors, notably residential and transport
- 'per capita' – several possible burden-sharing approaches, all based on the principle of equal per capita emissions entitlements
- 'accumulated historical emissions' – a proposal by Brazil, involving burden sharing based on historical responsibility for temperature change. As proposed originally, it provided for Annex I countries as a group to reduce their emissions by 30 per cent below 1990 levels by 2020, and suggested a methodology for allocating emissions-reduction burdens among countries based on their relative responsibility for global temperature increase. It also included a new CDM-type mechanism.

G.3.2 Non-binding targets

Proposals include a wide variety of targets:

- intensity targets, in which targets are indexed to some other variable such as GDP growth, either at the economy-wide or sectoral level
- 'no lose' targets, which are non-binding and involve no penalty if exceeded, but allow the sale of credits
- conditional targets, where funding is made conditional on emissions performance
- sectoral targets, in which targets are set at the sectoral level
- 'safety valve' targets, where the target is relaxed if the marginal cost of abatement rises about a pre-determined safety valve level.

G.4 Non-quantitative approaches

G.4.1 Policies and measures

These proposals allow countries to define their commitments on the basis of what they are willing and able to implement according to their national circumstances.

The commitments could take virtually any form, including domestic emissions targets, efficiency standards, financial transfers, investments in research and development or adaptation. Bilateral and multilateral negotiations would determine the scale and content of the packages of action.

Variations on this proposal apply to developing countries – specifically, that developing country commitments would initially take the form of pledges to implement national sustainable development policies, which would be subject to international review and scrutiny.

G.4.2 Technology arrangements

The main proposal in this category is aimed at promoting a technology transition in key sectors. It includes five components:

- a research and development protocol to promote the development of new technologies
- adoption of specific performance standards for key technologies
- a multilateral fund to help spread new technologies to developing countries
- a short-term system of pledge and review
- assistance for adaptation.

One proposal is for international agreements on energy efficiency, in which countries would develop energy efficiency standards for major appliances in the household and transport sectors, and negotiate an international agreement establishing target efficiency levels for the production process in major emitting industries.

G.4.3 Carbon taxes

Proposals for internationally harmonised domestic carbon taxes are based on the argument that they would be more efficient and effective, would provide certainty about marginal compliance costs and would make costs transparent.

Appendix H
Commissioned research

This appendix outlines research commissioned by the Task Group to assist in its deliberations about issues addressed in this report.

This work should not be read as constituting the Task Group's views on any of the analysed issues nor should it be taken as an indication of appropriate short-, medium- or long-term targets for emissions reductions.

Commissioned research consists of ten modelling scenarios from the Australian Bureau of Agricultural and Resource Economics (ABARE) (Section H.1); six scenarios from ACIL Tasman (Section H.2); one research paper from CSIRO (Section H.3); and three research papers from Baker & McKenzie (Section H.4).

H.1 Modelling commissioned from ABARE

The Task Group commissioned ABARE to provide a suite of ten scenarios using their global trade and environment model (GTEM), a dynamic general equilibrium model of the world economy. The scenarios were chosen to illustrate:

1. the effects of using a regulatory approach rather than a price mechanism to achieve emissions abatement (Chapter 3)
2. the impacts on global abatement and the Australian economy when different country coalitions contribute to global abatement (Chapter 6)
3. the effect of shielding trade-exposed, emissions-intensive industries (Chapter 6)
4. the impact of enhanced technology development and uptake (Chapter 8).

This modelling was undertaken to illustrate broad policy issues and was not designed or intended to provide a projection of actual policy impacts. Box 6.3 in the report outlines some issues that assist in interpreting any long-term economic projections, and some caveats that apply.

The first subsection discusses the international action scenarios. This is followed by a discussion of the unilateral action scenarios. Table H.1 summarises the modelling results.

Table H.1 ABARE scenarios to 2030

International action scenarios	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5 (enhanced technology)
Country coalition	Developed and 'transition' countries	Top 20 emitters minus some key competitors	Top 20 emitters	All countries	All countries
Carbon price in Australia (2006 A$ per tonne of CO_2-e in 2030)	$40	$42	$44	$46	$28
Australian emissions relative to the reference case (CO_2-e in 2030)	-22%	-22%	-22%	-22%	-22%
Global emissions relative to the reference case (CO_2-e in 2030)	-9%	-20%	-22%	-25%	-25%
Impact on Australian GDP levels relative to the reference case in 2030	-1.5%	-1.5%	-1.5%	-1.5%	-1.0%
Carbon leakage per unit of global abatement in 2030	6.1%	2.4%	2%	0	0

Australian abatement scenarios (only Australia abating)	Scenario A	Scenario B	Scenario B*	Scenario C	Scenario 6 (regulation)
Coverage	All sectors (other than land-use change and forestry)	As for Scenario A but natural gas, iron and steel, non-ferrous metals and agriculture shielded	As for Scenario A but natural gas, iron and steel and non-ferrous metals shielded	As for Scenario B	As for Scenario A
Carbon price in Australia (2006 A$ per tonne of CO_2-e in 2030)	$15	$31	$21	$18	n/a
Australian emissions relative to the reference case (CO_2-e in 2030)	-12%	-12%	-12%	-8%	-12%
Global emissions relative to the reference case (CO_2-e in 2030)	-0.12%	-0.13%	-0.13%	-0.10%	-0.12%
Impact on Australian GDP levels relative to the reference case in 2030	-0.7%	-1.1%	-0.8%	-0.6%	-1.5%
Carbon leakage per unit of Australian abatement in 2030	12.8%	3.6%	5.0%	3.8%	10.9%

H.1.1 International action scenarios

The Task Group commissioned ABARE to model an illustrative set of scenarios examining the impact of building progressively larger international coalitions of countries taking action to reduce greenhouse gases. The scenarios kept abatement for individual coalition members constant while assessing the effects on global abatement and economic activity.

Australian abatement is kept at an arbitrarily chosen emissions reduction of 22 per cent relative to our baseline in 2030, regardless of the size of the coalition modelled. This level of abatement for Australia is consistent with Australia's abatement in a hypothetical global participation scenario (Scenario 4) where global greenhouse gas emissions are reduced to 25 per cent below the reference case level at 2030. The abatement undertaken in each individual economy is determined within GTEM on the basis of a uniform global emissions penalty covering all sectors of the participating economies (other than land-use change and forestry). The resulting abatement is not the same across countries (relative to the corresponding reference case) and will depend on each country's specific circumstances, including their economic structure and the abatement opportunities available at different carbon prices. Countries are assumed to gradually reduce their emissions between 2013 and 2030.

The Task Group commissioned scenarios 1 to 4 to shed light on the sensitivity of global environmental outcomes to changes in the scope of coalitions of countries, and to illustrate the impact of excluding some of Australia's key competitors, many of whom are among the largest emitters. The country groupings modelled were chosen for illustrative purposes only.

Scenario 1 – Developed and 'transition' country participation: This coalition approximates the group of 39 countries with a target set out in Annex B of the Kyoto Protocol. To give effect to a model run approximating this country grouping in GTEM, ABARE has:

- excluded some Annex B countries that are aggregated in a broad GTEM region called Rest of World (including Bulgaria, Croatia, Iceland, Monaco, New Zealand, Norway, Romania and Switzerland). These are assumed not to undertake abatement under Scenario 1 although they are Annex B countries.
- included some European non-Annex B countries that are aggregated in two broad GTEM regions called EU25 (Cyprus and Malta) and Rest of the Commonwealth of Independent States (certain economies of the former Soviet Union other than Ukraine and the Russian Federation). These are assumed to undertake abatement under Scenario 1 although they are not Annex B countries.

Scenario 2 – Participation expanded to top 20 emitters minus some key Australian competitors: Scenario 2 models a coalition that is responsible for a larger share of world emissions by including the world's top 20 emitters, but excluding some key competitors (Scenario 3 has all top 20 emitters and their representation in GTEM is explained under that scenario). To give effect to this scenario, ABARE identified Australia's major commodity export competitors: Canada (for beef, veal and wheat), Indonesia (coal and natural gas), China (coal, gold and primary aluminium), Brazil (iron ore), the Russian Federation (primary aluminium, natural gas and coal), South Africa (coal and gold), the Confederation of Independent States (gas), and countries in the Middle East (crude oil, natural gas and primary aluminium). However, to expand the coalition's coverage of world emissions from the Annex B grouping, only Indonesia, Brazil, South Africa, the Confederation of Independent States and countries in the Middle East were removed for the coalition of top 20 emitters. Accordingly,

the economies participating in the international emissions abatement coalition are assumed to be: the United States, EU25, China, the Russian Federation, Japan, India, Canada, the Republic of Korea, Mexico and Australia. Together these economies accounted for about 70 per cent of global emissions of carbon dioxide from fossil fuel combustion in 2003.

Scenario 3 – Participation expanded to top 20 emitters: ABARE identified the top 20 emitting economies using the most recent International Energy Agency estimates of carbon dioxide emissions from fossil fuel combustion. Together these economies accounted for 78 per cent of world emissions in 2003. For the purposes of this scenario, these economies are mapped into GTEM regions to include: the United States, China, the Russian Federation, Japan, India, EU25, Canada, the Republic of Korea, Mexico, the Rest of the Organization of the Petroleum Exporting Countries, Australia, Indonesia, South Africa, Brazil, and the Rest of the Confederation of Independent States.

Scenario 4 – All country participation: This scenario contains all emitters. Overall global emissions are cut by 25 per cent relative to the reference case with a price path rising from zero in 2013 to $46/t CO_2-e by 2030.

As can be seen in Table H.1, scenarios 1 to 4 show a large improvement in environmental effectiveness when a majority of key emitters joins in the abatement task, and burden sharing broadens to include rapidly growing developing economies. Global abatement in 2030 is more than doubled (from 9 per cent in Scenario 1 to 20 per cent in Scenario 2) when the coalition of countries is broadened from those that have a target within the Kyoto Protocol to include a majority of key emitters. The amount of global abatement is further increased progressively as the coalition is broadened to include all top 20 emitters (Scenario 3) and all countries (Scenario 4).

Costs to Australia of achieving a 22 per cent emissions reduction from the reference case are around the same for all scenarios (1.5 per cent of GDP in 2030 for scenarios 1 to 4). Opposing factors are at play.

- On the one hand, the adverse economic impact of a specific domestic emissions cut increases when the coalition becomes larger (moving from Scenario 1 to Scenario 4), because demand for Australian exports falls (as outlined below, this impact can be significantly ameliorated by the development of low emissions technology globally).
- On the other hand, when the coalition becomes larger – that is, as more countries constrain emissions – less Australian economic activity is lost to non-carbon-constrained jurisdictions (leakage).

Given the specification of the scenarios it is coincidental that these two opposing effects almost exactly offset each other. However, this may not be the case for scenarios with different specifications. For example, the range of domestic abatement opportunities available will change at different carbon prices, resulting in different implications for domestic economic activity for any given amount of leakage.

Nevertheless, while the economic outcomes do not vary greatly in the modelled scenarios, the global environmental outcomes unambiguously improve as more countries contribute. Overall, this analysis suggests a strategy based on building a coalition from the 'bottom up', combined with efforts to make multilateral arrangements more inclusive, holds a prospect for reasonable outcomes for Australia even in the likely event that progress is uneven.

Modelling enhanced technological change

ABARE provided the Task Group with a further global action scenario. Scenario 5 assumes accelerated technology development and uptake but is otherwise directly comparable

to Scenario 4. The enhanced technology development and uptake assumed in Scenario 5 reduces the cost to Australia of achieving the target by one-third, from 1.5 per cent to 1 per cent of GDP in 2030 relative to the reference case. This highlights the potential for enhanced technology development and uptake to significantly reduce the costs of emissions abatement.

Key features of Scenario 5 include the accelerated uptake of advanced and hybrid vehicles; higher efficiency in the generation of electricity, cement, aluminium, iron and steel, pulp and paper products; and the accelerated adoption of more efficient technologies in the services sectors. Enhanced development and deployment of more energy-efficient and low-emissions technologies to 2030 is also assumed (in line with assumptions in the Global Technology scenario in Matysek et al. (2006), with modifications to assumptions about energy consumption by the services and chemicals, rubber and plastics industries).

The enhanced technology assumed in Scenario 5 on its own would have reduced global emissions by about 10 per cent relative to the reference case at 2030. This could be viewed as 'equivalent' to bringing forward the reference case 'global' technology profile by about five to six years.

H.1.2 Unilateral action scenarios

The Task Group commissioned ABARE to model three scenarios (and one sensitivity scenario) to illustrate the effects of shielding trade-exposed, emissions-intensive industries from a carbon price differential between Australia and the rest of the world. The industries identified by ABARE for this purpose were gas (including LNG), iron and steel, non-ferrous metals, and agriculture.

These industries were identified to provide indicative estimates of the impacts of introducing a carbon price with and without trade-exposed, emissions-intensive industries being subject to that price. The industry list identified here is not comprehensive – some likely trade-exposed, emissions-intensive industries were not included and the industry groupings identified are very broad – some subsectors in the industries identified are not likely to be trade-exposed, emissions-intensive industries. The results are therefore not indicative of likely outcomes on an industry basis. As noted in Appendix L, making decisions about which sectors are actually trade-exposed, emissions-intensive industries requires more detailed analysis.

The scenarios assume modest unilateral action by Australia to 2030, and model shielding of trade-exposed, emissions-intensive industries with and without adjustment of the Australian abatement target. For simplicity, the rest of the world is assumed not to undertake any emissions abatement action under these scenarios.

Scenario A: This scenario assumes the same Australian abatement targets implied under Scenario 1 until the emissions penalty reaches an arbitrarily chosen cap at A$15 (2006 dollars) per tonne of CO_2-equivalent. Once the cap is reached, Australia's emissions are determined within GTEM by the A$15 per tonne carbon penalty.

Scenario B: The emissions path is assumed to be the same as in Scenario A. However, this scenario shields the sectors identified by ABARE as trade-exposed, emissions-intensive industries for this exercise (gas, iron and steel, non-ferrous metals and agriculture) from cost increases related to their own emissions as well as from electricity price rises associated with emissions pricing. This reduces emissions leakage but raises the abatement burden for the rest of the economy. A sensitivity analysis was also performed (Scenario B*) where the agriculture sector was not included in the group of trade-exposed, emissions-intensive industries shielded from the direct and indirect effects of carbon pricing.

Scenario C: Trade-exposed, emissions-intensive industries are shielded from emissions pricing in the same manner as in Scenario B. However, non-shielded industries under Scenario C are assumed to undertake the same abatement as in Scenario A rather than having to undertake additional abatement as under Scenario B. Hence, Australia achieves less abatement over the period to 2030 under Scenario C than under scenarios A and B.

Scenario A illustrates that, in the case of Australia introducing a carbon constraint ahead of the rest of the world, a substantial proportion of Australian abatement (12.8 per cent) is offset by expanded production overseas. This 'leakage' is concentrated in a small number of industries; scenarios B and C highlight the impact of efforts to reduce such leakage.

Scenario B shows that shielding trade-exposed industries can cut leakage from about 13 per cent of Australian abatement to about 4 per cent. Leakage is undesirable for two broad reasons: (1) it reduces global environmental outcomes flowing from Australian action, thus reducing the environmental cost effectiveness of domestic action; and (2) it provides an additional incentive for countries to postpone their contribution to global abatement.

However, shielding trade-exposed industries also has the effect of redistributing the abatement burden to the non-shielded sectors within Australia, roughly doubling the carbon price required to achieve the same abatement and leading to an additional 0.4 percentage point reduction in GDP (relative to Scenario A). Precise impacts are dependent on the specific industries shielded – for example, removing shielding from agriculture significantly reduces the GDP impact (Scenario B*). However, a number of other trade-exposed industries are not shielded in these scenarios, and the aggregate nature of the industry categories shielded may mask some of the effects on particular subsectors.

In a situation where the global abatement effort is not sufficiently broad, government might consider both shielding trade-exposed sectors and adjusting the overall abatement task to ensure the rest of the economy does not carry an additional burden. This possibility is illustrated in Scenario C where the non-shielded sectors abate the same amount as they were abating under Scenario A. Thus, in Scenario C, the abatement achieved is reduced (from 12 per cent to 8 per cent) but so is the GDP impact (from 0.7 per cent to 0.6 per cent).

As noted in Box 6.6, the approach here – of shielding trade-exposed, emissions-intensive industries from the impact of a carbon price – differs significantly from the approach proposed by the Task Group in Chapter 7.

Modelling regulatory approaches

ABARE provided a further unilateral action scenario (Scenario 6) that models the impact of achieving a 12 per cent emissions reduction target by 2030 (relative to the reference case) through higher renewable energy targets and tighter fuel efficiency standards. This scenario is directly comparable with Scenario A. Scenarios 6 and A differ only in that Scenario 6 achieves abatement through regulation whereas Scenario A achieves it through a uniform carbon price across the economy. However, the regulation scenario more than doubles the cost to GDP by 2030, namely from 0.7 per cent in Scenario A to 1.5 per cent in Scenario 6.

In Scenario 6, non-hydro renewables are assumed to account for 11 per cent of total electricity generation by 2030 at the expense of coal-fired electricity generation. This implies more than doubling the share of non-hydro renewables in Australia's electricity generation under the regulatory policy scenario relative to the projected reference case contribution of 4.7 per cent. Under the scenario, it is assumed that the renewable energy targets are supplemented by mandatory efficiency standards

in vehicles, increasing the average fuel economy of the Australian transport vehicle fleet by 27 per cent, relative to the reference case at 2030.

H.2 Research paper commissioned from ACIL Tasman

The Task Group commissioned ACIL Tasman to provide stylised scenarios to illustrate how ongoing uncertainty around climate change policy might affect investors and consumers in the national electricity market.

ACIL Tasman used its in-house electricity market simulator model, PowerMark, to model six scenarios: two hiatus scenarios, two gas-fired generation investment scenarios and two coal-fired generation investment scenarios. Table H.2 summarizes the modelling results.

- **Scenarios 1 and 2** (hiatus scenarios) model an outlook where carbon price uncertainty leads to no investment in new baseload power generation until 2011–12, when the uncertainty is assumed to be resolved and either a high carbon price (Scenario 1) or a low carbon price (Scenario 2) is imposed.
- In **scenarios 3 and 4** (gas investment scenarios) electricity market investors assume a sufficient carbon price will eventuate to make gas fired generation more competitive than coal fired generation. Then in 2011–12 they find out either that they were right and a carbon price rising to $35 per ton of CO_2 by 2030 is imposed (Scenario 3); or they were wrong and no carbon price is imposed (Scenario 4).
- In **scenarios 5 and 6** (coal investment scenarios) electricity market investors assume a carbon price low enough to make coal-fired generation more competitive than gas-fired generation. Then, in 2011–12 they find out either that they were wrong and a carbon price rising to $35 per ton of CO_2 by 2030 is imposed (Scenario 5); or they were right and no carbon price is imposed (Scenario 6).

This analysis shows that consumers of electricity (including businesses) could face substantially higher electricity prices if existing uncertainty stifled investment in baseload generation capacity. Under the hiatus scenarios, wholesale electricity prices could rise by up to 25 per cent during the period from 2012 to 2017, amounting to additional cost to electricity consumers of between $1.9 billion to $3.5 billion in net present value terms compared to scenarios where carbon prices are known with certainty.

Investors in new capacity could lose $137 million in net present value terms if they invest in gas fired baseload generation in anticipation of a high carbon price only to find that no carbon price eventuates. Investors could lose $153 million in net present value terms if they invest in coal-fired generation in anticipation of no carbon price but find that a high carbon price eventuates. This shows that the costs to investors can be significant and could well deter them from committing to new investments until they have sufficient confidence in their outlook for long-term policy on carbon pricing.

The scenarios are intended to explore the consequences of uncertainty and the results should be interpreted carefully. The results of the two hiatus scenarios show the potential effects on consumers through higher prices, with the second scenario providing an upper bound for this effect. Furthermore, the costs to consumers arise because the hiatus in investment reduces the level of competition in the national electricity market and generators are able to achieve higher pool prices. These cost estimates constitute a transfer from electricity consumers to generators. Any electricity price rises will feed through the economy and impact on overall economic performance. It would particularly affect the competitiveness of electricity-intensive industries, such as non-ferrous metals.

Table H.2 ACIL Tasman scenario comparisons

	Description of cost	Cost net present value (NPV) ($'M)	Average increase in pool prices ($/MWh)	Period of impact
Scenario 1 (hiatus) compared to Scenario 3 (correctly judged gas investment)	Cost to consumers	$1,874	$2.29	2012–14
Scenario 2 (hiatus) compared to Scenario 6 (correctly judged coal investment)	Cost to consumers	$3,537	$6.90	2012–17
Scenario 4 (incorrectly judged gas investment) compared to Scenario 3 (correctly judged gas investment)	Cost to investors	$137	N/A	2012–42 (life-cycle of the investment)
Scenario 5 (incorrectly judged coal investment) compared to Scenario 6 (correctly judged gas investment)	Cost to investors	$153	N/A	2012–42 (life-cycle of the investment)

H.3 Research paper commissioned from CSIRO

Decisions on the detail of how many permits are issued – and how long in advance permits are made available – in an emissions trading scheme have important implications for business clarity and for the mechanisms needed to adjust emissions market arrangements in the light of new information and circumstances. The Task Group commissioned Dr Steve Hatfield Dodds of CSIRO to explore these issues, particularly the implication of different options for:

- the credibility of the system for investors and others
- the flexibility available to government to adjust the emissions trajectory in the light of new scientific findings and improved information about international willingness to reduce emissions
- promoting emissions market liquidity and price visibility
- enabling enterprise-level risk management
- promoting appropriate investment in the development of low-emissions technologies.

H.3.1 Implications for establishing a tradable emissions permit system

The conclusions reached by Dr Hatfield Dodds offer interesting insights as to the costs and benefits of issuing permits and signalling emissions trajectories over different time frames.

Short term (little flexibility in capital stock)

- While most or all permits should be issued for the current acquittal period, regular auction of some permits within the acquittal period would assist the functioning of markets and reduce economic costs. This is particularly important if a substantial share of permits is initially allocated administratively rather than auctioned.

Medium term (some flexibility in capital stock)

- There is a strong case for providing a credible signal of the medium-term emissions trajectory. Uncertainty over the nature of the Australian emissions abatement task would be alleviated by signalling upper and lower emissions bounds for more distant time frames, preferably with periods aligned

with international decision points, along with guidance on how actual permits will be determined.

- There is a strong case for forward issue of a modest share of permits to underpin price visibility and allow management of future price risk, thereby assisting business planning.
- A number of factors favour forward issue of more permits in the establishment phase than would be required to establish liquid forward markets, including signalling a long-term government commitment to emissions control, and facilitating one-off adjustment assistance (or compensation) through administrative allocation of permits.
- Other factors favour limiting the issue today of permits beyond the immediate operational period. Retaining an increasing share of the expected emissions trajectory over the medium term appears sensible, given rising levels of uncertainty and an associated greater need for government flexibility. Issuing today the majority of permits for years beyond the short-term operational period:
  - effectively signals the lower bound of the emissions trajectory but does not of itself establish a credible specific trajectory
  - does little more to assist enterprise-level risk management than issuing a modest share of permits or emissions options
  - increases fiscal risks associated with possible downward adjustments to the forward trajectory (although these risks could be reduced through mechanisms such as creating a reserve to fund potential permit repurchase).

Long term (significant renewal of capital stock)

- Consideration should be given to signaling Australia's long-term aspiration for emissions reductions, preferably through a robust objective. An objective-based approach is both more substantive and less likely to require adjustment than a specific quantitative emissions target.
- Issuing permits many years into the future enables firms to manage the risk of high emissions prices but may only provide limited incentives for technology development, as it does not assist firms in managing the risk of low future emissions prices, and does not of itself provide confidence in a stringent emissions target.
- Consideration should be given to including market features or creating specific instruments to reveal market views on future prices and allow better risk management, including mechanisms for managing the risk of low emissions prices as part of a wider innovation policy framework. This could include contract-based carbon price guarantees for technology proponents.
- Arrangements should encourage learning and refinement by government and business.

The analysis also reached conclusions regarding risk management and assignment between government and business.

- Government is best placed to weigh and manage the short-run uncertainties associated with determining Australia's total allowable emissions.
- Government has some advantage over businesses in judging medium-term uncertainties. However, these uncertainties increase significantly over time frames that are more than five years beyond current commitments, implying that policy should allow for the emissions trajectory to be adjusted in the light of changing circumstances.
- Government has no clear advantage over large businesses in identifying long-term emissions trajectories and emissions prices, and appears less able to diversify associated risks than private investors.

H.4 Research papers commissioned from Baker & McKenzie

Baker & McKenzie (together with the Australian Securities Exchange) were commissioned to prepare three research papers to assist Task Group members in their deliberations in the following areas.

- Paper 1: The role of financial markets and financial instruments in support of an emissions trading scheme
- Paper 2: The scope for hedging opportunities to mitigate carbon price risk for businesses
- Paper 3: The minimum requirements to link national emissions trading schemes

H.4.1 The role of financial markets and financial instruments in support of an emissions trading scheme

This paper noted that any financial market (whether trading in carbon or any other commodity or instrument) must have certain characteristics to be efficient and successful, namely:

- transparent price discovery
- liquidity or depth of price formation
- clearing and settlement security
- novation of counterparty credit risk.

Emissions trading schemes established under the Kyoto Protocol and other regional and national schemes increasingly take place within organised markets. These markets are generally reliant on the development of:

- defined mechanisms for creating and trading the property right
- a mechanism for recording trades and tracking the transfer in ownership
- a mechanism for clearing and settling trades
- rules setting out aspects such as
  - admission to, and exit from, the market
  - criteria on how the market's rules might be changed in the future
  - how the market's rules are enforced and disputes are resolved
  - how the property right is traded and the price discovered
  - general administration of the market.

A range of potential financial instruments can be created in support of a trading scheme, including scheme certificates, warrants, futures, options, swaps and other instruments. Australia already has in place all the necessary economic and institutional infrastructure to support a carbon market, including a sophisticated financial instruments market.

Government's role in developing and managing financial markets relates mainly to setting domestic legal provisions (including any international scheme obligations, as appropriate) and allocating emissions permits. It would also have a role to play in the monitoring, reporting and verification of emissions reductions to ensure the integrity of the scheme.

The private sector, on the other hand, would be responsible for providing the (existing) market infrastructure for open and transparent markets, monitoring and reporting, enforcement and compliance, a registry system to record trades, and central clearing services and settlement services.

Government could assist in the development of a carbon market by, at a minimum, providing a strong and unambiguous signal to industry about the likely nature of a trading scheme. However, to support the full development of an efficient market around carbon price instruments, government would need to consider signalling sufficient information in relation to a number of other parameters:

- the period for which the emissions trading scheme would be legislated

- the likely coverage of the emissions trading scheme across economic sectors
- likely overall scheme caps and expected emissions trajectories
- the likely form of permit allocation
- the sectors and types of projects that would be eligible to generate offsets under any scheme.

H.4.2 The scope for hedging opportunities to mitigate carbon price risk for businesses

This paper noted that many companies in Australia are already taking advantage of opportunities to hedge carbon risks. Hedging is being undertaken by internal actions to reduce the carbon footprint of firms, and thereby reduce anticipated future carbon liabilities under any mandatory emissions trading scheme.

Hedging is also occurring through the pursuit of emissions reduction activities and projects eligible to generate credits under existing schemes, or in anticipation of the acceptance of such offsets under a possible national emissions trading scheme.

A range of offset projects and activities are already open to Australian businesses, either as project developers or 'sellers' of credits – whether under mandatory or voluntary schemes – or simply as an arm's length purchaser to meet existing or anticipated compliance liabilities:

- under the Clean Development Mechanism, which presents a significant opportunity to obtain mandatory offset credits
- under the NSW/ACT Greenhouse Gas Reduction Scheme (GGAS)
- within voluntary and retail carbon markets that have also developed alongside these mandatory schemes in which many Australian companies are already participating.

Within the voluntary carbon market, abatement opportunities exist across all sectors, with most abatement projects operating under a few key offsets standards that have emerged (for example, the Australian Government's Greenhouse Friendly programme, the International Emissions Trading Association and The Climate Group Voluntary Carbon Standard, or the Gold Standard).

Given the voluntary nature of the retail carbon market, there are no restrictions on the sale and transfer of verified emissions reductions into offshore retail carbon markets, and so formal linking considerations do not ordinarily arise. However, within these markets there is a growing trend for greater standardisation of verification with the convergence of the market around fewer offsets standards. There is also increased formalisation of the mechanics of trading with the establishment of voluntary abatement and offset registries, such as the Chicago Climate Exchange or the Bank of New York's voluntary registry.

Measures that could further assist business to hedge carbon price risks include:

- commitments to certain design features in any possible future emissions trading scheme, which could assist firms in estimating likely future carbon prices
- even if the Australian Government did not commit now to the introduction of an emissions trading scheme, it could provide avenues for ensuring appropriate recognition of early abatement action before announcing or commencing a mandatory emissions trading scheme, so that firms can begin internal and offsetting activities as soon as possible.

Other measures to provide enhanced hedging or risk management opportunities include:

- ensuring that individual firm emissions caps are based on past data, so that firms have the strongest possible incentive to begin carbon footprint reduction immediately

- leveraging existing market infrastructure to minimise cost in delivery and operation of any mandatory emissions trading scheme
- creating appropriate relationships with other existing market-based schemes
- ensuring that any mandatory emissions trading scheme facilitates an active secondary market to increase liquidity
- ensuring any such scheme is long term in design and implementation
- seeking links with other national or regional schemes.

H.4.3 The minimum requirements to link national emissions trading schemes

This paper notes that, in general, linking emissions trading schemes with divergent designs is technically feasible as long as certain basic conditions are met. There are two threshold issues for creating inter-scheme linkages:

- The tradable commodity (for example, one tonne of CO_2-e) must be compatible, or an exchange rate must be developed.
- Adequate systems for tracking trades, which are compatible with those used in foreign schemes, must be used.

However, beyond these threshold issues, there are a number of other design features that should be considered in order to provide the flexibility required to allow successful linking with other national trading schemes. While differences in the design features below will not necessarily present a technical barrier to linking, they may increase the administrative burden of trading for participants and regulators:

- For unilateral links, a cap on the volume of credits accepted into the scheme should be considered to minimise the impacts of linking on price and structural adjustment incentives.
- Variations in scheme scope (including point of imposition of liability, direct or indirect emissions accounting and industry-sector coverage) may impact on inter-jurisdictional industry competitiveness and environmental integrity.
- Differences in offset categories recognised may influence perceptions of the legitimacy of credits in each scheme.
- Differences in penalty regimes, particularly the exclusion of a make-good provision, may make it difficult to create links because of the potential for lower abatement outcomes across the two schemes.
- Monitoring, reporting and verification systems must be perceived to be equally robust.
- Allocation rules, particularly those relating to new entrants and closures, may create efficiency problems and impact on industry competitiveness across the two schemes.
- Linking is easier between schemes with comparatively stringent caps.
- Differences in banking and borrowing may be perceived to have environmental-integrity impacts and may therefore create difficulties in negotiating links.

Appendix I

Cost and timing of low-emissions technologies for electricity generation

Estimates about the costs of low-emissions technologies over time are inherently uncertain.

- Estimates are limited to known technologies and those that are already in development; they cannot account for breakthroughs that are currently unforeseen. Thus, the longer the time frame for forward estimates, the more uncertain become both the cost estimates and the options likely to be available.
- Moreover, commercial viability depends critically on site- and application-specific parameters – for example, solar photovoltaic applications are already commercially competitive for some remote applications but far from independently commercial for baseload applications in large grids.

Nonetheless, the estimates below – which are drawn from third-party sources and do not reflect Task Group analysis – are instructive in that they provide some guidance as to the costs today of using various technologies in electricity generation. They also provide some speculative indication of the potential for cost reductions in future. Given the uncertainties involved, these estimates should be treated with caution.

Coal-fired generation produces in the order of one tonne of CO_2 per MWh of electricity generated (between 0.7 and 1.2 tonnes depending on the type of plant and coal used). The estimates of generation costs imply that a carbon price of around $20 is necessary to provide incentives for major shifts towards existing low-emissions technologies. They also suggest that a carbon price of $30 to $40 per tonne would be necessary to make a wider range of technologies commercially viable, including carbon capture and storage and many renewables, although some of these still require further technical development.

Many abatement opportunities exist outside the area of electricity generation. A carbon price under $20 per tonne is likely to trigger uptake of a range of abatement opportunities in energy efficiency, land-use change, forestry, agriculture and other sectors (IEA, 2007; IPCC, 2007).

The main factor that will influence investment decisions is the expected future carbon price path. Firms are likely to regard a technology as 'commercial' if the expected carbon price over the life of the investment is sufficiently high, even if the spot price today is lower. This highlights the importance of ensuring that the market receives sufficiently clear signals about future emissions constraints to allow it to develop a forward price curve.

Table I.1 Electricity generation cost estimates for selected technologies

	Cost range A$ per MWh (2006 unless otherwise indicated)	Comments
Existing technologies		
Brown coal	35–40	Limited to regions close to brown coal fields (Victoria)
Black coal	30–35	
Combined cycle gas turbines	38–54	Currently commercial for peak and shoulder load. The introduction of a carbon price would improve their competitiveness as baseload technology.
Nuclear	40–65	Would require at least 10 to 15 years before first plant could be operating in Australia (subject to a range of technical and policy steps and a carbon price of between $15 and $40 per ton of CO_2-e).
Wind	2010: 52–72 2030: 38–54	Principal market-ready renewable technology. Potential for further cost reductions. Further development of storage technology needed before wind can provide reliable baseload power.
Solar photovoltaic	120+ (solar concentrator; much more for flat plate)	Good potential for cost reductions. Currently most competitive in off-grid applications. Potential to become more competitive in distributed applications. Further development of storage technology needed before it can provide reliable baseload power.
Biomass	2010: 46–80 2020: 39–68	Gasification still being commercialised but cost reductions appear likely. Costs vary depending on feedstock.
New technologies		
Brown coal dewatering	2030: 43–49	Could be applied to brown coal plants in Victoria. A pilot is currently underway at Hazelwood. Commercial applications not expected in under five to ten years.
Supercritical/ ultra-supercritical coal with post-combustion capture (PCC)	64–108 2030: 40–45	PCC technology still in research/pilot stage. Costs are subject to availability of storage sites. Not expected to be commercialised for at least ten years.
Other carbon capture and storage (CCS) technologies	52–100 2030: 41–63	Various CCS technologies are at demonstration stages. Costs depend on availability of storage sites. First commercial plants fitted with CCS not expected for 10 to 15 years and likely to require a carbon price of at least $25 to $30 per ton of CO_2-e.
Solar thermal	100–200	Some solar thermal applications for heat gain already commercial. Electricity generation through solar thermal technologies are still at the demonstration/prototype stage and commercial applications are not expected for five to ten years.
Geothermal	2010: 59–73 2030: 43–53	Many good geothermal resources exist, but they are generally some distance from markets.

Note: Estimates drawn from Uranium Mining, Processing and Nuclear Energy Review, 2006; ESAA, 2006; CRA International, 2006; MMA, 2006b; and industry sources

Appendix J
Coverage

Practical issues associated with measuring emissions by source are assessed in Table J.1. The main considerations are the accuracy of methodologies for measuring facility emissions, and cost effectiveness – when emissions must be measured from a large number of small sources, the compliance costs of inclusion increase, other things being equal. This assessment suggests that it is feasible to measure emissions from most sectors, and thus there are no practical reasons to exclude these sectors from an Australian emissions trading scheme. Only agriculture and forestry emissions would appear to warrant exclusion at the initial stage of the scheme on practical grounds, with further detailed assessment to be undertaken during the design phase for the waste sector and for some subsectors (for example, open-cut coal mines).

Table J.1 Measuring emissions for inclusion in an emissions trading scheme: assessment of reliability and cost effectiveness

Source	Reliability of standard emissions estimator at facility level[a]	Number of emissions measurement points	Measurement and transactions costs per tonne of emissions	Overall assessment
Stationary energy	Good	Many if at point of emissions (though significant proportion of emissions from large facilities) Few if at upstream fuel supply	Low at point of emissions (moderate if include small facilities) Low if upstream liability	Suitable for inclusion. Mixture of imposing permit liability on direct emissions and on upstream fuel would appear practical
Industrial processes	Generally good	Relatively few	Low	Generally suitable for inclusion
Fugitives	Moderate; low for open-cut coal mines	Relatively few	Low to moderate for majority High for some subsectors such as open-cut coal mines	Suitable, with further detail to be assessed for some subsectors such as open-cut coal mines
Transport	Good	Very many Few if at upstream fuel supply	Moderate Low if upstream liability	Suitable for inclusion if permit liability on upstream sources If liability imposed downstream, practical only to apply to direct emissions of large commercial transport fleets
Agriculture, forestry and land use	Generally low for agricultural practices and moderate for forestry	Very many	High	Not suitable for initial inclusion. Improved and more cost-effective measurement methodologies to be developed
Waste	Moderate	Many	Moderate for majority	Requires further detailed assessment and consultation

Table J.2 shows coverage of industry sectors under different combinations of arrangements for permit liability. It indicates that if permit liability were imposed only on direct emissions from large facilities, many sectors would have only partial coverage of emissions, and emissions from some sectors (such as residential) would be excluded entirely. This would produce potential economic distortions around any emissions thresholds (as facilities above and below faced different carbon costs), and reduce the efficiency of the emissions trading scheme. The table also shows that close to 100 per cent coverage of most industry sectors would be possible if permit liability were also imposed upstream, using supplied fuel as a proxy.

Table J.2 Implications of emissions thresholds for industry and sectoral coverage

Industry category[a]	Emissions (Mt)[b] gross direct[c]	Number of facilities[d]	Share of direct emissions captured by facilities ›25kt (%)[e]	Share of direct emissions captured by facilities ›25kt with fuel liability allocated upstream (%)[e]
Manufacturing	74.1	104,000	85	95–100
Mining	40.9	4,000	80[f]	95–100[f]
Agriculture, forestry and fisheries	128.2	106,000	‹1	5–10
Transport	26.4	95,000	65	95–100
Commercial services	18.5	892,000	40	95–100
Electricity generation	195.2	228	99	~100
Residential (including transport)	38.1	Around 7m	‹1	95–100

a Industry categories are based on Australian and New Zealand Standard Industrial Classification (ANZSIC), 1993 (ABS cat. no. 1292.0) with reallocation of ancillary commercial and non-residential passenger motor vehicle transport emissions to other industries based on George Wilkenfeld & Associates (2007). Waste emissions have been excluded from the analysis due to data availability. b Based on industry categorisation in Wilkenfeld & Associates (2007). Agriculture and forestry emissions are from AGO, 2007b. c Direct emissions covers all emissions that occur at facilities and does not include indirect emissions associated with electricity. d 'Facility' means (1) a geographically defined site or building, including all structures and all mobile equipment operating within site boundaries or (2) a fleet of vehicles operating on public roads, or a fleet of aircraft, locomotives or vessels, whether or not based at a single site. e Derived from George Wilkenfeld & Associates, 2006. f Figures would be lower if classes of fugitive emissions were excluded – reducing to around 30 per cent and 40 per cent for columns 4 and 5 if fugitive emissions were excluded entirely.

Appendix K
Permit allocation

The allocation of permits in an emissions trading scheme is a mechanism to redistribute the wealth impacts associated with the introduction of a carbon constraint.

'Regardless of how the allowances were distributed, most of the cost of meeting a cap on CO_2 emissions would be borne by consumers' (CBO, 2007, p. 1), who would face higher prices for electricity, petrol and other products, and by workers and investors in parts of the energy sector and in various emissions-intensive industries.

To avoid these costs, policy makers would need to consider 'a trade-off between reducing the overall cost of the emissions cap to the economy or reducing specific sectors' or households' economic burdens.' (CBO, 2007, p. 2)

However, not all permits need to be distributed in the same way. In the model proposed in Chapter 7, there is a distinction drawn between trade-exposed, emissions-intensive industries and businesses in the rest of the economy. Allocations for these industries are addressed in Appendix L.

There is a range of approaches that can be used to allocate permits to firms that are not trade exposed and emissions intensive. These include:

- free allocation of permits to compensate, in part or whole, for loss of asset value
- free allocation of permits based on historical emissions (grandfathering)
- free allocation based on benchmarking against industry averages or best practice criteria
- auctioning.

Each approach has different distributional implications and the preferred choice will reflect, in large part, the policy objectives of government. However, the Task Group has used the following criteria to assess the relative merits of each approach. A system of allocation should:

- avoid creating disincentives for early abatement
- not provide ongoing incentives for 'rent seeking', or opportunities to overturn or undermine the scheme
- minimise ongoing transaction costs for business and government and promote market efficiency
- provide appropriate redress to firms for economic loss.

Each of the approaches is described and evaluated in greater detail below. Table K.1 also provides a summary of each approach against these criteria.

Table K.1. Summary assessment of alternative approaches to allocation

Criteria	Approach to allocation			
	Compensation	Grandfathering	Benchmarking	Auction
Ongoing incentive for rent seeking	N	Y*	Y*	N
Distortion to abatement incentives	N	Y	N	N
Redress for economic loss	Y	N	N	N
Complex (C) vs efficient (E)	C	C-	C	E

* There are options that can be used to make these approaches one-off allocations.

K.1 Compensation for loss of asset value

Under this approach, non-trade-exposed firms that suffer a loss of asset value due to the introduction of a carbon price (for example, emissions-intensive, coal-fired electricity generators) would receive compensation through the issue of a time-dated series of permits with aggregate value broadly commensurate with the expected loss in post-tax terms. Firms suffer a loss when they are unable to pass on additional (direct and indirect) carbon costs; this is reflected in a write-down of the market value of their assets.

Compensation can be calculated in the following way. A sufficiently disaggregated economic model would be used to identify those industries expected to suffer significant loss, and the level of that loss for any particular emissions reduction scenario. Because permits will have different expected prices in the future, it would be possible to broadly match the size of the loss with a bundle of time-dated permits with a value approximating the expected loss.

Losses for individual firms or facilities could then be calculated using more detailed sector-specific models (calibrated to match sector-level losses identified in the first stage). Data or economic modelling capacity constraints may make it impractical to undertake analysis at the individual entity level in some industries. In these circumstances, sector-level losses could be used as the basis for compensation that could be distributed on a pro rata basis across firms or facilities in that sector, using an agreed approach such as share-of-sector emissions.

Compensation would only be due in respect of assets in existence before the announcement of the scheme.

This approach is potentially complex and resource intensive compared to other approaches – for example, there may be a need to develop more detailed economic modelling capacity.

However, the compensatory approach has several advantages that make it worth pursuing:

- It most closely matches compensation to a firm's economic loss.
- Its once-and-for-all nature means that there are no ongoing incentives for emissions baseline manipulation, disincentives for abatement or re-negotiation of allocations.
- It would provide a significant proportion of residual permits which would be available for wider auction.

The advantage of using a time-dated series of freely allocated permits as an instrument of compensation (under this, or other free-allocation approaches) is that the value of the permits at any point in time matches the market price of carbon, helping to balance loss with gain and providing firms with an additional natural hedge against future prices.

K.2 Grandfathering

Grandfathering provides a free allocation of permits to existing emitters based on their historical emissions profile (either for a single year or multi-year average). Equity considerations suggest that new entrants would also receive allocations based on their projected emissions profiles. This is essentially the approach adopted in the first two phases of the European Union Emissions Trading Scheme.

Grandfathering effectively allocates the entire emissions cap under the trading scheme. Where the total of historical emissions plus any allowances for new entrants is greater than that available for allocation under the trading scheme emissions cap, it would be necessary to proportionally scale down individual allocations in order to ensure that the integrity of the emissions cap is maintained.

Grandfathering provides an ongoing series of periodic allocations, with an updating of allocations between periods being made using the most recent emissions data. This can distort abatement incentives. However, if required, allocations can also be made to phase down at any point. For example, in year one of trading a firm may receive permits covering 100 per cent of its base-year emissions but then receive permits equivalent to 95 per cent in the following year, with further 'decay' in subsequent years.

This approach requires accurate entity-level emissions data for a baseline year, or a time series where a multi-year average is used. Selection of the base year can be important in terms of the efficiency of allocation (that is, matching allocations to current emissions), in ensuring 'no disadvantage' for firms undertaking early abatement, and providing incentives for ongoing abatement.

An advantage of grandfathering is its administrative simplicity relative to other methods of free allocation. It can also provide firms with permits covering the majority of their fixed emissions (emissions that are relatively unalterable except through major changes in technology, fuel inputs or output) allowing them to abate or buy permits to cover their emissions at the margin. This reduces the short-term cash flow impost on companies associated with the need to purchase permits to cover all their emissions.

However, grandfathering has several undesirable features:

- Announcing that allocations were to be based on future emissions (for example, either close to commencement of trading and/or at future review points) can reduce the incentive for firms to abate. This disincentive to abate increases with the expected future price of carbon.
- Allocating on the basis of past emissions makes it challenging to match allocations to current profiles and to more recent market entrants.
- Allocations do not match firm losses and can result in large windfall gains.
  - Firms with large direct emissions, which can pass on the majority of carbon costs (such as power generators), will be substantially over-compensated, while firms with large indirect emissions (such as electricity-intensive manufacturers) may be under-compensated.
- Fully allocating the emissions cap in the initial period may result in fewer market trades and inhibit the price discovery process.

If grandfathering were to be considered as the preferred method of allocation, the Task Group considers that it would be important to make several design choices.

Allocations should be made once and for all and phased down over a preset time frame to avoid ongoing arbitrage or disincentives for future abatement. For example, year 1 allocations could be based around a percentage of historical emissions and then progressively decay each year to zero over the next 10 or 15 years.

Any base year (or years) chosen for allocation should be as close to the commencement of physical trading as possible with a credible 'no-disadvantage' rule to avoid disincentives for abatement in the period prior to trading. Finally, the level of allocation should be scaled so that not all permits are freely provided in order to ensure sufficient permits are available for auction and to provide an incentive for firms to enter the market.

K.3 Benchmarking

Benchmarking allocates permits based on an individual firm's emissions performance against a sector- or industry-wide yardstick. The yardstick can be forward looking (that is, a target) or based on historical performance. Typical benchmarks could include emissions per unit of output, value added or some other

relevant unit of measurement. Once the sectoral benchmark was identified, allocations for firms would be calculated against the desired indicator. New entrants could be allocated permits on the basis of expected performance against adopted benchmarks. Allocations would normally be provided to firms on an ongoing basis, although it would be possible to construct an approach that phased down over time.

This method has the advantage of providing more efficient firms with proportionately more of the permits they need, while those firms with poorer emissions performance face a larger incentive to improve. Under this approach there is no ongoing disincentive for abatement.

Depending on the benchmarks chosen and the degree to which the overall cap is freely allocated, this approach may provide a significant level of residual permits for auctioning.

There are several arguments against the use of benchmarking:

- The principal weakness is its administrative complexity. This approach may require the identification of sector, subsector, industry or even technology or product specific benchmarks, and these would likely proliferate as firms seek to persuade administrators of their unique circumstances.
- Benchmarks can have a degree of arbitrariness. The relevance of broad sector- or industry-wide benchmarks to individual firms can become questionable where firms in a sector undertake a range of disparate activities or use very different technologies (for example, coal-fired versus gas-fired electricity generators).
- It may be difficult to calibrate allocations on a consistent or equitable basis between sectors and it would be important that the use of 'bottom–up' benchmarking does not result in over-allocation of the overall emissions cap.
- While it requires the same quality of firm-level emissions data as other methods, it also requires accurate firm-level data relating to the benchmarking indicator.
- Like grandfathering, allocations do not readily relate to a firm's economic loss, although the use of efficiency or performance-related benchmarks would mean that it would be less distorting than grandfathering.

K.4 Auctioning

This method involves the government releasing permits into the market through an auction process. Where there are no free allocations, emitters would need to purchase all required permits, either through government auction or in the private market. Auctions can be fully open or more structured to promote opportunities for smaller emitters to participate effectively. Promoting market liquidity and price discovery, and smoothing the impact of a large volume of permit releases, suggests that phased releases of permits each period into the market would be preferable.

Auctioning is the most economically efficient of the alternatives. It ensures liquidity in carbon markets and promotes price discovery at low administrative cost (although there would still be a need to structure and manage the auction process to ensure efficient auction outcomes). However, this alternative fails to redress the wealth distribution impacts of the emissions constraint (that is, there is no compensation for loss) unless it is accompanied by direct payments from government to business.

Auctioning, even at low carbon prices, would generate a large transfer of revenue to government that would require redistribution. Unlike other methods, it may also potentially involve a significant cash flow impost for large emitters.

While full auctioning of permits may not be feasible at the start of emissions trading, from an efficiency perspective it is desirable that the allocation system make a smooth transition to

this goal over time. The proposed compensatory approach described in Chapter 7 would deliver this approach.

K.5 The Task Group's preferred approach

As with any equity-related decision, there is clearly no approach to allocation likely to satisfy everyone.

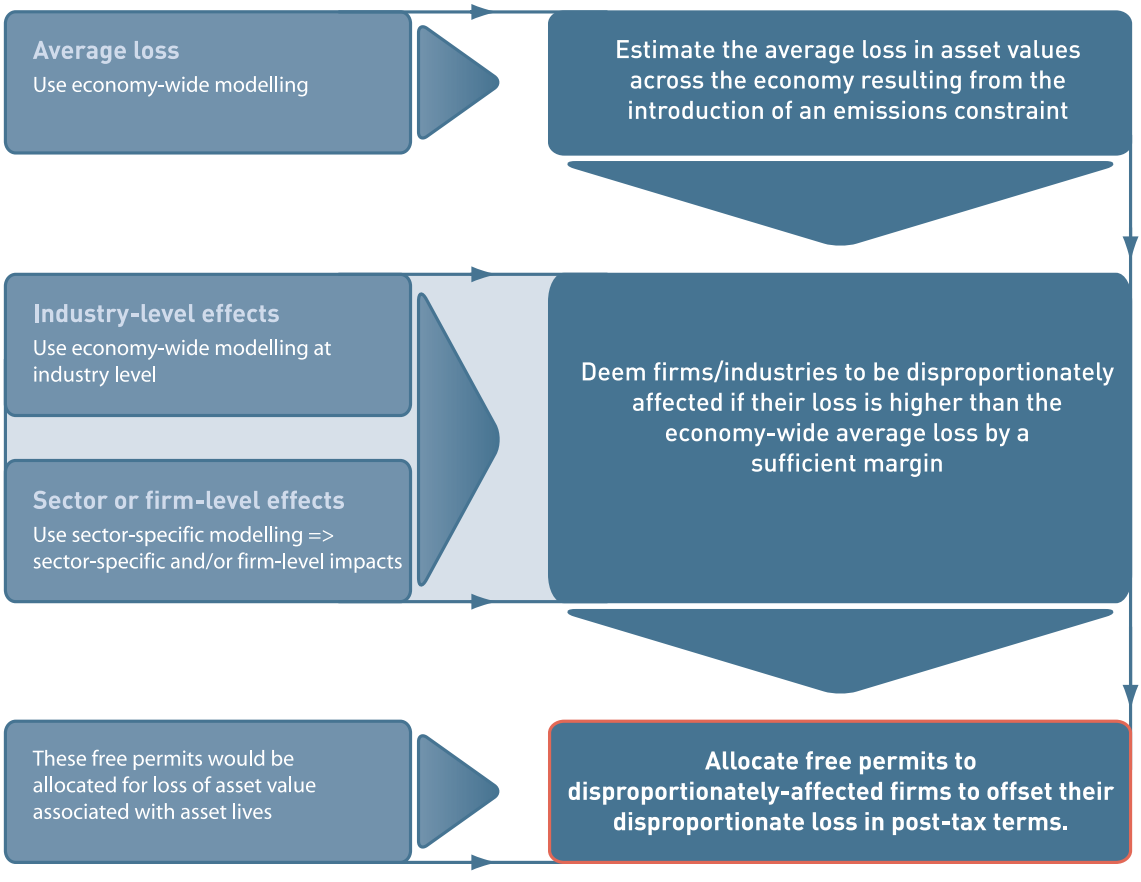
On balance, the Task Group supports the compensatory approach, as it considers that it best meets the criteria as shown in Table K.1.

In choosing this approach, the Task Group recognises that it is both impractical and undesirable to compensate for losses for all sectors and firms. Expected losses will be small for most firms in the economy (for example, energy typically represents less than 3 per cent of business costs in non-energy intensive industries). For this reason, the Task Group believes that an approach which focuses on compensating for **disproportionate** loss in asset value in post-tax terms (that is, a level of loss in excess of an economy-wide threshold) strikes a good balance between equity and administrative burden. Residual permits would be provided to the market through phased auctions, and the proportion of permits available in any given year for auction would be expected to rise over time.

The flow chart in Figure K.1 outlines, in an illustrative way, the steps involved in this approach.

The Task Group acknowledges that there are likely to be practical constraints on the ability

Figure K.1 Compensatory allocation



of the Government to calculate individual firm- or facility-level losses in some industries. Where this is the case the Task Group believes that sector- or industry-level losses could be distributed across the sector using an agreed approach. Where firms do not believe that this provides adequate compensation for their expected loss, provision could be made for this to be demonstrated. However, such claims would need to be supported with appropriate verifiable data and any compensation should still only be provided on the basis of disproportionate loss.

There clearly needs to be further work to refine the elements of this approach and to develop the required modelling and data capacities before it can be implemented. However, should the Government consider that an alternative approach is more desirable, the Task Group considers that it is critical that the preferred approach not provide ongoing incentives for firms to attempt to re-negotiate the system or provide disincentives to undertake abatement either during, or in the lead-up to, the commencement of the trading scheme.

Appendix L
Trade-exposed, emissions-intensive industries

Chapter 7 outlines, in broad terms, how trade-exposed, emissions-intensive industries could be treated under an Australian emissions trading scheme during the transitional phase where their major competitors do not face similar carbon constraints.

This appendix describes the potential treatment in more detail. It also explores some of the key issues that need to be considered when defining trade-exposed, emissions-intensive industries, and calibrating changes in competitors' behaviour.

L.1 Background

The cost to the Australian economy of meeting a given emissions constraint can be minimised through emissions trading if all sectors are exposed to the same incentive to abate. To the extent that any sector is given preferential treatment under a fixed national emissions cap, other sectors would be required to shoulder a greater proportion of the cost burden.

Accordingly, measures to address carbon costs faced by trade-exposed, emissions-intensive industries may not necessarily be welfare maximising for Australia. In the absence of a degree of flexibility in the emissions cap, such measures would shift the adjustment burden to the non-traded sectors and, ultimately, Australian households for any given level of abatement.

The inescapable problem, however, is that imposing a cap on emissions and placing a price on carbon would reduce the trade and investment competitiveness of trade-exposed, emissions-intensive industries if competitors located in other countries do not face similar constraints.

If Australian industries are unable to pass on carbon costs in traded markets (domestic and export), the resulting impact on profitability may risk so-called 'carbon leakage', whereby carbon-intensive activity in Australia relocates offshore and uses similar (or worse) emissions-intensive fuels or technologies. In such cases, the loss of Australian-based production would not be accompanied by a net reduction in global emissions.

If Australia were solely concerned about minimising the welfare cost of meeting a self-imposed emissions cap, it would be unconcerned about carbon leakage. However, if Australia imposes a cap as a contribution to a global emissions abatement objective, then carbon leakage becomes a cause for concern. To the extent that carbon leakage occurs, Australia will have suffered a welfare loss (from the adoption of the cap) for minimal global environmental benefit.

In order that the competitiveness of Australia's trade-exposed, emissions-intensive industries not be prejudiced during the evolution toward a comprehensive global emissions trading regime, the Task Group has focused on developing transitional arrangements for these sectors.

It is also important, from an equity and efficiency perspective, that any welfare loss associated with transitional support be minimised. Trade-exposed, emissions-intensive industries must be exposed to ongoing incentives to abate emissions.

L.2 Proposed treatment

The Task Group believes a suitable approach could be one that:

- allocated free permits to existing investments in trade-exposed, emissions-intensive industries equivalent to the carbon costs flowing from their direct (industrial process) and indirect (energy and embodied production inputs) post-tax costs. Over time, allocations

to offset direct emissions could be based as if firms were using world's best practice low-emissions technologies. It would be difficult to extend benchmarking to indirect emissions as these firms have little scope to influence upstream suppliers

- allocated free permits to any new investments in trade-exposed, emissions-intensive industries to offset direct emissions 'as if' the investments were using world's best practice low-emissions technology, and provided free permits equivalent to the post-tax costs of their actual indirect emissions.

This approach ensures that firms in existing trade-exposed, emissions-intensive industries receive free permits equivalent to their actual direct and indirect costs in the near term. Over time, free permits would only be available to a level consistent with production based on world's best practice low-emissions technologies.

Free permits for the direct costs of new investments will be subject to these technology-based allocation arrangements from the commencement of the emissions trading scheme. However, indirect costs will be covered in a manner consistent with that applying to existing firms or investments in trade-exposed, emissions-intensive industries.

While such technology-based arrangements are not generally favoured by the Task Group as a basis for permit allocation due to administrative complexities, the expected small number of well-defined trade-exposed, emissions-intensive firms suggest that benchmarking in this area should not present a significant administrative hurdle.

The technology-based allocation arrangements are necessary to maximise abatement during the period over which these transitional measures remain in place.

> Although producers would not bear out-of-pocket costs for allowances they were given, using those allowances would create an 'opportunity cost' for them because it would mean forgoing the income by selling the allowances (CBO, 2007, p. 5).

Accordingly, this technology benchmark still provides a significant incentive for trade-exposed, emissions-intensive industries to abate 'own emissions'.

To the extent there are significant new investments in trade-exposed, emissions-intensive industries, it would be appropriate for an equivalent increase to be made to the scheme's overall emissions cap (at successive review points), to minimise the welfare implications on other sectors of the economy. This also recognises that when these internationally mobile industries move to Australia it is displacing an investment in equivalent capacity elsewhere in the world.

When transitional arrangements are withdrawn, trade-exposed, emissions-intensive firms would be eligible for compensation for any resultant disproportionate loss of value similar to the treatment received by other firms at the outset of the trading scheme.

L.3 Determining permit allocations

The proposed approach incorporates two distinct elements of free permit allocation for firms in trade-exposed, emissions-intensive industries (see Figure L.1).

L.3.1 Direct emissions

Existing investments in trade-exposed, emissions-intensive industries would receive a right to a stream of free annual permits (for a period of five years – up to a nominated review point) to acquit against their estimated 'own emissions'.

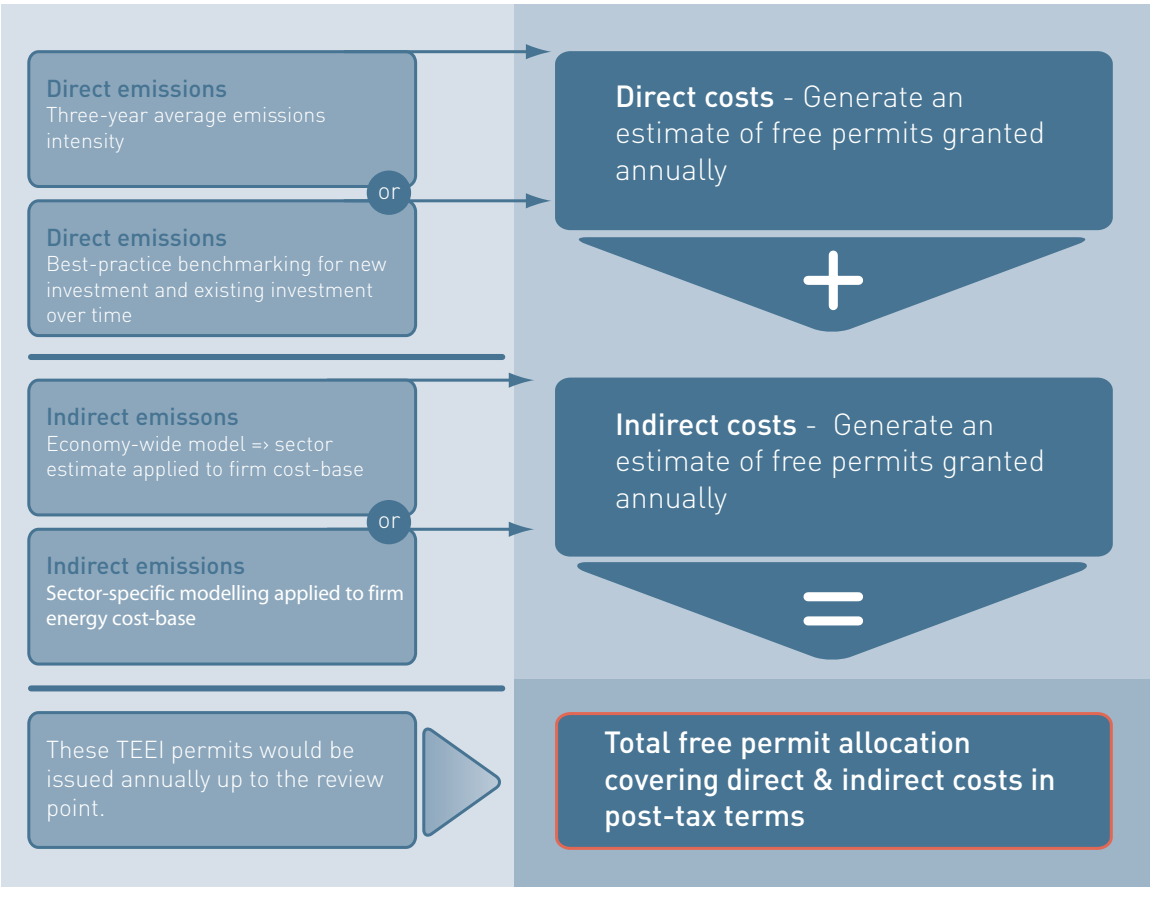
The stream of free permits could be calculated by reference to the existing firm's average emissions intensity (with respect to production), in the three years prior to the announcement of the scheme, and would be conditional on continued production in Australia. The review point would provide an opportunity to assess whether similar carbon constraints had been introduced in key competitor economies.

This approach provides permits equivalent to the post-tax direct costs to existing firms associated with 'own emissions', while maintaining an ongoing incentive for these firms to pursue abatement opportunities, and become permit sellers to other participants such as electricity generators.

However, as noted earlier, there is merit in progressively encouraging firms in these industries to bring their production processes more closely into line with the processes that would be expected to emerge when transitional support ceased (that is, there was an international level playing field in terms of carbon).

Therefore, after the first review point (five years) or at a subsequent review point, the free annual permit allocations should only be provided up to a level consistent with production utilising world's best practice low-emissions technology. The precise benchmarks for particular industries and the pace at which the free allocations are adjusted to this benchmark would need to

Figure L.1: Permit allocation flow diagram for trade-exposed, emissions-intensive industries



be given priority in any subsequent work on emissions trading.

This technology benchmark approach will form the basis of permit allocations to new investments in trade-exposed, emissions-intensive industries. The approach would apply from the commencement of the scheme for these new investments. Once the relevant benchmark was set, these new investments would receive a right to a stream of free annual permits at the benchmarked level (for a period of five years – up to a nominated review point), which they could acquit against 'own emissions'.

L.3.2 Indirect emissions

Both new and existing investments in trade-exposed, emissions-intensive industries will face higher indirect costs as a result of indirect emissions (that is, higher costs from emissions embedded in their energy and other production inputs).

It is more difficult to estimate these embedded costs. That said, a useful guide to the increase in net post-tax input costs faced by trade-exposed, emissions-intensive industries can be gained through the use of a detailed economy-wide economic model. Such a model could be used to estimate expected increases in input costs (both energy and other production goods) for existing and new investments by trade-exposed, emissions-intensive industries. This would serve as a consistent, robust and transparent basis for allocating free permits on the basis of the expected annual cost burden faced by various sectors.

The modelling would generate an estimated increase in total post-tax input costs for each sector. This estimated percentage increase by sector could then be applied to each firm's cost base to calculate an estimate of the number of free permits required annually for the period until the next review point.

In some cases it may be simpler for firms or industries, particularly energy-intensive firms or industries, to use a more detailed energy sector model to estimate the likely increase in energy prices. Where firms opted for this approach, their free annual permit allocation would determined by applying the expected increase in energy costs to their firm-specific or facility-specific energy bill.

While the proposed approaches to address direct and indirect emissions costs for trade-exposed, emissions-intensive industries may involve some complexity, they provide the greatest chance for the policy objectives to be met effectively.

The adjustment would need to take into account the taxation implications of the allocation of permits to ensure that the correct level of offset is provided.

Relevant technology benchmarks and modelling tools would need to be identified and developed in any subsequent work on emissions trading.

However, a higher priority in any subsequent work would be to define trade-exposed, emissions-intensive investments that qualify for these arrangements, and establish the rules which assess changes in the behaviour of competitors. Some of the key issues that require resolution are explored in the following sections.

L.4 Defining trade-exposed, emission intensive industries

It will be necessary to first determine which industries qualify as tradable (that is, those that export or compete with imports). Conceptually, this can be determined by using trade data and input–output tables from the Australian Bureau of Statistics which allow the calculation of the proportion of exports or competing imports versus domestic production in an industry. A relatively high proportion may be needed to ensure that a well-defined set of industries is captured by the 'tradable' definition.

However, in determining this proportion, careful consideration will need to be given to industries where trade represents only a modest proportion of sales but where Australian prices are heavily influenced by world prices.

In addition to assessing whether an industry meets the 'tradable' criterion, it needs to be assessed for its emissions intensity. National Greenhouse Gas Inventory datasets (along with others) can be used to assess the emissions intensity of industries. Emissions-intensity thresholds will need to be set that incorporate a firm's 'own emissions' as well as its indirect emissions.

The proposal under the National Emissions Trading Taskforce set a 3.5 per cent threshold for energy costs as a proportion of total operating costs. This may provide a possible starting point for any threshold design.

L.5 Calibrating changes in competitiveness

Determining ongoing competitive disadvantage will require assessments of the stringency and breadth of carbon constraints in key competitor economies. It will not be sufficient to assess the number of countries that fail to impose comparable constraints. Instead, it will be necessary to determine the extent to which world product prices are influenced substantially by producers in countries that do not impose emissions penalties comparable to Australia's. The quantum of total world production that is not subject to a carbon constraint will be an indicator in that determination.

If the threshold is set high for an industry (for example, competitiveness concerns do not persist when, say, 75 per cent of world production is subject to a carbon constraint), it will be important to determine the degree to which economies without a carbon constraint can realistically supply additional production and still pose a risk of carbon leakage.

The challenges in assessing these developments suggest that any change in the support arrangements should occur gradually over a number of years. Longer adjustment time-frames will also be necessary both to both validate any observed changes and to allow existing firms to adjust to a higher carbon price.

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Abbreviations and acronyms

ABARE	Australian Bureau of Agricultural and Resource Economics
AFCP	Alternative Fuels Conversion Programme
AGO	Australian Greenhouse Office
AP6	Asia–Pacific Partnership on Clean Development and Climate (members are: Australia, China, India, Japan, the Republic of Korea and the United States)
APEC	Asia–Pacific Economic Cooperation (members are: Australia, Brunei Darussalam, Canada, Chile, People's Republic of China, Hong Kong, Indonesia, Japan, Republic of Korea, Malaysia, Mexico, New Zealand, Papua New Guinea, Peru, Philippines, Russia, Singapore, Chinese Taipei, Thailand and Vietnam)
BAU	business as usual
BCA	Business Council of Australia
CCS	carbon capture and storage
CCSD	Cooperative Research Centre for Coal in Sustainable Development
CDM	Clean Development Mechanism
CFCs	chlorofluorocarbons
CH_4	methane
CO_2	carbon dioxide
CO2CRC	Cooperative Research Centre for Greenhouse Gas Technologies
CO_2-e	carbon dioxide equivalent
COAG	Council of Australian Governments
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSLF	Carbon Sequestration Leadership Forum
ECCP	European Climate Change Programme
ERIG	Energy Reform Implementation Group
ESAA	Energy Supply Association of Australia
ETS	Emissions Trading Scheme
EU	European Union
EU15	The member states of the European Union prior to the accession of ten new members on 1 May 2004. The EU15 membership is: France, Germany, the Netherlands, Belgium, Denmark, Italy, the United Kingdom, Ireland, Spain, Portugal, Sweden, Finland, Luxembourg, Austria and Greece

EU25	The EU15 member states plus Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia
G8	Group of Eight; members are: Canada, France, Germany, Italy, Japan, Russia, the United Kingdom and the United States
GDP	gross domestic product
GGAP	Greenhouse Gas Abatement Programme
GGAS	Greenhouse Gas Abatement Scheme
GHG	greenhouse gas
GST	goods and services tax
GTEM	global trade and environment model
HCFCs	hydrochlorofluorocarbons
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IPHE	International Partnership for the Hydrogen Economy
LETDF	Low Emissions Technology Demonstration Fund
LNG	liquefied natural gas
LPG	liquefied petroleum gas
LULUCF	land use, land-use change and forestry
M2M	Methane to Markets Partnership
MRET	Mandatory Renewable Energy Target
Mt	megatonnes
MWh	megawatt hour
N_2O	nitrous oxide
NAEEEP	National Appliance and Energy Efficiency Programme
NGGI	National Greenhouse Gas Inventory
OECD	Organisation for Economic Co-operation and Development
PFCs	perfluorocarbons
PPM	parts per million
PPMV	parts per million by volume
PPP	purchasing power parity
PVRP	Photovoltaic Rebate Programme
R&D	research and development

REDI	Renewable Energy Development Initiative
REEEP	Renewable Energy and Energy Efficiency Partnership
RRPGP	Renewable Remote Power Generation Programme
SF_6	sulphur hexafluoride
TWh	terawatt hour
UNFCCC	United Nations Framework Convention on Climate Change
VRET	Victorian Renewable Energy Target

abatement	Reducing the level of greenhouse gas emissions.
adaptation	An adjustment in natural or human social or economic systems in response to actual or expected climate change that moderates harm or exploits beneficial opportunities.
additionality	Pertaining to projects or activities that achieve 'additional' reductions in emissions compared with a 'business as usual' scenario.
adverse impacts	The potential negative effects of climate change as well as the impact of implementing response measures. Such effects or impacts include sea level rise, changes in precipitation levels or other weather patterns, and reduced demand for fossil fuels or other energy-intensive products. Impacts of climate change can be positive as well as negative.
afforestation	Planting of new forests on lands not recently forested.
allocation	In an emissions trading scheme, a mechanism to redistribute the wealth impacts associated with the introduction of a carbon constraint.
alternative energy	Energy derived from non-conventional sources, particularly renewable sources.
Annex I countries	Under the terms of the United Nations Framework Convention on Climate Change, Annex I countries include all developed (OECD) countries and the countries in transition in central and eastern Europe, including Russia and Ukraine.
Annex B countries	Annex B of the Kyoto Protocol lists those developed countries that have agreed to a commitment to limit their greenhouse gas emissions in the period 2008–12, including those in the OECD, central and eastern Europe and the Russian Federation. Coverage is not identical to Annex I, which also includes Turkey and Belarus, while Annex B includes Croatia, Monaco, Liechtenstein and Slovenia.
anthropogenic emissions	Emissions of greenhouse gases associated with human activities. These include burning of fossil fuels for energy, deforestation, land-use changes and emissions of other greenhouse gases.
arbitrage	The simultaneous purchase and sale of the same securities, commodities or monies in different markets to profit from unequal prices.
aspirational goal	Outlines the context for abatement efforts and provides more certainty for business and households regarding future carbon constraints. Such a goal would be subject to change as circumstances change. It could be expressed in terms of the percentage reduction in emissions from a point in time or in terms of the maximum number of tonnes of CO_2-e to be emitted by a particular year.
auctioning	A method of allocating permits in which government releases permits into the market through an auction process.

banking	The ability of emitting entities to use permits issued or created in one compliance period to be used in the future under an emissions trading scheme. Banking allows emitters to better manage annual variations in their emissions profiles. These variations may arise, for example, due to cyclical economic activity or disruptions to production.
baseline	A projected level of future emissions against which reductions by project activities could be determined, or the emissions that would occur without policy intervention.
baseline and credit system	An emissions trading system in which a predetermined emissions profile is allocated to each participant, with trading permitted in the unused portion of that profile, known as emissions 'credits'.
baseload power	A baseload power plant is one that provides a steady flow of power regardless of total power demand by the grid. These plants run at all times through the year except in the case of repairs or scheduled maintenance.
benchmarking	A system of allocating permits based on an individual firm's emissions performance against a sector- or industry-wide yardstick. The yardstick can be forward-looking (that is, a target) or based on historical performance. Typical benchmarks could include emissions per unit of output, value add or other relevant unit of measurement.
bilateral linking	The mutual acceptance of credits between two emissions trading schemes, allowing cross-border trade in permits.
biological sequestration	The removal of atmospheric CO_2, through biological processes (for example, photosynthesis in plants and trees).
borrowing	The ability of emitting entities to use credits from future compliance periods to meet their current obligations in an emissions trading scheme.
bubble	An option in the Kyoto Protocol that allows a group of countries to meet their targets jointly by aggregating their total emissions. Fifteen member states of the European Union (EU15) are utilising this option.
bunker fuels	Fuels used for international aviation and marine transport.
'business as usual'	An estimate of future patterns of energy consumption and greenhouse gas emissions which assumes that there will be no major changes in attitudes and priorities.
cap	See 'emissions cap'.
'cap and trade' scheme	An emissions trading regime in which a limit (or cap) is placed on the total emissions allowable from the activities or sectors covered under the scheme. Emissions limits are set below what they would be under a 'business as usual' scenario.
carbon	Carbon is used in the report to generally refer to the six major greenhouse gases.

carbon capture and storage (CCS)	Technology to capture and store CO_2-e emissions from the generation of electricity or industrial processes. Captured CO_2-e has the potential to be stored in a variety of geological or ocean sites.
carbon cost	See 'carbon price'.
carbon dioxide (CO_2)	A naturally occurring gas; it is also a by-product of burning fossil fuels and biomass, as well as land-use changes and other industrial processes. It is the principal anthropogenic greenhouse gas that affects the earth's temperature.
carbon dioxide equivalent (CO_2-e)	A standard measure that takes account of the different global warming potential of different greenhouse gases and expresses the cumulative effect in a common unit.
carbon footprint	A measure of the amount of CO_2-e emitted through the combustion of fossil fuels; it is commonly used at an individual, household or business level.
carbon intensity	CO_2-e emissions per unit of energy or economic output (for example, tonnes of CO_2-e per dollar of GDP).
carbon leakage	The effect when a firm facing increased costs in one country due to an emissions price chooses to reduce production or to close or relocate production to another country with less stringent climate change policies.
carbon market	A generic term for a trading system in which countries or private organisations may buy or sell units of greenhouse gas emissions in an effort to meet their national limits on emissions.
carbon offset	An activity that compensates all or part of the CO_2 emissions of an emitting entity, by reducing the emissions – or increasing the CO_2 absorption – of another entity. Examples of such activities are planting trees or funding alternative energy deployment. Offsets are commonly raised in relation to emissions trading schemes as they allow least -cost abatement outside the capped sector to be recognised.
carbon price	The cost of emitting carbon into the atmosphere. It can be a tax imposed by government, the outcome of an emission trading market or a hybrid of taxes and permit prices. The various ways of creating a carbon price can have different effects on the economy. Also referred to as carbon cost.
carbon price path	A forecast or estimate of where the future price of carbon permits will be at different points in the future.

carbon sequestration	The long-term storage of carbon or CO_2 in the forests, soils, oceans or underground in depleted oil and gas reservoirs, coal seams and saline aquifers. Examples include: the separation and disposal of CO_2 from flue gases or processing fossil fuels to produce hydrogen and carbon-rich fractions; and the direct removal of CO_2 from the atmosphere through land-use change, afforestation, reforestation, ocean fertilisation and agricultural practices to enhance soil carbon.
carbon sinks	Natural or man-made systems that absorb CO_2 from the atmosphere and store them, including trees, plants and the oceans.
carbon tax	A surcharge on the carbon content of products.
chlorofluorocarbons (CFCs)	Greenhouse gases covered under the 1987 Montreal Protocol on Substances That Deplete the Ozone Layer and used for refrigeration, air-conditioning, packaging, insulation, solvents or aerosol propellants. Since they are not destroyed in the lower atmosphere, CFCs drift into the upper atmosphere where, given suitable conditions, they break down ozone. These gases are being replaced by other compounds, including hydrochlorofluorocarbons and hydrofluorocarbons, which are greenhouse gases covered under the Kyoto Protocol.
Clean Development Mechanism (CDM)	A mechanism under the Kyoto Protocol through which developed countries may finance greenhouse gas emissions reduction or removal projects in developing countries, and receive credits for doing so which they may apply towards meeting their mandatory emissions targets. See 'Kyoto mechanisms'.
climate change	As defined by the UNFCCC, a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability over comparable time periods.
cogeneration	Production of two useful forms of energy such as high temperature heat (for hot water or space heating) and electricity from the same process. Also known as combined heat and power.
commitment period	Generally refers to the time frame in which Kyoto Protocol parties are required to meet their emissions reduction obligations. The Protocol's first commitment period is from 2008 to 2012.
compliance period	The period during which emitting entities are required to comply with the relevant scheme requirements.
congestion pricing	A traffic-management system where a fee is charged for motorists to enter certain parts of a city (such as the central business district) as a means of reducing the number of vehicles in that area.
coverage	The scope of an emissions trading scheme. Covered sectors are liable for their emissions under the scheme.

credit for early action	A provision of an emissions trading scheme that allows crediting of emissions reductions achieved prior to the start of an emissions control period. These credits can then be used to assist in achieving compliance under the scheme.
demand management	Policies and programmes designed for a specific purpose to influence consumer demand for goods and/or services. In the energy sector, for instance, it refers to policies and programmes designed to reduce consumer demand for electricity and other energy sources.
emissions	The release of greenhouse gases into the atmosphere.
emissions cap	A mandated restraint, in a scheduled time frame, that puts a 'ceiling' on the total amount of anthropogenic greenhouse gas emissions.
emissions intensity	A level or amount of emissions per a specified unit of economic output, such as GDP, sales revenue or goods produced.
emissions trading	A market-based approach to reducing emissions that allows an entity in one country that achieves reductions below what is required to use or trade the excess reductions to offset emissions at another source inside or outside the country. In general, trading can occur at the domestic, international and intra-company levels. International emissions trading constitutes one of the Kyoto mechanisms, and is designed to provide developed countries with flexibility in reducing emissions to achieve their agreed commitments.
energy intensity	The ratio of energy consumption to a measure of the demand for services (for example, constant dollar value of GDP for services).
European Union Emissions Trading Scheme	The scheme was launched on 1 January 2005 with an initial phase from 2005–07 to be followed by a second phase (2008–12). Key features include: CO_2 emissions permits are allocated on an annual basis to entities; and coverage includes large combustion installations from all sectors plus oil refineries, coke ovens, iron and steel, cement, lime, glass, ceramics, and pulp and paper.
fixed emissions target	A specified target measured relative to a historical baseline, for example, x per cent of 1990 levels or x megatonnes of greenhouse gas emissions.
forward price curve	A forecast or estimate of what the future price of carbon permits will be at different points in the future.
fuel switching	The substituting of one type of fuel for another, including reducing CO_2-e emissions by switching to lower carbon-content fuels, such as from coal to natural gas.
fugitive emissions	Greenhouse gases that are emitted as by-products or waste or that escape during the process of fuel production, storage or transport, such as methane given off during oil and gas drilling and refining or coal mining, or leakage of natural gas from pipelines.

futures	A derivative contract to buy or sell a certain instrument (such as a carbon permit) at a certain date in the future for a certain price.
gateway	A potential range for future caps under an emissions trading scheme.
geosequestration	The technology that aims to store CO_2 in deep underground rock structures (see 'carbon capture and storage').
global warming potential	A system of multipliers devised to enable warming effects of different gases to be compared. For example, over the next 100 years, a gram of methane in the atmosphere is currently estimated as having 23 times the warming effect as a gram of CO_2; methane's 100-year global warming potential is thus 23.
grandfathering	Grandfathering provides a free allocation of permits to existing emitters based on their historical emissions profile (either for a single year or a multi-year average).
greenhouse effect	The trapping of heat by naturally occurring heat-retaining atmospheric gases (water vapour, carbon dioxide, nitrous oxide, methane and ozone) that keeps the earth about 30°C (60°F) warmer than if these gases did not exist.
greenhouse gases (GHGs)	The atmospheric gases responsible for causing global warming and climate change. The major GHGs are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_20), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).
hedging	The taking out of an investment specifically to reduce or cancel out the risk in another investment.
hydrochlorofluorocarbons (HCFCs)	Compounds containing hydrogen, fluorine, chlorine and carbon atoms. Although ozone-depleting substances, they are less potent at destroying stratospheric ozone than CFCs.
hydrofluorocarbons (HFCs)	Compounds containing only hydrogen, fluorine and carbon atoms. They were introduced as alternatives to ozone-depleting substances in serving many industrial, commercial and personal needs. HFCs are emitted as by-products of industrial processes and are also used in manufacturing.
hydrogen economy	Refers to a prospective economy in which energy is stored and transported as hydrogen.
intensity targets	Policies that specify emissions reductions relative to productivity or economic output, for instance, tonnes of CO_2-e per million dollars GDP.
Intergovernmental Panel on Climate Change (IPCC)	Established in 1988, the IPCC surveys worldwide scientific and technical literature and publishes assessment reports that are widely recognised as the most credible existing sources of information on climate change. The IPCC also works on methodologies and responds to specific requests from the UNFCCC's subsidiary bodies.
Joint Implementation	See 'Kyoto mechanisms'

Kyoto mechanisms (or flexibility mechanisms)	Three processes established under the Kyoto Protocol to increase the flexibility and reduce the costs of making greenhouse gas emissions cuts: the Clean Development Mechanism, which provides an incentive for developed countries to invest in greenhouse gas–reducing projects in developing countries; emissions trading, which is allowed between Annex I countries with credits generated able to be transferred/tracked; and Joint Implementation, which facilitates projects that generate greenhouse gas credits between developed countries and countries in transition in central and eastern Europe.
Kyoto Protocol	An international treaty negotiated under the auspices of the UNFCCC. It entered into force in 2005. Among other things, the Protocol sets binding targets for the reduction of greenhouse gas emissions by developed countries. It includes individual emissions reduction commitments for developed countries to be met within the first commitment period of 2008–12.
land use, land-use change and forestry (LULUCF)	Land uses and land-use changes can act either as sinks or as emissions sources. It is estimated that approximately one-fifth of global emissions result from LULUCF activities. The Kyoto Protocol allows participating parties to receive emissions credit for certain LULUCF activities that reduce net emissions.
leakage	See 'carbon leakage'.
liquid market	A market whose essential characteristic is that there are ready and willing buyers and sellers at all times.
low-emissions technology	Technology that produces a product with minimal greenhouse gas emissions. The term is commonly used to refer to power generation technologies (such as renewable, nuclear and clean coal generation), but applies equally to other sectors including transport and agriculture.
macroeconomic	The branch of economics that deals with the performance, structure and behaviour of the economy as a whole.
megawatt (MW)	A unit of power equal to one million watts.
mitigation	A human intervention to reduce the sources of or enhance the sinks for greenhouse gases. Examples include using fossil fuels more efficiently for industrial processes or electricity generation, switching to solar energy or wind power, improving the insulation of buildings, and expanding forests and other sinks to remove greater amounts of CO_2 from the atmosphere. Also known as greenhouse gas abatement.

'no regrets' policies	Policies that would generate net social benefits whether or not there is climate change. 'No regrets' opportunities for greenhouse gas emissions reduction are defined as those options whose benefits such as reduced energy costs and reduced emissions of local/regional pollutants equal or exceed their costs to society, excluding the benefits of avoided climate change.
non-Annex B	The countries that are not included in the Annex B list of developed nations in the Kyoto Protocol.
non-Annex I	The countries that have ratified or acceded to the UNFCCC that are not included in Annex I of the UNFCCC.
offsets	See 'carbon offsets'.
options	A type of derivative contract where the future payoffs to the buyer and seller of the contract are determined by the price of another security.
perfluorocarbons (PFCs)	A group of human-made chemicals composed of carbon and fluorine only. These chemicals (predominantly CF_4 and C_2F_6) were introduced as alternatives, along with hydrofluorocarbons, to the ozone-depleting substances. In addition, PFCs are emitted as by-products of industrial processes and are also used in manufacturing.
permit	A certificate that enables an emitting entity under an emissions trading scheme to emit a quantity of greenhouse gases.
plurilateral agreement	An agreement that involves more than two parties, often concluded under the auspices of a multilateral agreement.
price signal	See 'carbon price'.
production leakage	The loss of economic activity from one country to another as a result of increases in costs caused by government intervention (for example, through a carbon cost).
process feedstocks	Material inputs used in the production of a product, for example, alumina in the production of aluminium, or petrochemicals in the production of agricultural products such as fertilisers.
reforestation	Replanting of forests on lands that have recently been harvested.
renewables	Energy sources that are constantly renewed by natural processes. These include non-carbon technologies such as solar energy, hydropower and wind as well as technologies based on biomass. Life-cycle analyses are required to assess the extent to which such biomass-based technologies may limit net carbon emissions.
rent seeking	A behaviour attributed to an individual, organisation or firm that seeks to make money by manipulating the economic environment rather than by making a profit through trade and production of wealth.
safety valve	A price cap on emissions permits that would prevent permit prices from rising above a specified level.

sequestration	The removal of atmospheric CO_2, either through biological processes (for example, photosynthesis in plants and trees), or geological processes (for example, storage of CO_2 in underground reservoirs).
sinks	See 'carbon sinks'.
sovereign risk	The risk borne by business caused by changes to government policy (that is, the risk associated with changing the 'rules of the game').
spot market	A market in which goods (for example, permits) are sold for cash and delivered immediately. Contracts bought and sold on these markets are immediately effective.
stationary energy emissions	Includes emissions from fuel consumption for electricity generation, fuels consumed in the manufacturing, construction and commercial sectors and other sources such as domestic heating.
sunk investment	Costs that have already been incurred and that cannot be recovered to any significant degree.
targets and timetables	Refers to the model embodied in the Kyoto Protocol in which countries have a specific target for the reduction of greenhouse gas emissions from a base year by a set date or according to a set timetable. For example, under the Kyoto Protocol's formula, the European Union has agreed to reduce its greenhouse gas emissions to 8 per cent below 1990 levels by the 2008–12 commitment period. These targets and timetables are, in effect, a cap on the total amount of greenhouse gases that can be emitted by a country or region in a given time period.
terms of trade	An index of the price of a country's exports in terms of its imports. The terms of trade are said to improve if that index rises.
trade-exposed, emissions-intensive industries	Industries that either are exporters or compete against imports (trade exposed) and produce significant emissions in their production of goods (emissions intensive).
transfer of technology	The broad set of processes covering the exchange of knowledge, money and goods among different stakeholders that leads to the spreading of technology for adapting to or mitigating climate change. As a generic concept, the term is used to encompass both diffusion of technologies and technological cooperation across and within countries. Also known as technology transfer.
Umbrella Group	A coalition of developed countries with common interests formed during the negotiation of the Kyoto Protocol, comprising Australia, Canada, Iceland, Japan, Kazakhstan, New Zealand, Norway, Russia, Ukraine and the United States.
UNFCCC	United Nations Framework Convention on Climate Change. An international treaty concluded in 1994 aimed at achieving the stabilisation of greenhouse gas concentrations in the atmosphere.

unilateral linking	A linking of a domestic emissions trading scheme to an overseas scheme that provides for permits under the overseas scheme to be surrendered against emissions liabilities in the domestic scheme, but that does not allow domestic scheme permits to be used in the overseas scheme.
warrant	A security that entitles the holder to buy another security at a specified price that is higher than the price of the second security at time of issue.

References

ABARE (Australian Bureau of Agricultural and Resource Economics), 2006, *Australian Energy: National and State Projections to 2029–2030*, ‹www.abareconomics.com/interactive/energy_dec06/pdf/energyaus_06.pdf›.

——2007a, Modelling Commissioned by the Prime Ministerial Task Group on Emissions Trading.

——2007b, *Energy in Australia 2006*, ‹www.abareconomics.com/publications_html/energy/energy_06/Energy_booklet06.pdf›.

ACIL Tasman, 2007, Research Commissioned by the Prime Ministerial Task Group on Emissions Trading.

AGO (Australian Greenhouse Office), 2003, *Renewable Opportunities, A Review of the Operation of the* Renewable Energy (Electricity) Act 2000 (Tambling Review), ‹www.mretreview.gov.au/report/pubs/mret-review.pdf›.

——2006a, *Tracking to the Kyoto Target 2006: Australia's Greenhouse Emissions Trends – 1990 to 2008–2012 and 2020*, ‹www.greenhouse.gov.au/projections/index.html›.

——2006b, *Factors and Methods Workbook*, ‹www.greenhouse.gov.au/workbook/pubs/workbook/index.html›.

——2007a, *National Greenhouse Gas Inventory 2005*, ‹www.greenhouse.gov.au/inventory/2005/pubs/inventory2005.pdf›.

——2007b, National Inventory by Economic Sector 2005 ‹www.greenhouse.gov.au/inventory/2005/pubs/inventory2005-economic.pdf›.

——2007c, National Inventory Report 2005 ‹www.greenhouse.gov.au/inventory/2005/pubs/inventory2005-nationalreportv1.pdf›.

Ahammad, H., Matysek, A., Fisher, B., Curtotti, R., Gurney, A. Jakeman, G., Heyhoe, E. & Gunasekera, D., 2006, *Economic Impact of Climate Change Policy: The Role of Technology and Economic Instruments*, ABARE Research Report 06.7, ‹www.abareconomics.com/publications_html/climate/climate_06/cc_policy_nu.pdf›.

Allan, G., Hanley, N., McGregor, P., Swales, J.K. & Turner, K., 2006, *The Macroeconomic Rebound Effect and the UK Economy – Final Report to the Department of Environment, Food and Rural Affairs*, ‹www.defra.gov.uk/science/project_data/DocumentLibrary/EE01015/EE01015_3553_FRP.pdf›.

Allen Consulting Group, 2006a, *Deep Cuts in Greenhouse Gas Emissions: Economic, Social and Environmental Impacts for Australia*, Report to the Business Roundtable on Climate Change, ‹www.businessroundtable.com.au›.

——2006b, *The Economic Impacts of a National ETS*, Report to the National Emissions Trading Taskforce, ‹www.emissionstrading.nsw.gov.au/__data/assets/pdf_file/0008/2015/060811_Final_MMRF_report.pdf›.

Australian Government, 2004, Energy White Paper, *Securing Australia's Energy Future*, ‹www.dpmc.gov.au/publications/energy_future/docs/energy.pdf›.

Australian Government, 2007, *Intergenerational Report 2007*, ‹www.treasury.gov.au/documents/1239/PDF/IGR_2007_final_report.pdf›.

Australian Securities Exchange, 2007, Submission to the Prime Ministerial Task Group on Emissions Trading, ‹www.pmc.gov.au/emissionstrading/submissions/133_sub_emissionstrading.pdf›.

Baker & McKenzie, 2007, *The Role of Financial Markets and Instruments in Support of Emissions Trading Schemes*, Research Report for the Prime Ministerial Task Group on Emissions Trading.

Bodansky, D., Chou, S. & Jorge-Tresolini, C., 2004, 'International Climate Efforts Beyond 2012: A Survey of Approaches', prepared for the Pew Center on Global Climate Change, ‹www.pewclimate.org/docUploads/2012%20new.pdf›.

Bovenberg, A.L. & Goulder, L.H., 2000, *Neutralizing the Adverse Industry Impacts of CO_2 Abatement Policies: What Does It Cost?*, National Bureau of Economic Research, Working Paper No. 7654, ‹www.nber.org/papers/W7654›.

Bozon, I.J.H., Campbell, W.J. & Lindstrand, M., 2007, 'Global Trends in Energy', McKinsey Quarterly, No. 1.

Cambridge Centre for Climate Change Mitigation Research, 2006, *The Macro-Economic Rebound Effect and the UK Economy*, Final Report to the Department of Environment Food and Rural Affairs, ‹www.landecon.cam.ac.uk/research/eeprg/4cmr/pdf/Rebound_effect_4CMR_Final_Report_v6-1.pdf›.

Center for Clean Air Policy, 2006, *Greenhouse Gas Mitigation in Brazil, China and India: Scenarios and Opportunities through 2025*, ‹www.ccap.org/international/developing.htm›.

COAG (Council of Australian Governments) Energy Market Review, 2002, *Towards a Truly National and Efficient Energy Market* (Parer Report), ‹www.mce.gov.au/assets/documents/mceinternet/FinalReport20December2002200 50602124631%2Epdf›.

COAG Greenhouse and Energy Reporting Group, 2006, *A National System for Streamlined Greenhouse and Energy Reporting by Business – Draft Regulatory Impact Statement*, ‹www.greenhouse.gov.au/reporting/pubs/ris.pdf›.

CRA International, 2006, *Analysis of Greenhouse Gas Policies for the Australian Electricity Sector – A Report for the National Generators Forum*, ‹www.ngf.com.au/html//index.php?option=com_remository&Itemid=32&func=fileinfo&id=99›.

CSIRO (Commonwealth Scientific and Industrial Research Organisation), 2007. National Research Flagships website, ‹www.csiro.au/org/AboutNationalResearchFlagships.html›, accessed 16 May 2007.

Department of Education, Science and Training, 2006, *2006 Selection Round Successful Cooperative Research Centres (CRCs)*, ‹https://sciencegrants.dest.gov.au/CRC/HTMLDocuments/Documents/PDF/Final_CRC_2006_SelectionRound.pdf›.

Energy Reform Implementation Group, 2007, *Energy Reform: The Way Forward for Australia. A Report to the Council of Australian Governments*, ‹www.erig.gov.au›.

Enkvist, P., Nauclér, T. & Rosander, J., 2007, 'A Cost Curve for Greenhouse Gas Reduction', *McKinsey Quarterly*, No. 1.

ERAA (Energy Retailers Association of Australia), 2005, *A Report on the Cost to Consumers of Greenhouse Gas Abatement Schemes*, ‹www.eraa.com.au/db_uploads/CosttoConsumersReport(Final).pdf›.

ESAA (Energy Supply Association of Australia), 2006, *Energy and Emissions Study – Stage 2*, ‹www.esaa.com.au/images/stories//energyandemissionsstudystage2.pdf›.

Ford, M., Matysek, A., Jakeman, G., Gurney, A. & Fisher, B.S., 2006, 'Perspectives on International Climate Change', paper presented at the Australian Agricultural and Resource Economics Society 50th Annual Conference, ‹www.aares.info/files/2006_matysek.pdf›.

George Wilkenfeld & Associates, 2006, *Cost and Benefits of Greenhouse and Energy Reporting*

Framework, Report for the Department of the Environment and Heritage, ‹www.greenhouse.gov.au/reporting/pubs/ris-attachmentb.pdf›.

Geoscience Australia, 2007, Unpublished data.

Government of Japan, 2006, *Japan's Fourth National Communication under the United Nations Framework Convention on Climate Change*, ‹unfccc.int/resource/docs/natc/japnc4.pdf›.

Grubb, M., 2004, *Technology Innovation and Climate Change Policy: An Overview of Issues and Options*, ‹www.econ.cam.ac.uk/faculty/grubb/publications/J38.pdf›.

Hatfield Dodds, S., 2007, Research Report for the Prime Ministerial Task Group on Emissions Trading.

Hepburn, C., 2006, 'Regulating by Prices, Quantities or Both: An Update and an Overview', *Oxford Review of Economic Policy*, 22(2):226–47.

Howard, J., 2007, Weekly Radio Message – Climate Change, 5 February 2007, ‹www.pm.gov.au/media/Speech/2007/Speech23887.cfm›.

IEA (International Energy Agency), 2006a, *World Energy Outlook 2006*, ‹www.worldenergyoutlook.org›.

——2006b, *Electricity Information 2006*, ‹www.iea.org/w/bookshop/add.aspx?id=34›.

——2006c, *Energy Technology Perspectives – Scenarios and Strategies to 2050*, ‹www.iea.org/w/bookshop/add.aspx?id=255›.

——2006d, *CO_2 Emissions from Fuel Combustion 1971–2004*, ‹www.iea.org/w/bookshop/add.aspx?id=36›.

——2007, *Climate Policy Uncertainty and Investment Risk*, ‹www.iea.org/w/bookshop/add.aspx?id=305›.

International Monetary Fund, 2007, World Economic Outlook Database, ‹www.imf.org/external/data.htm›.

IPCC (Intergovernmental Panel on Climate Change), 2007a, *Fourth Assessment Report: Climate Change 2007: The Physical Science Basis, Summary for Policy Makers*, ‹www.ipcc.ch/SPM2feb07.pdf›.

——2007b, *Fourth Assessment Report: Climate Change 2007: Impacts, Adaptation and Vulnerability, Summary for Policy Makers*, ‹www.ipcc.ch/SPM13apr07.pdf›.

——2007c, *Fourth Assessment Report: Climate Change 2007: Mitigation of Climate Change, Summary for Policy Makers*, ‹www.ipcc.ch/SPM040507.pdf›.

Matysek, A., Ford, M., Jakeman, G., Gurney, A. & Fisher, B., 2006, *Technology – Its Role in Economic Development and Climate Change*, ABARE Research Report 06.6, ‹www.abare.gov.au/publications_html/climate/climate_06/cc_technology_nu.pdf›.

McKibbin, W & Wilcoxen, P., 2006, *A Credible Foundation for Long Term International Cooperation on Climate Change*, Working Papers in International Economics, Lowy Institute, ‹www.pmc.gov.au/emissionstrading/submissions/7a_sub_emissionstrading.pdf›.

McKinsey & Company, 2007, Data provided to the Task Group.

MMA (McLennan Magasanik Associates), 2006a, *Additional Analysis of the Benefits and Costs of a Target for Renewables in Victoria*, Report to Victorian Department of Infrastructure. ‹www.dpi.vic.gov.au/dpi/dpinenergy.nsf/93a98744f6ec41bd4a256c8e00013aa9/cc46dd20c48e3f78ca2572b900041109/$FILE/VRET_AdditionalAnalysisReport.pdf›.

——2006b, *Renewable Energy – A Contribution to Australia's Environmental and Economic Sustainability*, ‹www.rega.com.au/Documents/Publications/J1281%20Final%20Report%20V3.

National Emissions Trading Taskforce, 2006, *Possible Design for a National Greenhouse Gas Emissions Trading Scheme*, ‹www.emissionstrading.nsw.gov.au›.

NSW Department of Energy, Utilities and Sustainability, 2006, *Extending the Greenhouse Gas Abatement Scheme*, ‹http://deus.nsw.gov.au/publications/Greenhouse_Gas_Abatement_Scheme_Policy_Paper.pdf›.

OECD (Organisation for Economic Co-operation and Development), 2004, *The Economic Impact of ICT: Measurement, Evidence and Implications, 2004*, ‹www.oecdbookshop.org/oecd/display.asp?CID=&LANG=EN&SF1=DI&ST1=5LMQCR2JFTLN›.

Philibert, C., 2005, *Climate Mitigation: Integrating Approaches for Future International Cooperation*, International Energy Agency, ‹www.iea.org/textbase/Papers/2005/cp_climatemitigation.pdf›.

Point Carbon, 2006, 'Carbon Funds Booming as Capitalisation Reaches €3.1 Billion', Press Release, 6 October 2006, ‹www.pointcarbon.com/getfile.php/fileelement_88616/6_October_2006_Carbon_funds_booming_as_capitalisation_reaches_€3.pdf›.

——2007a, *Carbon 2007: A New Climate for Carbon Trading*, ‹www.pointcarbon.com/getfile.php/fileelement_105366/Carbon_2007_final_print_2.pdf›.

——2007b, *CDM & JI Monitor*, ‹www.pointcarbon.com/article21980-195.html?articleID=21980&categoryID=195›.

Prindle, W.R., Shipley, A.M. & Elliott, R.N., 2006, *Energy Efficiency's Role in a Carbon Cap-and-Trade System: Modelling Results from the Regional Greenhouse Gas Initiative*, American Council for an Energy-Efficient Economy, Report No. E064, ‹www.aceee.org/pubs/e064.htm›.

Productivity Commission, 2004, *Reform of Building Regulation*, ‹www.pc.gov.au/study/building/finalreport/index.html›.

Queensland Department of Mines and Energy, 2007, Queensland's Greenhouse Response – Energy Sector website, ‹www.energy.qld.gov.au/climate_change.cfm›, accessed 15 May 2007.

Stern, N., 2006, *Stern Review: Report on the Economics of Climate Change*, Cambridge University Press, ‹www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm›.

United Nations, 1992, *United Nations Framework Convention on Climate Change*, ‹unfccc.int/resource/docs/convkp/conveng.pdf›.

United Nations, 2006, *World Population Prospects: The 2006 Revision Population Database*, ‹http://esa.un.org/unpp›, accessed 18 May 2007.

United Nations Framework Convention on Climate Change, 2006, *National Greenhouse Gas Inventory Data for the Period 1990–2004 and Status of Reporting*, UNFCCC Secretariat note FCCC/SBI/2006/26, ‹unfccc.int/resource/docs/2006/sbi/eng/26.pdf›.

Uranium Mining, Processing and Nuclear Energy Review, 2006, *Uranium Mining, Processing and Nuclear Energy – Opportunities for Australia*, ‹www.pmc.gov.au/umpner/reports.cfm›.

US Congressional Budget Office, 2007, *Trade-offs in Allocating Allowances for CO_2 Emissions*, ‹www.cbo.gov/ftpdocs/80xx/doc8027/04-25-Cap_Trade.pdf›.

Victorian Department of Sustainability and Environment, 2005, *Victorian Greenhouse Strategy*, ‹www.greenhouse.vic.gov.au›.

Weitzman, M., 1974, 'Prices Versus Quantities', *Review of Economic Studies*, 41:477–91.

World Bank, 2007. *State and Trends of the Carbon Market 2007*, ‹carbonfinance.org/docs/Carbon_Trends_2007-_FINAL_-_May_2.pdf›.

World Resources Institute, 2005, *Navigating the Numbers: Greenhouse Gas Data and International Climate Policy*, ‹www.wri.org/climate/pubs_description.cfm?pid=4093›.

——2007, *EarthTrends*, ‹http://earthtrends.wri.org›.

World Trade Organization, 2007, International Trade Statistics website, ‹www.wto.org/english/res_e/statis_e/statis_e.htm›, accessed 19 April 2007.