Australian Government
Productivity Commission

What Role for Policies to Supplement an Emissions Trading Scheme?

Productivity Commission Submission

Submission to the Garnaut Climate Change Review

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Foreword

The Australian Government, with the support of the Council of Australian Governments, has committed to the implementation of an Emissions Trading Scheme (ETS) as an efficient, nationally consistent mechanism for achieving targeted reductions in greenhouse gas emissions. With such a system now in prospect, a key issue for policy is what supplementary measures may be warranted. In particular, there is a question as to whether policy measures to reduce emissions that were devised in the absence of a market price for carbon would still serve a useful purpose.

In response to a request from the Garnaut Climate Change Review, this submission addresses that issue. It examines different categories of policy and whether they would complement an ETS to enable Australia to achieve greenhouse emission reductions in the most cost-effective way. In some cases, notably the Mandatory Renewable Energy Target, the answer seems conclusively negative, whereas other policy measures clearly have a positive role to play, provided they are well designed.

The submission also considers the scope to lower the national cost of reducing emissions by widening the sectoral coverage of policy action, either within the ETS or by other means. As in other respects, Australia's policy approach needs to be calibrated to the likely nature of an international agreement, to avoid incurring undue costs domestically for a negligible effect on global emissions.

In preparing its submission, the Commission has drawn on research undertaken for its earlier submission to the Task Group on Emissions Trading (2007) as well as additional analysis and modelling. The work was conducted within the Environmental and Resource Economics Branch headed by Alan Johnston, under the guidance of Commissioner Neil Byron.

Gary Banks AO
Chairman

May 2008

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Abbreviations

Abbreviations

IAC	Industries Assistance Commission
IC	Industry Commission
PC	Productivity Commission
CCS	Carbon capture and storage
CDM	Clean Development Mechanism
CO_2	carbon dioxide
CO_2-e	carbon dioxide equivalent
ETS	emissions trading scheme
FullCAM	Full Carbon Accounting Model
GHG	greenhouse gas
GWh	gigawatt hour
MWh	megawatt hour
ICAO	International Civil Aviation Organisation
IEA	International Energy Agency
IMO	International Maritime Organisation
IPCC	Intergovernmental Panel on Climate Change
kWh	kilowatt hour
kVA	kilovolt ampere
LETDF	Low Emissions Technology Demonstration Fund
LULUCF	land use, land use change and forestry
MRET	Mandatory Renewable Energy Target
NCAS	National Carbon Accounting System

NETT	National Emissions Trading Task Force
PJ	petajoule
REC	Renewable Energy Certificate
UNFCCC	United Nations Framework Convention on Climate Change

OVERVIEW

Key points

- Where activities are covered by an emissions trading scheme (ETS), individuals and firms factor the traded price of greenhouse gas emissions into their decision-making and adjust their production and consumption in the most cost-effective way.
  - An effective ETS therefore is most likely to achieve a given abatement target at least cost to the community.
- With an effective ETS, much of the current patchwork of climate change policies will become redundant and there will only be a residual role for state, territory and local government initiatives.
- Once an ETS is in place, other abatement policies generally change the mix, not the quantity, of emissions reduction. Retaining existing, or introducing new, policies to supplement the ETS would need to offer other benefits. Those with potential include:
  - addressing a lack of incentive to conduct research and development in low-emissions technologies
  - addressing barriers to the take-up of cost-effective energy efficiency opportunities
  - exploiting abatement potential in sectors and activities not covered by the ETS.
- Currently, the most significant climate change policy instrument is the Mandatory Renewable Energy Target (MRET) which is marked for significant expansion. However, with an effective ETS in place, the MRET would:
  - not achieve any additional abatement but impose additional costs
  - most likely lead to higher electricity prices
  - provide a signal that lobbying for government support for certain technologies and industries over others could be successful.
- The extent to which land use, agriculture and forestry will be included initially in the ETS is uncertain. While it appears feasible to include forestry and some elements of agriculture, it is unclear whether this is the best option.
  - Other policies in uncovered sectors could encourage additional abatement. A key example is credit for carbon sequestration (greenhouse gas offsets). But ensuring the effectiveness of such arrangements can be difficult and costly.
  - There is little benefit in Australia pursuing emission reductions that are not recognised under international rules. This has implications for linking with other countries' emissions trading schemes.
- All supplementary policies must be subject to rigorous evidence-based analysis to determine if their rationales are sound and, if so, whether intervention would deliver a net community benefit after consideration of the costs of action.

Overview

The Australian Government, like some other developed nations, has decided to reduce greenhouse gas (GHG) emissions in advance of achieving the comprehensive international response that will ultimately be needed to significantly reduce global emissions. Central to this is its decision to meet specified GHG targets through an emissions trading scheme (ETS).

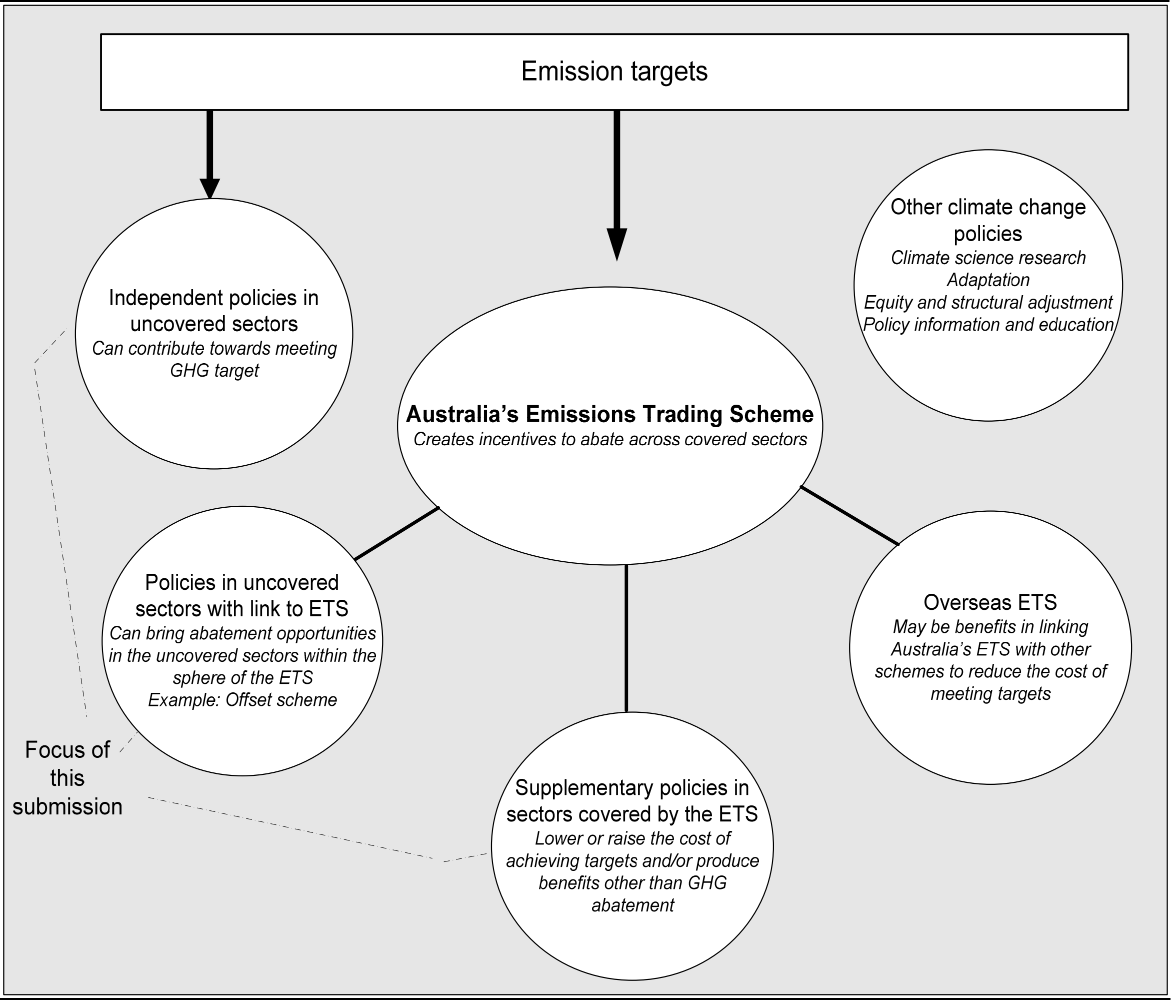
The hope is that Australian action will signal a commitment to be part of a global solution and add to momentum for other nations to take similar action. It could also assist Australia to gain a 'seat at the table' to influence the design and rules for any wider international agreement, including how national schemes might be linked. Of course, even if effective international measures are put in place to reduce GHG emissions, this would reduce, but not eliminate, climate change impacts. Consequently, adaptation to climate change is likely to be as important a consideration as abatement.

This submission considers the most cost-effective way that Australia can meet a given abatement target. (The scope is outlined in figure 1.) It does not consider: adaptation policy; the rationales for, or the costs and benefits of, pursuing given emissions targets; the specification of those targets; or design features for the ETS. Its focus is primarily on one key question: *in the presence of a well functioning ETS, what other domestic climate change policies are warranted?*

The objective needs to be least cost abatement

Once GHG targets are set, the optimal policy response is to price emissions directly — either through an emissions tax or an ETS. Under an ETS, the allowed amount of GHG emissions determines the creation of permits that entitle holders to emit a specified volume of GHGs. The demand for permits is driven by the requirement to acquit permits when releasing GHGs. Provided the emissions target 'bites', permits have value and can be traded in an emissions market. This harnessing of market mechanisms allows permits to be traded throughout the economy to reach their highest value uses. Unlike prescriptive command and control approaches, an ETS leaves it to producers and consumers — who have better information about their own production costs and preferences than governments — to work out the most cost-effective way to reduce emissions. In this way, the targets are most likely to be achieved at lowest cost to the economy and community.

Figure 1. **Relationship between the ETS and supplementary policies**



Bold arrows indicate that a policy can be used to meet (or contribute towards meeting) Australia's pre-determined emissions target. Other policies do not affect achievement of the target. Policies are connected to the ETS where they can influence the mix of abatement under the ETS and the permit price.

Achieving this least-cost abatement objective could, however, be subject to challenge from the confluence of several factors.

- The costs of abatement will be apparent from the start, but the benefits will not:
  – the community will bear highly visible costs through, for example, rising energy and fuel prices
  – benefits will be conditional on the actions of others and (to the extent that they arise) will not accrue for a long time
  – the effect of the policy response will be hard to assess owing to the difficulty of comparing climate-related and economic outcomes with and without an ETS — the counterfactual cannot be observed.
- If permits are auctioned, this will generate substantial government revenues, intensifying pressures to hypothecate funds to other climate change initiatives —

particularly schemes that appear to provide more tangible outcomes than the diffuse results of the ETS's economy wide price signal.

- There is a widely held view that a multiplicity of abatement measures must be pursued because there is no 'silver bullet' for addressing climate change and a lack of recognition that an ETS encourages a diversity of actions.
- The absence until now of an economy wide signal of the social cost of emitting GHGs has prompted all governments to devise a variety of indirect measures, with many such schemes now having an entrenched constituency.

These considerations suggest that not only are Australian governments about to face their most difficult ever regulatory challenge, they will be subject to lobbying to retain abatement measures and also to institute new ones. This is manifest already in government commitments to greatly increase expenditures on climate change programs. Unless carefully conceived, additional measures could significantly increase abatement costs yet provide no additional emission reductions.

By allowing the market to achieve an efficient outcome through the decentralised price-responsive actions of everyone in the economy, an effective ETS could do the 'heavy lifting'. In fact, an ETS could shoulder so much of the abatement effort that other policies would be needed only to fill any gaps in its reach. Accordingly, much of the current disjointed and fragmented patchwork of climate change policies throughout Australia would be expected to become redundant.

The case for additional climate change policies

Under a 'pure' ETS with a binding quota, the quantum of emissions is fixed. In this case, other abatement policies aimed at sectors covered by the ETS could change the composition of emission reductions but not total emissions (box 1). Under an ETS with a 'safety valve' — that is, allowing emissions above the cap, subject to a penalty — it is possible that supplementary policies could result in extra abatement. That said, the policies would generally result in additional emission reductions that were more costly than the safety valve price, thereby defeating its intent.

To be justified, supplementary policies would need other rationales, including:

- lowering the cost of abatement by correcting for:
  - unpriced 'spillovers' leading to underprovision of innovation in low-emissions technologies
  - information barriers that may prevent the uptake of cost-effective energy efficiency opportunities.
- addressing gaps in the coverage of an ETS where excluded sectors offer low-cost abatement or sequestration opportunities.

Box 1. Interaction of an ETS with other climate change policies: the case of light bulbs

Under an ETS, the emissions target is set below the level that would have otherwise occurred. With the demand for permits exceeding their supply, as in any market, the price of permits has to rise to equate quantity demand and supply. By enabling firms with access to lower cost abatement opportunities to reduce their emissions, and firms with high abatement costs to purchase permits and continue to emit, a fixed GHG emissions target can be met. Supplementary policies targeting sectors covered by the ETS will not alter total abatement.

Mandating energy efficient light bulbs, for example, could achieve greater abatement from less energy use, but there would be an equivalent decrease in abatement elsewhere. This is because the energy efficiency policy reduces emissions and thereby displaces other abatement that would have occurred in order to meet the ETS target, reducing the demand for permits such that their price falls. As it is unlikely that all firms and households would install energy-efficient light bulbs under an ETS, the policy-induced abatement occurs in place of other abatement that would have occurred with a higher permit price. The composition of abatement changes, not the amount.

Moreover, unlike market-determined abatement through the ETS, households and firms are constrained from acting according to their assessment of whether savings on their energy bills from replacing their incandescent lighting systems are greater than the cost. In contrast, an ETS by itself would allow households and firms to respond to price signals in the way they deemed most cost-efficient — for instance, opting to retain some incandescent bulbs while installing more efficient heating.

Other rationales for supplementary policies are generally weak. It has been suggested that, because it will take time to establish the credibility of an ETS, transitional policies are needed to fill the gap (box 2). This could be done, for example, by preventing construction of energy-inefficient buildings that might not be built if the expected ETS-related increases in energy prices were factored in. To the extent that the argument has a coherent underpinning, the policy response should be to address any such credibility problem directly in the design of the ETS. Moreover, the likelihood that policymakers would be able to correct for any credibility deficit in a way that produced more benefits than costs is questionable.

Another claimed rationale is that special measures might deliver additional non-mitigation benefits — for example, it is suggested that subsidies to assemble hybrid cars in Australia could reduce GHG emissions as well as fostering domestic activity in the motor vehicle sector. While it is clearly appropriate to assess all costs and benefits of a policy initiative, with an effective ETS in place any climate change benefit of a subsidy for the production of hybrid cars would be illusory. The policy would therefore need to be justified on industry policy grounds.

Box 2 Supplementary policies during the transition to an ETS

The credibility of an ETS is fundamental. If people expect the ETS to be rescinded or watered down in the future, abatement will focus on activities that have a short time horizon. Hence, the resulting abatement could be of the wrong character — that is, insufficiently focused on transforming long-lived capital goods. Investment in low-emissions technologies could also suffer. This has led some to argue for a greater role for supplementary policies in the initial years of an ETS, while the credibility of emissions prices is being established. There are problems with doing this:

- it can be difficult to tell whether an ETS has low credibility as there are many reasons why firms might respond differently to policymakers' expectations
- there would be a risk that supplementary policies could change the composition of abatement for the worse, due to the limited information and instruments available to policymakers
- supplementary policy can itself compromise the credibility of an ETS because it tends to lower ETS permit prices.

A better approach would be to set emissions targets and design the ETS and related institutions in ways that promote credibility. Australia appears to be in a good position to establish a credible ETS having gained insights from the National Emissions Trading Taskforce, the Task Group on Emissions Trading and now the Garnaut Review. Lessons have been learned from others in establishing an ETS, in particular the European Union. In addition, Australia has a demonstrated record in establishing independent institutional arrangements.

Lowering the cost of abatement through technology policy

An ETS — in raising the cost of emitting GHGs — would provide a powerful incentive to develop low-emissions technologies. Arguably, however, given the scale of the technological transformation necessary to reduce emissions, price incentives may not be sufficient. Knowledge spillovers are likely to be particularly marked in this area and thus private enterprises may underinvest in developing new technology. This arises from the difficulty the innovator may face in capturing the benefits associated with innovation — for example, the development of basic knowledge capabilities or diffusion of new ideas that can be used cheaply by others without payment to the originator. In essence, the benefits spill over for use by others at no cost to the user. Without intervention, this knowledge creation and diffusion could be underprovided.

The strongest case for public support occurs for basic research in science and/or where businesses undertake novel R&D activities that will either spill over cheaply to others, or trigger cycles of innovation by rivals. This could also include pre-commercialisation activities such as testing 'proof of concept' through demonstration plants.

The case for public funding to support business commercialisation and deployment is weaker because there are fewer potential spillovers at this later stage. For instance, as failure to commercialise would give rivals the time to poach the R&D knowledge, firms usually have adequate incentives to move quickly to commercialisation. Thus, public support at this stage risks financing investments that would have occurred anyway. That said, the price impacts of an ETS would provide a strong 'demand pull' for the commercialisation and deployment of low-emission technologies.

Taking a wider view, the degree to which the costs of abatement in Australia are reduced is likely to depend overwhelmingly on innovation that occurs elsewhere. Benefits from international cooperation on government support for research and development activities in low-emissions technologies are likely. Engagement with a more diverse portfolio across the globe will assist in promoting technology transfer. The composition of Australia's policy in this area should be guided by the contribution it can make and national interest considerations, including a reflection of domestic energy resources (for example, coal, uranium and the sun). However, a balance needs to be struck between providing technology-neutral support and targeting particular areas of potential promise, such as carbon capture and storage, that could reduce emissions from coal generated electricity consistent with Australia's national interest.

Renewable energy targets in the presence of an ETS

The capacity of an ETS to provide the demand pull to support deployment of low-emissions technologies means that they will play an increasingly important role as emissions targets are tightened. This has implications for the efficacy of the Mandatory Renewable Energy Target (MRET) scheme. The MRET specifies that an amount of electricity generation must come from renewable energy sources, but excludes other low-emissions technologies such as carbon capture and storage or nuclear power.

If the objective of the MRET is to address any spillovers associated with developing new renewable technologies, then it is not well-targeted. Being a quota, it fills with least-cost renewable sources — typically mature technologies such as wind. The main concern, however, is with its interaction with an ETS.

The current MRET target of 9500 gigawatt hours per year directly affects the mix of electricity generation — that is, the quota is binding. If, as planned, the MRET target were expanded to 45 000 gigawatt hours in 2020 (equivalent to 20 per cent of electricity generation), it could have a substantial impact on abatement costs (box 3). It would also reduce incentives to abate emissions or innovate in ways that do not meet the eligible technology criteria.

Box 3 **Operating the MRET in parallel with an ETS increases abatement costs**

An ETS would result in a significant increase in renewable energy generation. If an expanded MRET (with a 20 per cent electricity generation target) were to operate in conjunction with an ETS, the combination of the two instruments would drive substantially more renewable energy generation (unless the ETS target was so stringent that a 20 per cent generation target would be achieved in the absence of the MRET — a remote outcome at best and one which would render the MRET irrelevant). However, the overall level of GHG abatement would remain the same.

The MRET would displace other energy generation sources, particularly gas. This has implications for abatement costs. By 2010:

- natural gas combined cycle generation (which has less than half the emissions of black coal) is projected to cost around \$35–\$45 per megawatt hour
- renewable generation is projected to cost from \$55–\$80 per megawatt hour for wind to \$240-\$400 per megawatt hour for photovoltaics.

Reserving a proportion of electricity generation for renewable energy sources changes the generation mix in a way that increases abatement costs for no additional emissions reduction benefit. These problems would be further compounded if state-based renewable energy target schemes were retained (or introduced).

An MRET operating in conjunction with an ETS would not encourage any additional abatement, but still impose additional administration and monitoring costs. To the extent that the MRET is binding (which is its purpose) it would constrain how emission reductions are achieved — electricity prices would be higher than otherwise and market coordination about the appropriate time to introduce low-emissions energy technologies would be overridden. If it was non-binding, it would simply increase administrative, compliance and monitoring costs. Moreover, it would also help to foster a perception that governments are amenable to interfering with the least cost abatement objective of the ETS. This could encourage other potential beneficiaries to seek special programs that neither increase abatement nor reduce its cost.

Lowering the cost of abatement through energy efficiency policy

By increasing the price of energy, an ETS would strengthen incentives for greater energy efficiency. Importantly, it would encourage a longer-term view about prospective energy prices, thereby influencing investment decisions for long-lived capital goods — for example, more energy efficient buildings.

There may be some potential for additional policies to reduce abatement costs by addressing barriers to the uptake of cost-effective energy efficiency opportunities. Possible rationales are:

- failures in the provision of information — for example, information that has public good characteristics and/or information that is available to some parties in a transaction but not others
- split incentives — for example, a builder may reduce capital costs of construction unconcerned that the operating costs experienced by the occupant will be higher as a consequence.

However, care must be taken to ensure that intervention delivers net benefits. Often market failures are more perceived than real (because market mechanisms are operating adequately) and interventions can be ineffective and costly. Indeed, energy efficiency policies can have costs that extend beyond administration and compliance. For consumers, there is the prospect of being compelled to reduce particular emissions-producing activities and/or forgoing product features that they value more highly than energy efficiency.

Many energy efficiency policies pursued by Australian governments, from information provision to energy-efficiency standards and subsidies (for example, for solar water heating), have been used to a greater extent than warranted by the potential market failures. Although this may have, in part, reflected the lack of any mechanism to incorporate the social costs of GHG emissions, it appears that some measures were 'over-stretched' to fill this policy void. In the presence of an ETS to target GHG emissions directly, energy efficiency policy should be refocused on efficiently addressing any barriers to the uptake of energy efficiency opportunities.

Policies for excluded sectors

While broad coverage is desirable, in practice factors such as the administrative costs of monitoring and verification, and the number of entities required to be covered, can make a sector unsuitable for inclusion in an ETS. It is likely that Australia's ETS will commence with coverage of stationary energy, transport, industrial processes and fugitive emissions associated with the production, processing and distribution of fossil fuels. This would cover around 70–75 per cent of total emissions. It is unclear if the waste, agriculture and land use (mainly forestry) sectors will be included initially.

If an overall national target for GHG emissions is pursued with no abatement measures in some sectors, then total abatement costs are likely to be higher than need be. This is because low-cost abatement opportunities in excluded sectors are not accessed and must be substituted for by higher cost options in other sectors. This provides a clear rationale for considering abatement measures for all sectors, whether this is through the ETS or supplementary policy.

For sectors that pose particular difficulties for inclusion there are four main options:

- seeking to overcome these difficulties as best as possible and including the sector either fully or partially in the ETS
- introducing a ‘baseline-and-credit’ scheme that attempts to create incentives to achieve emission reductions relative to business-as-usual. Such schemes could link to the ETS
- pursuing independent policies that contribute to achieving the national target allowing the ETS cap to be higher than otherwise
- doing nothing, for example, if it were found that there were few low-cost abatement opportunities in excluded sectors and the policy-related costs of implementing separate schemes were high.

Agriculture, forestry and land use

There is a wide range of sources of emissions and sequestration in agriculture associated with the digestive processes of livestock, nitrogen fertilisation, and the build-up and depletion of soil carbon. The diversity and diffuse nature of sources makes the measurement and verification of GHG emissions difficult and potentially costly. This is compounded by a general lack of information about abatement opportunities. A further barrier to including agriculture in an ETS, or pursuing other mitigation policies, is the number of farms and facilities involved. In contrast, the land use, land use change and forestry sector can be a net sink for GHGs (through the removal of atmospheric carbon dioxide and its sequestration in biomass). It also poses fewer measurement difficulties and involves fewer participants.

It may be feasible to cover the forestry sector in an ETS quite soon (using one of several possible approaches), but whether the costs of doing so would outweigh the benefits is unclear. Another option being explored for forestry (and agriculture) is to introduce baseline-and-credit arrangements. For example, forest growers could provide credits for sequestering carbon in trees which could offset emissions in covered sectors. This would involve issuing credits for forests established as a consequence of the policy, but not for forests that would have been established anyway. The problem is that such baselines can never be established with certainty. And, while intuitively attractive, offset arrangements can be highly problematic. However, there are other potential approaches that could be taken independently of an ETS, such as specifically managing public forests for enhanced sequestration.

For agriculture, partial coverage of some emissions sources under an ETS is possible. New Zealand is going down this path, but the perceived imperative to do this — because agriculture accounts for around half of that country's GHG emissions — does not apply to Australia. Other approaches include: developing measurement protocols; promoting activities that reduce emissions, perhaps through extension services and/or subsidies; and taxes and regulation.

There are, however, two significant issues that must be considered for the land use, forestry and agriculture sectors.

1. The interactions of baseline-and-credit arrangements with an ETS: where there are deficiencies in verification, credits can be created that are not backed by genuine emission reductions (low additionality). A large influx of such credits has the potential to undermine the integrity and effectiveness of a linked ETS.
2. International accounting rules: where there is uncertainty about the treatment of emissions, it may be desirable to avoid committing to certain abatement opportunities until the rules are more certain. (The Kyoto Protocol excludes some major sources of emissions and sequestration.) Also relevant are the rules that might apply in other countries' emissions trading schemes. Some countries could deem it unacceptable to link with an Australian ETS that accepted a greater range of emissions and sequestration possibilities. (The European Union's ETS excludes carbon sinks as eligible offsets.)

There is a need for in-depth analysis of all mitigation policy options for agriculture, forestry and other sectors that pose particular difficulties for inclusion in an ETS. The policy that yields the greatest net benefits to the community should be chosen. If it transpired that the costs of action outweighed the benefits (including burden sharing from wider coverage), then this should have primacy over a singular desire to include as much of the economy as possible under an ETS.

The critical role of good governance

Once the GHG emissions target is set, the overarching objective must be to achieve that target at least cost. This necessitates the abolition of other climate change initiatives that, in the presence of an ETS, no longer contribute to additional, or lower cost, abatement. This leaves a limited range of policy niches that generally should be met by national-level policies (table 1).

Given that climate change is a global problem, the geographic source of emissions within Australia is of no practical relevance. While a national target is addressed most effectively by national policy, the potential for unwarranted supplementary policies to emerge is magnified in a federation.

Climate change initiatives at lower tiers of government are likely to conflict with national objectives, increase abatement costs, duplicate effort and encourage double counting of abatement. Moreover, if states and territories were to engage in bidding wars — through subsidies for renewable activities or 'compensation' for carbon-intensive activity — the location-related distortions would be of no benefit to the nation. As an extreme illustration, a negative net outcome would arise if, say, wind generators were attracted to subsidy-rich, but relatively wind-poor, locations.

There is a particular need to guard against governments introducing new policies to protect localised investments that arose from schemes that might be slated for abolition — for example, replacing mandated renewable energy targets with subsidies for renewable activities (including uncommercial feed-in tariffs).

State and territory (and local) government initiatives are best confined to:

- research on climate change impacts, adaptation and structural adjustment, where geographic location is an important consideration
- providing general information on energy efficiency where there might not necessarily be benefits from national coordination
- removing regulatory or other impediments to adoption of low-emissions technologies
- ensuring expected emissions prices are factored into their planning and investment.

It seems unlikely that particular jurisdictions would suffer unique, or more pronounced, market failures that warrant additional GHG mitigation measures.

With the introduction of an ETS, all existing and prospective climate related programs need to be (re)assessed comprehensively according to principles of good regulatory process. Essentially, this means that clear objectives should be targeted in a manner that maximises net community benefits. For climate change-related measures, there is an *additional* hurdle — namely, whether the policy objective is already met by the ETS. In a number of cases, including the MRET, the answer will be yes.

Table 1 **Policies to supplement the ETS — summary conclusions**

Type of policy/action	*Case for*	*Comments*
Development of low-emissions technologies		
Support at R&D stage of innovation (e.g. tax credits and offsets for R&D)	Strong	• Demand pull from the ETS likely to be insufficient due to innovation spillovers. • International cooperation on technology policy may require a contribution from Australia.
Support at middle stage of innovation (e.g. partial funding of demonstration plants)	Moderate	• Demand pull from the ETS may be insufficient due to innovation spillovers and risks associated with moving to 'proof of concept' and demonstration. • Matching grant arrangements may be appropriate.
Support at market accumulation and diffusion stage of innovation (e.g. mandatory renewable energy targets and feed-in tariffs)	Weak	• Increase abatement costs but leaves overall GHG emissions unchanged. • Case for deployment support additional to that provided by the ETS is weak due to limited spillovers. • Reduce incentive to implement abatement activities that do not meet their specific criteria. • Demonstrates willingness by governments to interfere with the objective of the ETS, thereby encouraging further rent-seeking.
Reduce barriers to deployment of low-emissions energy	Strong	• There may be fossil fuel subsidies, arrangements for electricity markets and infrastructure issues which create unwarranted barriers to the deployment of low emission technologies.
Energy efficiency[a]		
Provision of information	Strong	• ETS will stimulate greater provision of information, but general information on energy efficiency may be underprovided due to public good characteristics.
Requiring information disclosure (e.g. 'star-rating' labelling for appliances)	Moderate to strong	• Addresses information asymmetry between buyer and seller if market mechanisms do not operate. • Variations in energy savings and compliance costs mean this option is likely to be warranted for some appliances only. • Requiring such disclosure for buildings is problematic due to heterogeneity.
Preventing access to energy-inefficient products	Weak to moderate	• An intrusive way to address information problems as it can override informed consumer preferences. • Rationale is strongest if significant split incentive problems remain after an ETS is introduced.
Subsidies and other financial incentives (e.g. rebates on energy efficient goods)	Weak	• Do not address a policy relevant market failure. • Increases costs by redirecting abatement towards more expensive options and by adding unnecessary administrative tasks.
Energy efficiency target schemes	Weak	• The types of schemes proposed involve the creation of financial incentives and so the above comments apply. • Open to 'gaming', which can result in both high verification costs and low effectiveness.
Mandating investment in energy efficiency	Weak	• Firms are in the best position to respond to the incentives from the ETS.

Type of policy/action	Case for	Comments
Uncovered sectors		
Offset arrangements linked to the ETS (e.g. allowing forest growers to generate sequestration credits)	Uncertain	• The ETS will exclude some sectors initially. It may be desirable to include some of these sectors within a few years. Where this is the case, introducing offset arrangements in the interim may create high costs for only a small benefit. • Where sectors are to be excluded for an extended period, other policies that may exploit low-cost abatement opportunities should be explored. • Offset arrangements are one option. Being market-based instruments they have the potential to be relatively efficient. • However, to be effective and efficient they require activities to be credited only if they would not have occurred anyway (in the absence of the policy), and this can be difficult and costly to verify. These difficulties pose a threat to the credibility of the ETS and could preclude linking of Australia's ETS to schemes in other countries.
Other policies not linked to the ETS (e.g. subsidies, information provision, managing public forests for sequestration)	Uncertain	• There is a range of alternative policy options to offset arrangements. All options should be considered (including doing nothing). • Further research is needed to determine the way forward for agriculture and forestry.
Other		
Adaptation		
Policies to facilitate adaptation to climate change	Strong	• While people will adapt to changes in climate themselves, there are a range of market failures that are likely to require government attention. • Unlike mitigation, adaptation can be effectively pursued unilaterally.
Equity and structural adjustment		
Programs to assist people least able to cope with costs of GHG mitigation and for adversely affected regions	Strong	• Equity objectives should be met directly and in the most cost-effective way.

[a] Excludes policies to support the development of energy efficient technologies. Such policies are covered by the 'Development of low-emissions technologies' section of the table.

1 Policy framework

Key points

- The global nature of the greenhouse gas (GHG) problem has profound implications for the objectives and design of Australian climate change policy.
- National action to reduce emissions should be calibrated to the prospect and nature of the international response.
- The Australian Government's stated intention is to determine GHG emissions targets, and then pass the obligations for achieving these targets to firms using an emissions trading scheme (ETS).
- Once an ETS is in place, other abatement policies can change the mix of emission reduction activities, but generally will not bring about any further reduction in *total* emissions, or do so at higher cost.
- Supplementary abatement policies therefore need to offer other net benefits, such as lowering the cost of emission reductions (now or in the future). The potential suite of helpful policies to supplement an ETS include measures to:
  - overcome barriers to the development of low-emissions technologies and to the take up of cost-effective energy efficiency measures
  - promote emission reductions in sectors not initially covered by the ETS.

1.1 Scope of the submission

This submission sets out a framework, based on good practice policy principles, to identify the role of policies to supplement emissions trading. For the purposes of this submission, supplementary policies are defined as climate change mitigation[1] policies that are used in addition to an emissions trading scheme (ETS). The framework is then applied to different types of policy, including those to:

- support the development of low-emissions technologies
- increase energy efficiency where cost effective to do so

[1] The term 'mitigation', in this submission, encompasses both actions to achieve emission reductions directly (known as 'abatement') and actions to develop low-emissions technologies, which can make future emission reductions easier and less costly to achieve.

- encourage abatement in sectors not initially covered by the ETS.

The aim of the submission is to identify which policies are warranted to supplement emissions trading and which are not. Many existing and proposed policies are considered. In some cases a judgement on their merits is given, while in others issues that should be examined in more detailed reviews are outlined. A particular focus is given to targets for renewable energy and other types of low-emissions energy generation. This reflects the fact that, were the proposed expansion of the Australian Government's Mandatory Renewable Energy Target to go ahead, it would easily be the largest single element of supplementary policy.

The issues that fall within the scope of this submission are of great importance. The extent and composition of supplementary policies will have a large influence on the cost of achieving whatever greenhouse gas (GHG) emissions targets are chosen.

That said, the scope excludes many major issues covered by the terms of reference of the Garnaut Review. This reflects an attempt to focus efforts on those areas where the Commission is able to add most value. Among other things, the submission does not consider in any detail:

- setting domestic GHG emissions targets — although some of the factors that should be considered in setting targets for Australia, such as the global nature of the climate change problem, are briefly considered
- design of a domestic ETS — as outlined by the Garnaut Review, the Task Group on Emissions Trading and the National Emissions Trading Taskforce (Garnaut 2008a; PMTGET 2007b; NETT 2006), there are many important issues to be resolved, but there is insufficient time to add usefully to the general points made in the Commission's submission to the Task Group (PC 2007a)
- climate change policies that are focused on objectives other than mitigation — brief comments on some of these are given in box 1.1.

1.2 Responding to a global externality

GHG emissions are an example of what economists call an *externality*. Those who emit GHGs derive benefits from doing so (for example, by being able to heat their homes), while part of the cost of emitting (that is, related to any resulting temperature increases) is imposed on the wider community. Emissions are higher than desirable because individuals and firms take into account net benefits to themselves, but not the broader social costs and risks. GHGs are an unusual example of an externality in that it is global — all emissions contribute to atmospheric concentrations irrespective of where they occur.

Box 1.1 **Climate change policies focused on objectives other than mitigation**

Research into climate change

Better understanding of the science of climate change and its likely impacts (including regional impacts) could potentially be of great value in developing GHG emissions targets and informing adaptation efforts. There is a clear case for governments, including the Australian Government, to fund research into these areas given the public good characteristics of the knowledge gained.[2]

Adaptation

If effective international measures are put in place to reduce GHG emissions this would be expected to reduce but not eliminate climate change impacts. Accordingly, adaptation to climate change is an important consideration under all likely future abatement scenarios.

Individuals and firms will seek to adapt to changes in the climate themselves. Government intervention may be warranted where there are market failures, such as information failures and public goods. Areas that may require government strategies include provision of regional climate information and land-use planning. Unlike mitigation, adaptation does not, in the main, require internationally coordinated action and so can be effectively pursued unilaterally.

Equity and structural adjustment

The costs of the ETS are likely to fall unevenly across regions and socioeconomic groups in the community. There is a role for governments to assist people least able to cope with these costs and adversely affected regions. In general, equity objectives should be met directly and in a way that does not interfere with the incentives to abate created by the ETS. For example, it would be preferable to provide cash payments, rather than discounts on energy bills, to low-income households.

Policy information and education

The community's understanding of emissions trading is likely to be generally quite low, given that Australia has had little experience with this policy instrument. Accordingly, there will be a need for the Australian Government to explain emissions trading and its role in meeting climate change objectives. It will also be necessary to explain the objectives themselves, including the importance of focusing on overall emissions (and emission reductions) rather than more tangible, but less important, outcomes such as the amount of energy provided by a particular low-emissions technology.

2 Public goods are non-rivalrous (that is, consumption by one person will not diminish consumption by others) and non-excludable (that is, it is difficult to exclude anyone from benefiting from the good). Common examples include flood-control dams, national defence and street lights. Given that exclusion would be physically impossible or economically infeasible, the private market is unlikely to provide sufficient quantities of these goods.

There is a growing consensus that human-induced GHG emissions pose serious long-term risks and that action is needed to manage these risks. As it is a global externality, action to reduce emissions ideally would be taken at a global level. As there is no ‘world government’ to impose such a solution, international action needs to be based on the voluntary participation of almost 200 sovereign nations. Achieving such broad participation has proved elusive to date and is likely to remain very difficult for the foreseeable future.

The exclusion of major emitting countries from international action increases the cost of achieving a given level of abatement. This is because low-cost abatement opportunities in the excluded countries can not be accessed and must be substituted for by higher cost opportunities elsewhere. Stringent abatement targets are difficult, or impossible, to meet if more than one or two major emitters are excluded. This is a function of the level of emissions in excluded countries and the potential for emissions to be displaced to those countries (for example, by aluminium smelting activities shifting from a country taking action to one not taking action).

GHGs are also what is known as a *stock* pollutant. It is not the quantity of emissions in any given year that influences mean global temperatures, but rather the stock in the atmosphere. As many GHGs have a long residence time in the atmosphere (carbon dioxide, for example, remains in the atmosphere for up to 100 years), emissions now can continue to influence climate for many decades.

This attribute of GHGs partly explains why climate change is such a long-term issue. Atmospheric concentrations have been increasing for many decades and if no effective international action is taken to limit emissions, the concentrations would be expected gradually to accelerate, with consequent implications for temperatures. The damages expected from climate change are linked with possible temperature increases, which are expected to increase gradually under business-as-usual emissions. For example, in the most pessimistic scenario modelled for the Stern Review, mean damage costs reach 1 per cent of global gross domestic product around 2070 but continue to increase, reaching 13.8 per cent in the year 2200 (Stern 2007).[3]

The stock pollutant nature of the problem is very important in considering the international policy response to climate change. It implies that a given target for atmospheric concentrations of GHGs could be achieved via different emission paths. For example, strong action to ensure global emissions peak by 2020, followed by fairly gradual absolute reductions could achieve a similar result to allowing emissions to peak in 2030 and then

3 These estimates include the following types of damages: market impacts (such as reduced agricultural production), risk of catastrophic events (low-probability abrupt changes to the climate system) and non-market impacts (such as damage to the environment and human health).

cutting emissions more steeply. Ideally, once a target for atmospheric concentrations was established, the aim would be to follow the emission path that achieved the target at the lowest possible cost.

Australia's current policy situation

Climate change policy in Australia has developed as a patchwork of measures targeting particular sources of GHG emissions, including in individual states and territories. At the outset the focus was on measures that were expected to have no net cost (so called 'no regrets' measures). The underlying logic was that costly action by Australia in isolation was not justified because the problem was a global one, requiring a global response.

Over time, however, measures that impose a net cost on the community have been adopted. In addition, some measures conceived as fitting the 'no regrets' criteria appear to have been pushed beyond their original intention, imposing costs on individuals and firms (PC 2005). The current patchwork of policies has resulted in some relatively high-cost abatement opportunities being taken up while many lower-cost abatement options remain unexploited.

At the international level, the United Nations Framework Convention on Climate Change (UNFCCC) has been ratified by 190 countries (including Australia), making it one of the most widely supported international agreements in existence. The UNFCCC's ultimate objective is 'to achieve … stabilisation of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system' (UNFCCC, Article 2). The UNFCCC does not specify an overall target or time paths for emission reductions or binding targets for individual countries. This leaves any binding commitments on GHG emissions to be negotiated among parties to the UNFCCC. The first attempt to do this was the Kyoto Protocol negotiated in 1997.

The Kyoto Protocol commits developed countries (or 'Annex 1' countries) to limit or reduce their GHG emissions during the period 2008–12. It does not impose binding targets on developing countries, but allows for their participation through measures such as the clean development mechanism (CDM). The CDM allows Annex 1 countries to fund emission reduction activities in developing countries and count these towards meeting their own target.

Australia ratified the Kyoto Protocol in December 2007, leaving the United States as the only Annex 1 country not to do so. The Australian Government has also stated that its 'position is that any binding commitments need to encompass both developed and developing countries if we are to be successful in tackling climate change' (DCC 2008c). A reasonable interpretation would seem to be that the Australian Government recognises that the Kyoto Protocol is deficient in that it does not include binding targets for developing countries, but sees it as a useful (and perhaps equitable) step along the way to a more comprehensive agreement.

Australia's target under the Kyoto Protocol is to limit GHG emissions to 108 per cent of 1990 levels between 2008 and 2012. It is projected that this target will be met (DCC 2008e).

International negotiations on a climate change agreement for the post-2012 period are underway and, at the earliest, will be completed toward the end of 2009. The current policy development process in Australia, of which the Garnaut Review is an important part, is centred on the planned introduction of an ETS in 2010. With these timelines, decisions with far-reaching consequences for Australia's future will need to be taken before the outcomes of the international negotiations are known.

1.3 Framework for supplementary policy

For this submission, it is taken as given that targets will be set for Australia's GHG emissions and that the main policy instrument used to achieve these targets will be an ETS. To understand the role that supplementary policy should play in this context, it is necessary first to understand the role of targets and an ETS.

Targets

Good practice policy principles would require that targets for GHG emissions be set based on the costs and benefits of constraining emissions to various levels. The costs to be considered include those associated with:

- generating energy using low-emissions technologies that are more expensive than the main technologies currently in use
- adjusting to changed circumstances as industries and jobs are lost in particular regions and new opportunities arise elsewhere
- forgoing services in order to conserve energy (for example, putting up with a less comfortable living environment in order to save on energy for heating and cooling)
- administrative and other requirements that arise from whatever policy instruments are put in place to achieve the targets.

Various studies suggest that Australia's mitigation costs are likely to be higher than those in most other developed countries, reflecting Australia's economic structure, which is based on the availability of low-cost fossil fuels (Ahammad et al. 2006; Weyant and de la Chesnaye 2006). The costs to Australia would also vary according to the extent of mitigation in other countries. This variation, however, is subject to countervailing influences and so it is not clear whether the overall cost would be higher if a given level of Australian action was beyond that, or in step with, average international action (PC 2007a).

Ultimately, the benefits from reducing emissions are avoiding some of the expected risks and damages of climate change. To some extent these risks vary by country and region. Potential impacts identified for Australia include:

- increased water security problems in southern and eastern Australia
- risks to coastal development from sea-level rise and coastal flooding
- loss of biodiversity in ecologically rich sites (including the Great Barrier Reef, Queensland Wet Tropics and Kakadu wetlands)
- risks to major infrastructure from extreme events
- decline in production from agriculture and forestry (IPCC 2007).

Overall, these damages, and hence the benefits from mitigation, might also be higher for Australia than for most other developed countries (Garnaut 2008b).

As explained earlier, any benefits to Australia would arise overwhelmingly from abatement undertaken in other countries. Australian abatement on its own imposes costs on the Australian community for little or no climate-related benefit. It is for this reason that the Commission has argued that Australian action needs to be calibrated to the prospect and nature of an international response (PC 2007a). This raises particular challenges, given the timelines for international negotiations and the Australian policy development process outlined earlier.

The Australian Government has committed to reducing GHG emissions by 60 per cent from 2000 levels by 2050 (and also plans to set interim targets) (Wong 2008). A crucial question is the international circumstances under which this commitment would apply. In its early reports, the Garnaut Review favoured setting out different GHG emission trajectories (and targets) that would apply under different levels of international abatement (Garnaut 2008a). If this approach is pursued, it is important that each conditional commitment be carefully thought through, considering the likely outcomes for Australia if it were to be sustained over the long-term.

Another issue for the setting of targets is the time period over which they will apply. From the earlier discussion of the stock pollutant nature of GHGs, it would be desirable to set a single target for total emissions over a multi-decade period. However, this conflicts with current practice under the Kyoto Protocol, and the inevitable desire of the international community to see that progress is being made in particular countries and that commitments made are being honoured. Accordingly, the degree of flexibility Australia might have under a future international agreement to specify targets in the form it would like is unclear.

Emissions trading scheme

As governments do not control emissions directly, the obligation for meeting any target that is set must be passed down to the community using a policy instrument. The two main instruments that have the potential to be relatively cost effective are emissions trading and emissions taxes, because they price GHG emissions directly. The Australian Government has chosen to use emissions trading and plans to introduce an ETS in 2010. Many important design issues are yet to be resolved.

An ETS allows whatever targets are set to be achieved, but the more stringent the target the higher the unit cost of achieving those emission reductions. Essentially under an ETS, whenever a quantity of GHG is emitted, permits for that quantity must be surrendered to the administrator of the scheme. The target determines the number of permits, which in turn determines the quantity of emissions (provided that measurement and verification arrangements are adequate). There are, however, two qualifications:

1. If an ETS includes a ‘safety valve’ price, emissions can exceed the target under certain conditions.
2. Where an ETS excludes some sectors of the economy, the target may not be met if emissions growth in these sectors is higher than anticipated (this issue is discussed in more detail in chapter 3).

With a target set below the quantity of emissions that would have occurred without the ETS, there will be scarcity in the market for permits. This results in permits, and therefore emissions, having a positive price.

Under an ETS, firms can choose to reduce their emissions and invest in abatement options and/or purchase emissions permits (the right to emit) which are traded on the market. Firms will tend to invest in abatement to the point where abatement costs are equal to the cost of permits. By enabling firms with access to lower cost abatement opportunities to reduce their emissions, and firms with high abatement costs to purchase permits and continue to emit, a fixed GHG emissions cap can be met at the lowest overall cost to the community. In addition, an ETS also increases the incentive for firms to invest in the development of low-emissions technologies.

The ETS also influences the purchasing decisions of consumers and producers indirectly through the permit price. An ETS will make energy more expensive, increasing the incentive for people to conserve energy and seek out goods with higher levels of energy efficiency. In addition, goods that are energy intensive to manufacture will become relatively more expensive and so people will tend to buy less of them.

What role for supplementary policy?

From the preceding discussion it might be asked: If an ETS has the potential to enable GHG emissions targets to be met at least cost, why have any other mitigation policies?

Indeed, in many contexts where an ETS is used, this is exactly what is done. For example, an ETS has been used to achieve targeted reductions in sulphur dioxide pollution in the United States. It has been estimated that using an ETS instead of (rather than in concert with) other policy instruments, such as regulating that particular pollution-control equipment must be used, has resulted in annual cost savings of up to US$1 billion (Stavins 2005).

That said, there are legitimate reasons for having some carefully designed supplementary policies for GHG mitigation. However, before discussing these, some other rationales that are often suggested, but which have less merit, are considered.

Weak rationales for supplementary policy

The size of the task dictates that many policies need to be deployed

Meeting the target proposed by the Australian Government, or the more stringent ones discussed in Garnaut (2008b), would be an enormous task. There is, however, nothing inherent in the size of the task that requires other mitigation policies to be used in addition to an ETS. An ETS is an instrument that has the potential to achieve whatever targets are chosen, at least cost. With more stringent targets, costs to the community will be higher. The magnitude of these costs has the potential to moderate the targets set. Consequently, the choice of an ETS does not limit how ambitious the targets can be. Indeed, because the ETS is more cost-effective than most alternative instruments, more ambitious targets can be achieved for a given cost.

It is sometimes argued that climate change is such a large and complex problem that there can be no ‘silver bullet’ solution and so a wide range of approaches is needed. This has some validity in the context of the *technologies* that may be required to reduce emissions. However, the same argument does not apply to *policy*. Emissions trading and taxation are efficient policy instruments precisely because they can create incentives for emission reductions across the whole economy, involving a wide range of goods, services, activities and technologies. Importantly, unlike policies that target specific technologies, taxes and tradeable quotas do not distort technology choices.

An ETS will not achieve emission reductions quickly enough

There is a view held by some that whatever their advantages, market-based instruments such as an ETS are too slow in producing results (Environment Business Australia 2008). It is possible that this view derives from focusing on particular emitting activities rather than on total emissions. For example, it might be observed that an ETS has not caused coal fired electricity generation plants to shut down or that coal exports are continuing unabated, whereas a regulatory response could close plants and ban exports immediately. However, it seems likely that market-based instruments could achieve sharper reductions in *total* emissions than prescriptive regulation because they lower the costs imposed on the community.

An ETS could achieve rapid reductions in emissions if that is the policy objective and the targets are set accordingly. Again, it is the costs of reducing emissions sharply that would likely temper the emissions trajectory chosen, not the alleged limitations of an ETS.

Commitment to existing policies

Many existing climate change mitigation policies have been developed and refined over a period of years. Governments and government officials may consider that the considerable investment of time and resources spent developing these policies would be largely wasted if they were discontinued. With some policies there may also be a sense that they have worked well and so should continue.

The introduction of an ETS, however, fundamentally changes the policy landscape. Although some policies may have worked well in the past, it would be fortuitous if these effectively supplement emissions trading. In many cases, retaining then will simply add to the costs of achieving GHG emissions targets.

Extra policies are needed during the transition to a credible ETS

It has been suggested that it will take time to establish the credibility of an ETS and that supplementary policy should be used as a transitional tool to try and compensate for this (Stern 2007). This could be done, for example, by regulating to prevent the construction of buildings that are energy inefficient and which would not be built if the ETS-related increases in energy prices expected by policy makers were factored into the building's design.

While this argument has a coherent underpinning, it is the Commission's view that it is likely to have no useful application in the Australian context because:

- steps can be taken to reduce any such credibility problem

- there is little likelihood that policymakers would be able to correct for any deficit in credibility in a way that produced more benefits than costs.

Establishing the credibility of the forward path for emissions prices is widely seen as of central importance to the cost effectiveness of climate change mitigation policy (Helm, Hepburn and Mash 2003; McKibbin and Wilcoxen 2006; Stern 2007). If the ETS has high credibility and firms expect that emissions prices will be stable, or increase over time as envisaged by policy makers, they will factor this into their decisions on investment in long-lived capital goods and research into low-emissions technologies.[4] If, on the other hand, the ETS has low credibility (that is, people expect the scheme to be rescinded or watered down in the future), firms will tend to focus their abatement on activities that have a short time horizon. In addition, if the ETS allowed flexibility as to the timing of permit use, firms may not, in the early years of the ETS, reduce emissions by as much as they would if the scheme had high credibility.

If low credibility were expected to occur, there could well be reasons for thinking that the abatement resulting from an ETS would be of the wrong character (that is, insufficiently focused on transforming long-lived capital goods). This gives rise to an argument for a greater role for supplementary policies in the initial years of an ETS, while the credibility of emissions prices is being established. For example, the case for a renewable energy target as a transitional policy has been argued on this basis.

Whether a gap between the forward emissions price path envisaged by policy makers and the price path private agents factor into decision making might warrant a greater role for supplementary policies in the early years of an ETS depends in part on the reason for the discrepancy.

- If private agents think that major technological breakthroughs that will greatly lower the cost of achieving emission reductions are imminent, the gap may simply reflect the market having access to better information and no enhanced role for supplementary policies is warranted.
- If, on the other hand, the departure is due to low credibility because of a view that future governments are likely to water down or dismantle the ETS, a case for an extra role for supplementary policies during the transitional phase can be argued.

Attention should be given to setting targets and designing the ETS in ways that promote credibility, while allowing for flexibility in response to new information (for example, on climate science or the degree of international mitigation). One way of doing this is to set out in advance how targets will be revised in response to changed circumstances. The

4 Firms would be expected to begin to build future emission prices into their decision making before the ETS was actually introduced. This process would be expected to gain momentum once the major design features of the ETS were finalised, as this would allow informed expectations about emissions prices to be developed.

institutions set up to administer and regulate the ETS are also important to the level of credibility of the scheme (Helm, Hepburn and Mash 2003).

Australia would appear to be in a relatively good position to establish a credible ETS. The policy process being followed has gained insights from analysis and stakeholder consultation, conducted by the National Emissions Trading Taskforce, the Task Group on Emissions Trading, and now the Garnaut Review. Lessons have also been learned from the experiences of others in establishing an ETS, in particular the European Union. In addition, Australia has a demonstrated record in establishing independent institutions, such as the Reserve Bank of Australia and the Australian Competition and Consumer Commission.

If, despite this, there is still expected to be some deficiency in credibility, the question becomes whether giving an enhanced role to supplementary policies to compensate would be likely to produce greater benefits than costs. It is important to recognise the amount and quality of information that policy makers would need to be able to do this. First, they would need to estimate the forward emissions price that they think should be factored into investments in long-lived capital goods. Given that lack of credibility is not the only reason for discrepancies between the expectations of policy makers and firms, this is very difficult. Second, they would need to second-guess how firms would have responded to this forward emissions price and design policy interventions accordingly. It would seem unrealistic to expect that these information requirements could be met.

It should also be recognised that the use of supplementary policy can itself compromise the credibility of the ETS. As explained in box 1.2, supplementary policies can decrease the ETS permit price. If supplementary policies were used heavily in the initial years of the ETS and firms considered that this was likely to continue, then expected future permit prices would tend to be lower than they would be otherwise.

In the Commission’s view there is little or no scope to use supplementary policy to compensate for any deficiencies in the credibility of an ETS.

Stronger rationales for supplementary policy

An ETS will address the GHG externality for those sectors covered. For these sectors, supplementary policies may be warranted where they address a different source of market failure. The most significant related market failure is the spillover benefits that can arise from the development of low-emissions technologies. An ETS will create incentives for the development of low-emissions technologies, but these are likely to be inadequate given that innovators often can not capture all, or even most, of the benefits they create. There are also information-related market failures that can cause people to fail to take up energy efficiency opportunities that would have been cost-effective for them. These issues are taken up in chapter 2.

For sectors not covered (potentially including agriculture and forestry), the GHG externality will not be addressed by the ETS. There is, therefore, a prima facie case for investigating supplementary policies that provide incentives to abate in these sectors that are commensurate with those created by the ETS for covered sectors. Chapter 3 examines factors relevant to the coverage of an ETS and the various policy options that could be pursued for excluded sectors.

The existence of market failure does not automatically mean that a government response is warranted. The likely effectiveness of the response and the costs associated with it need to be assessed to determine if there are likely to be net benefits to the community from adding a supplementary policy.

In assessing costs and benefits it is important to recognise that, for covered sectors, the benefits from supplementary policies are unlikely to come in the form of extra emission reductions. Under a 'pure' ETS the quantity of emissions is fixed and so other mitigation policies (unless on a scale that makes the ETS redundant) may change the composition of abatement but will not change total emissions (box 1.2). For example, energy efficiency policies might increase the abatement from higher energy efficiency, but there would be an equal decrease in abatement elsewhere. For example, there could be less switching from coal generated electricity to lower emissions technologies, such as gas. If the ETS allows flexibility as to when permits can be used, there is also some potential for supplementary policies to influence the timing of abatement (this issue is discussed in appendix A).

Some proposals for an ETS (including those from the Task Group on Emissions Trading and the National Emissions Trading Taskforce) are not 'pure' in the sense that they include a safety valve price on emissions permits. This means that should emissions reductions be more costly to achieve than anticipated in a particular year, some firms would choose to emit in excess of their permit holding and pay the safety valve price on the balance. Accordingly, the emissions constraint under the ETS may not be binding in some years, leaving open the possibility that supplementary policies could result in extra abatement. This, however, seems to be a fairly minor departure from the general rule that supplementary policies will not result in extra abatement, because the safety valve price may rarely if ever come in to play. Moreover, the final design of the ETS has not been determined — it may not include a safety valve price, or include one only in the initial years.

More importantly, a safety valve price is a deliberate mechanism to cap the cost of emission reductions. If a supplementary policy were to result in extra abatement at a unit cost above the safety valve price, then it would defeat this intention. Accordingly, supplementary policies are unlikely to result in net benefits from extra abatement in covered sectors.

The quantity of abatement in excluded sectors will not be fixed and so supplementary policies here can reduce total emissions and, thus, contribute toward meeting national emissions targets. The size of this contribution should depend primarily on the potential for relatively low-cost abatement in these sectors and the policy-related costs of achieving abatement.

In summary, the main justification for supplementary policy is where it would lower the cost of abatement. This could occur, for example, where:

- an energy efficiency policy corrects an information failure, encouraging the uptake of cost-effective energy efficiency opportunities (care needs to be taken to ensure that all costs associated with the policy are taken into account in determining whether lower abatement costs are likely, as discussed in chapter 2)
- policy to support the development of low-emissions technology is successful in stimulating innovation that leads to abatement costs being lower in the future
- supplementary policy in uncovered sectors is able to exploit low-cost abatement opportunities, with reasonably low transaction costs.

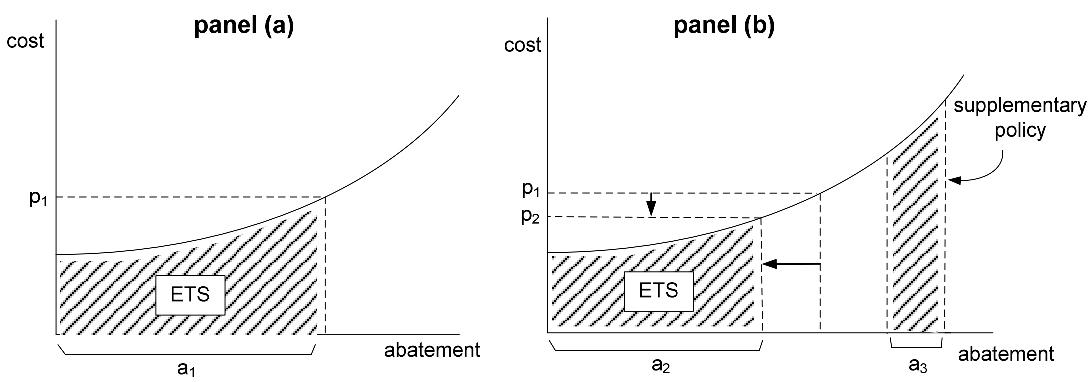
Box 1.2 **Why supplementary policies do not generally reduce emissions**

Consider the case of an ETS that covers all sectors of the economy, does not allow banking and borrowing of permits and does not have a safety valve price on emissions. Under such an ETS a set number of permits are issued and the emissions allowed under these permits add up to the emissions target. Because the target is set below the level of emissions that would have occurred without the ETS (business-as-usual), the permits are scarce and, therefore, valuable. This means that a firm that has more permits than it needs would be expected to sell the excess to a firm that will use them. Accordingly, the emissions each year would equal the emissions target.

The important point about supplementary policies is that they do not alter this outcome, unless they cause so much abatement that there is no longer any scarcity of permits, and the permit price drops to zero. If supplementary policies of this magnitude were contemplated there would, of course, be no point in having an ETS.

What supplementary policies of a realistic scale would do is reduce the abatement task required of the ETS. That is, the gap between business-as-usual emissions and the target becomes less than it would be without supplementary policies. Permits remain scarce, but are somewhat less scarce, and so the permit price is lower than it would be otherwise. Permits are still bought and sold at a positive price. All permits would be expected to be used and so total emissions still equal the target.

This is illustrated in the figure below. Panel (a) is for an ETS operating in isolation. The abatement required of the ETS to meet the target is 'a_1', which is achieved with a permit price of 'p_1'. The cost of abatement is given by the shaded area. In panel (b) a supplementary policy is introduced that achieves a quantity of abatement, shown as 'a_3'. The abatement required of the ETS falls by the same amount (that is, $a_1 = a_2 + a_3$), which causes the permit price to fall to 'p_2'. Total emissions, therefore, are the same with and without the supplementary policy.



(Continued next page)

Box 1.2 **(continued)**

In this example, the abatement achieved by the supplementary policy is relatively high cost and so abatement costs are higher with the supplementary policy (the two shaded areas in panel (b) added together is larger than the shaded area in panel (a)). Also, the figures do not capture administrative and some other policy-related costs. These will inevitably be higher where supplementary policy is used.

Another possible consideration is benefits other than a reduction in GHG emissions. For example, generating electricity from renewable sources rather than coal might result in less local air pollution as well as less GHG emissions. Where this argument is used, the non-mitigation benefits should be explicitly stated. For example, subsidies for the assembly of petrol/electric hybrid vehicles in Australia would need to be argued on grounds other than climate change mitigation.

Overarching design issues for supplementary policies

National coordination

A national ETS is being designed and it is also desirable that some types of supplementary policies be national or nationally uniform (a result that can be achieved through enacting template legislation across all jurisdictions). National uniformity is generally desirable where variations across jurisdictions would reduce cost effectiveness by:

- causing activities to locate away from their ideal location (for example, wind farms in less windy places)
- increase costs for firms that operate nationally (for example, requiring national firms to deal with jurisdiction-specific energy efficiency standards).

On the other hand, some measures, such as the provision of general information on energy efficiency, do not necessarily benefit from being nationally coordinated. Indeed, there can be benefits through jurisdictions pursuing different approaches and learning from one another's successes and failures.

Focusing on efforts that count towards meeting targets

If a new international agreement on climate change arises it will contain a set of rules for determining countries' GHG emissions. Such rules would cover what counts as emissions and the relative weighting given to each GHG. These rules would be applied to determine whether commitments made in the agreement have been met. It is important, therefore, that abatement efforts in Australia are attuned to these rules. There would be little point, for example, in pursuing costly measures to increase carbon stored in soil (which results in less carbon dioxide in the atmosphere) if this did not count toward meeting commitments.

International agreements may also extend to aspects other than each country's GHG emissions. For example, support given to the development of low-emissions technologies might be another metric used to measure effort.

At this stage, the rules that may apply post 2012 are not known, and it can not be assumed that they will be the same as for the Kyoto Protocol. This uncertainty needs to be taken into account in designing supplementary policies.

International considerations

In considering the design of an ETS the Garnaut Review and others have given appropriate attention to international issues, including:

- the potential for so-called leakage, whereby emission reductions in Australia lead to emission increases in countries without an emissions constraint
- that Australian action that leads to emission reductions in other countries is equally environmentally effective as emission reductions within Australia.

These issues should also be considered in designing supplementary policies. For example, the potential for leakage to occur should be taken into account in designing policies for sectors not covered by the ETS.

2 Technology and energy efficiency

Key points

- Technology policy provides scope to reduce the cost of meeting emissions targets.
- Additional 'technology-push' policies may be justified to supplement the 'demand-pull' effect of the emissions trading scheme (ETS).
  - Rationales for technology policies to operate in conjunction with an ETS include the need to address free-rider issues that lead to under-provision of innovation.
- In choosing the optimal portfolio of technology policies, consideration of the international environment is required.
  - The degree to which abatement costs in Australia can be reduced is likely to depend overwhelmingly on innovation that occurs elsewhere. Domestic policy should strike a balance between providing technology-neutral support and targeting areas, such as carbon capture and storage, that are consistent with Australia's interests.
- The most significant current technology policy is the Mandatory Renewable Energy Target (MRET).
  - Retaining the MRET in conjunction with an ETS would not result in any additional abatement but would constrain flexibility and increase abatement costs.
- Policies that address information barriers that impede the uptake of cost-effective energy efficiency opportunities also have a role in supplementing the ETS.
  - These policies should address the informational impediments directly and not operate as another tier of policy that simply reshuffles the abatement induced by the ETS.
- All climate change measures that are to operate in conjunction with an ETS must be rigorously assessed against principles of good regulatory practice.

2.1 Introduction

Technology will be integral in reducing greenhouse gas (GHG) emissions and adapting to climate change:

- some argue that geo-political realities prevent effective international mitigation action being taken and that the best chance of resolving this is to develop new technologies that greatly reduce mitigation costs (Montgomery and Smith 2005)
- others argue that the problem is so urgent that considerable emphasis needs to be given to achieving emission reductions now with the best available technologies (and through behavioural change) (Stern 2007).

The ETS will provide incentives for firms and individuals to adjust their production and consumption behaviour. While this will stimulate investment in and deployment of low emissions technologies, other policies may be justified because of the ‘public good’ or ‘spillover’ benefits associated with research and development. These matters are discussed in section 2.2.

There are some barriers limiting the uptake of cost-effective energy efficiency opportunities. The most important of these appear to be (i) inadequate information and (ii) inconsistent incentives facing providers (installers) and users of energy-efficient products. Policies targeting these impediments could be warranted to supplement an ETS to reduce abatement costs. These issues are discussed in section 2.3.

There are other actions that governments could take to advance mitigation objectives. These include ensuring that emissions prices are incorporated into decision making, removing distortions and promoting flexibility in the economy (section 2.4). Finally, section 2.5 discusses good practice regulatory principles with particular emphasis on the role for state and territory climate change policies.

2.2 Technology policies

The degree to which abatement costs in Australia are reduced will depend overwhelmingly on innovation that occurs elsewhere, reflecting the global public good nature of innovation. Accordingly, there would likely be benefits from international cooperation regarding government support for the development of low-emissions technologies. This could also encourage a more diverse portfolio of research and development activities across the globe.

The emphasis Australia gives to technology policy should depend, in part, on the nature of any future international climate change agreement. For example, will countries that make a disproportionately large contribution towards technological development be recognised for this effort?

The composition of Australia’s policy in this area should be guided by national interest considerations. However, a balance needs to be struck between providing technology-neutral support and targeting particular areas of promise, such as carbon capture and storage, that could greatly reduce the emissions from coal generated electricity, consistent with Australia's resource-based interests. The Australian Government can play a coordinating role by bringing together research organisations at an international level. Australia has entered into bilateral climate change partnerships with China, the EU, Japan, New Zealand, the United States, and South Africa. By working within international partnerships, more efficient innovation could result through non-duplication of research efforts, pooling of the various comparative strengths of partners and gaining access to required investment funds (ABCG 2007).

The role of innovation and technology policy

Recent research stresses the systems nature of innovation and the feedbacks between different stages of the innovation chain (Foxon 2003; Grubb 2004; Nemet 2008; Perlack and Shelton 1996). The process that begins with the accumulation of knowledge, and ends with the market uptake of a product incorporating that knowledge, is known as the innovation chain (box 2.1). Along this chain there are feedback loops operating between the different innovation stages. For example, in the market accumulation to diffusion stages, a problem in using the developed technology may be identified that would result in a return to the applied research stage to refine the technology to overcome the identified problem.

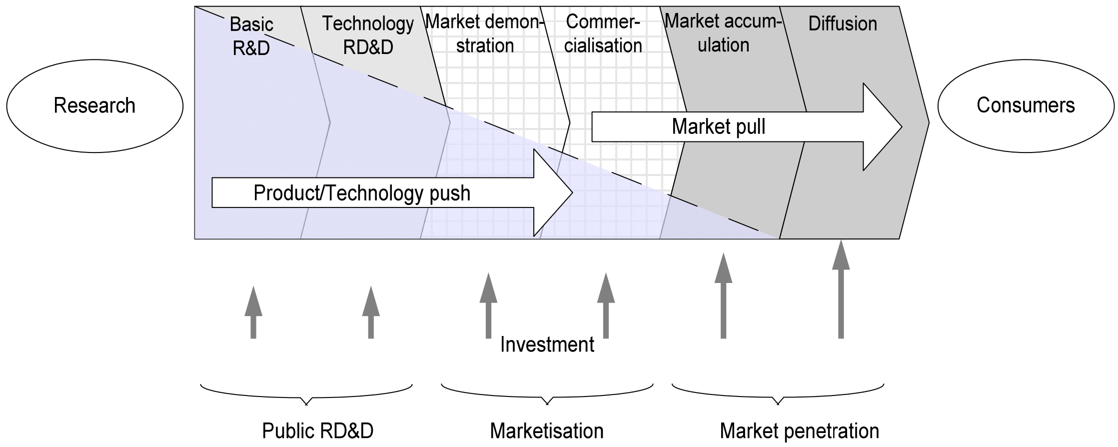
By introducing a cost for emitting GHGs, the ETS will result in greater profitability for, and innovation in, low-emission production technology. The higher the emissions price, the stronger the demand-pull effect on innovation. Whether that stimulus would be adequate to yield optimal innovation is the subject of debate. Some argue that the expected targets will necessitate innovation at a faster rate than that delivered under normal commercial timeframes (ABCG 2007).

In particular, there is a question of where the emphasis should reside in terms of:

- technology-push policies that support research and development
- demand-pull policies that increase deployment of available technology (box 2.2).

Proponents of technology-push policies (Hoffert et al. 2002; Wigley, Richels and Edmonds 1996) contend that the development of breakthrough technology will yield much lower cost abatement in the future. They propose that the overall lower cost of abatement justifies delaying action. Those in favour of demand-pull policies (Pacala and Socolow 2004) argue that the cost savings associated with learning-by-doing warrant intervention at later stages in the innovation chain.

Box 2.1 **Snapshot of the innovation chain**



For illustrative purposes, this diagram (Grubb 2004) presents a simplified, linearisation of the innovation chain. Of course, innovation does not necessarily follow a linear progression but is a dynamic system of feedback loops operating along the continuum (Grubb 2004; Perlack and Shelton 1996).

Basic research and development (R&D): The accumulation of new fundamental knowledge with no specific application. Usually undertaken, with public funding, by public institutions including universities and scientific research institutions.

Technology research, development and demonstration (RD&D): Involves synthesising new knowledge into an idea and subsequent development to an end use concept/product with commercial potential. The applied research phase may involve a combination of public institutions and public private partnerships.

Market demonstration: Shows that the concept/product is commercially viable with market potential.

Commercialisation: Established or newly created firms adopt the concept/product marking the transition from public to private institutional and funding involvement. This is recognised as a problematic phase — the so-called 'valley of the death' characterised by negative cash flows with large investments in demonstration plants.

At the market demonstration and commercialisation stages, first-mover firms bear the costs of developing the concept/product. There may be spillover benefits from the learning undertaken, where following firms benefit without paying for it.

Market accumulation: Marks the expansion of the scale of use of the concept/product, perhaps initially in niche or protected markets.

Diffusion: The concept/product is widely available and taken up at a broad market level. This phase is usually privately funded.

Source: Grubb (2004); Perlack and Shelton (1996).

Box 2.2 **Demand-pull and technology-push policies**

Demand-pull technology policies: Demand-pull refers to market demand creating the incentive for firms to innovate. Increases in demand for a good or service, through altered prices or economic conditions, may lead to increased profit expectations. In response, firms invest in innovation to meet market demand. In the climate change context, examples of demand-pull policies include an ETS or carbon tax, tax credits and rebates for consumers of new technologies (such as solar panels), government procurement, renewable technology mandates, regulatory standards and taxes on competing high-emissions technologies.

Technology-push policies: Technology-push refers to the increase in knowledge accumulation as the driver of firm innovation. It is thought that by increasing the pool of knowledge at the basic research stage, there is an increase in the rate and range of directions of innovation. Examples of technology-push policies to influence the supply of new knowledge or reduce the private cost of producing innovation are government grants for R&D, tax credits for R&D investments, developing knowledge exchange networks, support for education and training, and funding demonstration projects.

Source: Nemet (2008).

Others believe that both technology-push and demand-pull policies are needed because there is an interaction between them that leads to the optimal delivery of technology to the market (Arthur 2007). A domestic ETS supplemented by public funding for research and development would be consistent with this.

Current technology-related policies

There is a myriad of technology policies and programs across all jurisdictions directed across the span of the innovation system, encompassing technology-push and demand-pull policies — examples are given in box 2.3.

New Australian Government initiatives to be added to the burgeoning stock of current programs have been announced, including:

- National clean coal fund (to replace the Low Emissions Technology Demonstration Fund (LETDF)): $500 million to fund a national carbon mapping and infrastructure plan, a national research program, a pilot gasification plant in Queensland, a Carbon Capture and Storage (CCS) demonstration plant in NSW and a large-scale post-combustion capture plant in the Latrobe Valley, Victoria.
- Renewable energy fund (replacing the LETDF): aims to leverage investment in renewable technologies by $1.5 billion by making available $500 million in a matching funds scheme.

- Clean business fund: $240 million to improve energy and water efficiency by business and industry.

State and territory governments also continue to be active in announcing new programs in advance of an ETS.

Although current climate change policies cover a range of activities, the most significant initiatives tend to fall within two broad families — investment support and direct market support.

Investment support

Investment support policies aim to reduce the risks and costs of investment in low emissions technology research, development, demonstration and deployment. These policies consist of investment subsidies and taxation provisions and include the LETDF and policies such as accelerated depreciation allowances, tax credits and tax offsets that allow small companies to cash out investment equivalents (PC 2007b).

Advantages of investment support policies are that they can be technology neutral and that investing firms can be made to share the risk, leading to self-selection of viable projects. However, care must be taken in their design to ensure that they encourage development that would not otherwise have gone ahead ('additionality') and that they generate high spillovers (PC 2007b) (discussed next section).

Direct market support

Direct market support policies seek to increase the uptake of low emissions energy by either price support (for example, preferential feed-in tariffs and fiscal stimulation) or volume support (for example, mandatory quotas and government tender schemes) (Jansen 2003). Mandatory quotas require that electricity generators or retailers generate or buy a minimum amount of renewable sourced electricity. They operate in many countries, including Japan, the United States and many EU countries. In Australia, such policies are used or proposed at the national (for example, the Mandatory Renewable Energy Target (MRET)) and state level (box 2.3). Their drawbacks are discussed further below.

Price support measures are subject to gaming and rent seeking and are, as intended, distortionary — but often with unintended consequences. Volume measures tend to encourage development of the cheapest technology at the expense of those technologies which exhibit the greatest spillover benefits. And by attempting to pick winners they therefore constrain the pool of spillovers — to the extent that there are any. They are also likely to be difficult to withdraw because of the adjustment costs

Box 2.3 **Examples of climate change related technology policies**

Funding and investment support

- *Funding for Low Emissions Technology and Abatement*: $27 million over 2005-2009. It targets small-scale, low-emissions technologies and aims to encourage investment in the development, demonstration and deployment phases.
- *Low Emissions Technology Demonstration Fund* (LETDF): $500 million available to technologies at the commercial and demonstration stage, where they have potential to lower long-term emissions by 2 per cent and would be commercially ready by 2020 to 2030. Its aim is to facilitate private investment where the size and risk of investment required may be a barrier.
- *Solar Cities:* $75 million to address barriers to solar generation and demand-side participation to increase commercial uptake. Trials are occurring in Adelaide, Townsville, Blacktown and Alice Springs.
- *Victorian Renewable Energy Support Fund*: $10 million over three years for demonstration and human capital building for the installation and maintenance of, and access to, medium-scale renewable energy technologies.
- *New South Wales Renewable Energy Development Program*: $40 million over five years for demonstration and commercialisation of renewable energy technologies
- *National taxation and depreciation*: accelerated depreciation allowances, tax credits and tax offsets that allow small companies to cash out investment equivalents.

Quota-based market support

- *MRET*: aims to increase the share of electricity generated from renewable energy sources. The Government has announced that the target share will be increased to 20 per cent (45 000 gigawatt hours) by 2020.
- *Victorian Renewable Energy Target* (VRET): mandates that 10 per cent of Victorian electricity consumption be sourced from renewable energy generators by 2016. The policy came into force in 2007 and is slated to continue until 2030.
- The South Australian Government has committed to purchasing 20 per cent of its electricity requirements from Green Power from 1 January 2008.
- Like the MRET and VRET the following proposed policies would mandate the purchase of a percentage of electricity generated from renewable energy sources:
  - *New South Wales Renewable Energy Target*: 10 per cent by 2010 and 15 per cent by 2020
  - *Renewable Energy Target Western Australia*: 15 per cent by 2020
  - *Queensland Renewable and Low Emissions Target*: 6 per cent by 2015 and 10 per cent by 2020, remaining in force till 2030.

(Continued next page)

Box 2.3 **(continued)**

Price-based market support

Preferential feed-in tariffs mandate that a price premium is paid by retailers for electricity generated from renewable sources.

- *South Australia:* recently introduced a feed-in tariff of $0.44 per kilowatt hour of electricity for photovoltaic systems. This is double the standard retail price. To qualify, the system must be small scale (capacity up to 10 kilovolt ampere) and be operated by a small electricity customer (consuming less than 160 megawatt hour per hour).
- *Queensland*: has legislated a feed-in tariff of $0.44 per kilowatt hour of electricity for photovoltaic systems. This is approximately triple the general domestic use tariff of $0.154 per kilowatt hour of electricity.
- *ACT*: an exposure draft bill for feed-in tariffs for photovoltaic systems proposes a default feed-in tariff premium of 3.88 times the highest retail price of the day.
- *Victoria*: feed-in tariffs for electricity generated from solar, wind and biomass are required only to be fair and reasonable. There is no apparent premium accruing in Victoria.[1]
- *Photovoltaic Rebate Program*: $200 million is available between 2000–2012 for cash rebates for the installation of solar photovoltaic systems on homes, schools and community use buildings.

Partnerships

- *Australia–China Bilateral Cooperation on Climate Change*: covers 11 joint projects in renewable energy, energy efficiency and climate change science.
- *US–Australia Climate Action* Partnership: involves collaboration by Australian and US public institutions on projects such as hydrogen and fuel cell research, evaluation of climate change models and advanced clean coal technology R&D. It aims to facilitate the transition from development to demonstration to deployment.
- *Indian Ocean Climate Initiative*. The WA Government, in partnership with CSIRO and the Bureau of Meteorology are to assess climate variation, impacts and responses.

Sources: IEA (2008a, 2008b).

imposed on the new constituency formerly assisted. Such policies are of doubtful merit in their own right and become less relevant in the presence of an ETS.

1 AGL's published feed-in rates vary between $0.147/KWh and $0.1756/KWh (AGL 2008a) while the consumption tariffs are between $0.07623/KWh and $0.17171/KWh (AGL 2008b)

The volume of programs, the degree of overlap — particularly across national and state jurisdictions — is a cause for concern. Without appropriate rationalisation of this disjointed patchwork of policies, the Australian community could be in the invidious position of having an ETS, a range of state-based mandatory renewable energy targets and preferential feed-in-tariffs. Such a distortionary cocktail would undermine the least-cost abatement objective of the ETS.

Appropriate technology policies to supplement an ETS

The role for government in the innovation process was subject to review by the Commission in its report on *Public Support for Science and Innovation* (PC 2007b).

Support for basic research and development

The report found that the substantial support for research and development provided by the Australian, and increasingly by state and territory, governments is an important input into innovation. This support needs to be based on clear and credible rationales, which should also underpin the evaluation criteria used to assess the net benefits of each program.

There are many rationales for publicly-funded support of science and innovation, including:

- the need for government to use research and innovation for those activities in which it has a central role…;
- spillovers from innovation that cannot be captured by the innovator and that cannot be realised without support. The spillovers may arise through high quality human capital development, the development of basic knowledge capabilities, and diffusion of new ideas among firms and others. They arise from research undertaken in universities, businesses and public sector research agencies;
- intangible factors, such as national identity, moral obligations and national prestige, may also potentially justify some public support, subject to some substantiation for any large projects that the supported activities are likely to have these benefits. They relate mostly to scientific research in universities and public sector research agencies; and
- the asymmetric tax treatment of highly risky investments, which mainly relate to R&D undertaken in businesses. (PC 2007b, p. 100)

The Commission saw greater merit in the first two rationales. In relation to the first, there is a need for governments to invest in research to improve the products and services they offer — for example, expenditure on research and innovation is important for effective environmental management and social welfare and health services.

In relation to the second rationale, spillovers can and do arise from the development of basic knowledge capabilities or diffusion of new ideas among firms and others.

That said, the presence of spillovers does not, in itself, justify public support:

- many investments that produce spillovers have sufficient private returns for firms to invest without that support
- some spillovers accrue to foreigners, and so are generally not relevant to the appraisal of net benefits for Australia.

The challenge for public policy is to elicit private investments that:

- would not otherwise have been made (additionality) — programs need to be designed to ensure that public funds stimulate additional R&D rather than simply displace privately funded R&D
- generate total private and spillover returns that exceed the costs associated with the policy measures (for example, efficiency distortions of taxation required to finance the measures, administration and compliance costs).

Support for demonstration, commercialisation and deployment

The strongest case for public support occurs for basic research in science and/or where businesses undertake novel R&D activities that either spill over cheaply to others, or trigger cycles of innovation by rivals. This could also include pre-commercialisation activities such as testing 'proof of concept' through demonstration plants.

Beyond this, the case for support for commercialisation and deployment activities becomes progressively weaker because there are fewer clear-cut spillovers at these later stages. For instance, as failure to commercialise would give rivals the time to poach the R&D knowledge, firms usually have adequate incentives to move quickly to commercialisation. In such cases, public support risks financing investments that would have occurred anyway.

That said, rationales for public support are based on implicit models of the behaviour of agents. With the advent of more complex models, it is harder to make clear rules about when support should be given, especially for business innovation (PC 2007b). Indeed, as noted, innovation does not necessarily follow a linear progression but is a dynamic system of feedbacks operating along the innovation continuum. This suggests that policy demarcations between basic R&D, proof of concept, demonstration, commercialisation and deployment could likewise be somewhat blurred. It is therefore important to be open to empirical evidence that may reveal unexpectedly effective (or ineffective) policy initiatives.

Assessment

In the climate change policy context, the clear starting point is that an ETS would inevitably provide a strong demand-pull for the commercialisation and deployment of low-emissions technologies. This would be supplemented by the strong rationale for public support for basic R&D and for technical demonstration plants. It is therefore important that if program criteria are to extend toward the commercialisation and deployment stages they should seek to target innovative and high risk activities that can demonstrate additionality.

What about the MRET?

The MRET requires retailers and large wholesale purchasers of electricity to buy a proportion of electricity that has been generated using renewable sources. When the MRET commenced in 2001, it required electricity retailers and wholesale purchasers to acquire 9500 gigawatt hours per year of newly installed renewable energy by 2010 (box 2.4). Under current government policy there is to be:

- a near five fold increase to 45 000 gigawatt hours per year by 2020 — equivalent to a 20 per cent renewable share of electricity generation
- concurrent operation of the ETS and the MRET from 2010 to at least 2020.

The share of renewable energy in Australia is around 8 per cent and has decreased over the last four decades mainly because the contribution from hydro-electricity generation has been declining since the mid-1970s. When conceived, the MRET was intended to increase the renewable share by 2 percentage points between 1997 and 2010. However, the (previous) scheme was likely only to achieve the 1997 share by 2010 (appendix A). This is due to increases in electricity demand being greater than forecast and being met by cheaper coal and gas generation.

The implication is that the MRET, and in particular the planned increase of the target, is and would continue to dictate a quantum of renewables that would not otherwise have arisen. The binding nature of the MRET is confirmed by the fact that renewable energy certificates (RECs) are traded (box 2.4).

If the planned expansion of the MRET goes ahead, 20 per cent of electricity generation will be reserved for relatively expensive energy sources. For example, by 2010 black coal generation is estimated to cost $30-$35 per megawatt hour and natural gas combined cycle generation — with less than half the emissions of black coal — is estimated at a slightly higher $35-$45 per megawatt hour. In contrast, renewable generation is projected to cost from between $55-$80 per megawatt

Box 2.4 **MRET operation**

The MRET was introduced in 2001 to oblige electricity retailers and wholesale purchasers to acquire a defined percentage of electricity from renewable energy sources. In 2007, the Australian Government announced plans to extend the MRET so that 20 per cent of electricity would be sourced from renewable energy by 2020. The target in 2010 is 9 500 gigawatt hours per annum and in 2020 it is proposed to be 45 000 gigawatt hours per annum. The policy is to be phased out between 2020 and 2030, when it is thought that an ETS will be sufficiently established to make the MRET redundant.

The Office of the Renewable Energy Regulator advises electricity retailers and wholesale buyers of their liabilities by allocating the target according to their proportions of purchased electricity. Electricity retailers and wholesale buyers can discharge their liability by either purchasing RECs or paying the Renewable Energy Shortfall Charge — currently set at $40 per REC. A REC is equivalent to one megawatt hour of eligible renewable electricity. The RECs are generated by renewable energy generators or 'deemed output systems' such as solar water heaters or small generation units (for example, photovoltaic systems, mini hydro electric systems and small wind systems).

Renewable energy generators qualify for RECs by increasing their output of renewable electricity above 1997 levels. Eligible energy sources for electricity generation include hydro, wave, tide, ocean, wind, solar, geothermal-aquifer, hot dry rock, energy crops, wood waste, agricultural waste, waste from processing of agricultural products, food waste, food processing waste, bagasse, black liquor, biomass-based components of municipal solid waste and sewage, and landfill and sewage gas.

Source: ORER (2008).

(wind) to $240-$400 per megawatt hour (photovoltaics) (appendix A). According to CRA modelling (CRA International 2007) an ETS on its own would drive a 20 per cent increase in (non-hydro) renewable energy generation, but in conjunction with an expanded '20 per cent MRET' there would be more than a 300 per cent increase in the (non-hydro) renewable share. As the overall abatement quantity does not change, other sources, especially gas generation, are displaced by the MRET.

In essence, to the extent that the expanded MRET remained binding (its purpose), it would constrain how emissions reductions are achieved and electricity prices would be higher than otherwise. If it was non-binding, it would simply increase administrative, compliance and monitoring costs.

There are several espoused rationales for MRET-type schemes (Jansen 2003; DI and DSE 2005). These include to: increase energy security and regional employment; compensate for barriers to entry; and gain cost savings associated with realised learning-by-doing.

Energy security

Various EU countries support such schemes as a means to diversify energy sources. While this rationale may have validity in the European Union, which is a net importer of energy, it is largely irrelevant for Australia which has sufficient resources to meet electricity generation and heating energy needs for hundreds of years (ETF 2006).

Regional employment

It is possible that the MRET increases renewable energy investment in regional areas. Equally, however, the MRET could displace regional development opportunities that might have otherwise evolved from the structural changes induced by an ETS. Moreover, with the planned phase out of the MRET, while some of these investments might continue or expand under an ETS, others may no longer be sustainable.

Compensate for entry barriers

It is possible that there are barriers to the entry of low emissions electricity generation related to the configuration of transmission infrastructure and/or electricity market arrangements. To the extent that this is the case, the appropriate action would be to address any inappropriate barriers directly, rather than use an indirect approach such as the MRET (section 2.4).

Expedite new technology

There is a view that the price signal under an ETS will initially be too low to trigger investment in renewables and that therefore it would be optimal to bring forward such investments by other means. 'Delaying' investment is seen as forgoing valuable time to expedite innovation in low-emissions technology.

All of this presupposes that governments have greater insight into the optimal abatement trajectory and innovation paths than businesses, despite having less access to market information and firm's decision-making processes. More importantly, if the objective is to achieve very rapid reductions in emissions, targets could be set accordingly and met through an ETS.

Access cost savings associated with realised learning-by-doing

As installed capacity increases, there is a tendency for methods, work specialisation and labour efficiency to improve — 'learning-by-doing'. This tendency can be observed in virtually all fields of activity.

As use of low-emissions energy increases, learning-by-doing contributes to subsequent reductions in the cost of electricity generated from these sources. If the objective of the MRET is to address any spillovers that arise from learning-by-doing, then it is flawed because it tends to bring online mature technologies. This reflects the fact that because the MRET is a quota, it is filled with the least-cost renewable technology. In most modelling scenarios, the quota is filled to a significant degree by wind technology (CRA International 2007; MMA 2007b). As wind technology is a relatively mature technology, learning-by-doing has been largely captured already. In this context, the MRET can be viewed as just another (high cost) abatement policy, rather than a policy to facilitate technology development with the greatest spillover benefits.

The MRET in conjunction with an ETS

When the MRET is used in conjunction with an ETS no extra abatement is achieved.[2] The MRET constrains how emission reductions are achieved and lowers the incentive to abate in ways that do not fit its criteria. It would simultaneously lead to increased electricity prices and cause the emissions price under the ETS to be lower than it would have otherwise been. Modelling by Access Economics (2006), COAG (2002), CRA International (2006) and ABARE (PMTGET 2007b) found that the MRET was more expensive than either an ETS or emissions tax for a given abatement level (appendix A).

McLennan Magasanik Associates (MMA) (2007a, 2007b) and CRA International (2007) estimated the cost impact of introducing the MRET *in conjunction with* an ETS. The CRA International modelling concluded that the MRET would increase the cost to the economy by a further $1.8 billion in 2020 (estimate of lost GNP) and lead to electricity prices increasing by an additional 6 per cent.

In contrast, the MMA (2007b) modelling projected that the large upfront costs associated with higher cost renewable technology were offset over time by cost savings captured from accelerated learning-by-doing. In some scenarios it found a small net benefit in concurrently running the MRET and an ETS. However, the learning-by-doing estimates assumed in the modelling are very ambitious (box 2.5). In addition, the study assumed no learning-by-doing in fossil fuel generation, which inflates the estimated benefits of the MRET in the modelling. The study also excluded the costs of forgoing learning-by-doing benefits associated with activities displaced by the MRET. Taking all factors into consideration leads to an assessment that the costs of supplementing an ETS with an MRET are greater than the benefits.

2 Except for that which might eventuate if an ETS had a safety valve price (see chapter 1).

Box 2.5 **MMA's modelling of a concurrent low-emissions energy target and an ETS**

MMA modelled scenarios for adding a low-emissions energy target to an ETS. It indicates that costs accrue in early years but that these costs are compensated by subsequent benefits. The benefits arise from cost reductions for low-emissions technologies — early deployment is said to pull technologies down the cost curve sooner. MMA conclude that a moderate low-emissions energy target is likely to generate long-term benefits from learning-by-doing that are just large enough to offset additional short-term costs.

MMA's assumptions appear to overstate the benefits from learning-by-doing in low-emissions energy sources. For example, it assumes no learning-by-doing in fossil fuel generation which is inconsistent with evidence in the literature, particularly in relation to gas generation technologies. This inflates the estimated benefits because the switch to renewables is assumed not to crowd out any technology development in fossil fuel technologies. And, no consideration is given to the possibility that 'breakthrough' technologies for low-cost clean electricity might render learning-by-doing in existing technologies redundant. In addition, the study:

- uses learning-by-doing rates that appear to be very optimistic
- excludes the costs of forgoing learning-by-doing benefits associated with abatement activities displaced by the low-emissions target criteria
- applies to a tax, rather than a quantity restriction, so part of the estimated benefit from additional abatement is unlikely to occur under an ETS.

Also, given that additional generation under low-emissions energy targets might come mainly from relatively mature technologies, such as wind power, the potential for benefits from learning-by-doing is reduced. These considerations explain why MMA concludes that there are cost savings available from low-emissions energy targets, in contrast with other modelling work that shows that such targets impose net costs.

Source: Appendix A.

The Commission's analysis (appendix A) rejects the cost effectiveness of the MRET in conjunction with an ETS. However, even if it could be accepted that there was no net cost from running the two schemes in parallel, that would only be the first hurdle. It would further need to be established that if spillovers exist, there were not more cost effective policy instruments to promote them — for example, technology-neutral low interest loans.

Finally, the MRET would also demonstrate a willingness by governments to interfere with the operation of the ETS and to adopt non-technology-neutral supplementary policies. Such signals could undermine the credibility of the ETS and would almost certainly encourage rent-seeking for other special programs to target 'worthy' climate change initiatives.

There appears to be no case for continuing with the (expanded) MRET in the presence of an ETS. However, if it transpires that such a supplementary instrument is to continue, it could be made less damaging if the eligibility criteria were widened to include low-emissions, rather than specified renewable, technologies.

2.3 Energy efficiency policies

An ETS makes energy more expensive, thus encouraging energy savings. Individuals and firms will buy more energy efficient appliances, and seek out more energy efficient accommodation and transport options than they would in the absence of a price on emissions.[3] An ETS also encourages greater energy conservation. For example, in response to higher energy prices some people might turn up the thermostat on their air conditioner and tolerate a less comfortable house on hot days. Because most energy is generated by burning fossil fuels, greater energy efficiency and conservation usually mean lower GHG emissions.

Provided the ETS is credible, there will also be an incentive to factor in any expected future ETS-related increases in energy prices into investment decisions for long-lived capital goods (such as buildings). This could result in decisions to invest in goods that have a higher level of energy efficiency than would be justified by current energy prices alone.

There are, however, potential impediments to the uptake of cost-effective energy efficiency opportunities. The most important of these appear to be:

- inadequate provision of information because information has public good characteristics and/or is available to some parties in a transaction but not others
- the different incentives facing those who take decisions about installing energy-efficient products and those who might benefit from using them (PC 2005).

To the extent that such impediments exist, energy efficiency policies could be warranted to supplement an ETS. As with other supplementary policies, their potential benefit is reduced abatement costs rather than increased abatement. In assessing whether an energy efficiency policy does reduce abatement costs all costs need to be considered, including

3 There can be a ‘rebound effect’ from consumers buying more energy efficient appliances. The energy efficient appliance may use less electricity for a given performance level and duration – which would reduce electricity bills and/or allow the consumer to use the product more intensively (for example, running an air conditioner at a lower temperature). Gottron (2001) estimated that for households, depending on the device concerned, rebound effects of between 10 to 50 per cent might be expected. Rebound effects are likely to be larger where energy efficiency is increased by mandating energy efficient appliance standards, rather than by recourse to a price signal.

administrative and other costs to government, as well as compliance costs incurred by individuals and firms.

Experience with energy efficiency policies

Energy efficiency policies have featured strongly in Australia's GHG mitigation efforts to date. In 2005, the Commission identified 108 separate energy efficiency programs (PC 2005). Since then, other measures have been agreed to or introduced. For example, the Ministerial Council on Energy agreed to a package of five new energy efficiency measure in 2007 (MCE 2007).

The types of policies used include: information provision; mandatory energy-efficiency standards for appliances and buildings; subsidies; and government-business partnership programs. Such policies have been implemented by all Australian governments. A degree of national coordination has been provided through the National Framework on Energy Efficiency, which has been developed under the oversight of the Ministerial Council on Energy.

The Commission has examined the reasons why privately cost-effective energy efficiency opportunities are not always taken up, and appropriate policy responses (PC 2005). In considering existing policies, the Commission found that insufficient attention had been paid to the potential for energy efficiency policies to increase, rather than decrease, costs to the community (PC 2005). There is potential for this to occur where:

- there are hidden costs in implementing energy efficiency measures (such as the opportunity cost of devoting time to researching and implementing efficiency projects)
- administration costs are high relative to energy savings — this is particularly likely to occur where policies are pursued for appliances and equipment that are only responsible for relatively small energy usage
- valuable product features have to be forgone — banning products deemed to be energy inefficient can result in the loss of product features that are valued highly
- expected energy savings are not realised — the methods used to assess the likely energy savings from policy measures do not always closely align with actual energy use by consumers and this can lead to overestimates.

Based on PC (2005), it would appear that energy efficiency policy has been used to a greater extent than is justified by the market failures that cause people sometimes not to take up cost effective energy efficiency opportunities. This could be at least partly explained by a desire among policy makers to compensate for there being currently no general constraint on GHG emissions.

Once an ETS is introduced, however, this approach is no longer valid. With an ETS in place, an energy efficiency policy that produces a benefit from energy savings that is less than the sum of all policy-related costs, simply adds to the cost of abatement without reducing total emissions.

There is a need to review and refocus energy efficiency policies on the relevant barriers to energy efficiency, rather than on the GHG externality. The Commission's inquiry report on energy efficiency provides analysis that is relevant to this task (PC 2005).

Policy options

A range of policies can be used to encourage energy efficiency. Some of these address the policy-relevant barriers to energy efficiency and some do not.

Providing information

The case for government provision of energy efficiency information is strongest for general information directed at households. It is weakest where the users are large commercial and industrial firms. The information needs of such firms are usually very specific and, to the extent that energy costs are significant, firms have strong incentives and the resources to obtain that information.

Where there is sufficient private incentive, markets can be expected to provide information. Producers of energy-efficient goods and services advertise the merits of their products. Energy services companies are rapidly emerging, with business propositions that guarantee energy savings for their clients. An ETS would be expected to stimulate even more private provision of energy efficiency information.

Nonetheless, even with an ETS in place, there is scope for governments to provide information that would be otherwise underprovided due to its public good characteristics. Government provision might also achieve economies of scale and scope, and thus lower costs to users; and it might be justified for social reasons if it aids accessibility or provides credibility by deriving from a neutral source.

Requiring disclosure of information

Governments can pass regulations that require specific information to be provided. Current examples include compulsory labelling schemes, requiring that energy efficiency ratings be provided when selling or leasing a house, and compulsory auditing and reporting for large energy users. The case for such regulations is largely unaffected by the introduction of an ETS.

Labelling is used to indicate the energy efficiency of electrical and gas appliances and cars. Mandatory labelling directly addresses the asymmetry of information between buyers and sellers of energy-using products. By providing information in a readily-accessible and easily-understandable format, labelling can help consumers to make better-informed choices about energy efficiency. However, labelling involves administrative and compliance costs. When these are taken into account, mandatory labelling will be warranted for some goods but not others.

Requirements that those selling or leasing houses, or other buildings, obtain an energy-performance rating and disclose it to potential purchasers are in some ways similar to appliance labelling. For example, they both address information asymmetry. However, the heterogeneous nature of buildings and occupant behaviour, as well as problems in using ratings tools add to compliance costs and/or can compromise effectiveness. In deciding whether to impose, or continue with, such requirements, governments should seek and consider evidence on the performance of past schemes.

Compulsory auditing and reporting of energy efficiency opportunities for large energy users does not target information asymmetries, but rather organisational and behavioural barriers to energy efficiency. The Commission considers that these barriers do not warrant government intervention. Firms generally know how to control their own costs better than governments, and there seems to be no sound reason why this presumption should not apply to energy efficiency opportunities. In the past, such schemes could be argued on the basis of benefits from reducing GHG emissions, but with the introduction of an ETS this argument is no longer relevant.

Mandating investment

Some governments have taken compulsory energy efficiency auditing a step further by making it compulsory for firms to invest in opportunities identified by such audits. For example, this is a feature of the regulatory framework covering Victorian firms licensed by the Environment Protection Authority.

Mandating investment can significantly distort firms' investment decisions. In its inquiry into energy efficiency in 2005, the Commission did not support this approach as a way of pursuing greenhouse objectives. There would be even less merit in the policy once an ETS is in place as, in this context, it would be unlikely to result in lower total GHG emissions.

Preventing access to energy-inefficient products

Governments can prevent the sale of energy-inefficient products by enforcing minimum standards. Currently, standards apply to gas and electrical products (such as refrigerators and freezers, air conditioners, electric water heaters and electric motors) through

Mandatory Energy Performance Standard programs. For residential and other buildings standards are specified in the Building Code of Australia (and state and territory-specific standards). New regulations are planned, including one which would prevent the sale of standard incandescent light bulbs (Beletich Associates 2007).

The strongest rationale for mandating minimum energy standards is where there are significant spilt incentive problems, such as may apply for electric water heaters (where householders may have little influence on appliance choice) (PC 2005). These problems, however, need to be kept in perspective. Similar issues are prevalent throughout the economy and negotiated solutions can be found. That people have not always sought such solutions for energy efficiency matters is likely explained by the relatively low-cost of energy in Australia — they have simply not considered it worth their time and effort.

It has also been argued that minimum standards decrease the search costs associated with purchasing energy-efficient goods. The presumption is that if consumers had the time and ability to search out the product that suited them most they would come to the same conclusion as the regulator. However, if information failure is the main problem, providing information — including through labelling — would be a less intrusive alternative.

The main disadvantages of mandating minimum energy standards are that they:

- limit consumer choice
- add to costs (for example, through the requirement for appliance testing, and administration and enforcement of regulations)
- may impede innovation in design (for example, where moving away from common approaches to achieving the required standard for buildings results in extra compliance costs)
- may have adverse distributional consequences (consumers with limited capital may prefer to purchase cheaper appliances even if they cost more to operate over their lifetime)
- may not lead to expected outcomes, because the methods used to assess the likely energy savings do not always closely align with actual energy use.

This is an area where current policy appears to have extended beyond what is warranted to address the barriers to energy efficiency.

Subsidies and other financial incentives

There are many examples of programs that subsidise individuals and firms to buy energy-efficient appliances or take up energy-efficient practices. For example, the Victorian

Government provides subsidies of up to $1500 for solar hot water heaters (Sustainability Victoria nd).

Financial incentives do not directly address the market failures impeding the uptake of energy efficiency improvements. When used in conjunction with an ETS, they generally create incentives to take up relatively high-cost abatement opportunities. Because total emissions are capped under an ETS, the abatement encouraged by subsidies is exactly balanced by reductions in generally lower cost abatement elsewhere. In addition, significant costs are generally incurred in administering subsidy programs. The result is that financial incentives almost inevitably increase the cost of abatement and so are generally not in the community's interests.

Financial incentives for energy efficiency can be used to meet objectives other than reducing the overall cost of meeting GHG emissions targets. First, if low-income households are to be compensated for the effects of an ETS, it might be proposed that part of this compensation be provided in the form of assistance for improving energy efficiency. As a general principle, this is likely to be an inferior approach to providing cash payments, as it does not allow people to pursue their own priorities. However, without having examined this issue in detail, the Commission would not rule out the possibility that it has some merit. Second, financial incentives could be used to address the spillover benefits from research into, and development of, low-emissions technologies. This issue was discussed in section 2.2.

Energy efficiency targets schemes

The term 'energy efficiency target' usually refers to a scheme that imposes requirements on energy retailers, or major users of energy, to achieve efficiency-related energy savings. Trading is generally envisaged as a feature of such schemes, to enable firms to sell or purchase credits in a market for energy efficiency certificates. There has been interest in implementing energy efficiency target schemes in Australia, and Victoria is proceeding with plans to introduce one in 2009 (DPI 2008).

Energy efficiency target schemes can be understood as an instrument that provides financial incentives for taking up energy efficiency opportunities. Regulated entities must make the required quantity of eligible energy savings themselves or purchase certificates. Providers of certificates are paid by regulated entities for achieving increased energy efficiency. These schemes, therefore, have all the disadvantages of financial incentives discussed above.

They also have a range of other practical difficulties associated with establishing business-as-usual baselines for regulated entities and certificate providers, and with measuring improvements in energy efficiency against these baselines.[4] In particular, energy efficiency target schemes are likely to encourage gaming. Firms would have a strong incentive to artificially inflate business-as-usual projections. Certification of activities that would have occurred anyway (in the absence of the scheme) is likely to be prevalent, even if costly verification procedures are used to try and prevent this.

Proposals for energy efficiency target schemes seem to overlook the fact that there already is a market-based mechanism that encourages energy efficiency — the price of energy. Introducing an ETS will strengthen this mechanism. While there are some barriers preventing energy prices from always influencing decisions on energy efficiency appropriately, this does not warrant the establishment of a government created market mechanism, such as a flawed energy efficiency target scheme. Rather, as argued above, these barriers should be addressed directly where the benefits of doing so outweigh the costs.

2.4 Other government action to facilitate mitigation

Governments could take a range of other actions to advance mitigation objectives. Those relating specifically to sectors excluded from the ETS are considered in chapter 3, but others are briefly discussed below.

Incorporating emissions prices into government decision making

Firms will generally factor expected future GHG emissions prices and ETS-related increases in energy prices into their investment decisions, and governments should also apply the traded price in their investment decisions. For governments, however, this approach should extend to cost–benefit analyses for policy proposals, for example, in areas such as transport and urban planning. There is not so much a need for a particular policy to be adopted in this regard, it is more a matter of applying sound policy principles in the light of changed circumstances.

Failing to take expected emissions prices into account could result in, for example, the construction of infrastructure that is very costly to operate because of inadequate levels of energy efficiency. On the other hand, designing infrastructure to have an especially low ‘carbon footprint’ can impose high costs. In such cases, the implied value of reducing emissions could be much higher than expected emissions prices under an ETS. Taking this approach will not reduce total GHG emissions, but will simply increase the costs to the community of achieving GHG emissions targets (see box 1.2).

4 Energy efficiency target schemes are a type of baseline-and-credit scheme. Further discussion of such schemes is included in chapter 3.

Removing distortions and promoting flexibility in the economy

There is potential to reduce the cost of meeting GHG emissions targets through removing distortions and promoting flexibility throughout the economy. Some areas that could be examined are mentioned below.

First, it may be possible to reform energy markets in ways that make abatement less costly, by removing inappropriate barriers to the deployment of low-emissions technologies and/or increasing energy efficiency. For electricity markets, options include:

- reviewing arrangements for addressing the external benefits that may be associated with private investment in new network infrastructure
- reviewing market rules governing transmission pricing and connection fees to see if there is any different treatment of new and existing generators that is unjustified
- introducing more cost-reflective electricity pricing (including time-of-use pricing), which may improve energy efficiency in peak-load periods (PC 2005).

While in some cases the motivation for considering reform may relate to climate change objectives, the appropriate yardstick for assessing reform options is economic efficiency. For example, any new measures to address network externalities should not create incentives to build network infrastructure in locations where the overall costs, risks and returns indicate that proceeding with the investment would decrease economic efficiency.

Second, there may be interventions elsewhere in the economy (for example, in the taxation and tariff systems) that inadvertently create incentives for increased GHG emissions. While there could be good public policy reasons for these interventions, the emergence of more ambitious climate change objectives provides an additional reason for reviewing their appropriateness.

Finally, meeting GHG emissions targets could involve considerable changes to the structure of the economy. General microeconomic reforms that increase the flexibility of the economy would enable structural adjustment to occur more smoothly, with lower costs.

2.5 Good practice regulatory principles

The introduction of the national ETS as the primary policy to achieve the set abatement target triggers the need to review the various supplementary state and Australian Government policies.

Where they conflict or are made redundant by the introduction of an ETS, they should be abolished. There is no benefit to the community as a whole in pursuing a policy mix that achieves a given abatement target at a higher cost than necessary.

Even if after initial investigation a particular policy is determined to have a valid rationale for operating in conjunction with an ETS, a review is still required to ensure that it meets the necessary cost-benefit analysis hurdle (box 2.6). For example, with the introduction of the ETS, the induced response by firms and consumers may decrease the size of benefits formerly attributable to the policy's action.

In sum, to optimise the community's mitigation dollar, policy initiatives should have clear objectives and reflect evidence based cost–benefit assessment. Ideally, policy initiatives should include information on a consistent abatement benchmark, such as the cost per tonne of any *additional* carbon dioxide equivalent emissions saved or stored.

The residual role for state and territory policy

In relation to climate change, the Commission (PC 2007a, pp. 23, 34-38) proposed that policy should be applied in a way that creates uniform incentives for firms across the nation. Reflecting that climate change is a global problem, the geographic source of emissions within Australia is of no practical relevance. While a national target is addressed most effectively by national policy, the potential for unwarranted supplementary policies to emerge is magnified in a multi-jurisdiction federation.

Climate change initiatives at lower tiers of government are likely to conflict with national objectives, increase abatement costs, duplicate administration and compliance costs by government and firms and encourage double counting of abatement. Moreover, if states and territories were to engage in bidding wars — through subsidies for renewable activities or 'compensation' for carbon-intensive activity — location-related distortions of no benefit to the nation would arise. As an extreme illustration, a negative net outcome would arise if, say, wind generators were attracted to subsidy-rich, but relatively wind-poor, locations.

Box 2.6 Regulatory impact analysis

When contemplating regulation, government should undertake a regulatory impact analysis. This applies a systematic cost-benefit (including risk) analysis to the problem to determine whether the proposed regulation generates more benefits to the community than the costs incurred. It also determines whether the optimal regulation is chosen such that the benefits to society are maximised, while the costs of that intervention are minimised (OBPR 2007, p.1).

The overarching design principles which lead to best practice regulation are administrative simplicity, flexibility, efficiency and equity.

In developing and assessing the effectiveness and efficiency of policy, the regulatory impact analysis, which government agencies undertake, should identify:

- the problem – is there a need for government intervention?
- the policy objective
- the suite of policies that could achieve the objective (including inaction if the costs of intervention exceed the benefits)
- the economic, social and environmental consequences of options, and
- ultimately the response which maximises net benefits to the community.

Source: OBPR (2007).

There is a particular need to guard against state and territory governments introducing new policies to protect localised investments that arose from schemes that might be slated for abolition — for example, replacing mandated renewable energy targets with subsidies for renewable activities (including preferential feed-in tariffs).

State, territory and local government climate change initiatives are best confined to:

- research on climate change impacts, adaptation and structural adjustment, where geographic location clearly is a relevant consideration
- providing general information on energy efficiency where there might not necessarily be benefits from national coordination, or where regional variations are relevant (for example, heating in the southern states)
- removing any local distortions that artificially impede the application of low emissions technologies
- ensuring that expected future GHG emissions prices and ETS-related increases in energy prices are factored into planning and investment.

It seems unlikely that geographic jurisdictions would suffer unique, or more pronounced market failures, warranting additional mitigation measures.

3 Coverage of an ETS

Key points

- While an Emissions Trading Scheme (ETS) should have broad coverage to provide maximum scope to take up low-cost abatement opportunities, maximising coverage should not be an end in itself.
  - The objective should be to include sectors where this will lower the total cost of meeting a given emissions target.
  - Furthermore, mitigation policy should be focused on achieving reductions in greenhouse gases (GHGs) that will be counted towards Australia's international commitments.
- It is likely that the ETS will include all energy, industrial and fugitive emissions. Sectors that may initially be excluded include land use, forestry, agriculture and waste.
- There are possibilities for partial coverage of land use, land use change, forestry and agriculture sectors within an ETS — New Zealand's proposed ETS provides one model of this.
- Eventual inclusion of uncovered sectors within the ETS should be assessed alongside a range of alternative policy options, both transitional mechanisms and longer term alternatives, including leaving them unregulated.
  - This assessment should take into account the least-cost abatement objective and the acceptability of the response in international protocols.
- An offset scheme is one alternative policy option, but such schemes can have significant disadvantages.
  - The need to reduce emissions below a hypothetical level can necessitate complex and costly compliance processes with risks of inaccuracy.
  - If a large number of credits are issued that are not backed by genuine emission reductions, this can compromise the credibility of an ETS linked to the offset scheme.
- Options that do not involve any linkages with an ETS can be pursued. These include agreements to reduce deforestation in developing countries, incorporating a carbon price into the management of public forests, and extension programs to promote privately cost-effective activities that reduce GHGs in agriculture.

3.1 Deciding on coverage

Broad coverage in an Emissions Trading Scheme (ETS) is generally desirable to achieve given greenhouse gas (GHG) emissions targets at least cost. In some circumstances, however, inclusion of a sector in an ETS may increase costs beyond the benefits of abatement achieved or lead to reduced credibility of the scheme. Australia's ETS is likely to include all energy, industrial and fugitive emissions, but may exclude some forestry and agriculture emissions (box 3.1).

Where a sector is not included in an ETS, there is a strong rationale for examining whether there are supplementary policies that can be used to access relatively low-cost abatement opportunities in the sector. Such policies may be linked to the ETS or be independent of it.

Box 3.1 **Coverage of Australia's ETS**

The Minister for Climate Change and Water has announced that Australia's ETS 'will have maximal coverage of GHGs and sectors, to the extent that this is practical' and that 'there is wide agreement that over 70 per cent of our national emissions can be practically covered by emissions trading' (Wong 2008). This appears to broadly support the proposal by the Task Group on Emissions Trading, which recommended that the ETS include all energy, industrial and fugitive emissions.

The Government is proposing to consult with the agriculture and forestry sectors about their inclusion in the ETS (Wong 2008). The Task Group on Emissions Trading proposed that energy use in the agriculture and land use, land use change[1] and forestry (LULUCF) sectors be included, but that all other sectoral emissions be excluded because of measurement uncertainties and high compliance costs. Inclusion of the waste sector is also to be determined this year.

Such an arrangement would incorporate a broader range of sectors in the ETS than the National Emissions Trading Task Force proposal (NETT 2006), which posited initial coverage of electricity generators (above a given threshold), with offsets from excluded sectors, and inclusion of other stationary combustion of gas, coal, oil and other fossil fuels five years later. However, in mid 2007, the NETT broadened its terms of reference and proposed to investigate the potential for an ETS to cover other sectors beyond the stationary energy sector.

Australia's treatment of 'bunker fuels' (aviation and shipping fuels) used in international transport is yet to be determined. Currently, emissions from international aviation and shipping do not count towards Australia's Kyoto Protocol target.

[1] Where land use change refers to the emissions resulting from the conversion of land from one type of land use to another.

Why broad coverage is desirable

Where an ETS does not include all GHG emitting sectors of the economy, and there are no other mitigation policies in these sectors, the cost of achieving a given emissions target is likely to be higher than otherwise (box 3.2). The extent to which abatement costs will be higher depends on the quantity of relatively low-cost abatement opportunities in the excluded sectors, and the policy-related costs of obtaining them. For example, while there may be low-cost ways of reducing emissions in a sector, total abatement costs may be high because of high costs of measuring and verifying emissions.

Where an ETS does not have full coverage, there is a cost imposed on activities that emit GHGs in the covered sectors, but no cost to certain GHG emitting activities in the uncovered sectors. This can lead to adverse outcomes such as 'leakage', where emissions are reduced in a covered sector, and there is a corresponding increase in an uncovered sector. An example of this could be energy generators using biomass from deforestation to generate lower-emissions energy where land use change is not included in an ETS. While this may result in a decrease in emissions from energy generation (the covered sector), emissions from land use change (the uncovered sector) could increase, with the possibility of an overall increase in emissions. Introducing supplementary abatement policies may reduce this problem.

Exclusion of sectors from an ETS can also make the achievement of GHG emissions targets less certain. If Australia were to take on emissions targets through an international agreement, accounting against these targets would include net emissions from all sectors in the economy. Under these circumstances, the cap for the ETS will need to be set taking into account likely emissions from excluded sectors of the economy. If emissions in the excluded sectors are higher than expected (due to leakage or other factors) this could put achievement of the targets at risk. Furthermore, exclusion of significant sectors from the ETS may make it difficult for Australia to meet stringent targets. As in the case of leakage, introducing supplementary abatement policies in uncovered sectors may reduce these problems.

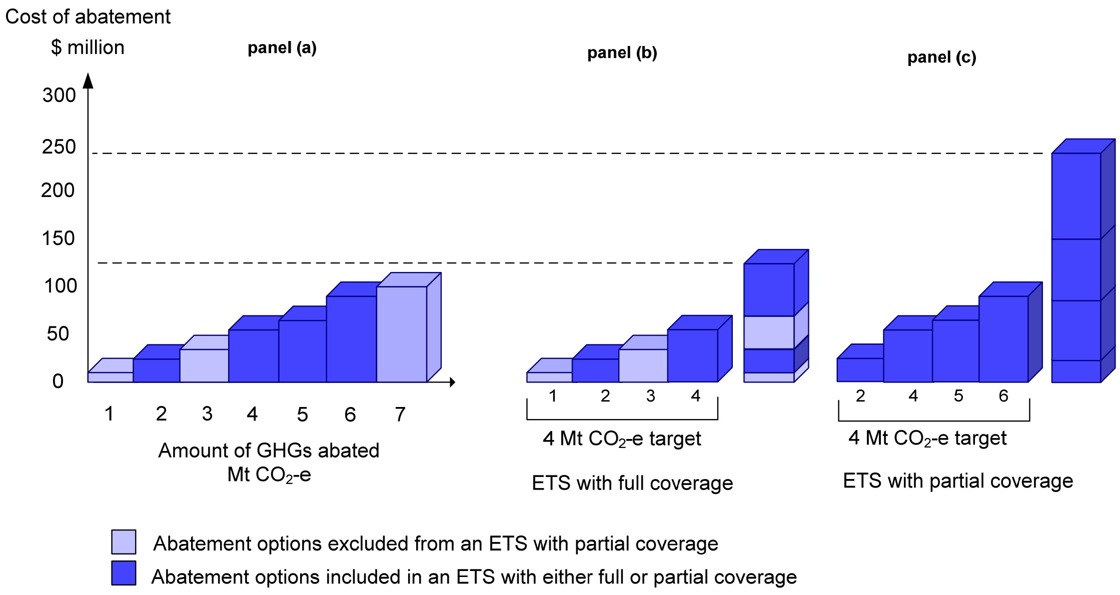
While broad coverage is desirable, in practice, some factors can make a sector unsuitable for inclusion in an ETS. By introducing an ETS, the Australian Government will be creating a market for the right to emit GHGs. Market creation is a policy approach that is best suited to situations where a number of criteria are met (table 3.1).

Box 3.2 **The costs of achieving a GHG target with partial vs full coverage: an illustration**

Panel (a) below shows a hypothetical GHG abatement cost curve for Australia using all possible abatement opportunities at different costs. Each abatement opportunity reduces emissions by one million tonnes of carbon dioxide equivalents (1 Mt CO_2-e). For example, the first abatement option, which might be improving forest management, reduces 1 Mt CO_2-e at a cost of $10 million dollars. The second option could be improving residential water heating, where 1 Mt CO_2-e of abatement can be achieved for $25 million dollars. And so on.

Where a 4 Mt CO_2-e target can be achieved through an ETS using abatement from all sectors in the economy (full coverage), the total cost is $125 million (panel (b)). Where the target must be met through an ETS which does not include all emitting sectors in the economy (partial coverage), the total cost of achieving this abatement in this illustrative example is $240 million (panel (c)).

The full coverage ETS achieves the 4 Mt CO_2-e target at a considerably lower cost as the cheapest forms of abatement (options 1 to 4) are used until the target is met, irrespective of the sector in which they occur.



Where these criteria can not be met in a sector, its inclusion in an ETS may not be desirable. For example, administration and compliance costs will be increased where there are difficulties verifying the quantity of GHG emissions that have occurred. High costs can be avoided by applying low standards for verification but this can reduce the credibility and environmental effectiveness of the ETS.

Table 3.1 **Desirable property right characteristics for creating markets**

	Property right characteristic	*Description*
1	Clearly defined	Nature and extent of the property right is unambiguous
2	Verifiable	Use of the property right can be measured at reasonable cost
3	Enforceable	Ownership of the property right can be enforced at reasonable cost
4	Valuable	There are parties who are willing to purchase the property right
5	Transferable	Ownership of the property right can be transferred to another party at reasonable cost
6	Low scientific uncertainty [a]	Use of the property right has a clear relationship with ecosystem services
7	Low sovereign risk [a]	Future government decisions are unlikely to significantly reduce the property right's value

[a] Low in the sense that it does not prevent a market from forming. Moderate levels of risk and uncertainty are not necessarily insurmountable barriers to the operation of a market.

Source: Murtough, Aretino and Matysek (2002).

It is important, therefore, that decisions on whether to include sectors are made after assessing all the costs and benefits of inclusion, and after establishing whether inclusion will lead to lower total costs of meeting a given emissions target. It may be necessary to re-assess such decisions over time, as future inclusion may become viable if measurement technologies improve and/or permit prices increase.

While coverage of a sector in an ETS is one option, it may not be the best option. Evaluation against other policy options (such as baseline-and-credit arrangements, subsidies and doing nothing) is necessary and the policy approach which yields the highest net social benefits should be chosen. This approach may conclude that, for the initial period of the ETS, no action is taken in a sector because the factors that make it costly or difficult to include it in an ETS also hinder the use of alternative policy instruments.

3.2 Land use, land use change and forestry

The Intergovernmental Panel on Climate Change (IPCC) specifies six broad catagories of land use (for example, forest land, grassland and cropland), where land is converted into another type of land use this is catagorised as 'land use change' (IPCC 2003). Land-based emissions as a result of agricultural practices, such as nitrous oxide emissions from soil due to fertiliser use, are reported separately under agricultural emissions.

As trees grow they absorb carbon dioxide and store the carbon in wood and other plant tissue. Where an activity withdraws carbon dioxide from the atmosphere (such as growing a forest) it is called a *sink*. When forests are destroyed by fire, cleared or harvested, some stored carbon is released as carbon dioxide, though some may remain sequestered (for example in wood products) for extended periods.

A key issue when considering emission withdrawals by sinks is the longevity of any sequestration. When an electricity generator reduces its emissions by one tonne, this is an enduring reduction of carbon dioxide in the atmosphere. Sequestration, on the other hand, only removes carbon dioxide from the atmosphere for the duration of sequestration. If the duration of sequestration equates to the residence time that emissions have in the atmosphere, then they cancel each other out, but this is rarely the case.

Overall, forests are generally viewed as being able to play a positive role in reducing GHG emissions. However, not all countries take this stance. In announcing its decision to exclude sinks as eligible offsets in the EU ETS, the European Commission stated that carbon sinks ‘do not bring technology transfer, they are inherently temporary and reversible, and uncertainty remains about the effects of emission removal by carbon sinks’ (European Commission 2003, p. 2).

Abatement potential

Australia’s net emissions for 2005 from the LULUCF sector (using Kyoto Protocol accounting provisions) were 34 million tonnes of carbon dioxide equivalent (Mt CO_2-e) out of total national emissions of 560 Mt CO_2-e (AGO 2007). This includes sequestration of 20 Mt CO_2-e from afforestation and reforestation, and emissions of 53 Mt CO_2-e from deforestation (box 3.3). Decreases in land clearing since 1990 have reduced emissions from this sector, with emissions from deforestation declining by 76 per cent (AGO 2007). This has made a significant contribution toward meeting Australia’s Kyoto Protocol commitment. In addition, withdrawals of emissions by sinks have also increased through reforestation and afforestation.

Land use shifts from agriculture to forestry, and vice versa, for commercial and other reasons. This can result in considerable changes in net carbon dioxide emissions. Even quite modest emission prices (or other mitigation incentives) could be expected to influence these decisions at the margin.

A recent report by McKinsey identifies a large quantity of low-cost abatement opportunities in the LULUCF sector (McKinsey 2008). It posits 100 Mt CO_2-e of abatement is possible by 2020, and 170 Mt CO_2-e by 2030, at an average price of $40 per tonne CO_2-e through avoided deforestation, replanting and improved forest management. However, it appears that the policy-related costs of achieving this

Box 3.3 **Emissions accounting in the LULUCF sector**

As a party to the United Nations Framework Convention on Climate Change (UNFCCC) Australia is required to publish a national inventory of anthropogenic emissions by sources and removals by sinks of all GHGs using methodologies agreed upon by the Conference of the Parties. Australia has produced national inventories since its ratification of the Convention in 1992.

Australia has also ratified the Kyoto Protocol which requires it to meet a target of 108 per cent of 1990 emissions over the period 2008 to 2012.

Australia's GHG emissions are not usually monitored directly, but are generally estimated through the application of models and methodologies that link emissions to data on observable activities. Australian methodology for estimating GHG emissions and sinks uses a combination of country-specific and Intergovernmental Panel on Climate Change methodologies and emission factors (DCC 2008b).

Reporting requirements under the Kyoto Protocol and the UNFCCC are not identical. The principal source of difference is the treatment of emissions from sources and sinks in the LULUCF sector. UNFCCC guidelines promote a more comprehensive approach to emissions accounting and require the inclusion of all sources and sinks where there is adequate data. In contrast, the Kyoto Protocol restricts allowed emissions and withdrawals to a more limited set of sources and sinks from land use and forestry activities.

The Kyoto Protocol requires reporting in three areas:

- Afforestation: direct, human-induced conversion of land, that has not been forested for a period of at least 50 years, to forested land.
- Reforestation: direct, human-induced conversion of non-forested land (that had once been forested) to forest. For the first commitment period, reforestation activities will be limited to reforestation occurring on those lands that did not contain forest on 31 December 1989.
- Deforestation: direct, human-induced conversion of forested land to non-forested land.

Additionally, under Article 3.4 of the Kyoto Protocol, parties may elect additional human-induced activities related to LULUCF (specifically forest management, cropland management, grazing land management and revegetation) to be included in their accounting of GHG emissions and removals for the first commitment period. Australia has not elected to account for any activities under Article 3.4.

Sources: DCC (2008b, 2008d); UNFCCC (2001).

abatement (such as government costs for administration and verification, and forest-owner costs of measurement and reporting) are not considered in these estimates (McKinsey 2008). These costs could be substantial and could have a large influence on the potential for low-cost abatement. In addition, a considerable number of profitable abatement opportunities were identified. If such opportunities are not currently being taken up this suggests there may be additional barriers to their adoption.

Abatement potential in the LULUCF sector depends very much on accounting rules for emissions. For example, emission removals from forests that are not subject to harvest are currently counted as zero under both UNFCCC and Kyoto Protocol provisions (table 3.2).

Policy issues

Accounting rules

Australian policy should focus on achieving emission reductions that will assist Australia meet national commitments under future international agreements. However, uncertainty over what emissions and sequestration might count under such an agreement makes this difficult. A conservative approach could be to defer introducing policy in areas of uncertainty until the rules are clarified. Within the current context this would entail LULUCF policy recognising emissions and sequestration currently counted under the Kyoto Protocol with flexibility for other types of sequestration and emissions to be included once the post-Kyoto framework is decided.

On the other hand, developing policy approaches that demonstrate that more comprehensive emissions accounting is practical may strengthen Australia's efforts to influence post-Kyoto rules for LULUCF accounting in its favour. There is, however, a possibility that this will be a 'dead end' if the attempt to influence the rules is unsuccessful. These issues need to be thought through carefully when developing policy for the sector.

A related issue is the rules applying to emissions trading schemes developed in other countries or regions that could potentially be linked with Australia's ETS. It is unlikely that countries with restrictive rules in their ETS will find it acceptable to link with a scheme that accepts a greater range of emissions and sequestration possibilities. For example, where Australia's ETS takes an inclusive approach to LULUCF (either through full inclusion in an ETS or with an offset scheme linked to the ETS) this may create an obstacle to linking with the EU ETS which does not allow forestry offsets (Betz 2008).

Table 3.2 **Australia's LULUCF GHG emissions under Kyoto Protocol and UNFCCC accounting rules**

Land use, land use change and forestry emission sources	*Emission levels*	*Kyoto Protocol*	*UNFCCC*
	Mt CO2-e (2005)[a]	yes included / no not included /partially included	
Afforestation and reforestation			
Land converted to forest	-21.9	partial[b]	yes
Plantations	2.3	partial[b]	yes
Deforestation			
Land converted to cropland	-4.5	yes	yes
Land converted to grassland	57.8	yes	yes
Other			
Managed native forests[c]	-43.5	no	yes
Fuel wood consumed	10.4	no	yes
Biomass burning	1.3	no	partial[d]
Land remaining cropland	- [e]	no[f]	yes
Land remaining grassland	- [e]	no	yes
Harvested wood products	-5.0	no	yes
Unmanaged native forests[g]	na	no	no
Total net LULUCF emissions in 2005		**33.6**	**-3.2**

[a] Negative figures indicate a net sink. [b] Plantations and land converted to forest after 1 January 1990 are included in the Kyoto Protocol as reforestation. Plantations and land converted to forest prior to 31 December 1989 are not included. [c] Where managed forests are subject to harvest and regrowth from prior harvest (DCC 2008b). [d] The IPCC Good Practice Guidelines (2003) states that it is good practice to incorporate the impact of fire in national inventories for all GHGs (except where fire occurs in unmanaged forests and does not result in land use change). Currently, Australian methodology for the National Greenhouse Gas Inventory does not account for *carbon dioxide* emissions from fire, both in terms of emissions as a result of fire and withdrawals of GHGs by regrowth after a fire (but does account for all other GHGs emitted through fire). This is in accordance with the IPCC (2003), which states that where methods are applied that do not capture removals by regrowth after natural disturbances, then it is not necessary to report the carbon dioxide emissions associated with natural disturbance events. [e] These figures do not include non-CO_2 emissions which are reported in Australia's agriculture emissions accounts. [f] Under Article 3.4 of the Kyoto Protocol, parties may elect to account for forest management, cropland management, grazing land management and revegetation in their national accounts. However, Australia has not elected to account for any of these activities. [g] Where unmanaged forests are not harvested (DCC 2008b). **na**: Not available.

Source: DCC (2008a, 2008b), IPCC (2003).

Other externalities

There are other externalities associated with forests besides GHG sequestration. Other positive externalities may include soil and water quality protection, while reduced run-off to rivers and streams as a result of increased water use by forests can be a negative externality. The extent and significance of these externalities vary enormously from place to place.

Introducing policy that internalises the externality of GHGs while other externalities remain may result in land use changes that are not in the community's interests. For example, inclusion of forestry in an ETS would encourage the development of forest plantation on agricultural land. While this would have a GHG mitigation benefit it may also have a cost in terms reduced run-off. The opportunity cost of reduced run-off can be substantial (Young and McColl 2008). In some locations this cost may exceed the value of the abatement achieved.

Policy options

Options to encourage a reduction in net emissions from the LULUCF sector include coverage of the sector under an ETS, offset arrangements that link to the ETS, or approaches that are completely independent of the ETS (such as financial incentives for new plantations).

Inclusion of LULUCF in an ETS

Under this option, inclusion could be either mandatory or voluntary. Participating LULUCF businesses would receive permits for any net sink activities and be liable for any GHG emissions. LULUCF businesses would need to report periodically on their emissions and withdrawals of GHGs.

The challenges of including LULUCF in an ETS have been grouped with those of agriculture, with a focus on measurement difficulties and the large number of small sources that would have obligations (PMTGET 2007b). However, the costs of inclusion of the LULUCF sector in an ETS appear likely to be lower than that for the agriculture sector. One reason is that the task of measuring carbon in standing trees is inherently easier than measuring the diffuse and ephemeral emissions that occur in agriculture. Measurement of wood volume made as part of normal business operations can be used to determine the amount of carbon sequestered (IFA 2008). Another reason, is that there is likely to be fewer obligated parties per unit of emissions/sequestration than for agriculture (A3P 2008).

Australia's National Carbon Accounting System (NCAS) accounts for GHG emissions from land-based sectors through an integrated system that combines remotely-sensed land cover change, land use and management data, climate and soil data, GHG accounting tools, and spatial and temporal ecosystem modelling (DCC 2008b). The NCAS currently meets national and international reporting requirements, and can be utilised at a project level through Full Carbon Accounting Model (FullCAM). Many large commercial forest growers are already utilising

FullCAM and estimating the total stock and annual changes of carbon in their forests (NAFI 2007).[2]

There are clear incentives for forest managers to be involved in an ETS in order to claim the value of carbon sequestered, although the extent of credits to be claimed will depend on methods used to estimate sequestration entitlements and the treatment of carbon stored in wood products. Credit for carbon stored in wood products would need to take into account the life of the wood product, the resulting emissions once in landfill, and the fact that the receiver of the credit will have no control over the product's use or eventual disposal.

Inclusion in an ETS would mean that forest owners would face liabilities where events, such as fire or harvest, reduce the carbon stocks in their forests. If it is assumed that all carbon is released at the point of harvesting, plantation owners would gain credits during the period of their plantation's growth, but be required to acquit equivalent permits to cover all carbon released at harvest. Where carbon stored in wood products is included as sequestration, this liability could be significantly reduced.

Options for modes of inclusion of the LULUCF sector in an ETS are presented in table 3.3. Although inclusion of the LULUCF sector in an ETS seems feasible, it is yet to be determined whether inclusion is the best option and, if so, how and when it should be done. Among other things, further work is required to:

- estimate transaction costs
- assess whether inclusion would be likely to undermine the credibility of the ETS by introducing a new source of uncertainty as to the quantity of low-cost abatement that meets the schemes' requirements
- determine the extent, and implications, of interactions between the incentives that would be provided by the ETS and other externalities (such as increased water interception by plantations).

Offset arrangements

The offset arrangements considered here are a type of baseline-and-credit scheme in which credits are issued for activities that are accepted as decreasing emissions below what they would have been in the absence of the scheme (box 3.4). An offset scheme operating in the LULUCF sector could be linked to the ETS by allowing the

2 There are divergent views on whether NCAS is appropriate for use at the project level (New Forests 2008)

Table 3.3 **Possible approaches to include the LULUCF sector in an ETS**

Approach	*Description*	*Comment*
Voluntary inclusion	All forest owners choose whether to participate in the scheme. Once included, forest owners are liable for all emissions and can receive credit for all withdrawals of GHGs.	
Mandatory inclusion	All forest owners that exceed a certain size threshold are liable for emissions and receive credit for withdrawals of GHGs.	
Combination of mandatory and voluntary inclusion	Owners of Kyoto compliant forests[a] can choose whether to participate in the scheme. Once included, Kyoto compliant forest owners are liable for all emissions and receive credit for all withdrawals of GHGs. Owners of non-Kyoto compliant forests are automatically liable for deforestation and do not receive credits for sequestration.	This is the approach proposed in NZ. Furthermore, in the NZ scheme a rule has been applied such that the liabilities of Kyoto compliant forest owners can never exceed their credits[b]. With this rule, Kyoto compliant forest owners would be expected to stay out of the scheme only where the transaction costs exceed the net value of the credits they expect to receive.

[a] The Kyoto Protocol makes a distinction between forests planted after 1 January 1990 ('Kyoto compliant forests') and forests planted before 31 December 1989 (non-Kyoto compliant forests). In the Kyoto Protocol, all deforestation is counted as an increase in emissions, and only sequestration in forests planted after 1 January 1990 is eligible as sequestration. [b] This rule aims to prevent participants being penalised for increasing carbon stocks prior to the commencement of the ETS. That is, where carbon stocks of Kyoto compliant forests are increased prior to the commencement of the ETS no credit for this sequestration is received. Once the ETS is in place and the forest is harvested the forest owner will be liable for all carbon stocks lost, but this liability will exceed credits received for sequestration. The rule addresses this by capping forest owners liabilities to the amount of credits received.

offset credits to be sold and used as substitutes for permits by firms that have liabilities under the ETS.[3]

An offset scheme has been, and is being, considered to supplement Australia's ETS. For example, one of the design features of the ETS proposed by the Task Group on Emissions Trading (2007b p. 101) was 'recognition of a wide range of credible carbon offset regimes, domestically and internationally'. In a subsequent paper concerning incentives for early abatement, the Task Group on Emissions Trading (2007a) provided further information regarding the proposal for the ETS to include an offset scheme, including a discussion of possible initial administrative arrangements and a proposal for a national offset registry.

3 Such offset schemes are distinct from those that currently operate in Australia; for example, those that allow people to offset their emissions from air travel. The key difference is that the 'air travel' type schemes are not linked to an ETS (that is, the offsets can not be used to substitute for ETS permits).

Box 3.4 **Baseline-and-credit schemes**

Baseline-and-credit schemes require emission reductions below business-as-usual levels (the baseline) to be achieved. Participants can achieve their own emission reductions and/or purchase credits from others who have made eligible emission reductions. Cap-and-trade schemes, such as the ETS, on the other hand, operate under a fixed overall emissions limit with emissions permits allocated, and traded, between parties.

Baseline-and-credit schemes can stand alone or be incorporated into cap-and-trade schemes (for example, using forestry offsets).

Measuring emissions is more straightforward than measuring emission reductions. As measurement and verification procedures in baseline-and-credit schemes require proof that emissions have been reduced below a hypothetical level, a complex and costly process is required. This process embodies a high risk of inaccuracy and overestimation of emission reductions, as at its essence it is trying to quantify something that is indefinite.

Where there are deficiencies in verification, credits can be created that are not backed by genuine emission reductions which undermines the integrity and effectiveness of the scheme. Where this occurs for a high proportion of credits there is said to be low additionality.

For example, concerns have been raised about the NSW Greenhouse Gas Reduction Scheme, which does not formally address additionality (MacGill et al 2005). The scheme enables forestry offsets for Kyoto compliant afforestation and reforestation activities. A zero baseline is applied which means that all carbon stock changes that occur in the project area are assumed to be below business-as-usual and are credited.

Some examples of baseline-and-credit schemes include:

- the Kyoto Protocol's Clean Development Mechanism
- offset scheme proposed for forestry and agriculture sectors by the Task Group on Emissions Trading (PMTGET 2007a)
- Victorian Energy Efficiency Target planned for introduction in 2009 (chapter 2)
- Greenhouse Gas Reduction Scheme (GGAS) (NSW and ACT Governments).

The main reason why an offset arrangement might be considered to be preferable to inclusion of the LULUCF sector in the ETS is that measurement and verification activities are confined to a self-selected subset of actors that are actively engaged in emission reducing activities. Offset arrangements are sometimes seen to be appropriate as a transitional measure with eventual inclusion as the desired end point. It is argued that experience can be gained in measurement and reporting that may make later inclusion in the ETS more feasible.

However, as outlined in table 3.1, government-created markets work best where the nature and extent of the property right is unambiguous, verifiable and can be measured at reasonable cost. In general, cap-and-trade schemes rate much better against these criteria. Baseline-and-credit schemes rely on measuring emission reductions below hypothetical business-as-usual levels which is difficult, often costly and potentially open to gaming. Because of this there is potential for offset schemes to have high transaction costs and/or credit emission reductions that would have occurred without the scheme (that is, credit emission reductions that were not 'additional').

A further difficulty with forestry offset schemes is that they must include arrangements for dealing with the uncertain longevity of sequestration. Most existing schemes do this by including a requirement that projects be maintained for a minimum time period, with penalties applied where carbon stocks do not remain at credited levels. For example, the Australian Government's Greenhouse Friendly program has legal requirements that carbon remains sequestered for at least 70 years. The Task Group on Emissions Trading has suggested that the same requirements could be incorporated into an offset scheme that linked with the ETS (PMTGET 2007a).

Such requirements may have a positive aspect in reducing the potential for additionality problems. For example, it is uncommon for commercial forest plantations in Australia to be older than about 40 years. Accordingly, anyone committing to establishing and maintaining a forest for 70 years might reasonably be assumed not to be contemplating doing this anyway as a commercial activity (they may, however, have been contemplating it for other reasons).

On the other hand, such requirements could result in much of the low-cost abatement potential of the sector not being realised by the scheme. For example, plantation growers who might have responded to inclusion of the sector in an ETS by establishing more forests and/or managing forest on a longer rotation would probably view a scheme with a 70 year requirement as irrelevant to their commercial interests.

In summary, while no definitive judgement on the merits of offset schemes for the LULUCF sector is intended, there do appear to be significant disadvantages to their adoption. These include:

- the possibility that a high proportion of the credited abatement would have occurred anyway (low additionality), lowering effectiveness of the ETS
- future difficulties when transitioning from offsets to full coverage in an ETS (such as resistance to a change where participants who used to receive credits subsequently face liabilities)
- high transaction costs, including those associated with monitoring obligations for many decades

- the creation of incomplete incentives for abatement, such that much of the low-cost abatement potential of the sector might not be realised.

Other policy options

There is a range of abatement policies for the LULUCF sector that could operate independently of the ETS.

Regulate 'undesirable' activities and / or reward 'desirable' ones

Regulation can restrict activities that tend to increase emissions. For example, land clearing regulations have been effective in this regard in Australia already. However, in its report on the impacts of native vegetation and biodiversity regulations the Commission found that these regulations have imposed substantial costs on many landholders (PC 2004). It also found that, due to a focus on prevention of native vegetation removal, rather than the promotion of desirable environmental outcomes, the regulations were not always effective in achieving environmental goals. In some cases, the regulations led to perverse environmental impacts such as premature clearing of regrowth and increased soil degradation due to more intensive rotation of paddocks.

Another option is to provide incentives for engaging in activities that tend to lower net emissions (for example, financial incentives for new plantations). These incentives are not generally efficient as they do not directly target the environmental outcome desired, although they can have low transaction costs.

Manage public forests for sequestration

The great majority of Australia's 164 million hectares of forests are government owned native forests (BRS 2006). These forests are managed for a range of values including conservation, recreation, and wood and water production. One option is for governments to agree to instruct their forest management agencies to factor in a value for sequestration (equivalent to emissions prices under the ETS) in managing these forests. This could have a similar outcome to including these forests in the ETS, but would not actually require inclusion, nor the level of reporting needed for an ETS. It would also not risk compromising the credibility of the ETS through the prospect of an influx of sink credits.

The merits of this option depends very much on the rules that might apply under future international climate change agreements. For example, it would not achieve emission reductions under current Kyoto Protocol rules, as sequestration in forests planted before 1990 does not count under this agreement. More inclusive rules, such as those under the UNFCCC, would make the option viable.

Promote forest retention in developing countries

Preventing deforestation in developing countries with dense tropical forests is a particularly effective way of reducing global GHG emissions (Stern 2007). The bulk of deforestation in developing countries occurs when forested land is converted for agricultural purposes. Australia could play a role through influencing international rules about how avoided deforestation is treated and/or assisting developing countries to reduce deforestation. Both of these options can be pursued independently of domestically focused policy.

Australia is advocating the inclusion of a broader range of LULUCF emissions and 'maintains that the international community can reach a workable framework to support reductions in emissions from deforestation in developing countries' (UNFCCC 2007 p. 8). In addition, Australia has committed $200 million over five years to the International Forest Carbon Initiative to facilitate reductions in GHG emissions in developing countries through promoting reforestation and sustainable forest management.

Conclusions

Inclusion of the LULUCF sector in the ETS appears to be feasible, and participation of LULUCF organisations could be either mandatory or voluntary. However, full inclusion of all sectors in the ETS should not be the ultimate aim. Inclusion of the LULUCF sector should only occur where it will reduce the total cost of meeting Australia's emissions target. Evaluation against other policy options is necessary, such as subsidies and managing public forests for enhanced sequestration.

When assessing mitigation policies for the LULUCF sector, consideration should be given to what will be counted towards Australia's international commitments. Offset arrangements could be introduced for the LULUCF sector, but they have significant disadvantages either as a transitional or long-term option.

3.3 Agriculture

The agriculture sector was responsible for 16 per cent of Australia's GHG emissions in 2005 (AGO 2007).[4] This is a higher proportion than in most other developed countries, although New Zealand is an exception as agriculture accounts for nearly 49 per cent of emissions in that country (New Zealand Ministry for the Environment and The Treasury 2007).[5]

Agricultural emissions in Australia are primarily from the digestive processes of livestock (67 per cent of the sector's emissions in 2005), fertiliser use (19 per cent), prescribed burning of savannahs (10 per cent) and manure management (4 per cent) (AGO 2007). Agriculture differs from most other sectors in that methane and nitrous oxide, rather than carbon dioxide, are the main GHGs. Agriculture can also be a sink for GHGs, through vegetation management, increasing carbon stored in soils and woodlots (small scale plantations).

Abatement potential

While there are significant knowledge gaps regarding abatement opportunities in the agriculture sector, it is known that emissions can be reduced by:

- changing fertiliser management practices, including applying nitrogen inhibitors to the soil to reduce nitrous oxide emissions
- improving livestock management to reduce enteric fermentation
- using no-till cropping and stubble retention in place of conventional tilling, to increase soil carbon levels (Wang and Dalal 2008)
- switching from higher to lower GHG emission forms of agriculture and/or changing land use from agriculture to forestry.

The ability of these techniques to reduce GHG emissions, however, can vary widely across locations and in ways that are not well understood.

Although the techniques themselves may achieve abatement at relatively low cost, measuring GHG emissions in the agriculture sector is difficult. In many cases, proxies are used to keep costs manageable. For example, measurement of emissions from the digestive processes of animals is calculated using formulas that take into account animal numbers, types and feed (pasture or feedlot) (DCC 2007). This means that some

4 This does not include emissions from energy use in the sector. The vast majority of energy-related emissions across all sectors are likely to be covered by the ETS.

5 This refers to pastoral and arable farming as well as horticulture and excludes agricultural energy use.

changes to farming practices that reduce *emissions* may not influence *measured emissions*. In assessing the potential to use policy to encourage abatement in the sector the costs of the measurement and verification systems that would be required need to be considered. Given the diffuse and poorly understood nature of agricultural emissions and the fact that Australia has over 130 000 farms, these costs could be considerable.

Consideration also needs to be given to what actually counts as GHG emissions under international rules as applied to Australia. For example, Australia has elected not to count carbon dioxide emissions and withdrawals from carbon in soils under the Kyoto Protocol (DCC 2008d) and such emissions are assumed to be zero in Australia's National Greenhouse Gas Inventory (DCC 2008b)[6].

Another consideration is whether the Kyoto Protocol rule that treats one tonne of methane emissions as equivalent to 21 tonnes of carbon dioxide emissions will continue to apply. Some analysts have suggested that much less emphasis should be given to controlling methane emissions over the next few decades as they reside in the atmosphere for only about ten years (Schelling 2007).

To assist the development of policy to mitigate GHGs in this sector, further research and development into methodologies to verify emissions and the impact of different abatement techniques is required.

Policy options

Inclusion in an ETS

Initial inclusion of agriculture in the ETS in a way that covers all emissions sources and sinks would have substantial costs. One way to reduce these costs is to cover only those emissions that are relatively easy to measure (directly or by reliable proxies). This is the approach proposed for New Zealand (box 3.5).

Another feature of the proposed New Zealand model is that individual agricultural producers will not have obligations under the scheme. Instead, liabilities will be placed at different points in the supply chain so as to greatly reduce the number of parties that are

6 Nitrogen and methane emissions from soil are accounted for in Australia's National Greenhouse Gas Inventory under agricultural emissions. Carbon from soil on the other hand is accounted for under LULUCF according to the IPCC Good Practice Guide (2003). According to the DCC (2008a) carbon stocks and carbon emissions from soil are assumed to be zero, as studies have shown that the biomass of annual crops is generally consistent year to year. The Kyoto Protocol enables a country to count these emissions where it elects to cover cropland management under article 3.4.

required to acquit permits and be monitored. For example, instead of farmers being liable for emissions from livestock, meat processers will be responsible for reporting and acquitting permits for these emissions.

Through restricting liability to specific sources of emissions and limiting the number of liable parties, the approach aims to decrease transaction costs and problems with monitoring and compliance. Coverage of emissions from livestock, manure management and soil (due to synthetic fertiliser use) would draw around 90 per cent of Australia's emissions in this sector under the ETS cap.

Box 3.5 **Agriculture in the New Zealand Emissions Trading Scheme**

In 2007, the New Zealand Government announced it will introduce a domestic ETS. It aims to include all sectors by 2013.

It is proposed to include the agriculture sector in the ETS by 1 January 2013. The intention is to focus on nitrous oxide emissions from synthetic fertiliser use and methane and nitrous oxide emissions from manure management and enteric fermentation. Other agricultural emissions will not be covered.

The Government's preferred option is for agriculture to be brought into the ETS through a mixture of downstream and upstream liabilities for agricultural emissions. This would mean that individual agricultural producers would not have obligations under the scheme. Responsibility for agricultural emissions would be given to groups at different points in the supply chain in a way that limits the number of obligated parties. The preferred option is that:

- meat processors be liable for emissions from livestock (downstream targeting)
- importers and producers of nitrogen fertiliser be liable for nitrogen emissions from fertiliser sold to farmers (upstream targeting).

Source: New Zealand Ministry for the Environment and Treasury (2007).

There are, however, trade-offs. One drawback to the New Zealand approach is that downstream targeting of emissions does not provide direct price signals to farmers regarding their GHG emissions. For example, where a downstream processor must pay for emissions from livestock (for example, using a formula that calculates emissions depending on factors such as type of animal, age, weight and whether fed on pasture or in feedlot), some actions that a farmer may take to reduce emissions on-farm, such as improving animal health, will not be taken into account in the calculation of emissions. Therefore, there will be little incentive under the ETS for a farmer to undertake such actions.

A general issue concerning the inclusion of the agriculture sector in an ETS is the risk of leakage of emissions overseas. An example of this would be where farmers reduce livestock numbers in response to the lower price they receive for their livestock (due to a carbon price being levied on the meat processer), global demand has not changed and production of livestock increases in another country where there is no cost to GHG emissions.

In summary, none of the ways in which the agriculture sector could be covered by an ETS seem to be very satisfactory. The trade-off appears to be between having high transaction costs and approximately the right incentives to abate, or having lower transaction costs but muted incentives. Emissions leakage is a potential problem regardless of the approach taken. That New Zealand is pushing ahead with inclusion may reflect the fact that almost half of its emissions are from agriculture. Excluding agriculture would, therefore, greatly limit the scope for New Zealand to reduce emissions and/or require very high (and expensive) levels of abatement in other sectors. As noted, Australia is in a different situation. Inclusion of agriculture in an ETS should only occur if it can be shown that it will reduce the total cost of meeting Australia's emissions target and that it is superior to other policy options.

Offset arrangements

The problems associated with using offset arrangements were outlined in section 3.2. In general, these apply equally to agriculture, with some exceptions. For example, the greater level of uncertainty regarding agricultural emissions may exacerbate problems of determining baselines and emission reductions. Another example, is a greater potential for moral hazard where farmers who are using best practice farming methods (in relation to reducing GHGs) go unrecognised and those who are not at best practice are rewarded. Conversely, duration of sequestration is potentially less of a concern for agriculture (except in the case of agricultural soils). Any proposal to use offset arrangements should be subject to rigorous evaluation.

Other policy options

There are other options that could be pursued for the agriculture sector that, while generally providing more limited incentives for abatement, may also have lower transaction costs. These options include:

- extension services to promote practices that reduce GHG emissions and are cost-effective for farmers
- subsidies to farmers for adopting specific agricultural practices that are known to reduce GHG emissions.

Conclusions

There is a paucity of understanding of abatement opportunities and emissions measurement in the agriculture sector. These uncertainties will pose challenges to developing most types of mitigation policies in this area. Consequently, it seems unlikely that this sector will be able to make a major contribution to abatement in the short to medium term. As such, a focus on research and development appears to be warranted to develop understanding of emissions measurement and abatement.

3.4 Other sectors

Waste

Emissions from the waste sector, predominantly methane emissions, were 17 Mt CO_2-e in 2005, which represents 3 per cent of total national emissions (AGO 2007). Emissions occur due to anaerobic decomposition of organic matter in landfills and sewerage facilities.

Abatement opportunities in the waste sector include diversion of solid waste from landfills, for example through recycling, composting organic materials and diverting waste for energy. Another option is the recovery of methane released from landfills which is then burned as fuel or flared. Rates of methane recovery from solid waste have increased substantially since 1990, increasing from a negligible amount to 3 Mt CO_2-e in 2005 (AGO 2007).

Waste will be considered for inclusion during the development period of the ETS.

Aviation and maritime fuels

The Kyoto Protocol includes domestic emissions for aviation and shipping but not international emissions associated with these activities. International aviation and shipping emissions are monitored, but not counted towards countries' targets. The Kyoto Protocol states that the responsibility for limiting or reducing GHG emissions from aviation and marine bunker fuels shall fall to the Annex I Parties (parties with fixed emissions targets under the Kyoto Protocol), working through the International Civil Aviation Organisation (ICAO) and the International Maritime Organisation (IMO) respectively.

In recent talks in Bangkok, a range of options were put forward for the treatment of shipping and aviation fuels. While consensus was reached that 'the current treatment of greenhouse gases, sectors and sources in the context of further commitments should continue, without introducing any major changes', there was no agreement on the specific treatment for aviation and shipping (UNFCCC 2008).

While the EU has signalled that it will incorporate emissions from international aviation within its ETS[7], it is not clear that any future international agreement will follow suit. As such, there appears to be little rationale for immediate inclusion of international bunker fuels in an Australian ETS. There may be a rationale for supplementary policies in these sectors, for example working with the ICAO and IMO. However, mitigation efforts should be focused on reducing emissions where it will count towards Australia's GHG emissions target.

7 The EU has announced that from the start of 2011, all emissions from domestic and international flights between EU airports will be included, and emissions from all international flights that arrive at or depart from an EU airport will be covered from 2012.

A Quantifying the costs and benefits of low-emissions energy targets

Economic modelling has generally projected that low-emissions energy targets are a more costly abatement measure than an emissions trading scheme (ETS). Two recent reports, however, project that low-emissions energy targets operating in conjunction with an ETS could lead to a small decrease in abatement costs. This conclusion rests on optimistic assumptions about the potential benefits from 'learning-by-doing'. Relaxing these assumptions is sufficient to bring the conclusions into line with other economic modelling.

A.1 Introduction

Low-emissions energy targets have been mooted as a supplementary measure to operate alongside an emissions trading scheme (ETS) (Australian Government 2007). The term 'low-emissions energy target' is a broad one, referring collectively to:

- clean energy targets — which specify that a certain amount of energy must come from a broad range of energy sources associated with minimal greenhouse gas (GHG) emissions
- renewable energy targets — which are more restrictive on the technologies that can be used to meet the target by excluding low-emissions technologies that are non-renewable, such as carbon capture and storage and nuclear power.

As discussed in chapter 2, adding a low-emissions energy target to an ETS is unlikely to lead to any additional GHG abatement and so would have to be justified on other grounds. This requires two criteria to be satisfied:

- the benefits from the target must outweigh its cost
- the low-emissions energy target needs to be the best way to access the benefits (rather than, for example, funding for research and development).

This appendix focuses on the first hurdle: are the benefits from a low-emissions energy target likely to exceed its cost?

The nature of costs and benefits from low-emissions energy targets are discussed in chapter 2. To summarise, there are immediate costs involved in meeting a low-emissions target because of reduced flexibility in how emissions reductions can be achieved. Relatively more expensive abatement activities are likely to be favoured. The benefits are more uncertain and, to the extent that they do occur, are likely to come in the longer term, mostly through technological development.

Quantitative evidence on low-emissions energy targets can be broken into two streams: data on the historical experience of low-emissions energy targets; and projections of the likely future impacts of targets. Historical data on the effects of low-emissions energy targets in Australia are presented in section A.1. Given data limitations, particularly regarding technological development, no attempt is made to place a numerical estimate on the costs and benefits from existing low-emissions energy targets. Instead, this section gives a broad overview of the impacts of existing targets. Section A.2 reviews modelling work that projects likely future costs and benefits. Recent work by McLennan Magasanik Associates has yielded results that are at odds with other studies, and is thus considered in some detail.

A.2 Experience with low-emissions energy targets in Australia

This section focuses on the most significant low-emissions energy target introduced in Australia to date: the Australian Government's Mandatory Renewable Energy Target (MRET). State-based schemes have also been introduced, but the MRET is the sole renewable energy target to have been legislated on a national basis. Moreover, the National Emissions Trading Taskforce has reported that, subsequent to the introduction of various state schemes (including the Victorian Renewable Energy Target), the MRET remained the major policy mechanism to encourage renewable energy generation in Australia (NETT 2006).

Mandatory Renewable Energy Target

The MRET scheme was introduced in 2001 to encourage additional generation of electricity from renewable sources to reduce emissions of GHGs (AGO 2003b).

The MRET requires wholesale purchasers of electricity to contribute proportionately towards a target of 9500 GWh of newly installed renewable energy by 2010, which must be maintained until 2020. There is a series of interim targets leading up to 2010.[1] Liable parties meet their requirements by purchasing 'renewable energy certificates', which are

1 In 2007, the Australian Government announced that the MRET would be expanded to meet a 45 000 GWh target by 2020, it is estimated that this would result in 20 per cent of electricity being sourced from renewable energy in 2020.

issued to renewable generators that use a variety of technologies including hydro-electricity, wind, biomass,[2] biogas, geothermal and solar power (NETT 2006).

Impact on the renewable share of generation

Low-emissions energy, in the form of various renewable energy sources, historically has been an important part of the energy supply in Australia. At various times in the past 40 years, more than one-fifth of the electricity generated in Australia has come from renewable energy sources (figure A.1). The main contributor has been hydro-electricity, but wind, biomass, biogas and solar power have all made some contribution. Prior to the introduction of the MRET, the development of renewable capacity was based on cost, reliability and other factors, rather than reducing GHG emissions. Non-renewable low-emissions energy sources, such as nuclear power and fossil fuel with carbon capture and storage, have not been a part of Australia's energy supply.

The share of electricity generated in Australia from renewable sources has declined over the past four decades. The renewable share of electricity generation peaked at over one-fifth in the mid-1960s, and rose to similar levels during the 1970s, before declining to less than 10 per cent by the start of this century (figure A.1). This decline was mainly because there has been little increase in the major source of renewable generation — hydro-electricity — since the Snowy Mountain Scheme was completed in the mid-1970s. With total electricity generation more than tripling between 1975-76 and 2005-06, the hydro-electric share (and the renewable share more broadly) decreased (ABARE 2007).

The current MRET is projected to stem the decline in the renewable share of generation. When originally conceived, the MRET was promoted as a measure that would increase the renewable share of generation by 2 percentage points between 1997 and 2010 (AGO 2003b). However, increases in the renewable share from 2005-06 levels are only likely to be sufficient to reach a level approximately equal to the 1997 share by 2010 (AGO 2003b; REGA 2004; Syed et al. 2007[3]).

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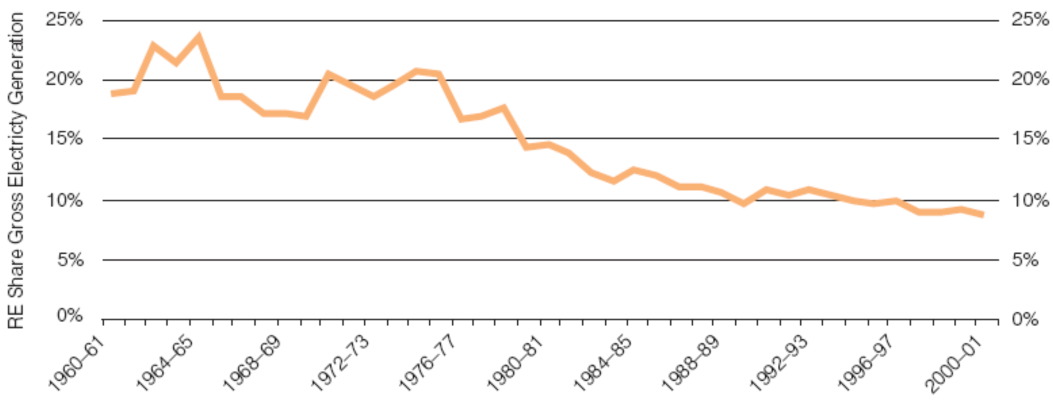
2 Energy derived from plant and animal material, including bagasse (a waste product from sugar refining), wood and woodwaste.

3 Syed et al. (2007) project that by 2010, taking into account existing policies including the MRET, the renewable share of electricity generation is likely to increase by about 1.3 percentage points from 2005-06 levels. Data reported in ESAA (2007) show that the renewable share declined by a similar amount between 1997-98 and 2005-06.

Figure A.1 **Renewable energy share of electricity generation in Australia[a]**



[a] ESAA and ABARE (Syed et al. 2007) data indicate that the renewable share of electricity generation was 7.5 per cent and 7.7 per cent respectively in 2005-06. However, the lack of historical data in these sources precluded the construction of a consistent time series through to 2005-06.

Source: AGO (2003b).

Impact by renewable generation source

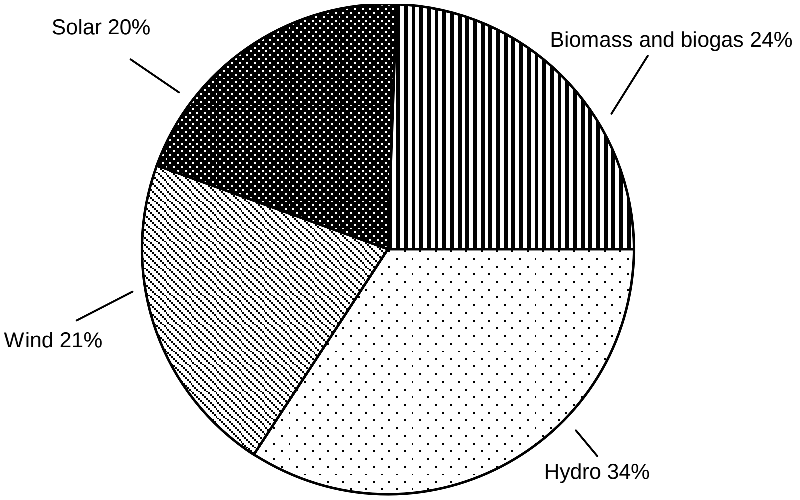
Renewable capacity installed under the MRET has been shared fairly evenly across different renewable sources (figure A.2). Hydro has been the most significant source of new renewable capacity, but wind and solar have grown rapidly from a low base. Most new solar energy has come from solar hot water heaters, which do not generate electricity, but rather are a substitute for electricity use. By 2010, biomass and wind are forecast to be the most important contributors to the MRET scheme, with shares of around 40 per cent and 30 per cent respectively (Short and Dickson 2003).

The importance of hydro-electricity in meeting the MRET is not surprising, given its dominance as a renewable electricity source (figure A.3). However, the potential for further hydro generation is limited, as most hydro resources in Australia are already developed (AGO 2003b).

Compared with their share of electricity generation (7.8 per cent), renewable energy sources account for a somewhat smaller (4.6 per cent) share of total energy use (figure A.3). The distinction between electricity and energy more broadly is important when comparing the contribution of different renewable sources. Total energy use includes the use of energy for purposes other than electricity generation. For example, oil is the largest single source of energy used in Australia, but is used for transport rather than to generate electricity (ABARE 2006).

Figure A.2 **Share of new generation under MRET**

Renewable energy certificates created by 31 December 2006, by source[a]



[a] Shares do not sum to 100 per cent due to rounding.

Data source: ORER (2007).

Biomass is the most important renewable energy source by some margin, but contributes much less to electricity generation. This is largely because most biomass is used directly by industry for process heat or as firewood in homes (Saddler, Diesendorf and Denniss 2004). Also, there are inefficiencies in converting energy from biomass to electricity, so that 36 PJ of biomass energy is used to produce 4 PJ of electricity (ABARE 2007). In contrast, all wind and hydro energy is used to produce electricity. As a consequence, hydro is the most important renewable source of electricity, in spite of being overshadowed by biomass as an energy source.

Existing and proposed low-emissions energy targets in Australia apply to electricity generation only. Therefore, a large part of the total renewable energy supply is not eligible to meet renewable energy targets as currently specified.

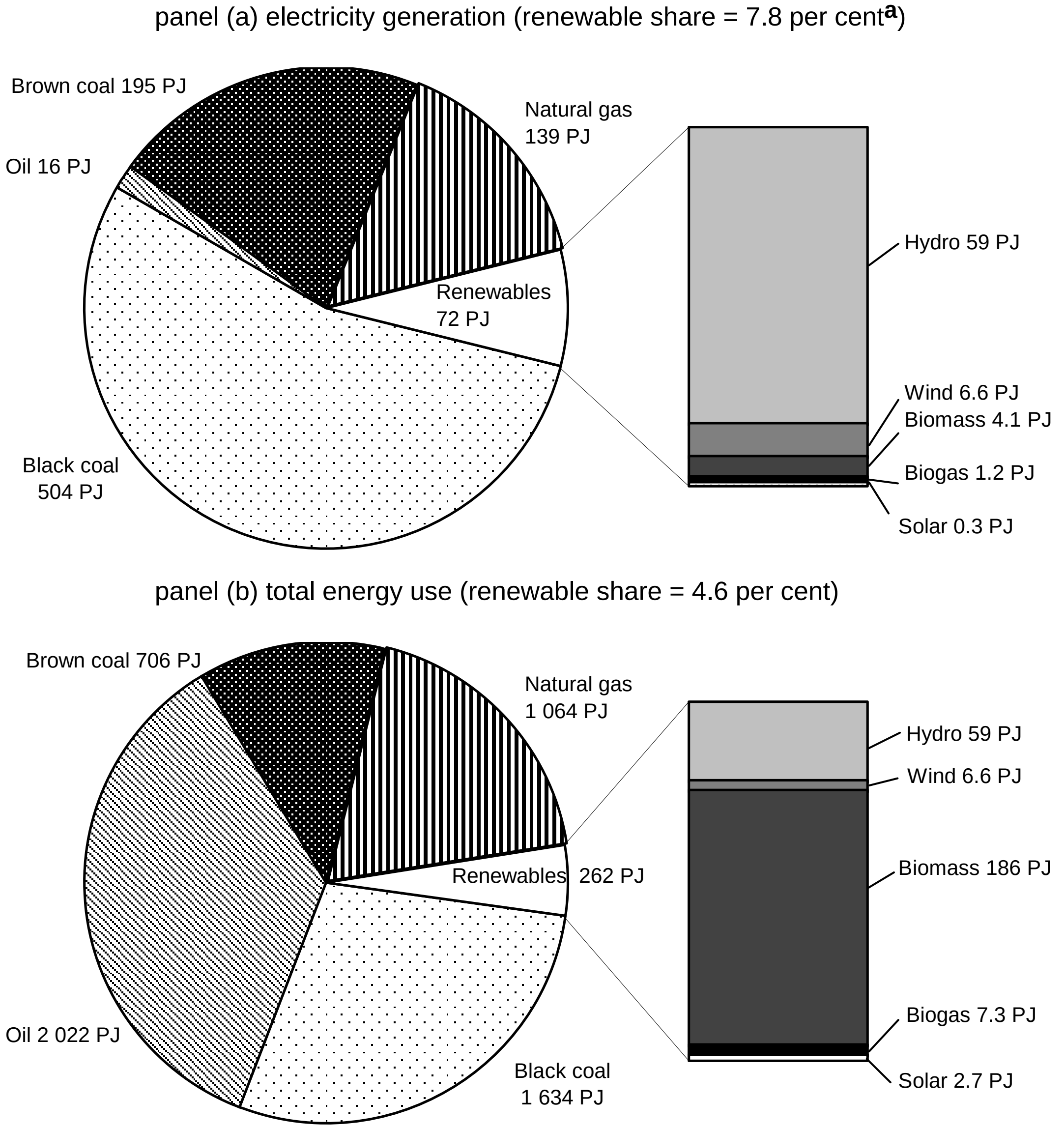
Costs

Indicative estimates show that renewable energy sources are generally more expensive than coal generation, but involve far lower GHG emissions (table A.1). Natural gas generation lies somewhere between coal and renewables, both in terms of costs and emissions.

The higher cost of generation from renewable energy sources means that the MRET imposes costs to the economy. These have been forecast to reach several hundred million dollars annually by 2010. AGO (2003b) cited research suggesting costs would amount to a

$260 million reduction in GDP in 2010, while COAG (2002) estimated the annual electricity cost of the current MRET scheme in 2010 at $323–543 million.

Figure A.3 Fuel shares of energy in Australia, 2005–06



[a] Estimate not strictly comparable with figure A.1 because different data sources were used.

Data source: Syed et al. (2007).

These costs mean that the MRET is a relatively expensive GHG abatement measure, costing more than $30 per tonne of carbon dioxide (AGO 2003b; COAG 2002). This is significantly more expensive than the average cost of abatement for Australian Government programs — $4 per tonne of carbon dioxide based on Australian Government expenditure to the end of 2003 and abatement projections (DEH 2005) — even allowing for some costs incurred by the private sector from these programs.

This average cost relates to a range of different types of abatement programs, including partnership programs with industry such as Greenhouse Challenge Plus. It is likely that this low unit cost could not be maintained if much larger quantities of abatement were required. This, however, does not invalidate the comparison with the MRET costs, as these would also be expected to increase substantially (per unit) if the target were to be increased (as is planned) (COAG 2002).

Table A.1 **Indicative costs and emissions for electricity generation**
Projections for 2010

Technology	*Cost per unit of electricity generated*	*Greenhouse gas emissions*
	\$/MWh in 2010	kg CO_2 per MWh
Supercritical black coal	30–35	780–820
Supercritical brown coal	36–40	1000–1100
Natural gas combined cycle	35–45	430
Wind	55–80	–
Bagasse[a,b]	30–100	–
Small hydro[a]	50–70	–
Solar hot water[c]	80–100	–
Photovoltaic	250–400	–

[a] Limited resources available. [b] One component of broader biomass energy. Short and Dickson (2003) estimate that other forms of biomass are likely to cost between \$20 and \$130 per MWh in 2010. [c] As solar hot water does not create electricity, costs are based on electricity savings. – Nil or rounded to zero.

Source: Department of the Prime Minister and Cabinet (2004).

A.3 Projections of future costs and benefits

Several studies undertaken in Australia have found that ETSs are a substantially cheaper abatement measure than low-emissions energy targets (box A.1). Whereas an ETS creates an incentive for the lowest cost abatement options to be taken up wherever they are found, low-emissions energy targets specify that abatement must come from certain sources, which are often relatively high cost. This modelling has been used to suggest that renewable energy targets should be replaced by an ETS (COAG 2002).

Three modelling studies differ from earlier work by modelling the effects of low-emissions energy targets in addition to — rather than as a substitute for — an ETS:

- CRA International analysis for the Australian Petroleum Production and Exploration Association finds that such an approach would be significantly less efficient than using an ETS alone to achieve a given level of abatement (the level of abatement modelled was 67 Mt carbon dioxide equivalent (CO_2-e) in 2020). It shows that, relative to an ETS only policy, an ETS combined with a 20 per cent renewable energy target would:
  - cost Australia \$1.8 billion more in economic welfare losses (gross national product) in 2020

- – result in the loss of an additional 3600 full-time job equivalents in 2020
  - – cause substantial switching away from gas fired generation
  - – result in electricity prices rising at least 6 percentage points (that is, rising by 24 per cent, compared to 18 per cent under an ETS only policy) (CRA International 2007)
  - – leave total GHG emissions unchanged.
- Two reports by McLennan Magasanik Associates (MMA) find that introducing a low-emissions energy target in addition to an ETS would result in a small net benefit for some scenarios, depending on the ETS permit price and the size and nature of the low-emissions energy target (MMA 2007a, 2007b).

This section considers the reasons why the conclusions reached by MMA are different from those of other studies.

Box A.1 **Modelling shows that low-emissions energy targets are a costly abatement measure**

Australian macroeconomic modelling has generally found that low-emissions energy targets are a more costly abatement measure than emissions pricing through an ETS or an emissions tax. As noted in the Productivity Commission submission to the Task Group on Emissions Trading:

> 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 economywide 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. (PC 2007a, p. 39)

Modelling work by ABARE commissioned by the Task Group on Emissions Trading is also broadly consistent with these findings. The ABARE modelling showed 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 ETS to achieve the same abatement outcome (PMTGET 2007b).

The second of the two MMA reports — commissioned by the Renewable Energy Generators of Australia — offers more sophisticated analysis of low-emissions energy targets than the first report. For the first report, MMA modelled a range of different abatement policies, including energy efficiency measures, and the modelling of low-emissions energy targets was less detailed. Technological benefits from low-emissions energy targets were assumed at an aggregate level and these assumptions were more optimistic than the disaggregated assumptions made for the second MMA report.[4]

The assumptions and methodology underpinning MMA's work for the Renewable Energy Generators of Australia are considered in more detail below.

MMA work for the Renewable Energy Generators of Australia

MMA was commissioned by the Renewable Energy Generators of Australia to model the benefits and costs of low-emissions energy targets in conjunction with an ETS. Various low-emissions energy targets were modelled, including a renewable energy target and several clean energy targets. The clean energy target could be met either by renewables or by coal with carbon capture and storage (according to an emissions intensity limit of 0.2 tCO_2-e/MWh). Nuclear energy generation was not considered.

The study finds that the benefits from a low-emissions energy target marginally outweigh its costs, provided the target is not too stringent (box A.2). The most stringent clean energy target found to deliver a net economic benefit requires 20 per cent of electricity demand in 2020 to be sourced from low-emissions generation.

Costs from a low-emissions energy target arise from reduced flexibility in how abatement is undertaken. This represents an unavoidable immediate and ongoing cost, as some low-cost abatement options are replaced with higher cost abatement mandated as part of the low-emissions energy target. MMA's modelling is consistent with modelling work by COAG (2002) and CRA International (2006) in finding that there are short-term costs to the economy associated with the shift to

4 In the first report, commissioned by The Climate Institute, a clean energy target equal to 70 per cent of electricity demand growth 'is assumed to lead to an effectively faster rate of cost reduction for all adopted low-emission technologies, with the rate of cost reduction reaching 5 per cent per annum' (MMA 2007a, p. 17). For the more mature low-emissions technologies at least (such as wind energy), this assumption is more optimistic than the assumptions made in the second MMA report.

Box A.2 MMA modelling indicates that low-emissions energy targets could yield net economic benefits to Australia

In its study for the Renewable Energy Generators of Australia, MMA modelled various scenarios for adding a low-emissions energy target to an ETS. The scenarios covered a range of carbon prices and different low-emissions energy targets.

In some scenarios, low-emissions energy targets were shown to bring about small net benefits, while others showed small net costs. MMA note the potential for net benefits from 'modest' low-emissions energy targets and draw a policy implication that benefits to the economy would be maximised by a low to modest target for low-emissions generation, in addition to an ETS.

The potential for low-emissions energy targets to produce a net benefit was based on comparing costs and benefits likely to accrue within Australia. This was achieved through detailed modelling using MMA's electricity market model, supported by computable general equilibrium modelling to capture economywide effects. The report indicates that costs accrue in the early years of the scheme (as investment in low-emissions generation occurs) but that these costs are compensated for by benefits later in the modelling period.

Benefits arise from cost reductions for low-emissions technologies, as early deployment is assumed to pull technologies down the cost curve sooner. Both private and external (spillover) technological benefits are included. Other benefits modelled are savings in fuel and other costs of displaced fossil fuel generation and increased GHG abatement.

Source: MMA (2007b).

low-emissions generation. Further, MMA's estimates of these costs appear to be reasonably consistent with these previous estimates.[5]

The benefits foreseen from a low-emissions energy target relate mainly to longer-term technological benefits, but there are also some benefits claimed from additional GHG abatement. Several billion dollars of technological benefits are estimated (in net present value terms), compared with a few hundred million dollars of benefits from additional abatement. Assumed technological benefits alone are sufficient to explain the difference

5 COAG (2002) estimates the annual cost of the existing MRET target at $190 million in 2020, compared with MMA's estimate of additional costs of just over $500 million (in 2020, with a low carbon price) to meet a renewable-only target that is more than three times as stringent. CRA International (2006) estimate that a low-emissions energy target of about double the 'high' target modelled by MMA will carry a net present cost of $12.4 billion, close to double MMA's estimate of $5.0–5.5 billion with no accelerated learning-by-doing. Methodological differences and the non-linearity of costs as the stringency of the target increases complicate these comparisons, but they suggest that MMA's estimates of additional costs from a clean energy target are approximately consistent with other studies.

between MMA's conclusions and those from previous studies that a low-emissions energy target would be costly. Previous studies do not assume the same technological benefits.

Technological benefits from low-emissions energy targets come from assumptions about 'learning-by-doing'. That is, the use of low-emissions energy technologies increase due to the target and this is assumed to lead to reductions in the cost of generating electricity using these technologies. As MMA (2007b, p. 21) explain, in assessing the potential for learning-by-doing in Australia, '[a] key issue is the degree to which deployment of low or zero emission technologies in Australia can lead to cost reductions'. They note that a large proportion of the equipment for renewable generation is sourced internationally and that Australia is a small part of the international market for renewable energy. This means that learning from additional Australian low-emissions energy deployment requires Australia-specific learning in other components of generation costs. Several examples of Australia-specific learning in wind generation are noted, such as responding to local wind regimes and dealing with high summer temperatures. MMA (2007b) claim that the assumptions made about technological benefits are conservative.

Rates of learning-by-doing were assumed to vary across low-emissions technologies. For a doubling of generation capacity, capital costs were assumed to decline by:

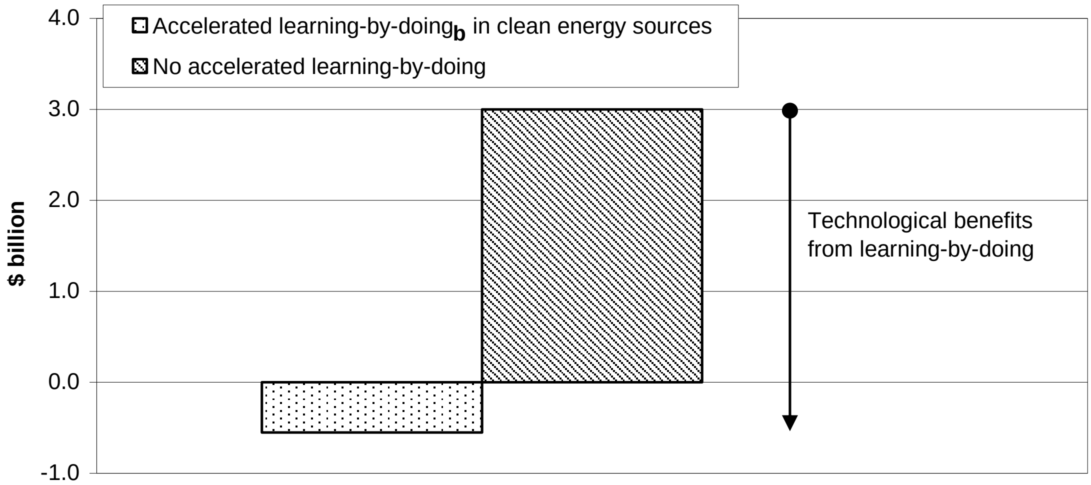
- 3 per cent for wind generation
- 6 per cent for new biomass options (such as gasification and pyrolysis)
- 10 per cent for geothermal and solar thermal/photovoltaic concentrator options
- 10 per cent for carbon capture and storage options (MMA 2007b).

No learning-by-doing was assumed for fossil fuel technologies. There is also some discussion of the possibility of cost reductions from factors beyond learning-by-doing — such as improved economies of scale — but these were not cited as justification for the assumed reduction in capital costs.

Under the learning-by-doing rates assumed by MMA, several billion dollars in technological benefits from modest clean energy targets are projected to marginally outweigh the costs of the target. Costs are reflected in a $2.5–3 billion increase in generation costs with no accelerated learning-by-doing (figure A.4). Where learning-by-doing in clean energy sources is assumed, the low-emissions energy target yields longer-term benefits, as investment in low-emissions energy in previous years leads to cheaper renewable energy. These benefits just offset the additional short-run costs, leading to a small net benefit from having a clean energy target together with an ETS.

Figure A.4 **Change in generation costs from a low clean energy target**[a]

Estimates from MMA's work for the Renewable Energy Generators of Australia



[a] Estimates are the average of ranges given for the net present value of the change in generation costs with the introduction of a 'low' clean energy target, under 'low' and 'moderate' carbon prices. The 'low' clean energy target modelled is equal to around 16 per cent of total generation in 2020 (the sum of the targets under all existing state-based renewable energy targets plus a 10 per cent margin).[b] 'Accelerated' learning-by-doing refers to extra learning-by-doing that is caused by the clean energy target.

Data source: MMA (2007b).

The other source of benefits foreseen from a low-emissions energy target — additional GHG abatement — arises because the modelling in the report pertains to a low-emissions energy target in the presence of an *emissions tax*, rather than an *ETS*. Under a 'cap-and-trade' ETS, emissions prices can adjust while total emissions are fixed by the cap. In contrast, under an emissions tax, prices are fixed while total emissions are set by the market. The modelling in MMA (2007b) is based on emissions prices that are not allowed to adjust in response to the introduction of low-emissions energy targets, and thus describes an emissions tax.[6] This point, which is not explicitly made in the report, means that abatement increases as a consequence of the introduction of low-emissions energy targets.

MMA reports that '[t]he benefit of additional abatement is a key contributor to the net benefits of the low-emission generation target (MMA 2007b, p. 49). Over two-thirds of the net benefits can be attributed to this factor alone'. Based on the assumed emissions price, additional abatement is valued at around $200–$400 million (depending on the scenario modelled).

6 The modelling could perhaps apply to an ETS with a 'safety valve' (as suggested in McKibbin and Wilcoxen 2002) which involves a penalty for non-compliance set at a low level, analogous to an emissions tax for any emissions that exceed the cap in the trading scheme. However, for emissions prices not to adjust there must be some emissions beyond the cap in every year, whereas a safety valve is generally proposed as a device that is only required occasionally.

In summary, MMA conclude that the benefits of moderate low-emissions energy targets — under an ETS — just outweigh their costs. This conclusion rests on the assumptions made about learning-by-doing in low-emissions energy sources. In its model, learning-by-doing delivers benefits of several billion dollars, which is sufficient to explain the difference between the conclusions of MMA and those of other studies. Thus, to evaluate the validity of MMA's conclusions, the assumptions made about learning-by-doing need to be assessed. This is undertaken below, drawing on estimated rates of learning-by-doing for renewable energy technologies from international sources, including the International Energy Agency (IEA).

Assessing the validity of assumptions about technological benefits

There is a scarcity of Australia-specific estimates of the technological benefits from increased deployment of low-emissions energy technologies. Consequently, international estimates need to be used for comparison with the MMA studies. Technological benefits from learning-by-doing can be quantified using 'learning rates', which estimate the reduction in the cost of a technology from a doubling of capacity. Projected, rather than historical, learning rates are appropriate for comparison with MMA's assumptions for future learning rates, as learning rates are liable to vary over time (Winskel 2007).

At first glance, projected learning rates from the IEA and the European Renewable Energy Council (EREC) suggest that the assumptions made by MMA are, as claimed, quite conservative (table A.2). These organisations project learning rates in the range of 5–20 per cent, depending on the technology and (in the case of the EREC estimates) the timeframe. The IEA is an international authority on energy technologies, while the EREC represents the European renewable energy industry. The EREC projections — referred to as supporting evidence in MMA (2007b) — are broadly consistent with those of the IEA.

The IEA and EREC projections, however, were not intended for individual country analyses and are likely to overstate learning-by-doing as a consequence of policy choices in Australia. There are two main reasons for this:

- *They pertain to global learning rates*: The benefits of technology learning are typically shared on a global level (IEA 2006a), so that it will take a doubling of *global* capacity to deliver the cost reductions foreseen. Australia's small share of global renewable capacity means that a doubling of capacity in Australia will only represent a small increase in global capacity, and thus deliver correspondingly small cost reductions. For example, the manufacture of wind turbines involves learning on a global scale, as more than 85 per cent of turbines are produced by just seven firms (Juninger 2007). Australia's share of worldwide wind energy capacity in 2007 was less than 1 per cent (GWEC 2008), meaning that, all else equal, a doubling of capacity in Australia could only be expected to generate a 0.05 per cent reduction in manufacturing costs, based on the IEA projections.

- *The learning rates ascribe all cost reductions to learning-by-doing*: Cost reductions can come from a number of sources apart from increases in capacity, most notably from learning through research and development. Jamasb (2007) shows that accounting for research and development significantly reduces estimated learning rates, with reductions ranging from 15 per cent for wind energy to as much as 90 per cent for solar thermal power. Studies referred to by EREC (2007) and IEA (2006a) to support their projections do not generally adjust for the impacts of research and development.

Table A.2 **Projected future learning rates**

Reduction in cost per doubling of capacity

Technology	*Global learning (EREC 2007)*		*Global learning (IEA 2006a)*	*Australian learning (MMA 2007b)*
	2010	*2050*	*2006–2050*	*2007–2050*
	Per cent	*Per cent*	*Per cent*	*Per cent*
Wind	6	6	5	3
Biomass	15	8	5	6
Geothermal	20	10	5	10
Solar photovoltaic	20	8	18	10[a]
Solar thermal	12	5	5	10
Carbon capture and storage	na	na	na	10

a Does not include small scale photovoltaic generation, which was not considered in the analysis. **na** Not available.

Sources: EREC (2007); IEA (2006a); MMA (2007b).

Thus, it is surprising that MMA assumed learning rates for Australia that are so close to the global rates projected by the IEA and the EREC. Australia's small share in worldwide renewable generation means that an increased reliance on renewables in Australia will have little effect on global learning-by-doing. While Australia may benefit from global learning as renewable capacity expands worldwide, the *marginal* effect on global learning from increased capacity in Australia (to meet a low-emissions energy target) is likely to be very small, if not negligible. For increased capacity in Australia to generate significant technological benefits, there must be considerable scope for Australia-specific learning. The extent to which there is potential for Australia-specific learning in renewable technologies varies by technology, but is typically small.

For wind energy, the limited scope for local learning suggests that MMA's assumed learning rate is optimistic. Wind energy has been described as 'a truly international learning system' (Junginger 2007) and, as mentioned above, learning in the manufacture of wind turbines is likely to be global. MMA (2007b) point to the potential for Australia-specific learning in other components of generation costs. However, on average, turbines represent around 75–80 per cent of the capital costs of wind energy projects (EWEA 2004; IEA 2006b).

Even of the remaining one-quarter to one-fifth of capital costs, there is much scope for learning to be global. There is potential to learn from international experiences in wind forecasting and incorporating wind energy into the electricity network (Porter, Yen-Nakafuji and Morgenstern 2007). In some of the examples noted for Australia-specific learning by MMA — dealing with local wind regimes and high summer temperatures — there is almost certainly some scope to learn from overseas experience.

Given the limited scope for local learning it seems very optimistic to assume a learning rate for Australia that is at least half that of the global learning rates estimated by IEA and EREC.[7]

The MMA assumptions for biomass and geothermal energy assume an Australian learning rate that is *higher* than the global learning rate projected by the IEA. Assessing the basis for these assumptions is difficult, as the MMA report contains no discussion of the potential for Australia-specific learning in these technologies. The mix of technologies used for geothermal power in Australia is likely to differ from the international mix. Geothermal power in Australia is likely to come predominantly from emerging 'hot dry rocks' technologies, whereas internationally, developments in hot dry rocks will augment existing 'hot springs' technologies (Peacock 2007). This will affect the relationship between global and Australian learning rates. However, it is unlikely that a doubling of global capacity will have a smaller impact on innovation than a doubling of capacity in Australia alone.

The assumptions about learning-by-doing in solar energy — for solar thermal at least, MMA assumes a higher local learning rate than the IEA's global rate — are also not supported by any evidence of Australia-specific learning. While some technology breakthroughs (such as thin-film photovoltaic technology (AGO 2003a)) might emerge in Australia, a low-emissions energy target in Australia is unlikely to drive significant global learning and it is unclear that there is potential for significant Australia-specific learning. Thus, Australia-specific learning rates would be expected to be significantly lower than for the world as a whole.

For carbon capture and storage, the assumptions about learning-by-doing are also more optimistic than appear to be justified by the literature, which recommends more circumspect use of learning curves. As the IEA has pointed out, as carbon capture and storage 'has yet to enter the demonstration stage, using learning curves for unproven

7 An argument could be made that the global learning rates for wind energy projected by EREC and the IEA might be biased downwards. The studies referenced to support these projections typically exclude learning that increases the actual quantity of electricity generated without increasing the installed capacity — i.e. improving wind capture from a particular site. This biases estimates downward (Neij et al. 2003). However, this must be offset against the bias upwards that comes from assuming all cost reduction come from learning-by-doing, so the net bias is ambiguous.

technologies can lead to uncertain results' (IEA 2007a, p. 6). An Australian learning rate of double the global projection of 5 per cent suggested by the IEA (Tam 2007) would seem very optimistic.

On the other hand, MMA (2007b) projects *no* learning-by-doing in fossil fuel technologies, which is inconsistent with evidence in the literature — particularly in relation to gas generation technologies (for example Jamasb 2007; Nakicenovic and Riahi 2002). Consequently, the estimated net benefits from low-emissions energy targets in the MMA analysis are inflated because the switch to renewables is assumed not to crowd out any technology development in fossil fuel technologies, and associated learning-by-doing.

In the MMA modelling approach there is also no consideration of the potential to miss out on learning-by-doing in abatement activities other than clean electricity generation. As mentioned previously, a low-emissions energy target will likely deliver no additional abatement when brought in within the umbrella of an ETS, because some other abatement actions will not occur. If these forgone abatement measures also exhibited learning-by-doing, then an additional opportunity cost of the low-emissions energy target will be a reduction in this learning. For example, a low-emissions energy target might mean that some improvements in the energy efficiency of the transport network are no longer necessary to meet the emissions cap, and potential learning in this area would thus be lost. The MMA modelling does not consider this issue because a tax, rather than an ETS, is modelled, so there is no crowding out of abatement. This would not be the case for an ETS that covered the sector affected by the low-emissions energy target.

It should be noted that the interactions between an ETS and a low-emissions energy target are complex. If the ETS allows flexibility as to when emissions permits can be used, then there is potential for a low-emissions energy target to affect not only the composition of abatement, but also its timing.

For example, a low-emissions energy target that was phased out over time could cause an increase in abatement initially matched exactly by a decrease in abatement once the phase out was complete (relative to an ETS operating alone). As GHGs are stock pollutants there would be virtually no environmental consequence of this. It would, however, be expected to add to abatement costs, assuming that the market determined emissions trajectory under an ETS was efficient. This would be an additional cost of adding an MRET to an ETS (and one that is not factored into MMA's analysis). There could also be consequences for learning-by-doing with various abatement technologies from the change in timing.

The implications of these complexities could only be understood through modelling of specific proposals for an ETS and a low-emissions energy target.

Further assumptions implicit in MMA's analysis need to be understood in interpreting their results. First, there is no consideration given to the possibility that 'breakthrough' technologies for low-cost clean electricity might render learning-by-doing in existing renewable technologies redundant. Some analysts have suggested that this is highly likely to occur (Montgomery and Smith 2005).

Second, the results are specific to a particular mix of low-emissions energy technologies being brought forward by the target. If a greater proportion of the target was met by relatively mature technologies, such as wind power, the estimated learning-by-doing benefits could be substantially reduced. Sensitivity analysis would be useful to understand this better.

Third, MMA estimate that there are cost reductions available that would quite quickly make a range of renewable technologies competitive without the support provided by a low-emissions energy target. Despite this, these technologies are for the most part assumed not to be deployed unless this support is provided. This seems questionable, given the financial rewards that would accrue to firms prepared to incur losses initially (provided, of course, that the assumed cost reductions could be achieved).

Conclusions

MMA's modelling suggests that a moderate low-emissions energy target is likely to generate long-term benefits from learning-by-doing that are just large enough to offset additional short-term costs (figure A.4). This means that making even slightly less optimistic assumptions about learning rates would tip the balance, so that a low-emissions energy target (acting in parallel with an ETS) would carry net costs.

MMA (2007b) uses learning-by-doing rates for low-emissions energy technologies that appear to be very optimistic compared to international estimates, while simultaneously assuming no learning-by-doing in fossil fuel generation. The modelling results also require specific conditions to hold about the make-up of technological advances — breakthrough technologies or a dominance of mature renewable technologies could reduce the importance of learning-by-doing. Finally, the modelling applies to a tax, so part of the estimated benefit of a low-emissions energy target from additional abatement would not occur under a pure ETS.

Just one of these factors — the optimistic assumptions about learning-by-doing — is sufficient to explain why MMA concludes that there are cost savings available from low-emissions energy targets, in contrast with other modelling work that has shown that they increase costs compared to an ETS only policy. In addition, the conclusions of MMA's work should be considered in the light of the IEA's warning that: '[t]he sole use of learning curves to estimate future technology costs can lead to over optimistic results on cost reductions and deployment needs' (IEA 2007a, p. 4).

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