
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:

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- 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.

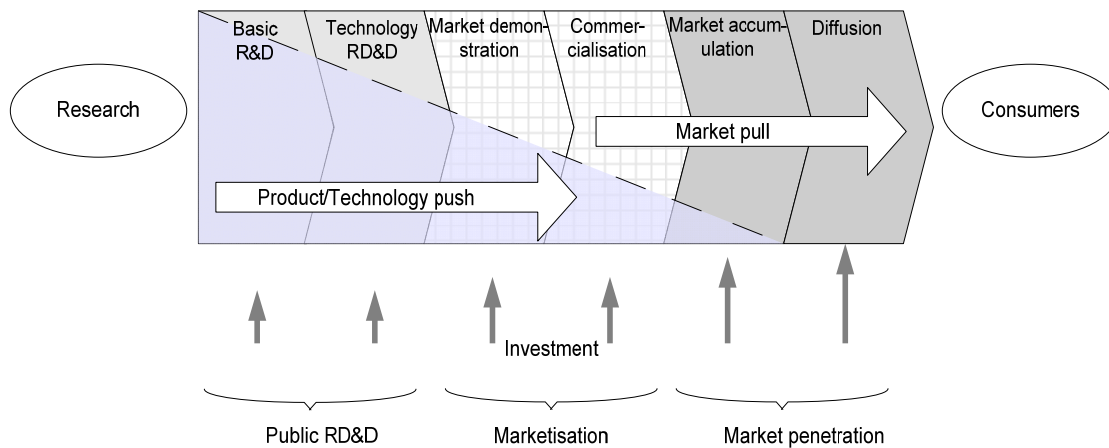
By introducing a cost for emitting GHGs, the ETS will result in greater profitability for, and innovation in, low-emission production technology. The higher the emissions price, the stronger the demand-pull effect on innovation. Whether that stimulus would be adequate to yield optimal innovation is the 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.

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- 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.

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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 measures 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.