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National Emissions Trading for Australia: key design issues and complementary policies for promoting energy efficiency, infrastructure investment and innovation

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Responding to the threat of dangerous climate change is one of the great policy challenges of our time. A fundamental transformation of our society seems likely to be required, particularly to dramatically reduce dependence on low-cost fossil fuels. There is growing worldwide interest in emissions trading as an economy-wide policy response to climate change. In Australia, the recent CoAG Energy Market Review has called for a national emissions trading scheme to replace an existing range of greenhouse-related policy mechanisms.

There are, however, many unanswered questions about such an approach. In this paper, we consider some of the likely limitations of national emissions trading and the potential for complementary measures to compensate for these. We focus particularly on the policy challenges of driving improved energy efficiency, appropriate infrastructure investment and technological innovation. In our view, the introduction of an emissions trading scheme in Australia would be a significant and welcome policy development. Its effectiveness, however, would depend on the overall policy framework within which it was embedded, as well as a number of critical design choices.

In particular, other policy mechanisms would be required to reach those areas of the economy that emissions trading cannot, and to drive longer-term change through investment and innovation. Key design questions include coverage and permit allocation. There are good reasons to include only combustion related emissions given their major contribution, and the measurement challenges associated with other sectors. Energy intensive users in the traded goods sector should be required to participate but, along with other industry sectors, provided with support to lead world's best practice in their fields. There are also good arguments to support permit auctioning over grandfathering.

Energy efficiency will have a critical role to play yet is likely to respond poorly to price-based policy measures alone. Other policy measures will be required. Similarly, many important decisions on infrastructure investments lie outside the direct reach of emissions trading. Finally, governments have an important role in promoting market-led technology innovation that includes R&D, yet also industry development. The CoAG Panel proposal to end measures such as MRET is troubling in this regard. These measures should, instead, be reconfigured to provide industry support compatible with emission trading.

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Introduction

There is considerable and growing worldwide interest in emissions trading as an economy wide policy response to climate change. In Australia, the recent CoAG (2002) Energy Market Review has called for a national emissions trading scheme to replace an existing range of greenhouse-related policy mechanisms.

There are, however, many unanswered questions about such an approach. Firstly, there is our present limited understanding of what is likely to be required in any effective and efficient policy framework for responding to climate change. Second, there is the very limited experience to date with developing trading schemes to achieve environmental objectives, particularly on the scale required here.

In this paper, we consider some of the key likely limitations of national emissions trading, and the potential for complementary measures to compensate for these. We focus particularly on the policy challenges of driving improved energy efficiency, appropriate infrastructure investment and technological innovation.

We first consider the policy challenge of responding to climate change. Recent proposals to introduce national emissions trading while ending a number of other climate change policy measures are then evaluated. Key design issues for establishing an effective and efficient emissions trading scheme are explored. We then consider the additional policy measures required to drive three key climate change responses – improving energy efficiency, driving appropriate infrastructure investment and supporting environment enhancing technology innovation.

The policy challenge of climate change

Mitigating climate change would appear to be one of the great policy challenges of our time. Reasons include the:

- long time frame and global nature of this problem – both in terms of the impacts of climate change, and in developing and maintaining a policy response over decades to a century or more,
- many uncertainties both in the types and scale of adverse impacts from global warming and the most appropriate responses our society can undertake,
- transformation of our society that seems likely to be required in order to protect the climate, particularly in our dependence on fossil fuels, and
- many other important economic, environmental and societal factors associated with our present, and possible future energy systems. These include economic development, other environmental impacts, land-use and resource management issues, energy security and equity concerns.

A climate change policy framework is going to require a longer-tem perspective and mechanisms to allow adjustments and further development over time. It will have to 'reach' virtually all sectors of the economy, and be able to drive far-reaching changes in many of these, especially the energy sector. It also needs to be compatible with the many other societal policy objectives driving our energy choices.

This is unlike any other environmental challenge that we have successfully faced to date. In particular, there would not seem to be any quick and easy technical 'fix' to solve all our problems. We are in uncharted policy waters.

Nevertheless, there is valuable guidance in developing this framework, including:

- the scale and timeline of emissions reductions likely to be required is perhaps a global 50% cut over the next century (IPCC, 2001), with developed countries potentially obliged to take greater cuts over a shorter time frame than this (UK DTI, 2003),
- most of these reductions will have to come from reducing fossil fuel use (IPCC, 2001),
- carbon sequestration within our ecosystem offers difficult to quantify and limited emissions reduction opportunities that are more risky than reducing fossil fuel use (Lohmann, 2001),
- there is a wide range of options for reducing energy related emissions through improved end-use energy efficiency and lower emission and renewable energy supply, with improved energy efficiency holding particular promise (UNDP, 2002; IPCC, 2001),
- infrastructure investment will play a key role – both because of its critical role in framing energy use within society, and because of its

long capital stock-turnover that means inappropriate choices will drive continued emissions for decades (IEA, 2003b),
- technical innovation and progress is essential as our present technology options are almost certainly inadequate for the scale of change required,
- such transitions in infrastructure and technical innovation have important time lags, and therefore need urgent attention, and
- there are many other compelling reasons for taking immediate action (Pew Center, 2002).

Climate change policy frameworks:
In terms of policy development, one key issue is the different role of broad measures that aim to 'reach' across many and diverse economy sectors versus mechanisms targeted at particular sectors or technologies. This is highly relevant to any discussion on how to drive major emissions reductions across the economy, and on how emissions trading might be able to replace a number of more targeted measures.

Policy measures can also be broadly categorised into (Vine et al., 2002):
- support mechanisms such as the provision of information, encouragement and possibly assistance,
- control or regulatory mechanisms including minimum equipment performance standards and electricity retailer licence conditions, and
- market mechanisms including environmental taxes, emissions trading, tax credits and subsidies that change the effective 'price' seen by decision makers for different energy options.

Mechanisms that create a competitive 'market' to find the most appropriate way to achieve a desired policy objective have been receiving growing attention. There is, however, only limited experience with these to date.

Another useful categorisation of policy is in terms of the scope and timeframe of decision-making that is being targeted:
- the use (operation) of existing assets,
- investment choices in infrastructure and equipment, and
- R&D and innovation to widen this range of choices over the medium to longer-term.

As identified above, policies to mitigate climate change will have to focus on driving appropriate investment choices and technical innovation.

Assessing policy efficiency and effectiveness:
Development of a policy framework for climate change has to be assessed on its:
- 'effectiveness' in actually mitigating the dangers of climate change, without damaging progress in other societal objectives, and
- 'efficiency' in doing this at reasonable cost and effort compared against both the benefits of meeting policy objectives, and the other possible frameworks that might be used.

In terms of effectiveness, no country has yet developed a policy framework that promises to deliver the large-scale greenhouse emissions reductions required – emissions in most countries continue to rise (IPCC, 2001). Some countries have, however, made far better progress than others.

Discussions of efficiency often seem to drive policy assessment. Given this focus it is important to clarify how the term is being used. Efficiency can be broadly categorized into:
- *productive*: relating to more efficient use of existing systems and processes,
- *allocative*: the most efficient mix of available options, and
- *dynamic*: referring to the processes of technological and organization innovation responding to longer-term developments.

Despite the common focus on productive and allocative efficiency improvements, it is actually dynamic efficiency that is clearly the most relevant for long-term climate action. This is because it focuses on *transformation* through investment and innovation, rather than incremental improvements.

One of the key policy issues is therefore 'induced technical change' – the role of policy in driving early actions that stimulate technological change and reduce the cost of emissions reduction technologies (Grubler et al, 1999).

Given all of the policy considerations above, it seems highly unlikely that any single policy instrument, even economy-wide emissions trading, could drive all of the necessary changes to meet our climate objectives.[2]

National Emissions trading for Australia

Policy objectives:
The Australian government's stated climate objectives are to meet our Kyoto target and prepare Australia for the large-scale emissions reductions required over the coming century (Australian Government, 2002).

These two objectives have to be coherently linked in policy development. The modest average 108% emissions target in 2008-12 and generous land-use provisions negotiated by Australia within the Kyoto Protocol mean that this target might be met without any significant change within the energy sector (Australia Institute, 2003).

A much more ambitious transformation is, however, clearly required in the longer term, and failure to act now may impede our ability to make future serious emissions cuts. Driving longer-term action therefore represents a rather different policy challenge to that of merely meeting our Kyoto Protocol target.

Assessing the present policy framework:
Australian Federal climate policy to date has largely been based on:

- some targeted R&D funding,
- public education and support programs,
- voluntary industry programs such as the Greenhouse Challenge, Generator Efficiency Standards (GES) and the Greenhouse Gas Abatement Program (GGAP),
- targeted industry development measures including the Renewable Energy Commercialisation Program (RECP), PV Rebate Program (PVRP), Renewable Energy Industry Development (REID), and
- legislated measures including the Mandatory Renewable Energy Target (MRET) and Mandatory Equipment Performance Standards (MEPS) (AGO, 2003).

A number of State based measures including Greenpower, the NSW Greenhouse Benchmarks Scheme and the Queensland 13% Gas Scheme have also been implemented. Some of these key Federal and State schemes are reviewed in MacGill et al (2003).

The CoAG (2002: 229-30) Energy Market Review assessed present Greenhouse policies and concluded "Particular measures being used to abate greenhouse gas emissions from the stationary energy sector are imposing major and unnecessary costs on the Australian community and economy. These measures are poorly targeted, uncoordinated and compete with each other, and creating uncertainty for the energy industry and the wider economy."

In our view, however, this CoAG analysis has some weaknesses. Clearly the major failing of policy measures to date in Australia has been in effectiveness – that is, their failure to reduce emissions, or even halt their continued growth (Outhred et al, 2002a).

Furthermore, the CoAG assessment of the efficiency of current measures appears to be based on macro-economic modelling undertaken for the review by ACIL Tasman (2002). This study attempted to model the costs of different policy frameworks in order to achieve the relatively minor (18.3 MtCO2) emissions reductions for the year 2010 projected for existing stationary energy sector measures. In particular, this study compared the estimated economic costs of existing measures to 2010, against the cost if they were to be replaced by an emissions trading scheme.

This modelling, however, is of only limited use in assessing the likely efficiency of climate policy measures. The appropriate short-term policy objective is to meet the national 108% emissions target of the Kyoto Protocol *in a way* that best supports the long-term objective of major emissions reductions, rather than just minimising short-term costs.

Furthermore, even if a longer timeframe and larger emissions reductions had been modelled, the available macro-economic tools generally have major weaknesses in modelling innovation and, in particular, induced technical change.[3]

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[2] See IEA (2002), which details more than 200 *new* policies and measures undertaken in the year 2000 to address energy-related emissions in IEA member countries.

[3] See, for example, Grubler et al (1999) who note "Technological choices largely determine the long-term characteristics of industrial society, including impacts on the

The goal of determining the best mix of 'least cost' measures to achieve our climate protection objectives has to be seen in the context of concerted long-term action. Large-scale innovation and change in the energy sector will be required, rather than merely seeking the cheapest available 'options' now.

For example, MRET is intended to drive renewable energy industry development as well as emissions reductions (ORER, 2003). Such industry development could provide key long-term emissions reductions by reducing the cost of renewable energy. Its 'value' in achieving this can hardly be measured in macro-economic modelling with a 2010 time horizon and 'highly stylised' models of technology development.

Proposed National emissions trading to replace existing measures:
The CoAG panel proposed that a range of existing climate policy measures – MRET, GES, GGAP and the NSW and Queensland State schemes – be replaced by an economy wide emissions trading system (2002: 233).

In our view, the introduction of an emissions trading scheme in Australia would be a significant and welcome policy outcome, which, if appropriately structured, could greatly assist the transition to an economy with lower carbon intensity (Outhred et al, 2002a). The effectiveness of such a scheme, however, will depend on the overall policy framework within which it is embedded, as well as a number of critical design choices.

While it is possible to argue what other policy measures might best complement emissions trading, there is no question that other policy mechanisms will be required. No single universal policy could reach across the widespread and diverse greenhouse emitting activities within the economy, appropriately motivate all of the many possible policy 'agents' and stakeholders involved and drive the transformation required.

This is acknowledged in the AGO (2002: 10) submission to the CoAG Panel – "In addition to a national emissions trading system, there is likely to be a need for supplementary measures that address market impediments and aim to promote consistent incentives for abatement and innovation in those areas of the economy that an emissions trading system would have trouble reaching."

Others have made the point more forcefully, such as the UK Energy White Paper (UK DTI, 2003) – "On its own emission trading will not be enough to deliver our environmental goals. We will need additional measures."

As noted earlier, areas of climate change response particularly likely to require additional policy support include energy efficiency, infrastructure investment and innovation. For example, the MRET scheme is a development policy for the renewable energy industry that is compatible with permit-based emission trading.

Lessons from the Australian National Electricity Market:
A greenhouse emissions market will be intimately linked to present energy markets. There are valuable lessons from experiences to date with the National Electricity Market (NEM) that can contribute to the present debate on emissions trading.

The electricity industry is not a 'natural' fit for competitive markets and the NEM is a 'designer' market in many regards (Outhred, 2003b). Governments create and can change the rules. The chosen 'design' rules can greatly impact the relative competitiveness of existing market players, and possible new entrants. Rule changes also have to be made with care as they can change the market signals, relative competitive positions and hence drivers for participants.

National emissions trading would be even more of a 'designer' market than the NEM, and the chosen set of 'design' rules, and the 'meta-rules' for changing these design choices, will both be critical to its operation.

The operation of the NEM in practice has also surprised some policy makers. For example, governments apparently expected emissions from the electricity sector to reduce after restructuring despite brown coal power stations having lower operating costs than black coal or gas power stations (CoAG, 2002). We can similarly expect some surprises with emissions

natural environment. However, the treatment of technology in existing models that are used to project economic and environmental futures remains highly stylised."

trading as the 'magic of markets' drives participants to seek low cost emissions through all means available. The scheme design will require mechanisms to correct unexpected, adverse, outcomes in market operation.

Another issue that has become apparent is how the existing NEM rules favour incumbents. It is always going to be easier to write rules for existing players than possible new ones. In consequence, it would seem easier to deliver 'economically efficient' operation than appropriate investment. Correcting this requires broad stakeholder involvement, design effort and the ability to change rules as technology progresses. Major reductions in greenhouse emissions will critically hinge on appropriate investment, and markets can struggle to deliver this.

Design of national emissions trading:

The Australian Greenhouse Office has given considerable thought to national emissions trading with four (1999) discussion papers and, most recently, a (2002) submission in response to a request from the CoAG Panel. This CoAG Panel (2002: 236) noted that "Implementation of an economy wide emissions trading system is dependent on resolving key design issues." In this section, we consider some of these key design issues, in particular the CoAG Review proposal that energy intensive industries in the traded good sector be excluded from any emissions trading.

'Cap and trade' versus 'baseline and credit':
'Cap and trade' systems are built around measurable, physical emissions. 'Baseline and credit' schemes on the other hand must abstract 'baselines' of business-as-usual behaviour of participants in order to then 'credit' those participants that don't emit as much as they would otherwise have. Determining baselines is fraught with measurement challenges, assumptions and moral hazards.

It is widely accepted that 'cap and trade' schemes are preferable for economy-wide emissions trading (AGO, 1999; CEP, 2002) for these reasons and also higher market liquidity, fairer permit allocation and greater credibility and reliability. The 'baseline and credit' NSW Greenhouse Benchmarks Scheme has glaring failings in this regard (Outhred et al, 2002b) and could not be easily integrated or transformed into effective national emissions trading. This scheme also illustrates the hazards involved in attempting to quantify and trade efficiency improvements.

Coverage:
As noted, by the AGO (2002: 8-9) "The greater the reach and consistency of the price signals generated by a trading system, the greater its capacity to drive emission reductions in those areas of the economy where this can be accomplished most cheaply… Combustion-related emissions can be covered very effectively by arrangements focusing on emissions from fossil fuel use [which] accounts for around 63 per cent of total emissions."

The AGO continues – "The economics of extending a trading system beyond combustion-related CO2 emissions are less clear, because reliable estimation and attribution of these emissions can be expensive."

This would actually seem to understate the challenge with those sectors of the economy where there is not yet sufficient knowledge to reliably and credibly estimate emissions, regardless of expense. Ecosystem sequestration is a relevant example (Lohmann, 2001).

Such sectors will certainly need complementary measures to drive abatement activities. We are not sure, however, that trading "does offer scope for the voluntary participation of emitters engaged in these activities, and those seeking to earn 'credit' for sequestration activities" (AGO, 2002: 9).

The dangers of incorporating 'baseline and credit' emissions reductions into 'cap and trade' schemes were noted above. Allowing 'volunteers' generally makes the baseline problem worse since those participants in a sector with easy 'business-as-usual' credits will join up, while those participants facing a real abatement challenge stay away.

Exclusion of energy intensive users in the traded goods sector
The CoAG (2002: 233) Review has proposed "energy intensive users in the traded goods sector are to be excluded from the emissions trading system until Australia's international competitors introduce similar schemes." This is

because of their contribution to the economy and the competitive disadvantage they would face.

Although the Australian economy certainly has important energy industries, care needs to be taken in linking Australia's economic potential to energy intensive industry development. For example, the Aluminium smelting industry consumes almost 15% of Australia's electricity generation yet contributes only 0.15% of Australian GDP or around A$1 billion (AGO, 2002) while receiving electricity price subsidies estimated at A$210 million to more that $250 million a year (Australia Institute, 2002).

Energy intensive industries are responsible for a very significant proportion of national greenhouse emissions. A policy choice to continue to subsidise and promote them should be taken only after full consideration of its economic and climate change implications. Any such subsidies should be made in a transparent manner as targeted 'industry development', not potentially concealed by excluding them from emissions trading. Such exclusion would seem to shield these industries from pressures to reduce emissions and might therefore promote economically inefficient outcomes.

The CoAG Panel has proposed that "excluded entities will be required to meet world's best practice in relation to their energy use".

There are, however, great practical difficulties, and potential moral hazards, in defining 'world's best practice' for this approach. For example, Energetics (2003) notes that "Benchmarks are frequently cited as a performance measure. The establishment of meaningful benchmarks in a regulatory context, however, while intuitively appealing, is potentially complicated and problematic… To be meaningful and credible, benchmarks developed must be specific to the exact product, or mix of products being produced."

Thus, it would likely be more productive to assist the traded goods sector to consistently lead world's best practice, than to waste time and money trying to measure it.

Permit allocation:
The CoAG review did not recommend any particular permit allocation, however, the AGO (2002: 3) submission suggested that "While it can play a part in determining the incentives and efficiency characteristics of a system, and care must be taken in this regard, its dominating influence is most likely to be in the area of equity."

As Burtraw (2001) notes, the idea that allocation doesn't greatly affect economic efficiency "is based on an idealized characterization of markets that often is not realized." This qualification is very true for our non-ideal energy markets.

A study of emissions trading in the US electricity industry estimated that auctioning the permits would be dramatically more cost-effective than the other approaches—roughly 50% cheaper than grandfathering or an approach based on generator performance standards. The advantages of auctions were even greater for larger emissions reductions targets (Burtraw, 2001).

These findings are specific to the US electricity industry. Nevertheless, they highlight the importance of permit allocation. Given that effective climate action will be driven by infrastructure and equipment investment, and innovation it is important not to entrench the incumbents against new entrants. Furthermore, the choice of approach should be made with consideration of the very significant emissions reductions required over the longer term.

Energy efficiency

End-use energy efficiency will play a critical role in any economically efficient and environmentally effective policy response to climate change. It offers some of the most cost-effective greenhouse gas emissions reductions available – many energy efficiency options have negative abatement costs – as well as offering many other environmental and social advantages (UNDP, 2002; IPCC, 2001). The potential scale of efficiency improvements is also great.[4]

Despite these many benefits, there is a clear need for policy intervention to promote energy efficiency as many of its benefits are market

[4] For example, the recent UK (DTI, 2002) *Energy White Paper* states that "The cheapest, cleanest and safest way of addressing all our goals is to use less energy." It also estimates that half of the emissions reductions required within the UK by 2020 can come from energy efficiency.

externalities while there is also widespread market failure in demand-side decision making as energy users fail to undertake even cost-effective energy efficiency options.[5]

While emissions trading can 'internalise' some of these present market externalities, the greater challenge appears to be in solving existing market failures in decision-making. The reasons for these failures are complex, but include:

- a poor understanding of energy efficiency by key decision makers,
- difficulty in separating the effects of energy efficiency enhancements from other phenomena that influence energy consumption,
- little motivation for many participants facing generally low costs for energy, and
- institutional barriers to action for even informed and motivated decision makers.

Adding to these policy challenges are the wide range of energy services, diverse equipment and infrastructure, and many decision makers involved.

Emissions trading alone can only promote energy efficiency by adding a price incentive. This is, however, unlikely to influence decision makers who already fail to act on many cost-effective energy efficiency actions.

The UK Energy Saving Trust (2002) notes that "Price based mechanisms, in general, will not address the information and consumer related barriers to energy efficiency investment – here regulatory solutions tend to be more effective." In particular, "Neo-classical economic conceptions of regulation as inherently less efficient than market based instruments cannot be applied to energy efficiency, because of the extent of market failure… In practice, some examples of regulation have proved very cost-effective."

The role of regulation for energy efficiency is also highlighted in the UK (DTI, 2003) *Energy White Paper*. Its major policy proposals are higher building and product standards and encouraging innovation. This would seem to be an urgent policy priority for Australia, regardless of the progress of this proposed national emissions trading scheme.

Infrastructure investments

Our future infrastructure investments will play a critical role in major longer-term emission reductions. They define the available choices for many climate change action, and their respective costs. The planning of our cities, building stock, transport networks and energy supply industries are all key infrastructure in this regard.

This infrastructure also typically has a long capital stock turnover – from decades to half a century or more (IEA, 2003b). This means that inappropriate infrastructure investments now lock in significant greenhouse emissions for decades to come.

Many important decisions on infrastructure are made, or tightly directed, by local, state and federal governments. Price-based mechanisms such as emissions trading may not 'reach' these decision makers, without other policies to guide government decision-making in place.

Examples include regulation of energy industry investment through revenue regulation for gas and electricity network service providers (CoAG, 2002). Other examples could include a regulatory requirement for interval metering of all industry participants, and standardised connection agreements for small generators (Outhred et al, 2002a).

The potential for emissions trading to appropriately drive investment will critically depend on the longer-term price signal that it sends. An emission trading scheme designed to minimise the price of emissions over the shorter term may diminish this signal, and adversely impact on appropriate investment decision making for the longer term.

Even with an appropriate long-term signal, particular investors may not be the party required to buy permits to operate its infrastructure in the longer term. For example, the prospects for improving energy efficiency in our building stock have been greatly damaged by the split incentives between builders paying capital costs and tenants paying operating costs.

[5] For Australia, see SEDA (2002) which reports that "Numerous studies indicate up to 20% potential energy savings (on average) with efficiency measures that deliver at least 20% internal rate of return."

There is also the question of assessing and responding to adverse cumulative impacts that arise from many relatively small private investments. It is unreasonable to expect that private investors can, or should, have to account for such cumulative impacts if their own potential contribution is relatively minor. Again, governments have a vital role to play.

For example, large-scale wind industry development in Australia seems to require a regional planning framework for reasons including the potential for projects to share network investments and their cumulative impacts on power system operation (Outhred, 2003a).

The limitations of emissions trading in driving investment are very relevant to the Australian electricity industry given recent projections that very significant investments will be required over the coming decade (CoAG, 2002).

There are great risks for longer-term emissions in getting such investments wrong. For example, one new conventional 1000MW coal fired base-load generator will emit almost seven million tCO2 each year.[6] Over a typical 40-year life, this plant will emit nearly 280 million tCO2.

Technological innovation

The IPCC identifies "technology as a more important determinant of future greenhouse gas emissions and possible climate change than all other driving forces put together" (IIASA, 2002).

Innovation has two key themes, *invention* and *application.* Research and development are the key steps of the invention phase. Demonstration and commercialisation are needed to move from invention to possible widespread adoption. Many argue that taking a technology from technical feasibility to full commercialisation actually poses the greatest innovation challenge (Norberg-Bohm, 2000; Grubler et al, 1999).

The IEA (2003a) has recently reported on the development of markets for new energy technologies, identifying three key components:

- Research, Development and Deployment, focussing on the innovation process,
- Market Barriers, focussing on decision making within markets using economic analysis, and
- Market Transformation, focussing on the distribution chain from producer to user.

Experience suggests that all three components are generally required to successfully introduce new energy technologies.

The important role of Government in driving 'public good' innovation is widely accepted yet not entirely understood. One of the key policy opportunities for governments is 'induced technical change' – measures that stimulate technological progress to rapidly drive down the costs of particular technologies.

One clear role for government is supporting R&D. The problem of obtaining sufficient private investment in socially beneficial R&D such as that into sustainable energy systems is not just one of market externalities.[7] Therefore, it cannot be solved merely through pricing mechanisms such as emissions trading.

R&D is, however, only part of the story. It is widely agreed that government activities to promote environmentally driven technological development must include both supply-push and demand-pull policies (Norberg-Bohm, 2000). Loiter and Norberg-Bohm (1999) note that weak demand-side policies risk public R&D expenditure on technological innovation. Markets have the role of testing R&D results and providing guidance for future efforts.

At the same time, this demand-side support cannot just be price mechanisms for environmental externalities such as emissions trading. For example, the 'price' of new energy technologies can be greatly lowered through government support that drives learning from experience and economies of scale in these industries (Isoard and Soria, 2001).

[6] A 1000MW plant with emissions of 850kgCO2/MWh operating at 92% capacity factor will emit around 6.85 million tCO2 each year.

[7] See for example, the UK EPU (2001) which states "The rationale for Government funding of R&D applied both in the UK and internationally is based on the premise that social rates of return on some R&D, for example energy technologies that can contribute to environmental problems and which involve lengthy development timescales, are higher than private rates of return. Investment in these areas is therefore likely to be to low without Government support or intervention."

Industry support programs will therefore still be required, even with the introduction of emissions trading. The CoAG Panel proposal to end MRET among other measures is troubling in this regard. Such measures should, instead, be reconfigured to provide industry support compatible with emission trading. Many countries are setting very ambitious renewable energy targets in comparison with that of MRET, in order to drive development of their own renewable energy industries (BCSE, 2003).

Conclusions

Responding to the threat of dangerous climate change is one of the great policy challenges of our time. A fundamental transformation of our society seems likely to be required, particularly in reducing our use of low-cost fossil fuels.

In Australia, the recent CoAG Energy Market Review has called for a national emissions trading scheme to replace an existing range of greenhouse-related policy mechanisms.

In our view, the introduction of an emissions trading scheme in Australia would be a significant and welcome policy development. Its effectiveness, however, would depend on the overall policy framework within which it was embedded, as well as a number of critical design choices.

We have only limited experience with emissions trading schemes to draw upon in establishing this supportive policy framework and making appropriate design choices. Nevertheless, some lessons seem clear.

Key design questions include coverage and permit allocation. There are good reasons to include only combustion related emissions given their major contribution, and the measurement challenges associated with other sectors.

Energy intensive users in the traded goods sector should be required to participate but, along with other industry sectors, provided with support to lead world's best practice in their fields. There would also seem to be good arguments to support permit auctioning over grandfathering.

Other policy mechanisms would be required to reach those areas of the economy that emissions trading cannot, and to drive longer-term change through investment and innovation.

Energy efficiency will have a critical role to play yet is likely to respond poorly to price-based policy measures alone. Similarly, many important decisions on infrastructure investments lie outside the direct reach of emissions trading. Finally, governments have an important role in promoting market-led technology innovation that includes R&D, yet also industry development.

The CoAG Panel proposal to end measures such as MRET is troubling in this regard. These measures should, instead, be reconfigured to provide industry support compatible with emission trading.

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