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Some design lessons from market-based greenhouse gas regulation in the restructured Australian electricity industry

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Abstract

There is growing worldwide interest in the use of market-based policy instruments for climate change regulation in the electricity sector. These mechanisms would seem to offer some efficiency and flexibility advantages over more traditional regulatory approaches, while being highly compatible with competitive market-based electricity industries. Australia has been an early and enthusiastic adopter of both electricity industry restructuring and market-based environmental instruments. This paper first outlines some of these recent policy developments. In particular, we describe the objectives, design and outcomes to date of electricity industry restructuring, the Mandatory Renewable Energy Target, the NSW Greenhouse Benchmarks, the Queensland 13% Gas scheme and Government accredited Green Power. From this, we draw some key design lessons for such market-based instruments. These include the perils of abstraction in scheme design, the vital importance of setting appropriate baselines in 'baseline and credit' schemes, the possibility that such measures may interact in ways that reduce their environmental effectiveness, 'market for lemon' risks with tradable instruments that have measurement, verification or 'additionality' difficulties, and the challenges of creating transparent liquid markets for these mechanisms. The mixed performance of these Australian schemes to date illustrates the need for great care in designing such market-based approaches.

Keywords: Climate change; Regulation; Market-based instruments

1. Introduction

Electricity industries worldwide are undergoing rapid and widespread change. This has been largely driven by the market-oriented restructuring underway in many countries and the growing role of efficient and flexible natural gas-fired combined cycle gas turbine (CCGT) generation. Increasingly, global environmental concerns about climate change are also becoming a major driver in industry development.

Australia is no exception to these international trends. Electricity industry restructuring has been underway for over a decade and a multi-region National Electricity Market now covers some 90% of the population. Also, the electricity sector's major contribution to Australia's greenhouse gas (GHG) emissions is of growing concern, and has now led to the introduction of a number of regulatory measures. Of interest here is that Australia has been an early and enthusiastic adopter of market based mechanisms for climate change regulation in the Electricity Industry.

This paper builds on earlier work by the authors and others on the design of these market-based measures.[1] In particular, we attempt to draw some of the key design challenges that have emerged from early experience with these mechanisms.

The paper is structured as follows. In Section 2 we consider the particular regulatory challenges posed by

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[1]See, for example, MacGill et al. (2003a). The UNSW Electricity Restructuring Group (ERGO) website at www.ergo.ee.unsw.edu.au provides more information on this ongoing work.

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global warming and the electricity sector, and the growing interest in market-based approaches as a way to address these challenges. Section 3 discusses climate change regulation in the restructured Australian electricity industry, and the emerging role of market-based regulatory tools.

Section 4 then analyses the objectives, design and performance to date of some relatively recent and innovative Australian policy developments. We consider electricity industry restructuring, the Federal Mandatory Renewable Energy Target (MRET), the NSW Greenhouse Benchmarks, the Queensland 13% Gas Scheme and Government Accredited Greenpower.

In Section 5 we consider some of the key design issues identified so far from the implementation and operation of the schemes. Finally, Section 6 discusses possible future developments in climate change regulation for the Australian electricity industry.

2. The regulatory challenge of climate change

2.1. The role of regulation in energy markets

A possible economist's, and Australian National Competition Policy,[2] perspective on the role of governments is that they are there to act when markets do not provide efficient outcomes for society. Reasons for such market failure can include monopolies and the failure of competition, the need to provide essential public goods, incomplete markets, information failures, boom-bust business cycles and market externalities.

Energy markets appear to be at risk of market failure for all the above reasons, as they often exhibit:

- natural monopolies in at least some network provision, and a generally concentrated supply side,
- a vital role in providing essential public services, and contributing to wider societal objectives such as economic growth,
- dysfunctional interactions with some other important markets due to uncoordinated decision making,
- information failures, particularly on the demand-side where many end-users are poorly informed,
- capital intensive and long lived assets that can lead to cycles of over and under-investment, and
- very significant environmental externalities, particularly from the GHG emissions that arise from the use of fossil-fuels.

Each of these factors may limit the power of competition by itself to effectively regulate participant behaviour in energy markets. Within this economic perspective, the role of government regulation is to ensure that imperfect energy market 'means' still lead to desired societal 'policy' ends.[3]

2.2. The challenge of climate change regulation in the electricity industry

Climate change is one of the most urgent and fundamental problems facing energy market policy makers. Market externalities pose particular challenges because of the difficulties in measuring many of social costs and benefits, and the need to trade off these, and private costs and benefits, between parties. Furthermore, climate change appears to be the most challenging environmental externality that governments have attempted to regulate to date. Beyond the prospect of highly damaging and perhaps irreversible global warming, there is 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,
- only recent, widespread, recognition of the need to reduce GHG emissions,
- many uncertainties both in the types and scale of adverse impacts from global warming and the most appropriate responses society can undertake,
- far-reaching transformation of society that seems likely to be required in order to protect the climate, particularly in its present dependence on fossil fuels, and
- many other important economic, environmental and societal factors associated with present, and possible future energy systems. These include economic development, other environmental impacts, energy security and equity concerns.

The electricity sector in many countries is one of the largest contributors to GHG emissions, and therefore a major target of climate change regulation. Along with all of the potential market failures with energy markets noted earlier, the closely coupled nature of electricity industry operation poses particular regulatory problems. Electricity consumers receive a complex and opaque mix of energy from all operating power stations. Decision making—both investment and operational—by all generators, network operators and end-users contributes to overall industry operation over time. This creates particular difficulties in distinguishing participant responsibility for environmental impacts, and in inducing them to take actions to reduce these.

[2]See the National Competition Council's website www.ncc.gov.au for more information on Australia's National Competition Policy.

[3]As noted by Jacobs (OECD, 1995) governments engage in three main activities: they tax, they spend and they regulate. Of these, "regulation is the least understood… but… has a broader and more far-reaching impact on economic growth, development of the rule of law and government effectiveness than do tax and fiscal policies."

2.3. Approaches for environmental regulation in restructured electricity industries

Approaches to environmental regulation can be classified broadly in two categories (IEA, 2002)

- *technical*—traditional 'command and control' regulation; for example, maximum allowable emissions limits for equipment, and
- *financial*—including pollution taxes, tax credits or subsidies, and markets in tradable pollution permits or credits.

Most environmental regulation in electricity industries to date has focussed on air, water and solid waste pollutants as well as resource planning issues, but not GHG emissions. Many regulatory frameworks were originally implemented for traditional, vertically integrated and monopoly (often government) owned and operated power systems.

Technical 'command and control' approaches have generally been favoured. Such regulations are generally focussed on particular types of environmental impacts, and their direct causes. They are therefore applied to the industry participants physically causing the environmental impact—predominantly the generators in the case of the electricity industry.

Financial approaches to environmental regulation change the effective 'price' seen by decision makers for different energy options, rather than mandating technical performance. Such approaches take advantage of existing competitive pressures on market participants to reduce costs and maximise returns. Regulated parties are given a financial motivation to act, and considerable flexibility in how they choose to do so. For example, generators facing a tax per unit of a particular pollutant they emit can choose to reduce such emissions through any means available to them—for example, investment in new technology or reduced operation. Alternatively, they can choose to pay the tax. The potential advantages for regulators are many. In particular, they can transfer much of the decision making over to parties who are motivated and often well placed to determine economically optimal solutions for meeting regulatory objectives. The use of financial approaches can also help avoid perverse interactions between different policy measures—their separate pricing signals can be weighed up, in total, by regulated parties.

Creating markets for tradeable pollution permits and credits can potentially offer even greater flexibility to participants and their regulators. The last thirty years has seen growing interest in the concept of implementing environmental policy through use of market mechanisms to take advantage of the efficiency of the market process (Montgomery, 1972; Ellerman, 1999; IEA, 2002). For the electricity industry example above, generators might be required to have a permit for each unit of a particular pollutant they emit. These generators could choose to reduce emissions or, instead, purchase permits from other participants who have lower abatement costs. Regulators can set environmental objectives, and then leave it to the market to resolve how this objective is actually achieved.[4]

Regulators also have greater flexibility in determining which parties the environmental obligations are imposed upon. For example, pollution taxes are most easily levied directly on generators, yet tradable permits and credits schemes can designate that other industry participants (usually retailers[5] in the case of the electricity industry) are liable for their 'imputed' environmental impacts.

The electricity industry restructuring now underway in many countries has generally had the stated intention of increasing economic efficiency and customer choice by introducing greater competition into, formerly monopoly, electricity generation and retailing.[6] Such restructuring can markedly change the context in which regulators operate. Environmental regulation in a restructured electricity industry must be compatible with competition yet still be effective in meeting environmental objectives. This is not easy to achieve, as many environmental impacts appear as un-costed externalities to electricity industry participants, who may give them low priority compared to their primary objectives of surviving and prospering in a competitive industry.

While some traditional regulatory approaches remain clearly appropriate in restructured industries, others may no longer be effective following the introduction of market-based competition. An example of this is the implicit regulation possible when a government owns a vertically integrated monopoly industry.

There are, however, other regulatory approaches that might be particularly appropriate for restructured industries. For example, restructuring may provide for more commercially driven behaviour by industry participants and therefore enhance their responsiveness to financial measures.[7] Environmental 'markets' for tradeable pollution permits and credits have certainly been argued to be highly compatible with

[4]See, for example, Burtraw's (2000) discussion of the Tradable Sulphur Dioxide Emission Permits Program in the US, and its role in driving innovation within the electricity sector.

[5]The electricity industry parties that are actually responsible for selling electricity to end-users are called retailers in Australia. Different terms are used in some other industries—for example, suppliers in the UK.

[6]The terms 'industry reform', 'deregulation', 'liberalisation' and 'restructuring' have all been used to describe this general process. The authors prefer 'restructuring' to 'reform', although the latter is the term of choice amongst Australian governments and regulators.

[7]See, for example, the Working Group 3 Report on *Mitigation*; policies, measures and instruments in the IPCC (2001) Third Assessment Report.

competition-based restructured electricity industries, and there is growing worldwide interest and efforts in such approaches. Australia has been a particularly early and enthusiastic adopter of market-based tools for climate change regulation.

3. Climate change regulation in the restructured Australian electricity industry

Electricity restructuring in Australia has been underway for over a decade as a key part of National Competition Policy (NCP) reforms begun in the early 1990s. The centrepiece of this restructured industry is a multi-region 'National Electricity Market' (NEM) that now covers five States and Territories (jurisdictions)—home to almost 90% of the Australian population.[8] This physical wholesale spot market has an associated ancillary services market, while there is active forward trading in financial instruments (Outhred et al., 2003a). Compulsory participants in NEM include all generators and dispatchable links greater than 30 MW, as well as network service providers and electricity retailers.

Australia is a confederation of six states and two territories. Five of these states and territories are in the NEM. The NEM is administered and operated by the National Electricity Market Management Company (NEMMCO) in accordance with the National Electricity Code (NEC). The National Electricity Code Administrator (NECA) is responsible for supervision, enforcement and ongoing development of the NEC. NEMMCO and NECA are both owned by the participating jurisdictions and, in that sense at least, both organisations take direction from the Australian Federal government and the governments of participating jurisdictions. The NEC gives the Australian Competition and Consumer Council (ACCC) a specific role as economic regulator of transmission networks as well as its usual role of general market regulation under the (Federal) Trade Practices Act.[9]

The NEC sets out principles for economic and technical regulation of Distribution Network Service Providers and Jurisdiction-level regulators are responsible for its implementation. Jurisdiction-level governments determine retail electricity market arrangements.

A significant number of large generation companies within the NEM remain under government ownership, mainly at the jurisdictional level. These rather complex arrangements reflect the development of the electricity industry in Australia over the last century as state owned and operated, vertically integrated and largely state-based networks.[10] It certainly raises particular challenges for industry regulation (Sharma, 2003).

The Australian electricity industry currently contributes over 32% of Australian GHG emissions and has shown the highest growth in emissions of any sector over the last decade (Commonwealth of Australia, 2002). This rapid emissions growth is projected to continue unless additional measures are taken. One of three national energy policy objectives agreed by the Federal and State governments is "Mitigating local and global environmental impacts, notably greenhouse impacts, of energy production, transformation and use" (CoAG, 2002).

While restructuring of the Australian stationary energy sector has been largely driven by economic objectives, the Federal government expected that these reforms might also contribute to climate change objectives (Commonwealth of Australia, 1997, p. 4). This is consistent with the original government brief to design a restructured industry that was both economically efficient and environmentally sound.[11] In this paper we therefore consider the Australian experience with market-based electricity industry restructuring as well as specific market-based climate change measures.

Federal Government efforts in climate change policy development are led by the Australian Greenhouse Office (AGO). It has programs that regulate the technical performance of electrical end-use equipment (Mandatory Equipment Performance Standards) as well as a number of voluntary schemes for both generators and energy consumers. There are also financial incentive (grant) schemes including the Greenhouse Gas Abatement Program (GGAP) and Renewable Energy Commercialisation Program (RECP).[12] Of interest in this paper, however, is the AGO's Mandatory Renewable Energy Target (MRET)—a tradeable certificate scheme for promoting 'new' renewable generation.

State governments have a range of regulatory roles in managing the environmental impacts of the Australian electricity industry. The operation of generators is subject to state-based environmental regulation of air (but not currently climate change), water and ground pollutants. At least one Australian state has introduced

[8]The island State of Tasmania also seems set to join the NEM with advanced plans for an undersea interconnector to the South Eastern grid (NEMMCO, 2003).

[9]See the NEMMCO website, www.nemmco.com.au, the NECA website, www.neca.com.au and the ACCC website, www.accc.gov.au for more information.

[10]The CoAG (2002) Energy Market Review recommended major changes to energy market regulation, including the creation of a single national regulator. The Ministerial Council for Energy (MCE, 2003), which brings together Federal and all State Energy Ministers, has recently recommended that two new statutory commissions be established—an Australian Energy Market Commission (AEMC), with responsibility for rule-making and market development; and an Australian Energy Regulator (AER), with responsibility for market regulation.

[11]National Grid Management Council, National Grid Protocol First Issue, December 1992.

[12]For more information on these and other programs of the AGO, visit its website at www.greenhouse.gov.au.

financial regulations that apply to these electricity generators. New South Wales (NSW) has introduced 'load based licensing' of various pollutants that operates like a pollution tax. NSW also has an innovative, Internet based, salinity-trading scheme to regulate saline discharges from mines and power stations in the Hunter River catchment.[13]

In terms of climate change, jurisdictions require environmental impact assessments for significant new projects including power stations. The assessment may take into account GHG considerations.[14] The focus of this paper, however, is a number of recent market-based state government schemes with primarily climate change objectives:

- the NSW Greenhouse Benchmarks Scheme,
- the Queensland 13% Gas scheme, and
- a scheme for 'Government certified' Green Power implemented by the jurisdictions.

Electricity industry restructuring, MRET and the above three policy measures represent a range of possible market-based approaches to driving GHG emissions reductions. Most have climate change as a major objective, although other societal objectives such as industry development also feature. All rely on competitive markets to help deliver environmental 'goods'.

In the next section we assess the objectives, design and experience to date with each of these measures. From this, we then draw some of the key design lessons that have arisen from the use of market-based measures for climate change regulation within the Australian electricity industry.

4. Key Australian market-based climate change measures

4.1. Electricity industry restructuring

As previously discussed, there was an expectation by at least some government policy makers that the electricity industry restructuring process would contribute to climate change objectives by promoting (Commonwealth of Australia, 1997, p. 4):

- efficient competition in supply by embedded cogeneration and renewable energy sources,
- more appropriate patterns of energy use through incentives for investment in energy efficiency, and
- penetration of natural gas into the energy sector with consequent lowering of the average GHG intensity of energy.

Unfortunately, these outcomes have not materialised. Rather than the original estimate that energy market reform would drive a 14 Mt reduction from 'business-as-usual' GHG emissions by 2010, changes to industry structure and operation over the last five years are now projected to increase emissions by 0.1 Mt CO2-e (CoAG, 2002). Reasons include:

- the low cost of coal fired generation in Australia,
- excess electricity capacity in the initial stages of the reform process that depressed market prices therefore favoring increased electricity use, and low operating cost but high emission generators, particularly brown coal units (Commonwealth of Australia, 2002),
- reduced emphasis on energy efficiency given lower industrial and commercial electricity prices (Pears, 2002),
- relatively immature and inflexible gas markets (CoAG, 2002),
- the failure to design an electricity market that internalised GHG emissions,
- market design and regulation based in part on historical arrangements, that can therefore disadvantage new technologies; for example, wind energy (Outhred, 2003b), and
- the supply side orientation of market reforms to date that have not engaged end-use consumers to become active market participants (Outhred et al., 2002a).

A number of these issues are now being addressed. Supply demand balance has tightened considerably over the past several years, and new gas generation is coming on line. The CoAG Energy Market Review has also proposed changes to the Australian gas market to foster competition and new supply (CoAG, 2002, p. 37). However, new coal-fired power stations have also recently entered the NEM and there are plans for more.

International experience with restructuring has also highlighted the impact of pre-existing circumstances including fuel mix, national endowment of resources and existing infrastructure on environmental outcomes (IPCC, 2001, Working Group 3).

Some of the reasons for the failure of Australian electricity restructuring to deliver reduced GHG emissions, however, appear to be a more fundamental outcome of the restructuring process itself. Electricity is not a natural fit to commodity style competitive markets. Hence, electricity markets are 'designer markets' in attempting to match a manageable commercial model to the complex physical realities of electrical power systems (Outhred, 2003a).

One problem for these market designers is that it is usually easier to be guided by historical arrangements

[13] See the Environmental Protection Agency of NSW website, www.epa.nsw.gov.au for more details of these policy measures.

[14] For example, the NSW government has recently rejected a development proposal for a new coal-fired power station, Redbank 2, because it "…would generate greenhouse emissions higher than the state average and at a higher intensity than other coal-fired station in the Hunter Valley" (AAP, 2003).

and the preferences of incumbent participants than it is to create level playing fields for different possible arrangements and new participants. Market structures that unfairly disadvantage new renewable and distributed (embedded) generation technologies or focus largely on the supply side of the electricity industry are examples of how such design choices can affect GHG outcomes of restructuring.

Again, some of these challenges are now receiving attention in Australia. For example, the CoAG Energy Market Review has recommended changes to increase opportunities for embedded generation and demand-side participation, including the introduction of full retail competition (FRC) into all NEM state markets as soon as practical. Nevertheless, it is clear that electricity restructuring does not, in itself, guarantee environmental improvements. It may, however, improve responsiveness to price signals from market-based environmental regulations such as those that will now be discussed (IPCC, 2001, Working Group 3).

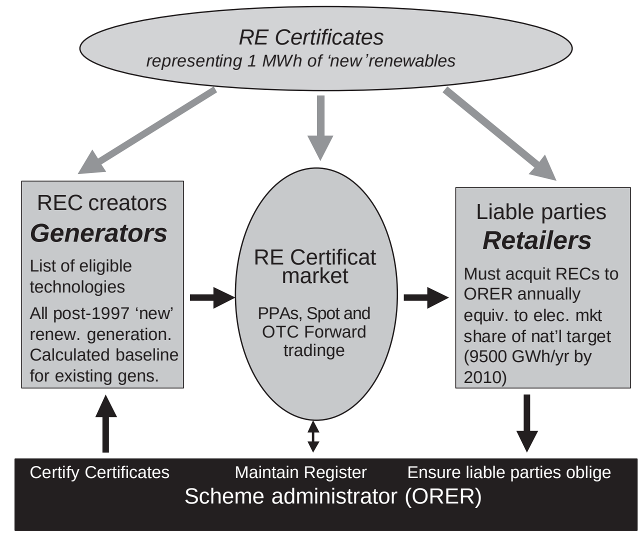

Fig. 1. Scheme design for the Australian Mandatory Renewable Energy Target (MRET).

4.2. The mandatory renewable energy target

The Federal MRET scheme requires all Australian electricity retailers and wholesale electricity customers to source an increasing amount of their electricity from new renewable generation sources. The stated objectives of the scheme are (Commonwealth of Australia, 2000):

- to encourage the additional generation of electricity from renewable sources;
- to reduce emissions of greenhouse gases; and
- to ensure that renewable energy sources are ecologically sustainable.

4.2.1. Scheme design

The design of this 'baseline and credit' scheme built around tradeable renewable certificates is shown in Fig. 1. Similar green certificate schemes are now entering force in a number of. European countries and US States, while several other countries are now preparing for their introduction (Morthorst, 2003).

MRET is based around the use of Renewable Energy Certificates (RECs) that represent 1MWh of 'new renewable electricity' generation. This can come from either new generators, or by increasing the output from existing generators. Eligible sources include hydro, biomass, wind, solar and co-firing of biomass in large coal fired power stations. Domestic solar hot water and small generators can also earn RECs through deeming provisions. The liable parties are electricity retailers in NEM states, large consumers who purchase directly from the NEM, and the notionally equivalent electricity industry participants in non-NEM states. The Office of the Renewable Energy Regulator (ORER) administers the scheme. It accredits eligible generators, audits the creation of RECs, maintains a database for registration and trade of these RECs, determines the obligations of liable parties and retires the RECs they surrender to it for compliance purposes.[15]

Accredited generators can create RECs from 'additional renewable electricity' following the commencement of the scheme in April 2001. This requires the establishment of baselines for existing generators. Eligible renewable energy power stations that have entered service since January 1997 can earn RECs from their entire output—that is, they are given a zero baseline. For generators commissioned prior to 1997, an annual baseline is established and only generation beyond this baseline within the year earns RECs. This is to ensure that the scheme only rewards 'additional' generation beyond that prior to MRET's introduction. A station that generates less than its baseline in a year is unable to create RECs but is not required to actually surrender RECs to make up this shortfall. Once accredited, generators are able to register RECs they have created at any time.

The 'additional renewable electricity' liability that the liable parties are required to acquit was originally intended to be equivalent to 2% of their electricity purchases by 2010. This 2% target has been translated into a fixed national target of 9500 GWh of additional renewable generation in 2010. The annual target ramps up linearly to this 2010 target, which is then maintained until 2020, when the scheme terminates. This target is apportioned to each of the liable parties according to their market share of national electricity sales. Liable parties acquit their obligation by surrendering sufficient

[15] See the ORER website, www.orer.gov.au.

RECS annually to ORER. A penalty of A$40/MWh is charged for any shortfall beyond an allowed buffer that can be carried forward to the following year. The scheme therefore represents a hybrid trading and taxation measure.

ORER does not provide trading arrangements for RECs. An Internet based spot-market trading scheme known as the Green Electricity Market (GEM) was established by some of the major Australian energy companies, although this recently ceased operation.[16] Power Purchase Agreements (PPAs) between renewable generators and liable parties are also in use, while there is also active over-the-counter (OTC) forward trading in RECs (AFMA, 2003a, b).

4.2.2. Performance to date

The MRET scheme has now been operating for over two years. Liable parties have comfortably met the targets for new renewable generation to date. The scheme has already driven the development of a number of new renewable projects, and more are in advanced planning (BCSE, 2003). It is too early to definitively confirm the ability of MRET to drive project finance, yet early signs are encouraging given the concerns in this regard for certificate schemes that have been raised by observers including Mitchell et al. (2002).

The flexibility of this technology neutral approach has also proved valuable. Some early projections of which renewable technologies would contribute to the target suggested that biomass would make the greatest contribution. In practice, a number of proposed biomass projects have encountered difficulties. The market has therefore redirected its attention somewhat to other technologies, in particular wind projects (BCSE, 2003).

There appears to be competition between project proposals that will help drive cost reductions in renewable generation. A viable forward market for RECs would also seem to be developing, and forward bid-offer spreads are declining as the market evolves (AFMA, 2003b).

However, some significant concerns have emerged as well. Considerable attention has been given to question of whether a much more substantial MRET target will be required to significantly reduce emissions and develop the Australian renewable energy industry. The MRET target is certainly low in comparison with some countries in Western Europe that also have renewable energy targets (BCSE, 2003).

Also, a number of important yet currently high-cost renewable technologies do not derive any significant market impetus from the scheme. Photovoltaics is one such technology, and there is anecdotal evidence that some small Australian PV projects do not even bother to claim the RECs that they are entitled to because it is not worth the effort of doing so. This is occurring despite the deeming arrangements in place.[17]

There have, however, also been a number of concerns relating to the scheme design that relate to the abstractions necessary when implementing such a measure. These concerns include:

Incorrect target calculation: The scheme's intent to ensure an additional 2% renewable generation was translated to a fixed 9500 GWh target for 2010 in the enabling legislation in order to increase market certainty. More recent energy projections, however, suggest that 9500 GWh will fall well short of this 2% (BCSE, 2003). Some stakeholders are campaigning for an increased GWh target on this basis.

Public opposition to the classification of some generation sources as renewable: There has been considerable controversy with the decision that biomass generation from native forest waste materials is eligible. Interestingly, the market has responded to this concern. The scheme registry includes the source of renewable generation for each REC. RECs derived from these types of biomass power stations are denoted as such ('dead koala' RECs according to environment groups) and are trading at a discount to those from other sources (AFMA, 2003a).

Baselines for existing renewable generators, particularly large-scale hydro: For each renewable generator that existed before 1997, a baseline must be calculated before it can be rewarded for additional renewable generation. The default baseline is annual generation averaged over the period 1994 to 1996. Alternative baselines can be negotiated with ORER if this average doesn't represent 'normal' power station output. These baselines are confidential.

Some analysis including BCSE (2002) has identified that baselines for some of Australia's large-scale hydro generators may have been set at levels below their present long run average system yield. For example, ongoing growth in electricity demand in Tasmania's isolated, hydro-dominated and single owner electricity industry might allow its generators to create significant number of RECs without undertaking any additional investment. The proposed BassLink interconnection between Tasmania and mainland Australia could add to this REC windfall.

All renewable generators with non-zero annual baselines can also benefit from the variability in their annual energy production as they are eligible to earn RECs in the years when their output is above the baseline, but are not obliged to return RECs in years where their generation falls below it. By BCSE's estimation, some

[16] See the GEM website for more information, www.greenelectricitymarket.com.

[17] The Australian PV market is largely being driven, instead, by financial incentive (grant) programs for purchasers of PV systems. See the AGO website for more details—www.greenhouse.gov.au.

35% of the summated MRET target to 2010 can be met by existing large-scale hydro because of these two baseline problems.

Price uncertainty: A number of factors contribute to uncertainty and potential volatility on RECs pricing within green certificate markets (Chupka, 2003). There is the annual variability and unpredictability of many renewable energy sources, and hence their supply of RECs. Existing generators with non-zero baselines can only create RECs once they have generated beyond their annual baseline for that year. MRET has banking and borrowing provisions to help counter this uncertainty.

One important contributor to pricing uncertainty for MRET is that there is only a single annual acquittal of RECs to ORER. Another important issue is that generators are permitted to register RECs that they have generated *at any time* within the life of the scheme. Unfortunately, there appears to be some 'information asymmetry' advantages to generators, particularly large-scale hydro operators, in concealing their true RECs holdings. It obscures their baselines and creates uncertainty in future RECs pricing amongst other participants—a critical input into decisions on financing new projects.[18]

Future uncertainty: A number of factors have increased market uncertainty with regard to regulatory risk, and potentially impacted on new investment. One is the legislated review process for MRET. While there are many advantages in timely reviews of innovative new policy measures, the 2003 MRET review appears to have reduced forward trading as participants await its outcomes, which might include regulatory changes (AFMA, 2003b).

The greatest uncertainty facing MRET at this time, however, is the recommendation of the recent CoAG (2002) Energy Market Review that the scheme (and a number of other measures) be replaced by an emissions trading scheme. This has created a great deal of concern in the market and damaged the prospects of numerous proposed renewable generation projects (Outhred et al., 2002a; BCSE, 2003).

4.3. The NSW Greenhouse Benchmarks Scheme

The NSW Greenhouse Benchmarks Scheme is the most significant jurisdictional environmental regulation on climate change to date in Australia. The scheme set emissions reductions benchmarks for NSW electricity retailers based on 'imputed' NSW emissions from the electricity sector compared against a declining per-capita state emissions target. Retailers can demonstrate compliance through certified low-emission generation, energy efficiency and sequestration activities. The stated policy intent of the scheme is to reduce "greenhouse gas emissions created through NSW electricity consumption" (NSW Government, 2001).

The original scheme failed to achieve these objectives over its legislated life of 1997–2001 (Nolles et al., 2002). Recent changes to the scheme have been made to introduce penalties for non-compliance, allow special arrangements for large consumers, amend the measurement of different types of actions under the scheme and introduce certificate based trading.[19]

4.3.1. Scheme design

Operation of this 'baseline and credit' trading scheme is now built around NSW Greenhouse gas Abatement Certificates or NGACs, each representing a notional tCO2-e of 'avoided' GHG emissions, as shown in Fig. 2.

The scheme objective is defined in terms of a declining per-capita emissions target (tCO2-e/NSW resident) imputed from population estimates, state electricity consumption and an abstracted 'NSW pool coefficient' (average tCO2-e/MWh) for emissions from state-based electricity generators.

Liable parties include state electricity retailers, large consumers buying directly from the NEM, generators directly supplying customers, and other parties who request to directly participate. Liable parties are assigned shares of the overall target emissions volume equivalent to their market shares of State electricity sales. These parties must either surrender NGACs for emissions above their assigned targets for each year or pay a penalty per tonne of emissions above their assigned targets.

Accredited NGAC providers can create NGACs through:

- reduction in the greenhouse intensity of electricity generation,
- activities that result in reduced consumption of electricity, and
- the capture of carbon from the atmosphere in forests, referred to as carbon sequestration.

All of these activities for creating *emissions reductions* require the establishment of business-as-usual (BAU) baselines. The arrangements for low-emission (largely gas-fired) generators are similar in some regards to the MRET approach although the eligibility date for a zero baseline is post-2001, and emission reductions are calculated by the annual generation output times the difference in tCO2-e/MWh between the notional NSW pool coefficient and the accredited generator. The baseline arrangements for demand-side abatement activities must attempt to cover the range of possible

[18]For example, Hydro Tasmania has revealed that it had generated more than three times as many RECs as it had registered for the first year of the scheme (Australian Senate, 2002).

[19]The scheme administrator, IPART, has a website for the scheme at www.greenhousegas.nsw.gov.au.

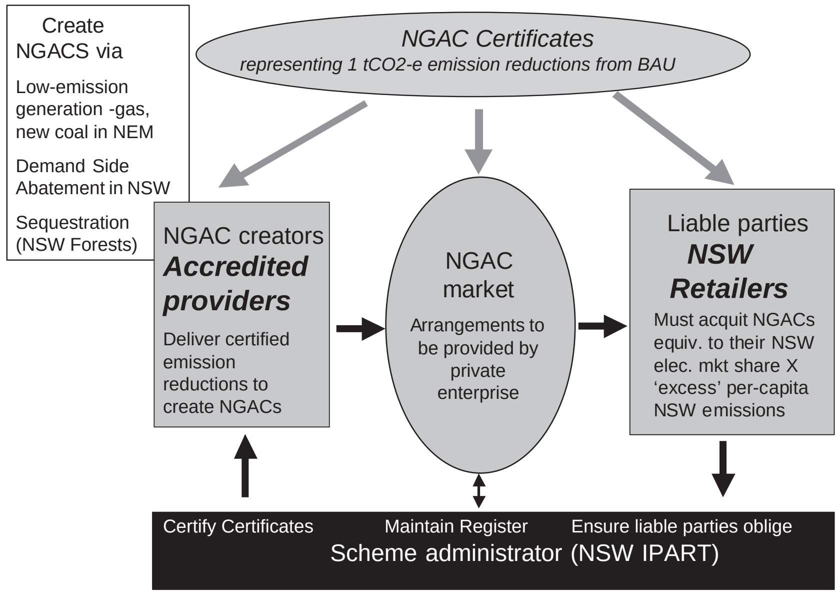

Fig. 2. Scheme design for the NSW electricity retailer benchmarks.

activities that reduce electricity consumption from what it would otherwise have been. Arrangements for this are still being finalised.

The NSW Independent Pricing and Regulatory Tribunal (IPART) administers the scheme in a similar manner to ORER's role for MRET. One difference with MRET is that NGAC providers are required to register NGACS within six months of the end of the calendar year in which they were created.

4.3.2. Scheme performance

The scheme only commenced in January 2003, and work continues on some aspects of the scheme including verification arrangements for creating NGACs.[20] It represents an ambitious attempt to introduce a far-reaching financial incentive signal for electricity industry participants and other industry sectors. However, some observers including the authors have raised concerns about the likely performance of the scheme. Again, many of these perceived problems relate to the 'abstractions' chosen in the scheme's design.

A 'baseline and credit' scheme for emissions reductions: There has been growing international interest in national GHG emissions trading schemes as an economy-wide policy measure for meeting physical emissions caps such as those placed on developed countries within the Kyoto Protocol.[21] Note, however, that *emissions trading* with a 'Cap and Trade' scheme is very different from *emissions reductions trading*, as undertaken in the NSW Benchmarks. 'Cap and Trade' schemes trade in measurable physical emissions. The 'Baseline and credit' scheme implemented in NSW, however, trades imputed emissions *reductions* from forecast BAU emissions. The challenge lies in forecasting what would happen in the absence of the scheme. It is widely accepted that 'Cap and Trade' national GHG trading schemes are preferable to 'baseline and credit' schemes because of the subjectivity of this baseline setting process, as well as for other reasons including higher market liquidity, fairer permit allocation and credibility (MacGill et al., 2003b).[22]

Fungibility of emissions reductions activities: The NSW scheme treats low emission generation, energy efficiency and sequestration activities that reduce emissions as directly comparable and tradeable (fungible) through a single instrument, the NGAC. While this offers potential economic efficiency advantages, the cost of these different activities will largely depend on the methodology (and baselines) by which they are measured.

Sequestration: Considerable uncertainties remain in the measurement of sequestration activities, and there are fundamental differences between emissions reductions through reduced use of fossil fuels and through increased uptake of atmospheric carbon in ecosystems. For example, the NSW scheme requires sequestration providers to 'guarantee' that sequestered carbon will be maintained for 100 years—a considerable achievement

[20]See IPART's NSW Benchmarks website, www.greenhouse-gas.nsw.gov.au, to keep up with ongoing scheme developments including changes to the regulations and rules.

[21]See, for example, IPCC (2001) and, for Australia, AGO (2002).

[22]The risk that the 'baseline and credit' Clean Development Mechanism (CDM) within the Kyoto Protocol may threaten the credibility of the Protocol's physical emissions caps on developed countries has been widely discussed, including Lohmann (2002) and Ellis and Bosi (1999).

even for the NSW State Forests agency. Even if this is achieved, a hundred year sequestration period has little significance in climate change response terms, and none whatsoever when compared to stable sequestration in fossil fuels for millions of years.

'Imputed' emissions: The scheme uses 'attributable' emissions measures rather than 'physical' emissions from NSW electricity production, and these may diverge markedly. For example, the 'NSW pool coefficient' would in our opinion be more accurately described as a historical benchmark as the 'pool' is specified to contain a particular group of existing power stations (Outhred et al., 2002b).

Baseline calculations: The scheme requires that baselines be established for a wide range of 'low-emission' and demand-side abatement activities. It may be very difficult to ensure that only activities additional to business-as-usual (BAU) progress will be able to generate NGACs. For example, relatively efficient coal and all gas-fired generation anywhere in the NEM commissioned after January 2002 will be able to create NGACs from their entire output. The challenge is even greater for demand-side abatement (DSA) given the myriad end-use equipment and processes that consume electricity, and might be able to contribute to emissions reductions. The rules required to cover all such activities may not be capable of ensuring additionality beyond BAU developments (MacGill et al., 2003a).

Double counting across policy measures: Adding to the baseline challenge, is the potential that the NSW Greenhouse Benchmarks scheme might 'free ride' off other existing Federal and State Government policy measures. For example, retailers can claim the emissions reduction associated with their MRET obligations on NSW electricity sales, against their NSW benchmark targets. This is a particularly problematic form of 'double counting'.

Complexity: The 'imputed' measures of emissions and necessary baseline rules for the scheme have contributed to its unwieldy complexity—a problem for participants, the administrator and also for the transparency of the scheme's operation.

Jurisdiction: There are difficulties in implementing this type of measure at the State level. As indicated in the NSW Governments reform proposal, a consistent multi-State or national policy of this type would be preferable to a NSW scheme alone. In the absence of a multi-State scheme, it is questionable to allow new low-emission generation anywhere within the five States and territories participating in the NEM to be counted as contributing to reducing per-capita emissions in NSW. For example, what will happen if one or more of the other states introduce a similar scheme at a later date (Outhred et al., 2002b).

It will be interesting to see how the NSW scheme fares in practice. Some OTC forward trading of NGACs has commenced even though not all of the scheme's measurement and verification methodologies are yet in place.[23] Prices are currently relatively low—around US$5-6/tCO2-e. This might represent participant views on the low cost of actions to reduce electricity related GHG emissions or, alternatively, their views on the scheme's present design arrangements. Finally, a number of other jurisdictions are contemplating the introduction of similar schemes while some work undertaken for the CoAG Energy Market Review has explored the potential of extending the NSW Benchmarks nationwide (Allen Consulting, 2003).

4.4. The Queensland 13% gas scheme

Currently, around 97% of the Australian State of Queensland's electricity is sourced from coal (Queensland Government, 2000). Queensland is implementing a scheme that will require electricity retailers and other liable parties to source at least 13% of their electricity from gas-fired generation from 1 January 2005 (Queensland Government, 2002).

The objective is to establish a demand for gas-fired electricity that will encourage the development of new gas sources and infrastructure. This is intended to help meet Queensland's future energy requirements while reducing the growth in GHG emissions, and therefore "reduce the vulnerability of the State's economy to the introduction of any national and international greenhouse gas abatement measures such as the introduction of emissions trading" (Queensland Government, 2002).

4.4.1. Scheme design

The 13% Gas Scheme is based around gas-electricity certificates or GECs, each representing one MWh of eligible gas generation. The participants are:

- Accredited Parties—generators of eligible gas-fired electricity who can create GECs, and trade them separately to the electricity from which they arise, and
- Liable Parties—largely electricity retailers, who are required to surrender GECs to the Regulator to acquit a liability set at 13% of their Queensland electricity sales.

The baseline for creating GECs is set at new or additional gas fired electricity from May 2000 that contributes to supporting Queensland load. This latter requirement prevents GECs being earned from Queensland gas-fired generation that is exported to NSW, but also allows GECs to be earned from NSW generators that export into Queensland. The stated intent of the chosen baseline is as "a device that essentially

[23] The AFMA website, www.afma.com.au, provides national Revaluation Curves for RECs and NGACs.

encourages and rewards a change in behaviour'' (Queensland Government, 2002).

4.4.2. Scheme performance

This scheme formally commences in 2005 so it is not yet possible to report on its performance in practice. However, it appears in our view to be an appropriately designed 'baseline and credit' scheme to drive gas infrastructure development. Its stated objective of increasing gas-fired generation to meet Queensland electricity demand has manageable and clearly defined scope. The scheme's tradeable instrument, the GEC, is relatively tangible and 'measurable', while the baselines for new and existing generation are at least consistent, and don't over-reach beyond Queensland jurisdiction. One possible weakness is the potential for large energy intensive consumers to receive an exemption from the scheme (Queensland Government, 2002).

Given that the 13% gas generation target must be met from 2005 onwards, it appears that the Queensland scheme is already driving considerable gas infrastructure activity and development in the State (Origin Energy, 2002).

4.5. Greenpower

A number of electricity industries worldwide have voluntary schemes to allow electricity consumers to purchase 'Greenpower'. Because electricity industry networks 'mix' all generation, this Greenpower (typically electricity generated from renewable energy sources) can't physically be delivered to these environmentally minded consumers. All that an electricity retailer can actually do is to guarantee to enter into contracts with 'green' generators that cause the generators to produce enough 'green' electricity to cover the volume purchased under the retailer's Greenpower schemes.

This necessary 'abstraction' creates a challenge in counting and certifying premium priced green electricity sales against different types of renewable generation across the industry. Most electricity industries already have some renewable component in their overall generation mix, generally large-scale hydro. Customers motivated by the desire to support increased use of renewables are unlikely to wish to pay a premium to merely have such existing generation 'allocated' to them.

4.5.1. Australia's national greenpower accreditation program

External auditing may increase consumer confidence in such arrangements, creating a potential regulatory role for government. Such is the case in Australia, where a national accreditation scheme has been in place since 2001 under the auspices of the Sustainable Energy Development Authority of NSW. The stated purpose of the program is ''to promote the installation of new green electricity generators by increasing consumer demand and confidence in Greenpower products'' (Greenpower, 2003).

One key element of this program is that retailers have been required to source increasing amounts of their green electricity from 'new' (post 1997) generators—80% of total sales since mid-2001. Another is that the controversial use of materials (including wastes) from high conservation value native forests for renewable 'biomass' generation is not acceptable. This is not the case for MRET.

4.5.2. Outcomes

Over 95% of Australian electricity consumers now have access to accredited Green Power. These customers are assured of having the premium that they pay for their electricity actually contribute to increasing renewable electricity generation. The customers who have elected to purchase Greenpower, however, represent less than 1% of total electricity customers in Australia, while Greenpower sales are less that half of one percent of total Australian electricity sales.

Accredited Greenpower appears to face an uncertain future with legislated retailer requirements for renewable generation under MRET and the NSW Benchmarks scheme, and the recent introduction of full retail competition in the two largest Australian states. For example, the accredited 100% Greenpower product from Australia's largest retailer, Energy Australia, charges residential customers a premium of around 60% per MWh consumed (Energy Australia, 2003). This retailer has recently introduced a non-accredited Greenpower product for which the premium is only around 5% for a typical customer. However, this scheme's design does not require this 'green' electricity to be sourced from 'new' renewable generation or prevent double counting across legislated requirements.

5. Some key design lessons

A number of important design lessons have emerged from experience to date with industry restructuring and market-based climate change instruments in the Australian electricity sector.

5.1. Electricity industry restructuring

The Australian experience to date appears to support worldwide evidence that restructuring electricity industries will not necessarily deliver improved environmental outcomes (IPCC, 2001). One issue is that many environmental externalities are unpriced in present competitive electricity markets and therefore unlikely to influence decision-making. Competitive pressures in some restructured industries including Australia appears to have reduced electricity costs, at least in the short term. This can encourage increased energy consumption, and hence exacerbate environmental impacts. Much appears to depend on circumstances prior to restructuring including fuel mix, national endowment of resources and existing infrastructure.

Another key issue, however, is that electricity markets are 'designer markets' that attempt to match a manageable commercial model to the 'non-commodity' physical realities of power systems. It is hardly surprising that market designers can be greatly influenced by existing industry arrangements and the needs of incumbent participants. However, some design choices can greatly impact on the restructured industry's GHG performance.

In particular, restructuring must not begin and end with the introduction of wholesale electricity markets. End-users must be both motivated and able to participate. Also, design, regulatory and institutional choices should not favour incumbent centralised technologies and supply side participants against new distributed generation technologies, and possible 'new entrant' demand-side players.

5.2. *The perils of abstraction*

One of the great strengths of market-based instruments is the flexibility they offer market 'designers'. However, flexibility also implies design choices and abstractions that can have a marked impact on scheme effectiveness and efficiency. It can be very difficult to project how complex 'designer' markets will behave in practice. Worse, there are potential moral hazards for policy makers when making these design choices. For example, it is possible to create market-based measures that deliver wide-ranging 'imputed' environmental benefits without the inconvenience and cost of actually driving real, perhaps politically unpalatable, change. The Australian experience with market-based environmental instruments highlights some of these risks with abstraction.

5.3. *Baselines for 'baseline and credit' schemes*

Appropriately defined baselines are vital to the effective and efficient operation of 'baseline and credit' schemes in driving change. The problem is that all baselines are actually forecasts—we cannot *know* what would happen in the absence of a particular policy measure.

For example, many types of renewable energy projects clearly represent additional effort and investment compared to likely BAU progress and would therefore seem to be well suited to 'credit' certificate schemes. MRET, however, has still faced problems in defining 'additional' generation from existing large-scale hydro schemes.

The baseline challenge is greater for low-emission gas-fired generation in Australia because unrelated developments in the NEM seem likely to facilitate a growing role for such generation. This is not particularly problematic for the Queensland 13% Gas Scheme because of the limited scope of its objectives. The NSW scheme, however, has the stated objective of reducing that State's electricity related emissions, and it is difficult to see why BAU growth in gas-fired electricity generation throughout the NEM should be counted towards this objective.

The challenge of establishing baselines for the enormously diverse range of demand-side abatement (DSA) activities that could potentially respond to a 'baseline and credit' scheme for energy efficiency is even more difficult given ongoing technical progress in end-use equipment and processes, and the wide range of motivations involved in decisions that influence end-use consumption. This is proving particularly problematic in the NSW scheme. Energy Efficiency Certificate Trading (EECT) is therefore probably best implemented by limiting the scope of allowed activities, and ensuring that these are clearly beyond likely BAU progress as well as readily measurable and verifiable (MacGill et al., 2003b).

5.4. *Interactions between measures may reduce their effectiveness*

Two strengths of market-based measures are the potential to give them broad (even economy-wide) reach, and their potential compatibility with other financial measures—if they are independent instruments, regulated parties need only 'sum' up all their pricing signals when choosing what actions to take.

However, broad reaching measures are likely to overlap other policy measures, and it is possible for interactions between them to reduce their respective environmental effectiveness. One example from Australian experience is that NSW electricity retailers have obligations under the Federal MRET legislation, which the NSW scheme also permits them to count, in part, towards meeting their NSW Benchmarks obligations. The physical change in industry behaviour driven by these two measures is therefore not fully additive, and the credibility of both schemes may be threatened.

It can be difficult for policy makers to predict how wide-reaching market-based instruments may interact with other existing policy measures. Unfortunately, there are also moral hazards for market designers because of the opportunity to design measures that free-ride on pre-existing policy measures.

5.5. Possible dangers with trading schemes

While trading has the potential to allow participants to meet GHG obligations in a way that reduces overall societal costs, there are serious 'market for lemons' risks with tradable instruments that have measurement, verification and additionality difficulties[24]—low-cost, 'poor quality', projects can crowd out more expensive, 'high quality' projects.

This is a very real concern for the 'baseline and credit' Clean Development Mechanism (CDM) within the Kyoto Protocol. Developing countries requiring rigorous tests of 'additionality' for projects will obtain greater benefits from such projects in terms of infrastructure and technology transfer, yet risk missing out on the CDM market if other countries are permitted to undertake projects that have applied lower 'additionality' standards (Jotso, 2003).

In the case of MRET, some existing hydro schemes would appear to be able to create large quantities of RECs that are essentially zero-cost because no additional investment or operational changes are required. These RECs reduce the opportunities available for new renewable generation projects, as competitive pressures drive participants towards the lowest cost ways to create RECs. Given that new generation projects will still be required to meet the target, the market price for RECs is likely to be set by their 'new entrant' costs. This provides windfall profits to those creating BAU RECs.

5.6. Creating markets for 'environmental' instruments

It can be a challenge to create transparent, liquid and efficient markets for tradeable environmental instruments that allow efficient price discovery and risk management by participants. Issues include the potential variability and uncertainty in both supply and demand of these instruments and infrequent (e.g. annual) acquittal of instruments to regulators.

Mechanisms to reduce electricity related GHG related emissions for the longer-term have to primarily drive investment decision making, not operational decision-making. These investments may have significant time lags between the decision to proceed and actual creation of the environmental instruments—for example, 'additional' renewable generation. This can cause volatility in short term market pricing, and means that derivative markets have a vital role to play.

[24]The term 'market for lemons' arises from some work by economist George Akerlof (1970) into this problem. If buyers in a market are unable to verify the quality of what they are buying then sellers of 'lemons' are encouraged to enter. Unfortunately, cautious buyers then aren't prepared to pay the high prices required to cover the cost of 'high quality' products. Good products are penalised, even as poor products are subsidised.

Finally, the present regulatory uncertainty in climate change policy adds greatly to the risks faced by market participants. Abstract 'designer' markets are not constrained by the physical realities that shape many commodity markets. Instead, they represent an environmental policy intent that may change and hence lead to changes in the design rules that markedly affect the commercial outcomes for participants.

For example, the recent CoAG (2002) review of Australian energy markets has recommended scrapping MRET, while the scheme is also now under independent review as required by its legislation. This has created a great deal of concern amongst RECs market participants.

6. Discussion

Current projections suggest that Australia's climate change emissions will continue to rise markedly even with the 'climate change' regulation that has already been put in place (Commonwealth of Australia, 2002).

While present measures are therefore clearly inadequate, Australian policy makers have been early and enthusiastic proponents of novel market-based 'climate change' measures. This paper has focussed on some key issues in market design that have been highlighted by Australian experience to date with these instruments.

These design lessons underscore the key role of 'abstraction' in market-based instruments. While abstractions can give policy makers great flexibility in the design of these tools, they also hold potential pitfalls and moral hazards. One key driver of policy development must be that measures actually drive change—if some of a scheme's targeted outcomes will likely happen anyway there is little point, and much to argue against, going to the effort of including them within the scheme implementation.

Also, providers of eligible activities or liable parties looking to minimise the costs of meeting the scheme's environmental obligations or maximise can be expected to thoroughly search the market design for loopholes and weaknesses to exploit. The greater the complexity and abstraction in a market design, the greater the likelihood that such design weaknesses exist. Establishing an effective process for designing markets in environmental instruments is critical for getting the design choices right.

Finally, while all environmental policy measures are constructs of changeable policy intent, abstract 'designer' environmental markets pose more complex regulatory risks for participants than policy measures, which prescribe participant behaviour.

Climate change is one of the great policy challenges of our time. The mixed success of Australian market-based GHG regulation no doubt reflects the magnitude of this challenge, as well as the particular strengths and weaknesses of 'environmental' market approaches. It is also early days for the use of these approaches. As the IEA (2002) has noted, "the complex framework required to exploit the flexible and efficient nature of these measures fully has meant a slow start in their use." The Australian experience to date is useful in this regard, and appears to support the need for policy makers to take great care in scheme design.

Finally, the future of the Australian market-based instruments outlined in this paper is unclear. The recent CoAG (2002) review of Australian energy markets has suggested sweeping changes to GHG measures in the Australian electricity industry. A national emission trading scheme is proposed to replace existing measures including MRET, the NSW Benchmarks and the Queensland 13% Gas schemes. The stated reasons are that the existing measures are poorly targeted, attempt to pick technology 'winners and 'distort' each other through double counting and other adverse interactions. Thus considerable uncertainty surrounds policy developments in market based environmental regulation of the Australian electricity industry over the coming years.

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