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Braking wind in Australia: A critical evaluation of the renewable energy target

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ABSTRACT

This paper provides a critical evaluation of Australia's new Renewable Energy Target (RET) program with respect to its capacity to support wind power development. Four structural flaws associated with the RET which undermine its effectiveness as a catalyst for technological change in the electricity sector are discussed: (i) the inclusion of waste coal mine gas (WCMG) as an eligible fuel source which acts as an indirect coal industry subsidy, (ii) program duration which is too short and ill-structured, (iii) a multiplier that is well-intended to support small-scale renewable technologies but which creates "phantom capacity", and (iv) the capped target of 45,000 GWh which will stymie long-term wind power market investment. The paper concludes with recommendations which stress the importance of passing effective Carbon Pollution Renewable Scheme (CPRS) legislation to offset the weaknesses associated with the RET. If an effective CPRS cannot be implemented, the paper recommends that amendments be made to the RET to (i) remove WCMG from the list of approved alternative energy sources, and (ii) extend the RET targets to reach 120,000 GWh by 2030.

1. Introduction

December 3, 2007 was a watershed day for Australian politics; a new government was sworn into power under the Labor Prime Minister, Kevin Rudd. One of the regime's first acts was to ratify the Kyoto Protocol, and in doing so, committed Australia to meeting a greenhouse gas (GHG) abatement target amounting to 8% above 1990 levels for the period 2008–2012. Although Australia will likely meet this liberal target for the first Kyoto Protocol emissions reduction period thanks to favourable changes in land-use and forestry, any subsequent reductions will require radical structural changes to how the nation uses energy, which even the government realises is of a magnitude that few other industrialised nations face (Government of Australia, 2009h). Given that nearly 50% of the GHG emitted in Australia comes from power generation (Government of Australia, 2008a), it should come as no surprise that one of the first policy initiatives directed at mitigating GHG emissions was a fortified program to encourage enhanced development of renewable energy capacity in the electricity generation sector.

The flagship program of these enhanced efforts is the Renewable Energy Target (RET) which consolidates all state-level Renewable Energy Target programs and legally requires Australia's electricity utilities to ensure that 45,000 GWh of electricity purchases (approximately 20% of total electricity generated) will be from renewable energy technologies by 2020. On the surface, the new RET brings Australia's renewable energy development program in line with EU targets (Hindmarsh and Matthews, 2008) and gives Australian renewable energy development firms the requisite market window to establish stronger market presence, thereby enhancing economies of scale and the likelihood of reduced costs of renewable-sourced electricity.

For wind power developers in particular, the RET potentially represents an opportunity to establish a strategic beachhead in Australia's electricity sector by capturing the economies of scale necessary to close the commercially corrosive cost gap that exists between wind power and coal-fired electricity. Actual cost differentials are hard to pin down for electricity sources due to technological, operational and regional factors which cause costs to vary; and peer reviewed sources on this topic for Australia are somewhat dated. However, as a general indicator of the current cost disparity, data from the Australia Institute in 2006 estimated that the cost range of coal-fired power was A$31–40 per MWh (megawatt hour) while the wind power cost range was A$60–80 per MWh (Macintosh and Downie, 2006). As of December 2009, the cost of coal had increased by over 25% from December 2005 levels.[1] Moreover, wind power generation costs, which improved

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[1] Source: The Energy Information Administration, Accessed on January 3, 2010 at http://www.eia.doe.gov/cneaf/coal/page/coalnews/coalmar.html.

4–7 fold from 1981 to 2006 (Celik et al., 2007), are widely expected to continue to improve (Wizelius, 2007; DONG Energy, 2008). Accordingly, it is possible to argue that the cost disparity has narrowed in the three years since this report was released. Moreover, a recent study by the Australian Academy of Technological Sciences and Engineering (ATSE) estimates economically quantifiable externalities associated with coal range between A$42 and A$52 per MWh while the cost of economically quantifiable externalities associated with wind power amount to only $1.5 per MWh (ATSE, 2009). Taking into account these external cost disparities, the cost of wind power is actually much closer to the cost of coal-fired power than market prices indicate and might in some cases be less expensive. As the RET commences in 2010, wind power prospects are positive because wind power has the advantage of being close to commercially competitive and capable of immediate adoption (Kann, 2009).

Of other promising alternative energy technologies, engineered geothermal, solar PV and solar thermal technologies hold promise given Australia's abundance of these resources; however, these technologies are not yet commercially viable for wide-scale application (Hindmarsh and Matthews, 2008). Geothermal hot rock technology possesses massive appeal in terms of scale potential. Geoscience Australia contends that tapping just 1% of the energy from hot rocks located within 5 km of the earth's surface would be enough to supply 26,000 times Australia's annual power consumption on a perpetual basis for 2.6 million years (Clean Energy Council, 2009). However, it is still at an early developmental stage with only one operational site as of 2009 (Government of Australia, 2009a). Overall, geothermal is not anticipated to contribute to Australia's electricity supply until at least 2015 and even then only at a marginal level due to cost (Government of Australia, 2009b). Solar PV technology is still 3–4 times the cost of gas-fired electricity (Gurney et al., 2007). Consequently, despite significant government support programs, recent projections estimate solar PV growing at an annual rate of only 15 MW (medium case) up to 2020 (CME, 2009). Utility scale solar thermal technology is also at a developmental stage, albeit closer to commercialization with a 10 MW demonstration plant planned in Queensland for 2010 (Government of Australia, 2009a). As a stand-alone technology, large-scale solar thermal remains an expensive proposition thereby limiting commercial diffusion to subsidised programs such as the Solar Flagships program which earmarks AU$1.6 billion over 6-years to support construction and demonstration of large-scale solar power stations, with an ultimate target of 1000 MW (Government of Australia, 2009c).

Other prominent alternative energy technologies face non-commercial barriers that are equally as formidable. Waste to energy biomass is currently cost effective but growth is limited by the capacity of Australia's sparse population to generate and more effectively manage waste. Although on the surface, agricultural biomass and combustible materials (i.e. wood and wood by-products) appear promising thanks to surplus land to support such initiatives, wide-scale adoption of these technologies is impeded by environmental factors which include extreme water shortages, environmental impacts associated with wide-scale harvesting of energy crops, seasonal harvests which produce a feast–famine supply profile and competing agricultural interests (IEA, 2005; MacGill et al., 2006; Gerardi et al., 2007). Growth potential for hydropower is limited by a dwindling number of exploitable water sources and severe regulation of water utilization (Hindmarsh and Matthews, 2008; Government of Australia, 2009b).

Meanwhile, research into carbon capture and sequestration (CCS) technology to render fossil fuel technologies as alternative "clean" energy sources is still at the developmental stage (Gurney et al., 2007). As of April 2009, no functional CCS and power plant integration exists at an industrial scale anywhere in the world (Government of Australia, 2009h). Furthermore, it was estimated as recently as 2007 that utility-scale implementation of CCS technology would increase generation costs by 38–44% for new natural gas combined cycle plants and 44–65% for new pulverised coal plants, thereby rendering both technologies competitively uneconomical (Gurney et al., 2007).

Finally, despite indications of increasing pressure to revisit existing nuclear policy, Australia is a nation in staunch opposition to the development of nuclear power. Any policy changes in support of nuclear power will likely face vociferous opposition. Moreover, there is evidence that the cost of nuclear power in Australia would exceed the cost of wind power and even if the cost disparity were negligible, further evidence indicates that CO_2 associated with the entire nuclear fuel cycle is comparative in volume to emissions from gas-fired power stations (Saddler et al., 2007; Sovacool, 2008).

In summary, although all of the alternative energy technologies listed can and likely will have a role to play in Australia's transition away from carbon-intensive electricity generation, wind power developers in Australia face an unprecedented opportunity to snap up the majority of business generated by the January 1, 2010 commencement of the RET, provided the RET is structured in a way to support progressive wind power development.

In order to effectively support progressive development of wind power, two elements must be integrated into a policy instrument. The first element is that support policies must be designed to simultaneously encourage utilities to make the investments necessary to operationally support enhanced levels of wind power. For example, in Japan, despite the existence of government subsidies to encourage wind power development, utilities purportedly place undue storage demands on wind power developers due to concerns that the existing grid will be destabilized due to the fluctuating nature of wind power (Englander, 2008). Although wind developers are keen to take advantage of government inducements to sell wind power into the existing system, Japanese utilities are not making the investments necessary to support a progressive presence of wind power (Valentine, in press). The second element is that any support policies must encourage wind power developers to commit the investment necessary to render wind power commercially competitive when the support policy is removed. For example, in Taiwan, the feed-in tariffs provided to wind power developers are viewed as insufficient for encouraging in-land wind farm development; and as a result, a situation is emerging wherein wind power developers are exploiting only the most financially attractive sites in Taiwan before moving on to other countries. Once all the financially attractive sites have been exploited, it is highly likely that wind power development in Taiwan will stall (Valentine, 2010).

This study first aims to evaluate Australia's new RET on the basis of these two elements in order to evaluate the efficacy of this new program to support progressive wind power development. The analysis highlights a number of flaws in the RET which may significantly undermine progressive development of wind power; therefore, this paper also seeks to put forth recommendations on how to improve the RET.

The layout of this paper is as follows. Section 2 presents a profile of the Australian electricity industry and discusses recent developments and trends in regard to wind power development. Section 3 evaluates the new RET in the context of supporting progressive wind power development. Section 4 provides some concluding thoughts on how to improve the effectiveness of RET.

2. The Australian electricity industry and wind power development

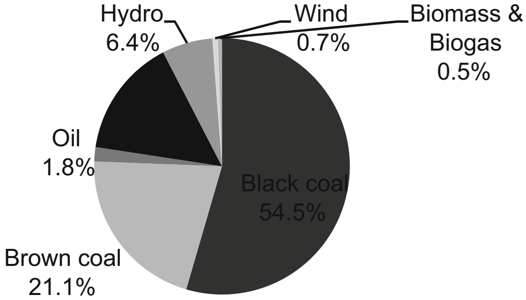
With the exception of the Northern Territory and Western Australia, Australia boasts an integrated national energy market (NEM) which was established in 1998 to enhance electricity grid security and provide a more competitive market for the supply of electricity (NEMMCO, 2005). The NEM which serves about 90% of Australia's population (MacGill et al., 2006) is a "compulsory gross pool market" in which bids to sell electricity are collected en masse and electricity dispatches are sequenced according to the price (Owen, 2009). Australia is the only major economy to have introduced and maintained this type of mandatory wholesale electricity trading market (Chester, 2007).

Australia is blessed with massive stores of coal, laying claim to 24.1% of the world's economic demonstrated reserves of brown coal and 5.4% of the world's economic demonstrated reserves of black coal (ABARE, 2009). Consequently, it should come as no surprise that coal plays a dominant role in the Australian electricity generation industry. To get a feel for the significance of coal in Australia's electricity mix, Table 1 summarizes electricity generation by fuel type in 2005–06. In 2005–06, brown and black coal accounted for 75.6% of Australia's electricity generation (ABARE, 2008).

One energy technology that is conspicuously absent from Australia's electricity generation mix is nuclear power. Although national uranium reserves account for 40% of total economically accessible uranium stocks (Wesley, 2007), Australia does not produce any electricity through nuclear power. Although there is considerable public opposition to the prospects of nuclear power (Falk et al., 2006), there has been renewed political discussion over nuclear power development as a possible solution to CO_2 emission abatement (Schlapfer, 2009).

Table 1 also highlights how important it is for the Australian government to facilitate a transition away from coal. Per capita emissions of CO_2 from fuel combustion in Australia are amongst the highest in the world and 43% above the average for International Energy Agency countries (IEA, 2005). Of the 576 Mt (CO_2 equivalent) of GHG that Australia emitted in 2006, 47% was from electricity generation (Government of Australia, 2008a) and the vast majority of that was from coal combustion (IEA, 2005). Moreover, under "business as usual" practices, Australia's greenhouse gas emissions from electricity generation are expected to increase by 37% between 2004 and 2050 (Gurney et al., 2007). Clearly if the new Labor government is to achieve marked progress in reducing domestic CO_2 emissions, a radical realignment of Australia's electricity industry will be required. The trouble is that the low price of coal in Australia along with the apparent security that huge stores of this resource provides portends a rocky road for a transition to renewable energy.

Table 1
Electricity generation by fuel type in Australia, 2005–06.
Source: (ABARE, 2008).



Wind energy, as the most commercially viable utility-scale renewable technology, is expected to be the largest contributor to Australia's new RET targets (Government of Australia, 2009b). Wind power is rapidly expanding in Australia thanks in large part to former national and state-level initiatives to encourage enhanced uptake of renewable energy by Australia's utilities. According to the World Wind Energy Association, Australia possessed 1494 MW of installed wind power capacity at the end of 2008, which represents the 14th highest level of installed capacity in the world. In 2008, Australia's installed wind power capacity grew by 83% which was the third-highest growth rate in the world (WWEA, 2009). A study commissioned by the Australian government in 2005 projected an increase in installed wind power capacity in Australia of at least 7360 MW by 2029/30 (Akmal and Riwoe, 2005). This would represent a five-fold increase over current levels. However, statistics pointing to the success of wind power development in Australia can be misleading because when Australia's total installed wind power capacity is compared to the wind power potential which exists in the country, it becomes evident that a significant opportunity to abate the national dependency on coal-fired power generation is being missed.

With the exception of Australia's northern coast, coastal areas throughout Australia boast average annual wind speeds in excess of 8 m/s (at 10 m) and are considered to be excellent locations for wind turbine placement (Coppin et al., 2003). Furthermore, there are huge tracts of land in the southern portion of Western Australia and throughout the states of Southern Australia and Victoria with average annual wind speeds in excess of 7 m/s (at 10 m) which would constitute "good" wind conditions for wind turbine sites (Coppin et al., 2003). Mark Diesendorf estimates that long-term wind power potential in Australia may be as high as 20,000 MW (Diesendorf, 2003, 2007). Assuming a capacity factor of 35%, harnessing this potential would generate 60,000 GWh of electricity annually, which represents about 28% of Australia's projected supply of electricity in 2020.

Although the theoretical potential of wind power in Australia is sufficient to provide all of Australia's current electricity requirements, there are technical constraints that dampen the prospects of a virtually carbon-free electricity system. The stochastic nature of wind power makes it necessary at higher levels of electricity grid integration for wind power to be integrated with storage or back-up reserve in order to avoid destabilizing electricity grid operational security (Ackerman, 2005). As Saddler and colleagues (2007) point out, "currently, the limitation is not the wind resource, but rather the transmission infrastructure, which has evolved for large centralised power stations". Nevertheless, the Australia Institute, drawing from international experience with wind power integration into electricity grids, has estimated that spare capacity in Australia's existing electricity grid can accommodate up to 20% wind power before the stochastic nature of wind power begins to pose a technical threat to grid security (Macintosh and Downie, 2006).

It might be tempting for critics to argue that the Australia Institute's estimate may be overly optimistic given the dominant role that coal plays in the national energy mix and the relatively low levels of installed capacity in hydropower and gas-fired power plants which are essential technologies for responding effectively to the type of load fluctuations associated with wind power. However, there is also a counter-argument to such criticism that the addition of electricity storage technologies or enhanced reserve peak-load generation capacity could enable the integration of wind power levels that extend well-beyond the 20% benchmark (Diesendorf, 2007). As a testament to the technological feasibility of incorporating high levels of wind power with enhanced back-up support, electricity grids in two towns in

Western Australia (Denham and Hopetoun) incorporate as much as 70% electricity from wind energy (supported by diesel generation), with an average wind power contribution of approximately 40%.

Enhancing reserve capacity comes at a cost. One study estimates that the additional cost of backup generation (i.e. gas fired power plants) necessary to allow wind power to reach high contribution levels (i.e. 40%) in Australia would increase the cost of wind generated power by approximately 25% on top of existing wind power generation costs (Diesendorf, 2003), constituting a premium of only 1–2¢ per kilowatt hour. Aside from these technical costs of supporting high levels of installed wind power capacity, there are grid connection costs that need to be considered in order for Australia's wind power potential to be better exploited. In many cases, grid connections would need to be extended into remote areas where the absence of competing land uses enhances the commercial viability of wind farms. One estimate of the cost of new transmission and distribution infrastructure is at least AU$50 per meter for laying the cabling and AU$35 per meter for any necessary access roads (Wizelius, 2007). This can amount to a 10% or higher premium on wind power project costs (Wizelius, 2007).

Although in aggregate the economic costs associated with additional reserve capacity and grid connection significantly increase wind power generation costs at high levels of installed capacity, there are also economic savings associated with CO_2 reductions that offset these additional costs. Many of the external costs referred to earlier (A$42–A$52 per MWh (ATSE, 2009)) represent real costs that the nation is currently incurring even if the nation's citizens have not yet been forced to pay for some of the more insidious economic impacts that are ineluctably bound to progressive global warming. Furthermore, the ATSE external cost estimates fail to take into consideration environmental impacts such as damage to ecological habitats that temperature change will bring because the ATSE projection only considers impacts that can be economically quantified.

Irrespective of the barriers to full exploitation of Australia's technical wind power potential, evidence presented to this point in the paper suggests that achieving a target of 20% or greater contribution from wind power is both technically feasible and less economically damaging than critics contend. A study by the Australia Institute estimates that adding approximately 5% of wind power to the existing grid by 2010 would only cost consumers AU$15–$25 per year extra (Macintosh and Downie, 2006). The study further points out that if the costs of pollution associated with fossil fuel power generation were fully internalized, the additional costs (including generation cost disparity) to the homeowner would be fully offset (Macintosh and Downie, 2006). These conclusions are supported by the study into the externalities associated with coal by Australian Academy of Technological Sciences and Engineering, referred to earlier (ATSE, 2009).

In terms of assessing the impact that a 20% or greater electricity supply contribution from wind power would make to CO_2 abatement in Australia, the New South Wales government estimates that each MWh of power produced by wind farms can displace 0.929 tons of CO_2 which would otherwise be generated through coal-fired generators (Macintosh and Downie, 2006). Employing this metric, if wind were to supply the 45,000 GWh of electricity which is projected to account for 20% of the electricity supply in 2020, wind power would displace approximately 42 million tons of CO_2, which represents a 16% reduction of 2006 national CO_2 emissions attributed to electricity generation.

In symbiotic fashion, three notable developments have appeared in the policy sphere to indicate that a path is being created for encouraging greater uptake of wind power in Australia. First, over the past decade, Australia's state-owned electricity grids have been integrated to form a national grid (the NEM). Now, all regions except for the state of Western Australia and the Northern Territory have interconnected electricity grids (Owen, 2009). For wind energy, grid inter-connectivity delivers a number of notable benefits. For example, an interconnected electricity grid allows states to integrate higher levels of wind power without the risk of stochastic flows destabilizing the grid (Ackerman, 2005). It also allows wind farms to be geographically dispersed which further dampens the adverse effect of wind intermittency (Coppin et al., 2003). Second, the market liberalization initiatives that accompanied grid inter-connection have significantly improved the prospects for wind energy developers to sell energy into the grid (Owen, 2009). Third, the RET artificially enhances market prospects by mandating enhanced purchases of electricity generated from renewable technologies. Given that a bill for a new CO_2 emission trading system – the CPRS (Carbon Pollution Reduction scheme) – which the government sought to implement in conjunction with the RET was defeated in Parliament, the RET is currently the centerpiece of the government strategy to facilitate a transition to renewable energy. Accordingly, assessing the pros and cons of this legislation warrants further attention.

3. The efficacy of the RET for supporting wind power development

The Renewable Energy Target (RET) announced in August 2009 builds on the Mandatory Renewable Energy Target (MRET) program of 2001 which aimed to encourage 9500 GWh of electricity generation from renewable energy sources by 2010 (Government of Australia, 2009e). This MRET target was prematurely achieved in 2006 (Kann, 2009). As mentioned earlier, the new RET aims to encourage 45,000 GWh of electricity generation from renewable sources by 2020 and consolidates all existing state and territory renewable energy schemes into a single national scheme which significantly simplifies the planning process for renewable energy developers (COAG, 2009). Moreover, the 2009 amendment increases the penalty levied on electricity retailers who fail to reach their 20% quota of renewable electricity sales from A$40 to A$65 (Government of Australia, 2009f). This penalty is not tax deductible (Gerardi et al., 2007); therefore, the punitive value of this penalty to the firm is approximately A$90 (Government of Australia, 2009g), which serves as a robust incentive for electricity providers to meet their quotas. On the surface, the RET appears to be a bold initiative that places Australia's climate change response efforts on equal footing as that of the EU, both aiming to ensure that 20% of electricity generated will be delivered via renewable energy technologies by 2020 (Hindmarsh and Matthews, 2008). However, there are four specific features of the RET that indicate it may under-deliver both in terms of meeting its intended goal of facilitating 45,000 GWh of renewable energy generation and encouraging enhanced commercial viability of wind power.

The first feature of concern relates to the treatment of waste coal mine gas. When the government was designing the RET program, it did so under the assumption that the CPRS would also be legislated and the RET would gradually be phased out. Under this assumption, the government agreed to a political concession to allow waste coal mine gas (WCMG) to be included in the RET as an "eligible energy source" to differentiate it from the "renewable energy sources". The concession allows WCMG-fired power plants to apply to obtain renewable energy credits (REC) for electricity generated using this fuel source. The government capped the number of RECs available to WCMG projects (at 425 GWh in 2011 and 850 GWh every year from 2012–2020) and increased the aggregate RET by these amounts to avoid eroding the market for RECs attached to renewable energy projects (Government of Australia, 2009d). Unfortunately, there is a flaw with this treatment of WCMG in the absence of a CPRS. WCMG is a by-product of the coal mining process. Accordingly, any wholesale price of captured WCMG that is above the marginal cost of capture represents additional profits to coal mining firms. If WCMG were not included in the RET mandatory purchase program, it is unlikely that there would be much profit in capture for sale of WCMG because the cost of capture makes the technology commercially unattractive. However, in the presence of a mandatory purchase program, WCMG can be captured and sold at a profit. In short, the policy as it now stands is a form of subsidy to coal mining firms which if passed on through the coal value chain will reduce the cost of coal and widen the gap between the costs of coal-fired power and wind power. Any progress made during the course of the RET in closing the economic divide between the costs of coal-fired power and wind power will potentially be usurped by profits accruing to the coal mining industry as a result of WCMG capture for sale. It also incentivizes the commercialization of a technology that is far from a clean energy source because methane combusted for electricity generation produces CO_2 emissions. This subsidy to WCMG power facilities along with a proposed AU$270 million "Coal Sector Adjustment Fund" which the government proposes establishing within the Climate Change Action Fund to provide funding for coal sector abatement projects and capital grants (Government of Australia, 2009c), represents a level of financial assistance to a dirty energy source that should be taxed rather than subsidised.

A second feature of concern related to the RET involves the duration of the program. As it stands now, the program is designed to expire in 2030 with annual targets fixed in the manner outlined in Table 2 (Government of Australia, 2009f). The renewable energy targets increase steadily over the first decade to reflect a cumulative increase in installed capacity. To illustrate, the annual target of 14,400 GWh in 2011 conceptually consists of 12,500 GWh of pre-existing renewable energy generation and 1900 GWh of new generation to be added in 2011. Accommodation is made for adding annual capacity up to 2020 when the annual target of 45,000 GWh of total generation is slated to be met. No additional capacity has been targeted beyond 2020 because the CPRS was expected to be enacted at the same time as the RET and it was felt that emissions trading under the CPRS would become robust enough to level the technological playing field and render the RET moot (COAG, 2008; Government of Australia, 2008b). Unfortunately the CPRS Bill was defeated in Parliament and this has significantly weakened the efficacy of the RET as originally planned. As it now stands, in the final 10 years of the RET program, there will be diminished incentive for electricity retailers to add additional renewable energy capacity beyond that which was established in the first ten-year period. Barring any amendments to this target post-2020 or the implementation of other CO_2 emission reduction policies, one can expect a significant drop-off in renewable energy growth once the target of 45,000 GWh of generation is reached (cf. IEA, 2005). An additional complication arising from the manner in which the targets have been laid out over the 20-year period is that there will likely be heavy competition amongst renewable energy developers in the first five years of the scheme because establishing renewable technology capacity in the early years of the program ensures that renewable energy developers will be able to compete for 15–20 years of guaranteed purchases. Long-term revenue earning capability is essential to renewable energy developers who typically extend debt financing and amortize investments over 15-year periods (Gerardi et al., 2007; Wizelius, 2007). Conversely, renewable energy developers bidding for the 4600 GWh of new electricity supply between 2019–2020 will only have 10 years of certain business prospects before the program expires. Consequently, assuming there is no emergent supplemental policy to regulate GHG emissions, one can anticipate reduced competition for renewable energy sales in the latter part of the program and; therefore, comparatively higher renewable sales prices. In short, the current structure of the RET works counter to the goal of encouraging an acceleration of renewable energy demand to support the economies of scale to facilitate further reductions in renewable energy prices. It supports the process half way and then allows the market to drop out.

A third feature of concern relates to a multiplier scheme established to support small electricity generators. Essentially under this mechanism, renewable electricity credits produced by small-scale (rated output under 1500 KW) solar PV, solar thermal (water), wind and hydro electricity systems will be multiplied by a pre-established "multiplier" for electricity output as outlined in Table 3 (Government of Australia, 2009f). Under this system, 10 MWh of electricity generated by an approved small-scale technology will receive REC credit for 50 MWh of generation, thereby reducing the RET pool by that inflated amount. In short, the program creates phantom credits that exaggerate the real amount of renewable electricity generated. Moreover, although this will catalyze robust sales in early years for solar thermal heaters and household-scale electricity generators, the added competition from small generators might be significant enough to impair the development of utility-scale renewable electricity projects during the 2010–2015 period, which is specifically when wind power and other larger utility-scale developments need to be initialized in order to provide 10–15-years of revenue to allow developers to profitably amortize investments.

Finally, as a fourth feature of concern, the strategic decision to design a capped target system for renewable energy as opposed to offering renewable energy developers a feed-in subsidy or production tax credit for unlimited amounts of electricity generated is arguably a questionable strategy if the goal is to nurture the emergence of a commercially viable domestic renewable energy industry. For wind power developers to be successful in any given market over a sustained period, two things must exist. First, the wind power developers must be able to make

Table 3
Australia's multiplier system for small generation units.
Source: Council of Australian Governments, 2009.

	2010	2011	2012	2013	2014	2015	2016 Onwards
Multiplier	5	5	5	4	3	2	No multiplier

Table 2
Annual generation targets under Australia's RET.
Source: Council of Australian Governments, 2009.

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021–2030
Annual target (GWh)	12,500	14,400	16,300	18,200	20,100	22,000	26,600	31,200	35,800	40,400	45,000	45,000

a profit in order to support the type of investment (i.e. capital investment, R&D initiatives, capacity expansion, etc.) that is essential for reducing future costs and enhancing the long-term commercial viability of wind power. Second, revenue flows need to be cumulative, the current year's revenues building on past years. This provides wind power developers with increasing economies of scale which further help reduce costs and further enhance the long-term commercial viability of wind power. Under a capped target system, especially one with relatively mild targets at the front-end such as that exhibited by the RET, neither of these two criteria are likely to be met. First, wind power developers will see profits squeezed by heated competition in the early years (with small-scale solar thermal water heaters complicating the competitive mix); and therefore, wind developers will have diminished capacity to finance capital expenditures and other investments to stimulate cost reduction. Second, the capped target system disrupts revenue flow predictability and undermines strategic planning. Under the RET, unless there is a drastic change in market economies or additional policies to support a transition to renewable energy, it is likely that market demand for new renewable energy capacity will diminish in 2020. This means that established wind power firms that have gained momentum over 10 years of progressive revenue increases will suddenly find themselves mired in a contracting market with the bulk of revenue being provided by an asset base is gradually aging toward obsolescence.

4. Improving the RET

Methods for improving the RET will differ depending on whether or not an effective emission trading scheme (ETS) is eventually enacted.

The four weaknesses of the current RET which were outlined earlier could be offset by the benefits a robust cap and trade regime can provide. First, the financial benefits to the coal industry that the waste coal mine gas (WCMG) subsidy provides would be significantly minimised if the WCMG project developers had to purchase CO_2 emission permits and still generate WCMG-fired power at competitive rates. Second, an ETS that effectively taxes CO_2 emissions would level the competitive playing field between coal-fired power and wind power and enhance long-term revenue prospects for wind power that extend beyond the duration of the RET. Third, the small generator multiplier intended to give a boost to small-scale technologies would be less of a threat to wind power market development because the business lost to small-scale generators in early years would be compensated for through business taken away from carbon-intensive power plants in ensuing years (once the multiplier program expires) as the electricity industry evolves in response to the positive market signals that an ETS would convey. Finally, the cap of 45,000 GWh would no longer be an issue of concern regarding progressive wind power market growth because once the ETS begins to reflect international values for CO_2 emissions credits (as the Australian CPRS was intended to achieve), wind power would become cost competitive and render the RET cap moot. In summary, under a scenario which includes enactment of an effective ETS, the RET as it now stands is sufficient for supporting wind power development.

Obviously, this presupposes that any ETS (such as the CPRS) would set annual emission ceilings at a level that would significantly alter the comparative costs of electricity sources. A weak cap and trade system would do little to level the competitive playing field in the manner necessary to provide wind developers with long-term market growth prospects. Indications are that the proposed CPRS is designed to be an aggressive program under which annual permits would be restricted over time to achieve the national 60% GHG reduction target (based on 2000 levels) by 2050 (Government of Australia, 2008b). This implies a robust program where the value of carbon credits would substantially increase the overall cost of fossil fuel-based electricity and significantly alter market dynamics.

In a "business as usual" scenario where an effective ETS is not enacted, the RET is not currently sufficient to improve commercial viability of wind power. As such, all four of the weaknesses identified earlier need to be amended.

First, if the goal is to wean the nation off a dependence on coal-fired electricity, the WCMG should not be eligible for RECs. Any part of the coal value chain that is subsidised in this way strengthens the economic case for continued reliance on coal-fired power and makes it harder for utility-scale alternative electricity sources (such as wind power) to compete on a level basis. Already, alternative energy technologies face an uphill battle when competing against coal-fired electricity providers due to disproportional government support. For example, the coal sector benefits from two programs – COAL21 which is a 10-year, AU$1 billion public–private partnership program to finance research into reducing emissions from coal (Government of Australia, 2009g) and the CCS Flagship program which is a 9-year AU$2.4 billion program to support carbon capture and sequestration research (Government of Australia, 2009c) – while the main renewable energy support program under the Clean Energy Initiative provides just AU$465 million to be shared across numerous renewable energy technology platforms. Although other renewable energy support initiatives exist, they pale in comparison to the R&D expenditures in the coal industry. If the release of methane from coal mines is a concern, flaring or capture for energy use should be regulated, not subsidised.

Second, the government should consider formally extending the RET program to facilitate a measured expansion of installed renewable energy capacity from 2020 onwards in order to encourage the scale of transformation necessary to meet the government's 2050 target of 60% GHG reduction (based on 2000 levels). Table 4 provides a quantified recommendation in this context. If the targets outlined in Table 4 were adopted, renewable power developers would have a high degree of financial certainty past the 2020 period and would be incentivized to make the investments necessary to aim for an entrenched market position beyond 2040. Although it can be argued that such long-term security can inadvertently encourage commercial apathy (Komor, 2004), Australia's unique system of pooled bids for

Table 4
Proposed renewable energy capacity targets post-2020.

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Annual target (GWh)	12,500	14,400	16,300	18,200	20,100	22,000	26,600	31,200	35,800	40,400	45,000
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031–2040
Extended target (GWh)	50,000	55,500	61,500	68,000	75,000	82,500	90,500	99,000	108,000	120,000	120,000

electricity ensures that even amongst renewable energy providers, a high degree of cost competition will ensue as firms vie for long-term market share leadership. The final target of 120,000 GWh recommended in Table 4 would represent approximately 50% of Australia's electricity supply and as such the dynamics of load balancing would likely catalyze coordinated initiatives to support the most commercially viable renewable technology (wind power) through highly responsive technologies such as geothermal power (the renewable technology that holds the most potential for providing peak load supply) and natural gas-fired power. Not only would the extension of the RET encourage the development of two technologies that are key to a carbon-free electricity sector (wind power and geothermal power), the achievement of the targets outlined in Table 4 would place Australia firmly on track to achieving the 60% reduction on GHG emissions levels (based on 2000 emission levels) by 2050 (Government of Australia, 2008b) and position Australia to achieve the type of aggregate deep emission reductions (in the range of 80% from 1990 levels) that each nation will have to make to offset the worst impacts associated with global warming (Stern, 2006; IPCC, 2007). Obviously, setting such bold wind power targets would benefit from advances in storage technology. Therefore, the government should consider ramping up funding support for storage technology research. This is arguably a more sustainable use of the AU$2 billion in government funding that has been earmarked for carbon capture and sequestration research (Government of Australia, 2009c).

An additional benefit of extending renewable energy generation targets beyond the 2020 period is that the new targets would mitigate the threat posed by the multiplier system for small-scale generators and negate the fourth concern associated with the current RET that a capped target system does not encourage long-term market investment. Although, under the proposed target extensions in Table 4 a cap is still in place, the cap comes into play far enough into the future to provide the long-term purchase guarantees (15 years +) necessary to entice wind power developments (after the incentivization of solar water heaters runs its course) and provides more time to allow research in renewable energy technology to yield the cost-saving innovations needed to compete without market support.

In summary, the best approach for the government is to push for the passage of the failed CPRS bill provided that the CPRS is robustly structured to force electricity generators to internalise the external costs of CO_2 emissions – at least to a level that parallels notable international carbon taxation efforts such as the ETS in the EU. However, in lieu of an effective ETS, eliminating WCMG from the RET list of eligible energy sources and extending the RET targets to a 2040 target of 120,000 GWh will enable wind power developers and other renewable energy developers to achieve the scale of activity necessary to support the type of radical transition that the nation acknowledges is necessary in the face of the threats posed by global warming (Government of Australia, 2009h).

At the end of the day, it comes down to the political will and capacity of the new Labor government to fight the battles necessary to infuse the RET with the transformational impact it was intended to exhibit. In the absence of such political will, like so many other national governments in states where wind power is underperforming, it ends up being the governing party in Australia that is responsible for "braking wind" in Australia.

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References

ABARE, 2008. Energy in Australia 2008. Australian Bureau of Agriculture and Resource Economics (ABARE), Australia.
ABARE, 2009. Energy in Australia 2009. Australian Bureau of Agriculture and Resource Economics (ABARE), Australia.
Ackerman, T., 2005. Wind Power in Power Systems. John Wiley and Sons, UK.
Akmal, M., Riwoe, D., 2005. Australian Energy: That National and State Projections to 2029–30. Australian Bureau of Agricultural and Resource Economics (ABARE), Australia.
ATSE, 2009. The Hidden Costs of Electricity: Externalities of Power Generation in Australia. Australian Academy of Technological Sciences and Engineering (ATSE), Parkville, Victoria, Australia.
Celik, A.N., Muneer, T., Clarke, P., 2007. An investigation into micro wind energy systems for their utilization in urban areas and their life cycle assessment. In: Proceedings of the Institution of Mechanical Engineers, Part A: Journal of Power and Energy 221, 1107–1117.
Chester, L., 2007. Who benefits from the restructuring of the Australian electricity sector? Journal of Economic Issues 41, 981–1001.
Clean Energy Council, 2009. All About Geothermal Energy. Clean Energy Council, Southbank, Victoria, Australia.
CME, 2009. Renewable Energy Projections: 2009–2028. Carbon Market Economics (CME) Pty Ltd., Australia.
COAG, 2008. Design Options for the Expanded National Renewable Energy Target Scheme. Council of Australian Governments (COAG), Canberra, Australia.
COAG, 2009. Renewable Energy Target Scheme Design. Council of Australia Governments (COAG), Barton, ACT, Australia.
Coppin, P.A., Ayotte, K.A., Steggel, N., 2003. Wind Resource Assessment in Australia: A Planners Guide. CSIRO Wind Energy Research Unit, Australia.
Diesendorf, M., 2003. Why Australia needs wind power. Dissent 13, 43–48.
Diesendorf, M., 2007. Greenhouse Solutions with Sustainable Energy. University of New South Wales Press, Sydney, Australia 432 pp.
DONG Energy, 2008. Final Report on Offshore Wind Technology. New Energy Externalities Developments for Sustainability Consortium.
Englander, D., 2008. Japan's Wind-Power Problem. Greentech Media.
Falk, J., Green, J., Mudd, G., 2006. Australia, uranium and nuclear power. International Journal of Environmental Studies 63, 845–857.
Gerardi, W., Nsair, A., Falcon, N., Ott, S., 2007. Review of REC Markets. McLennan, Magasanik and Associates, Melbourne, Australia.
Government of Australia, 2008a. Australia's Greenhouse Gas Emissions. Government of Australia, Canberra, Australia.
Government of Australia, 2008b. Executive Summary to White Paper Volume 1: Carbon Pollution Reduction Scheme: Australia's Low Pollution Future. Department of Climate Change, Government of Australia Canberra, Australia.
Government of Australia, 2009a. Energy in Australia 2009. Department of Resources, Energy and Tourism, Government of Australia, Canberra, Australia.
Government of Australia, 2009b. National Energy Security Assessment. Department of Resources, Energy and Tourism, Government of Australia, Canberra, Australia.
Government of Australia, 2009c. Clean Energy Initiative. Department of Resources, Energy and Tourism, Canberra, Australia.
Government of Australia, 2009d. Discussion Paper 4: Treatment of New Waste Coal Mine Gas Power Generation in the RET. Department of Climate Change, Government of Australia, Canberra, Australia.
Government of Australia, 2009e. MRET: The Basics. Office of the Renewable Energy Regulator, Government of Australia, Canberra, Australia.
Government of Australia, 2009f. Renewable Energy (Electricity) Amendment Act 2009. Government of Australia, Canberra, Australia.
Government of Australia, 2009g. Energy White Paper: Realising Australia's Energy Resource Potential. Australian Department of Resources, Energy and Tourism, Canberra, Australia.
Government of Australia, 2009h. White Paper: Maximising the Value of Technology in the Energy Sector. Department of Resources, Energy and Tourism, Government of Australia, Canberra, Australia.
Gurney, A., Ford, M., Low, K., Tulloh, C., Jakeman, G., Gunasekera, D., 2007. Technology: Toward a Low Emissions Future. Australian Bureau of Agricultural and Resource Economics (ABARE), Canberra, Australia.
Hindmarsh, R., Matthews, C., 2008. Deliberative speak at the turbine face: community engagement, wind farms, and renewable energy transitions in Australia. Journal of Environmental Policy and Planning 10, 217–232.
IEA, 2005. Energy Policies of IEA Countries: Australia 2005 Review. International Energy Agency (IEA), Paris, France.
IPCC, 2007. Climate Change 2007: Synthesis Report. Intergovernmental Panel on Climate Change (IPCC), Geneva, Switzerland.
Kann, S., 2009. Overcoming barriers to wind project finance in Australia. Energy Policy 37, 3139–3148.
Komor, P., 2004. Renewable Energy Policy. iUniverse, USA.
MacGill, I., Outhred, H., Nolles, K., 2006. Some design lessons from market-based greenhouse gas regulation in the restructured Australian electricity industry. Energy Policy 34, 11–25.

Macintosh, A., Downie, C., 2006. Wind Farms: The Facts and the Fallacies. The Australia Institute, Australia.
NEMMCO, 2005. An Introduction to Australia's National Electricity Market. National Energy Market Management Company Limited (NEMMCO), Melbourne, Australia.
Owen, A.D., 2009. The inquiry into electricity supply in New South Wales. Energy Policy 37, 570–576.
Saddler, H., Diesendorf, M., Denniss, R., 2007. Clean energy scenarios for Australia. Energy Policy 35, 1245–1256.
Schlapfer, A., 2009. Hidden biases in Australian energy policy. Renewable Energy 34, 456–460.
Sovacool, B.K., 2008. Valuing the greenhouse gas emissions from nuclear power: a critical survey. Energy Policy 36, 2940–2953.
Stern, N., 2006. The Stern Review: Report on the Economics of Climate Change. Cabinet Office – HM Treasury, London, UK.
Valentine, S.V., Japanese wind energy development policy: Grand plan or group think? Energy Policy, article in press, doi:10.1016/j.enpol.2009.10.016.
Valentine, S.V., 2010. Disputed wind directions: Reinvigorating wind power development in Taiwan. Energy for Sustainable Development 14, 22–34.
Wesley, M., 2007. Power Plays: Energy and Australia's Security. Australian Strategic Policy Institute, Barton, ACT, Australia.
Wizelius, T., 2007. Developing Wind Power Projects: Theory and Practice. Earthscan, UK.
WWEA, 2009. World Wind Energy Report 2008. World Wind Energy Association (WWEA), Bonn, Germany.