Prospects for Meeting Australia's 2020 Carbon Targets, given a Growing Economy, Uncertain International Carbon Markets and the Slow Emergence of Renewable Energies

Colin Hunt
Visiting Fellow in the School of Economics at the University of Queensland
St Lucia Campus, QLD, 4072, Australia
(Email: c.hunt3@uq.edu.au)

Abstract: The carbon emissions of Australia's future energy consumption are compared with the emissions targets implied by the cuts in carbon emissions committed to by the Australian government for 2020 and 2050. Analysis shows that even the seemingly modest cut of 5% of carbon emissions by 2020 cannot be met without substantial contributions by low carbon sources that are in addition to the contribution of 20% of electricity supply mandated by the government. The choices in renewable energy are constrained by the need for base-load power to constitute a large proportion of energy supply but the short lead time to 2020 precludes sources that require more development or lengthy planning processes. The official forecasts of energy generation assume a large proportion of Australia's emissions will be offset through international emission trading. However the prospects for the development of international carbon market are presently poor. The conclusion is that, even with a domestic price on carbon, the Australian government's 2020 targets for carbon emission reductions are unlikely to be met and should be revised downwards.

I. CARBON POLLUTION TARGETS

On 4th May 2009 the then minister for Climate Change and Water, Senator Penny Wong, announced new targets, below 2000 levels, for Australia's carbon pollution (Wong 2009). These were:

- an unconditional commitment of 5% by 2020;
- 15% by 2020, if major developing economies commit to substantial emission restraints and advanced economies take on commitments comparable to Australia's;
- 25% by 2020, if the world agrees to stabilise levels of CO_2 equivalent at 450 ppm or lower.

This undertaking was later reiterated by the government in its response to the UNFCCC's Copenhagen Accord (Wong 2010).

Earlier, the Australian government had committed to a reduction of 60% in carbon emissions, on 2000 levels, by 2050 (Australian Government 2008).

II. ENERGY MIX AND EMISSIONS

Carbon emissions are mainly the result of burning fossil fuels to provide transport and electricity. The energy mix in 2008 and the associated emissions are given in *Table 1*. The energy mix and estimates of carbon emission from fuel sources adopted in *Table 1* give CO_2 emissions totaling 395.1 Mt, which is a difference of less than 1% from International Energy Agency estimates of Australia's total sectoral emissions of CO_2 in 2008 of 397.5 Mt (IEA 2010, p.65).

Table 1: Energy sources, consumption and associated carbon dioxide emissions, Australia, 2008

Sources	%	PJ[a]	CO_2/PJ[a]	CO_2 Mt
Black coal	29.1	1587	92.1	146.1
Brown coal	10.6	577	96.6	55.7
Coal total	39.7	2163	93.3	201.8
Petroleum	33.6	1832	71.5	131.0
Natural gas	21.6	1179	52.8	62.2
Renewables	5.0	274	0.0	0.0
Totals	100.0	5448		395.1

[a]PJ=petajoule
Sources: Energy mix ABARE (2010, p. 31); CO_2/PJ US Energy Information Administration (1993: Table B.1).

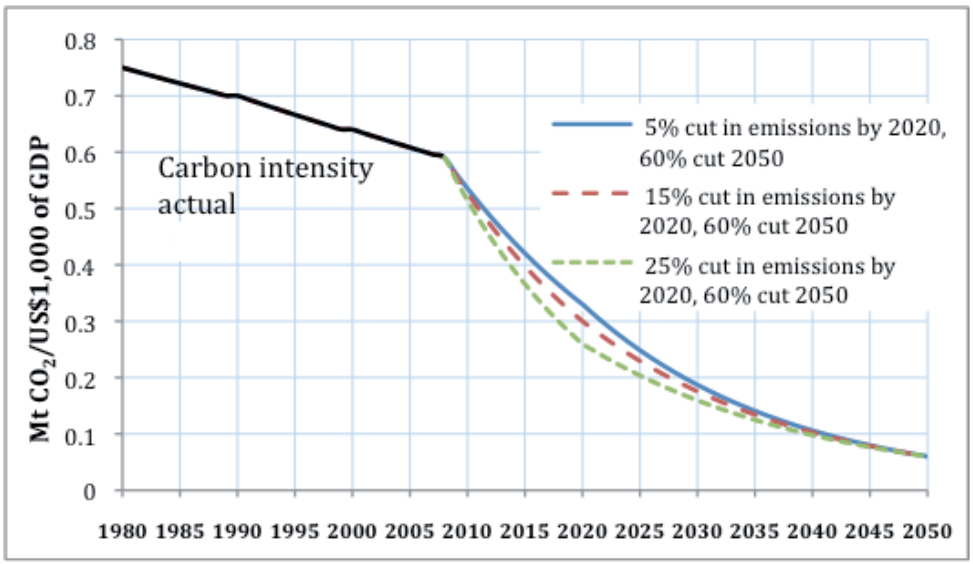
Australia's Gross Domestic Product (GDP) has grown by more than 3% in each of the last three decades. It is therefore assumed that this rate of growth will continue for the foreseeable future. While there is a high correlation between energy consumption and Gross Domestic Product (GDP), the energy intensity of the Australian economy (PJ/GDP) has declined steadily at about 1% a year since 1980 (source of energy supply and GDP at purchasing power parity, is IEA (2010, pp. 71, 80). Taking this into account, energy consumption is expected to grow by 1.58% per year to 2020, resulting in energy consumption of 6,579 PJ in that year (compared with 5,448 in 2008).

III. CARBON INTENSITY OF THE AUSTRALIAN ECONOMY

The other important parameter in forecasting energy consumption and associated carbon emissions is the carbon intensity of the economy (CO_2/US$1,000 of GDP) (Source is IEA (2010, p. 92)). This has declined steadily by 1% a year in each of the last two decades, resulting in a carbon intensity of 0.59 in 2008 compared with 0.75 in 1980.

Figure 1 illustrates the carbon intensity of the Australian economy, actual from 1980 to 2008 and forecast to 2050. The Figure illustrates the rapid rate of the reductions in carbon intensity, relative to the reductions actually achieved, that are required if the targets are to be met. *Table 2* gives the actual and projected rates of decarbonisation.

Figure 1: Carbon Intensity of the Australian Economy[a]



[a]Rate of growth of GDP is 3%
Source: Author.

Table 2: Annual Rates of Decarbonisation of Australian Economy 1980 to 2008, and Rates implied by Carbon Emission Targets for 2008 to 2020, and for 2008 to 2050, %[a]

	1980-2008	1990-2008	2000-2008	2008-2020	2008-2050
Actual rate of change	-0.86	-0.95	-1.02		
Implied rate of change					
5% reduction target & 3% GDP				-5	
15% reduction target & 3% GDP growth				-5.8	
25% reduction target & 3% GDP growth				-7.1	
60% reduction target & 3% GDP growth					-5.6

[a] Rate of decarbonisation is rate of change in Mt CO_2/US$1,000 of GDP.
Source: Author.

3.1 Meeting Energy Demand within Carbon Constraints

Given the projected rate of growth in energy consumption and the carbon content of the main energy sources, the question is what mix of energy sources will meet the government's CO_2 emission targets, that is, that will satisfy equation (1).

$$CE \leq CT \quad (1)$$

Where: CE = carbon emissions from energy consumption
CT = carbon emissions target

Electricity production constituted 42% of energy production in 2007-2008 (ABARE 2010, p. 16) and while 5% of energy supply is generated by renewables only 1.1% of energy supply is electricity, the balance being heat (ABARE 2010, p. 31). In August 2009 the Australian government implemented the Renewable Energy Target Scheme designed to deliver 20% of electricity generation from renewable sources in 2020 (Australian Government 2010). On the assumption that electricity generation continues to contribute 42% to energy supply in 2020 and that 20% of this will be mandatory from renewable sources, then 8.5% of total energy supplies will be from renewables. If 3.9% continues to be heat energy from renewables then the total contribution from renewables to energy supply in 2020 will be 12.4%.

To meet energy requirements while at the same time constraining CO_2 emissions within targets requires a reduction in coal burning and a substitution by energy sources that generate zero emissions. *Table 3* shows that for a 5% reduction in emissions by 2020, on year 2000 levels, and at the same time a generation of 6,579 PJ, requires 17.8% of energy generation from non-polluting sources in addition to the 12.4% that will be mainly contributed by mandatory sources. That is, fully 30% of energy requirements will need to come from non-polluting sources. Petroleum and natural gas contributions in 2020 are greater in absolute amounts than in 2008 because of the increase in projected total energy requirement from 5,448 PJ in 2008 to 6,579 PJ in 2020 (see *Table 3* for contribution of renewables at higher targets).

Petroleum, used mainly in transport, is more difficult to replace than solid fossil fuels. Moreover, a carbon price is unlikely to change fuel use in the transport sector given that a carbon price of A$100/t$CO_2$ increases the price of fuel by only A$0.25/L (CSIRO 2008, p. 10). The proportion of liquid fuel is therefore held constant in 2020.

If the proportion of natural gas is increased above that in *Table 3*, then emissions are driven below the target but at the same time the fuel mix requires a greater contribution by renewables than shown in the Table to satisfy energy requirements.

Table 3: Energy Mixes that meet Energy Requirements and are within the Constraints on Carbon Emissions, 2020 and 2050

	yr 2020	yr 2020	yr 2020	yr 2050
Targets				
Cut CO_2 on yr 2000	5%	15%	25%	60%
Target CO_2 Mt	322	288	254	136
Energy required 000PJ	6,579	6,579	6,579	10,545
Energy mix %				
Coal	14.5	8.9	3.4	0.0
Petroleum	33.6	33.6	33.6	10.0
Natural gas	21.6	21.6	21.6	10.8
Renewables	12.4	12.4	12.4	12.4
Other, with zero CO_2 emissions	17.8	23.5	28.9	66.8
Totals	100.0	100.0	100.0	100.0

Source: Author.

IV. DISCUSSION

The rapid adoption of a large proportion of renewable energy by 2020, in order to satisfy energy requirements and carbon pollution restraints, suggested by *Table 3*, depends on the availability of renewable energy alternatives and an adequate return on investment in them. If cost-effective renewable alternatives to coal are not available for adoption, then energy suppliers will simply pay the carbon taxes and the fines associated with breaching emission caps. A recent study suggests that even with a carbon price the alternatives to fossil fuels in 2020 are limited (ATSE 2010). Moreover, a large proportion of Australia's energy supply needs to be base-load, but

> "… two of the best technologies for addressing Australia's base-load power requirements, solar thermal and geothermal, do not appear in any significant proportion of the energy mix until about 2040." (Australian Academy of Science 2010, p. 30).

The Garnaut (2008) review identified the important role of international offsets in allowing Australia to meet its emission targets. And the government's 2020 targets are specifically based on the assumption that international emissions trading gradually expands, developed economies participate from 2010 and developing countries join over time, and there is global participation by 2025 (ABARE 2010a, p. 10). The extent of the reliance on international trading is illustrated by ABARE's (2010a, p. 27) energy projections of 7,715 PJ for 2029-2030 from an energy mix of 17% black coal, 6% brown coal, 36% oil, 33% gas and 8% renewables. Based on emissions by fuel source in *Table 1*, this mix will emit almost 500 Mt of CO_2 and the carbon intensity of the economy would be 0.39. Trading would need to offset 50% of Australia's emissions by 2029-30 if the carbon intensity of 0.2 is to be achieved on the path to a low carbon economy in 2050, as indicated by *Figure 1*. However, the prospects for international action that will bring a robust international carbon market into being, and allow Australia to continue to generate a large proportion of its energy from fossil fuels and only a small proportion from renewables, have steadily receded since the Copenhagen Climate change conference in December 2009; no such agreement being reached at the recent Cancun conference for targets and trading after 2012, when the Kyoto Protocol expires.

Garnaut (2011) is now circumspect about the emergence of markets, stating that a binding international agreement on emissions is "…likely to take more than a few years". Garnaut (2011) adds that emission credits could, however, become available for purchase by Australia through partnerships and trading arrangements with developing countries in our region. Credits for sale would likely be at prices well below Australia's marginal cost of abatement, generated – I suggest – largely through reductions in deforestation and forest degradation (REDD). But the availability of reliable offsets from such sources might also be delayed for several years. Mechanisms for measurement, reporting and monitoring of emissions reductions from forestry have not yet been agreed. Moreover, there may be high risks for Australia in outlaying for REDD credits until those countries have undergone institutional reform to tighten both their forest and financial management (see, for example, Dyer and Counsell (2010); Hunt 2010; World Bank (2009)).

Birrell and Healy (2009) and Pielke (2010), using different methods of analysis, also conclude that Australia's 2020 emission targets are unattainable. The former authors assert

population growth – fuelling GDP growth and therefore emissions – is the problem. While population policy is now on the Australian government's agenda the prospects for the adoption of cuts to immigration sufficient to bring Australia nearer its emission targets are very unclear.

Pielke (2009) suggests that adoption of nuclear power generation is the only feasible path to a low carbon economy. Australia would need 17 nuclear power plants to cover its energy requirement and meet the emission cut of 5%, assuming that an average nuclear plant provides 1,000 PJ of energy (see Table 3, 'Other with zero CO2 emissions' for 5% cut). However, the Australian Labor Party has a longstanding opposition to nuclear power. And even if a change in policy came soon, Australia's first reactor could not be ready before 2020, with the construction of one plant a year thereafter being Australia's capacity (Switkowski 2007).

V. CONCLUSIONS

As recently as a year ago Australia reported to the UN that it would unconditionally reduce its emissions by 5% below 2000 levels by 2020, and by up to 15% if there is global agreement including developing and developed countries. The commitments are dependent on the availability of international offsets but the prospects for an international agreement that will generate robust carbon markets are not presently favourable.

In reviewing Australia's endogenous capacity to reduce its carbon intensity by 2020 it is apparent that technologies that provide base-load power and substitute for coal are unlikely to contribute substantially until 2040. While a rising price on carbon will contribute to the commercialisation of these low carbon alternatives, near-term absence of aternative base-load power sources that offer attractive investment returns means that carbon polluters are likely to simply pay the carbon tax or the fines from breaching caps.

Australia needs to revise its commitments downwards. Doing so will further weaken the fragile fabric of international agreements to limit climate change; nevertheless it is a responsible strategy and one that will avoid embarrassment in the future.

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