Submission to the Inquiry into the Clean Energy Bills

Joint Select Committee on Australia's Clean Energy Future Legislation

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The Role and Effect of Carbon Taxes in Australia

Summary

Measures to reduce greenhouse gas emissions are aimed at preventing an atmospheric warming that is said to follow from the likely doubling of carbon dioxide emissions expected over the current century. Carbon dioxide poses no direct threat to human wellbeing but climate change from higher concentrations of emissions may be significant. Studies put the global economic effect at between plus or minus 2.5 per cent of GDP though the Garnaut report estimated costs of up to 12 per cent.

Australian mitigation measures entail highly detrimental economic effects as a result of the economy's dependence on fossil fuels. Australia is a high emitter of carbon dioxide as a result of our industry structure – we export "congealed" carbon dioxide in the goods we sell whereas other affluent nations tend to be net importers.

Already Australia is incurring considerably greater costs from regulations (largely through mandating high cost renewable energy) and taxes to reduce emissions. Our costs are considerably higher than in countries other than EU members. The proposed carbon tax would add considerably to those costs.

Treasury puts the costs of the economy's restructuring forced by a carbon tax at only $2,700 per capita in 2050 (half its cost estimate of four years ago). This is based on:

- All countries imposing a similar regime to Australia's; only the EU will do so
- rapid technological development of carbon capture and storage and other technologies that are presently unviable; there is no basis for such forecasts
- a continued expansion of coal and other energy exports; this is in spite of assuming global carbon restraining measures in which coal can have no place
- increased Australian labour productivity growth; this is despite of the forced abandonment of our most productive industries and other cost impositions.

Treasury proposals involve Australia buying from overseas about half the carbon credits that would be necessary to achieve the target. This requires costs equivalent to about twice the revenues presently earned from agricultural exports.

The costs of deferring action to 2020 and then taking accelerated measures to achieve the 2050 goals would, according to Treasury, be a loss of about 0.3 per cent of 2050 incomes. This is a very modest insurance policy and should be followed.

Measures to abate CO_2 emissions mean a comprehensive override of business decisions by politicians and bureaucrats. Many people supporting such overrides are successors to a long tradition favouring hands-on government controls. Their opponents see the damage these approaches have inflicted on economies in the past.

Introduction

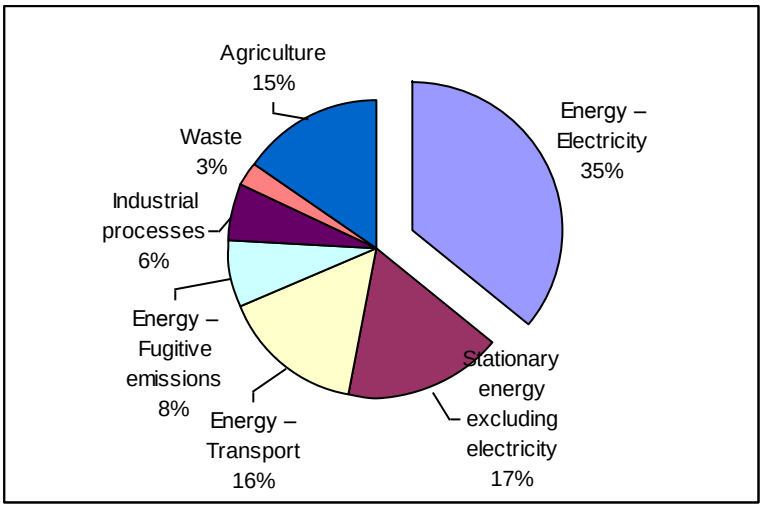
Reducing emissions of CO_2 and other greenhouse gases to prevent human induced warming can only be effective if all nations take abatement action.

Among those who advocate abating these emissions, many favour taxes as the best regulatory approach. A tax based approach, like its related approach of imposing a cap and allocating tradeable emission rights, allows considerable scope for markets to find the lowest cost means of abatement. With taxes this occurs automatically as a result of the tax's cost imposition; under tradeable rights it takes place indirectly as firms buy and sell rights to emit in order to maximise profits.

Whatever the benefits of lower greenhouse gas emissions, all approaches to forcing abatement have costs. All can be modelled to allow comparisons in terms of their tax equivalent.

Greenhouse gas emissions stem from many different sources. Electricity is the highest profile source but is responsible for a minority of emissions. In Australia electricity comprises only 36 per cent of emissions. Shares from different processes are indicated in Figure 1.

Figure 1 Australian shares of different GHG producing processes



The Setting

The Scientific Measurements

Prudent policy behaviour in Australia is predicated on two matters:

- Global temperature trends that might be caused by human activities; and
- The heightened level of carbon dioxide and similar 'greenhouse gases' said to be causing climate change.

Policy is conditioned by other facets including the actions of other countries, the costs to Australia of various actions that might be taken to reduce emissions and the tools available to effect such reductions.

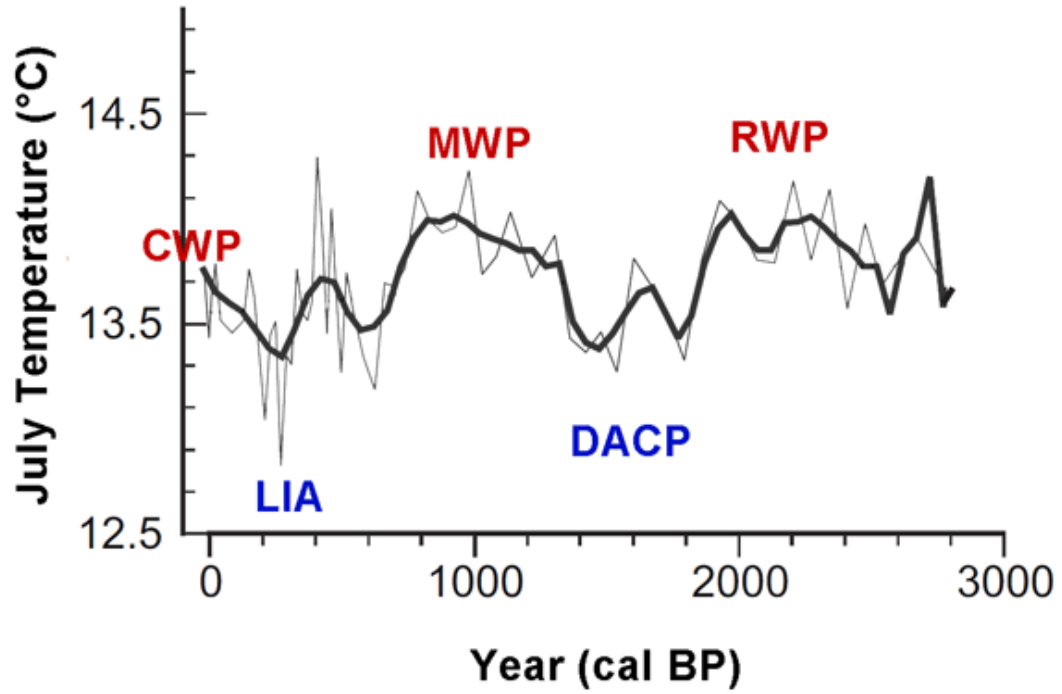
Global concentrations of the main greenhouse gas carbon dioxide, are presently at about 380 parts per million (ppm) and are forecast to rise to 550 ppm during the course of this century. CO_2 levels started to increase prior to the world commencing its industrialisation but have grown more rapidly in recent decades. In geological terms, atmospheric concentrations have been at much higher levels than those of today. CO_2 is essential to life and is harmless to man at any concentration levels presently envisaged – commercial greenhouses have CO_2 levels at around 1,200 ppm which is the optimal level for growing many plants.

Estimates of the effect on global temperatures from warming caused by human induced emissions of greenhouse gases range from zero to as much as 5º Celsius. There are many conflicting assessments about whether such warming is actually taking place and the effects of warming, should it be taking place, on the earth as a host for human liveability. The pre-eminent global expert on atmospheric physics, Professor Richard Lindzen, has estimated that the maximum possible temperature increase from increased emissions of greenhouse gases is 2ºC, most of which, if it were to occur, has already taken place.

Effects of Global Warming

Current global temperatures are low compared to the levels of the past 3000 years.

Figure 2 Estimated Temperature Levels



Source: S. Fred Singer, Craig Idso, Robert M. Carter, *Climate Change Reconsidered*, August 29, 2011

Temperatures several degrees warmer and colder than present average levels have existed over geological time including in the 100,000 years or so that *homo sapiens* have thrived.

It is likely that climate changes, even relatively minor ones, would have some effect on human well being, though the effects would clearly be less severe today than in earlier eras when forecasting and ameliorating measures were less readily available.

There are widely varying estimates of the effects. Government financed studies like Stern[1] and Garnaut[2] have high global cost estimates (8-12 per cent) as a result of global warming but these estimates were not subject to rigorous peer review. Those studies have been scathingly criticised by reputable economists, including the Productivity Commission, for among other reasons using extremely low discount factors in estimating future costs.

For the world as a whole, the dozen or so peer reviewed economic analyses[3] suggests a doubling of emissions would bring costs over the course of a century in the range of +/-2.5%. Though significant, such costs are low – less than the economic growth experienced during a single year. Even the Government financed studies' costs are low when examined in the context of real incomes doubling over the course of the period during which the costs are incurred.

The question for the world is whether the costs of reducing emissions outweigh the benefits. Measures which shut-off the cheapest forms of energy would seriously reduce this expected increase in global income levels. Indeed, many areas would make unambiguous gains from warming (e.g. much of Russia, China and north America). This in itself is likely to make an international agreement impossible.

Australia within the World

The issues are what action, if any, Australia should take in the form of taxes or related instruments, to restrain its carbon emissions; what actions are currently being undertaken; and what instruments might be the best to use.

The outcome on the climate resulting from Australia taking action alone is negligible. Those favouring such action do so on the basis that we have a moral obligation to 'do our bit' in emission reductions and, less persuasively, that our own actions will motivate the less committed nations to follow suit. Australia accounts for a trivial 1.3% of global emissions, the major emitters are:

[1] Stern, N. (2006). "Stern Review on The Economics of Climate Change". HM Treasury, London
[2] Garnaut Climate Change Review Update 2011. 31 May 2011.
[3] See Richard Tol, "The impact of climate change and its policy implications", in *Climate Change: the Facts*, edited by Alan Moran, IPA 2010

Table 1 Major greenhouse gas emitting nations

Top-5 emitters for the year 2005

Country or region	% of global total annual emissions	tonnes of GHG per capita
China	17 %	5.8
United States	16 %	24.1
European Union-27	11 %	10.6
Indonesia	6 %	12.9
India	5 %	2.1

On a per capita basis Australia has a relatively high level of emissions comparable to those of the US. However, this is amplified relative to other developed countries because:

- Australia is among the few developed countries that consume fewer emissions in its goods than it uses to produce them – other developed countries, in effect, outsource part of their emissions, in some cases like Switzerland, the outsourcing amounts to 50 per cent of consumption.
- Nuclear power and major extensions of hydro power, both of which are emission free, are banned in Australia but commonly provide one fifth or more of other countries' electricity generation.

Emissions of greenhouse gases are a bi-product of consumption in general; hence the highest emitters tend to be the more affluent nations. Although Australia is among the highest per capita producers of greenhouse gas emissions, in terms of consumption we rank 10th. Table 2 illustrates this in terms of carbon dioxide emissions (i.e excluding the other less important greenhouse gases, whose trades cannot be readily traced).

Table 2 Developed countries emissions of carbon dioxide ranked by per capita consumption

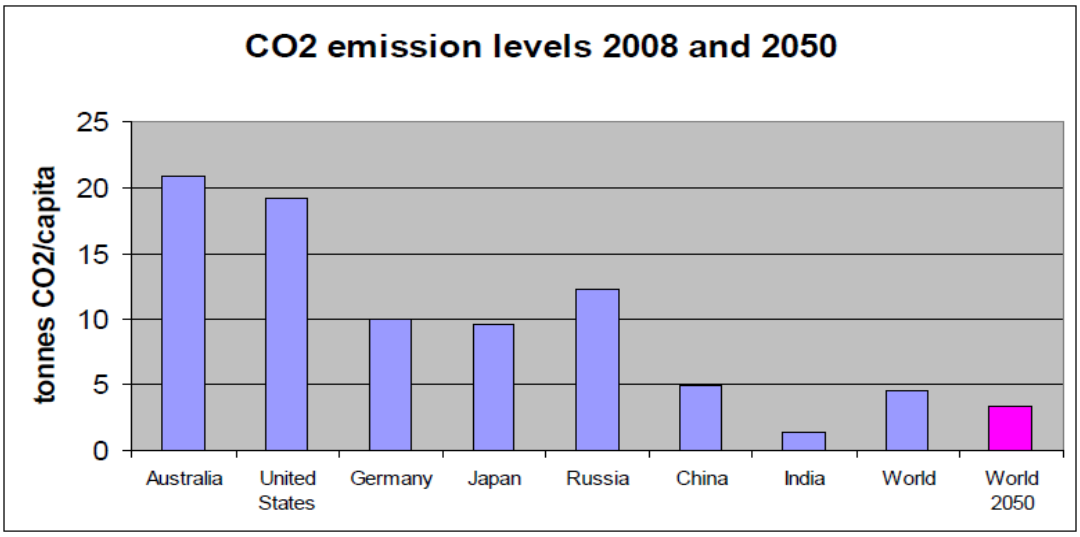
Country	Production	Production per head	Consumption	Consumption per head
Singapore	63	14.1	178	40.1
Luxembourg	11	22.7	17	33.1
Belgium	115	10.7	234	21.9
United States of America	5674	18.5	6153	20.0
Canada	563	16.6	600	17.7
Ireland	43	9.5	72	15.9
Finland	56	10.6	80	15.2
Norway	40	8.3	71	14.9
Switzerland	41	5.3	108	14.0
Australia	353	16.0	297	13.5
Netherlands	169	10.3	215	13.1
Germany	772	9.4	994	12.1
Austria	72	8.5	100	11.9
Japan	1311	10.2	1516	11.8
United Kingdom	546	8.8	704	11.4
Denmark	46	8.4	60	10.8
Greece	99	8.8	122	10.8
Portugal	57	5.4	111	10.4
Italy	458	7.6	611	10.2
Spain	346	7.5	441	9.6
New Zealand	31	7.1	38	8.8
Sweden	48	5.1	80	8.6
France	381	5.9	536	8.3

Source US Academy of Science, Davis and Caldiera. http://www.stwr.org/climate-change-environment/carbon-emissions-outsourced-to-developing-countries.html#Carnegie

It is however the production of emissions that dominates policy setting issues and conditions the Government's proposed carbon tax and cap and trade policy directions. The objective is to stabilise global emissions of carbon dioxide and its equivalent. The following chart depicts the goal, which for Australia entails a reduction of over 80 per cent of current emission levels.

Figure 3

CO2 levels for 2050 stabilisation ~590 ppm (adjusted for population growth)



In order to achieve these emission levels, Australia would need to replace all its fossil fuel sources of energy – gas and electricity – with renewables (or nuclear). As nuclear is off the table and the only source of low cost renewables, hydro power, is also ruled out politically as well as close to being fully exploited, that means using wind or solar.

To achieve such a switch in sources of energy is in principle extremely costly and in practice downright impossible. Central to the Government's "Climate Change Plan" is a carbon dioxide tax, starting at $23 per tonne in 2012 and eventually rising to $131. In principle, wind, the cheapest exotic renewable could displace fossil fuels at a tax of about $100, which would mean trebling the cost of generation. But this, aside from dotting the landscape with tens of thousands of turbines would be impossible because the intermittent nature of wind requires back-up. Treasury is relying on technological developments not yet in place – like carbon capture and storage – to meet its impossible dream

If Australia were to wind-down activities that are prominent emission producers - in particular the one quarter of our electricity used for smelting – the effect would be fully offset by expansions elsewhere. This is unlikely to result in a net reduction in global emissions and might even increase them if the gap was filled by producers who use more emissions in the electricity supply than Australian sources.

Moreover, the likelihood of international action is receding. And it is not credible to imagine that Australia taking unilateral action will prompt similar measures by others. The US is abandoning its efforts at the federal level and individual states are pulling out of previously announced emission reduction commitments. The Productivity Commission[4], in its research that assessed overseas emission policies, reported that of the 11 US States and Canadian Provinces that had agreed to a carbon tax, only one remains fully committed.

[4] Carbon Emission Policies in Key Economies, Productivity Commission, May 2011

Of other countries, China is not moving towards emission restraints, in spite of its leaders proclaiming they will show global leadership on the matter – wind and solar comprises less than one per cent of electricity supply. Japan stated at Cancun that it was not going to take further action towards promoting renewables and it would not introduce a carbon tax. The Fukuyama disaster has closed off, at least temporarily, the prospect of a nuclear power resurgence throughout the world.

Forms and Incidences of Carbon Taxation

The intent of emission abatement action is to bring about changes in the composition of the economy. These changes primarily entail forcing reduced usage of fossil fuels (or isolating the CO_2 emissions through carbon capture and storage (CSS)) by:

- Switching use of fuels from high emission sources like coal to lower emitting sources like gas or to zero emission sources like hydro, nuclear and wind/solar.
- Changing the nature of consumption from energy intensive expenditures.

In terms of switching out of high greenhouse gas emitting energy sources, the emission free sources are hydro, nuclear and wind/solar. Hydro potential globally is limited. Nuclear faces public concerns and, partly as a result of this, is relatively expensive in most countries. There are considerable limits on the role that might be expected of solar/wind. For electricity generation, wind is and will remain three times as costly as coal with solar perhaps six times as costly. Moreover, in both cases the unreliability adds further expenses. And in spite of vast outlays on research, there is no prospect that coal power based on carbon capture and storage will get off the drawing board.

There are three mechanisms for bringing about emission reductions.

The first is a carbon tax, which sets the price level and allows the quantity to adjust. The second is a cap and trade approach, which sets a level of emissions and allows the price to be the outcome. A tax and cap-and-trade are called "economic instruments". They are a comprehensive use of market mechanisms which generally will allow the objectives to be achieved at least cost.

The third regulatory approach seeks to set specific solutions or direct actions. Australia has a multitude of these already including:

- The mandatory Renewable Energy Target (RET) which requires that 'exotic' renewables like wind and solar will supply 20 per cent of electricity by 2020.
- Regulations on housing construction, domestic appliances etc. designed to ensure they use less energy and hence bring about lower greenhouse gas emissions.
- Budget subsidies and grants to activities the government thinks provide the best bang-per-buck.

The cost per tonne of carbon saved can be estimated from all of these policies and expressed as a tax effect. The Productivity Commission estimated the effect of Australia's regulatory measures as at 2010 was equivalent to a tax (which it calls an "implicit subsidy") of between $44 and $99 per tonne of CO_2.

Table 3 illustrates the PC's estimates of the tax effect of specific measures.

Table 3 Effects of emissions-reduction policies, Australia

Policy name	*Policy type*	*Subsidy equivalent*	*Abatement*	*Implicit abatement subsidy*
		A$m	Mt CO_2	A$/t CO_2
Renewable Energy Target	REC scheme	335–556	4.3–8.0	42–129
Large-scale component		283–459	4.1–7.6	37–111
Small-scale component		52–98	0.2–0.3	152–525
GGAS (NSW and ACT)	Emissions offsets	3	0.6	5
Queensland Gas Scheme	Gas-fired electricity	38	2.1	18
Total for solar PV		149–194	0.2–0.3	431–1 043
Total		**473–694**	**7–11**	**44–99**

Derived from PC Table 4.3

The PC modelling estimated that a single tax on electricity set at $9 per tonne of CO_2 would produce the same amount of emission reduction, though this depends on very strict assumptions.

Although the PC analysis is the most comprehensive that has been undertaken it does not claim to include all measures. Significantly, Budget expenditures are excluded, at least for Australia. According to material assembled by the Department of Climate Change and Energy Efficiency, in 2009-10 $1069 million was spent by Commonwealth Departments on climate change measures. This dwarfs the $473-694 million of total subsidy equivalent of the schemes assessed by the PC.

Moreover, there are regulatory standards on top of these effects. These often began life with the objective of saving energy, supplies of which were thought to be getting scarce and a market solution faced a supposed disconnect between consumer reactions to a coming price tightening and conservation measures. The regulations have morphed to target the catastrophe *de jour*, greenhouse gas emissions. In the case of housing, regulations in the form of 5/6 Star call for energy savings that impose a cost estimated by the PC at over $3 billion per annum

Global Effects of Current Abatement Measures

Almost all greenhouse gas measures target electricity both in Australia and worldwide. In aggregate terms the effects of taxes and tax-like measures for the countries the PC examined were as follows:

Table 4 Productivity Commission estimates of abatement

Country	Per cent increase in electricity price
Australia	1-2
China	1
US	0
UK	17
Germany	12-14
Japan	1
S. Korea	0
New Zealand	1-2

India was on the list of countries to be examined by the PC but the Indian authorities refused to cooperate. India does have a modest tax on coal but no other significant measures are in place or in prospect.

The Government chose to interpret the PC report as finding that Australia is similar to countries other than those in the EU. It is certainly the case that the EU has implemented major policies involving genuine costs to reduce emissions.

Overwhelmingly these have been through two means. First, there is the EU wide cap-and-trade system where incumbent businesses have had their emission levels grandfathered at a little below historical levels and been allowed to buy and sell these rights. Secondly, nearly all EU nations have put in place policies requiring renewable power to be incorporated into consumers' supplies. In Germany wind produces 7 per cent of electricity and in Spain nearly 17 per cent, in both cases at considerable expense[5].

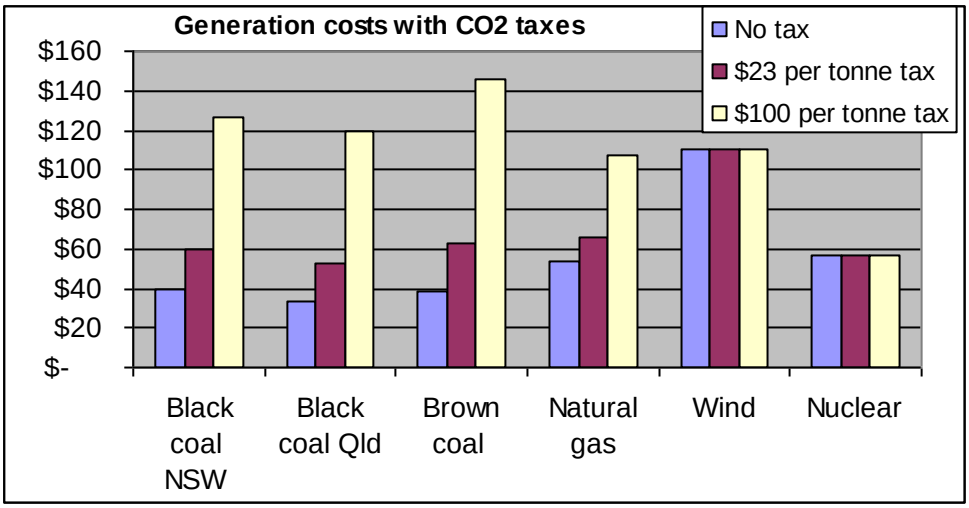
Unfortunately the PC did not examine the policies adopted by Australia's trading rivals. In fact, Canada, South Africa, Brazil, Indonesia, and Middle East suppliers of fuel and raw materials have negligible abatement measures in place. Carbon taxes figured prominently in the Canadian Liberal Party's platform in that country's 2011 election and the party suffered its worst defeat in a century. (Canada's policy is to follow the US's actions but not to implement measures in advance of these)

[5] For Germany a respected study concluded, "The total net cost of subsidizing electricity production by PV modules is estimated to reach 53.3 Bn € (US $73.2 Bn) for those modules installed between 2000 and 2010. The wind power subsidies may total 20.5 Bn € (US $28.1 Bn) for wind converters installed between 2000 and 2010." RWE, Economic impacts from the promotion of renewable energies: The German experience, October 2009. For Spain "The study calculates that since 2000 Spain spent €571,138 to create each "green job", including subsidies of more than €1 million per wind industry job." *Study of the effects on employment of public aid to renewable energy sources*, Gabriel Calzada Álvarez, March 2009

Additional Measures Proposed

Central to the Government's "Climate Change Plan" is a carbon dioxide tax, starting at $23 per tonne in 2012 and eventually rising to $131. The effect of CO_2 taxes on different sources of electricity is illustrated in Figure 4 below

Figure 4



As previously noted, it is not possible fully to substitute intermittent energy like wind for controllable fossil fuel derived electricity even if taxes lead to the former becoming price-competitive.

In addition to imposing taxes and placing renewable energy requirements on energy suppliers, the Government has allocated considerable sums to forms of direct action. One centrepiece is a new $10 billion fund to finance innovatory measures (but excluding CCS which is not favoured by the Greens). Such expenditures are similar to those in the US, which have led to the government having to write-off a $500 billion loan to a heavily promoted solar panel factory. The track record in Australia of 'winner picking' measures like these is equally poor.

This "Climate Change Plan" is to be on top of measures, like the RET, already in place. According to the modelling undertaken by Treasury and DCC by 2020 Australia's emissions of greenhouse gases will be 38% lower than under "business as usual". A major element of this is a fall in supply/demand of electricity by 18%.

These outcomes are the result of a diminished demand for electricity due to:

- the higher prices forced by the carbon tax;
- and the substitution of low carbon sources of electricity for high carbon sources.

The modelling assumes a rapid adoption of new technology in order to reduce emissions. It does not specify how much capital cost is incurred in the implementation of this. Nor does it indicate how much of the technology modelled is actually operating at present, though the Treasury modelling does indicate a rapid dissemination of new technology.

The initial effect of imposing the carbon tax is illustrated below using Victorian consumers as the case study. The tax brings net increases in electricity costs of around $200 for the average Melbourne household and $835 for a small hairdressing salon.

Table 5 Initial Additional Costs of the Carbon Tax

Household/Business Type	Electricity used (KWh)	Current Average Bill	Bill with carbon tax	Net Increase
Melbourne residence with gas hot water	4,700	$1,306	$1,435	$129
Melbourne residence with electric hot water	7,400	$1,635	$1,839	$204
Rural residence with gas hot water	4,700	$1,380	$1,517	$137
Rural residence with electric hot water	7,400	$1,739	$1,955	$216
Suburban clothes shop	8,000	$2,214	$2,434	$220
Rural accountant's office	8,000	$2,271	$2,504	$233
Metropolitan pizza shop	20,000	$5,003	$5,553	$550
Rural milk bar	20,000	$5,275	$5,858	$583
Suburban hairdresser	30,000	$7,326	$8,151	$825
Country pub	30,000	$7,777	$8,652	$875
Dairy Farm	50,000	$9,197	$10,655	$1,458

Longer term price effects are less easy to model since they will depend on future changes in demand and on the possibilities of using alternative energy sources. Beyond a year or so, forecasts of price outcomes for these reasons are highly unreliable.

The Government has been reticent in specifying precisely how much it expects the tax to raise but the Garnaut report had estimated a tax at $26 would raise $11.5 billion and the lower price and exclusion of petrol from the tax's ambit has led estimates of its incidence to be around $9 billion in its first year. The tax is, rather like a protective tariff, designed to shift activities away from those that are carbon intensive. Its success is therefore measured in the changed behaviour it forces rather than in the revenue it raises. Its interim target is to reduce emissions by 5 per cent in 2020 from the level they were at 2000.

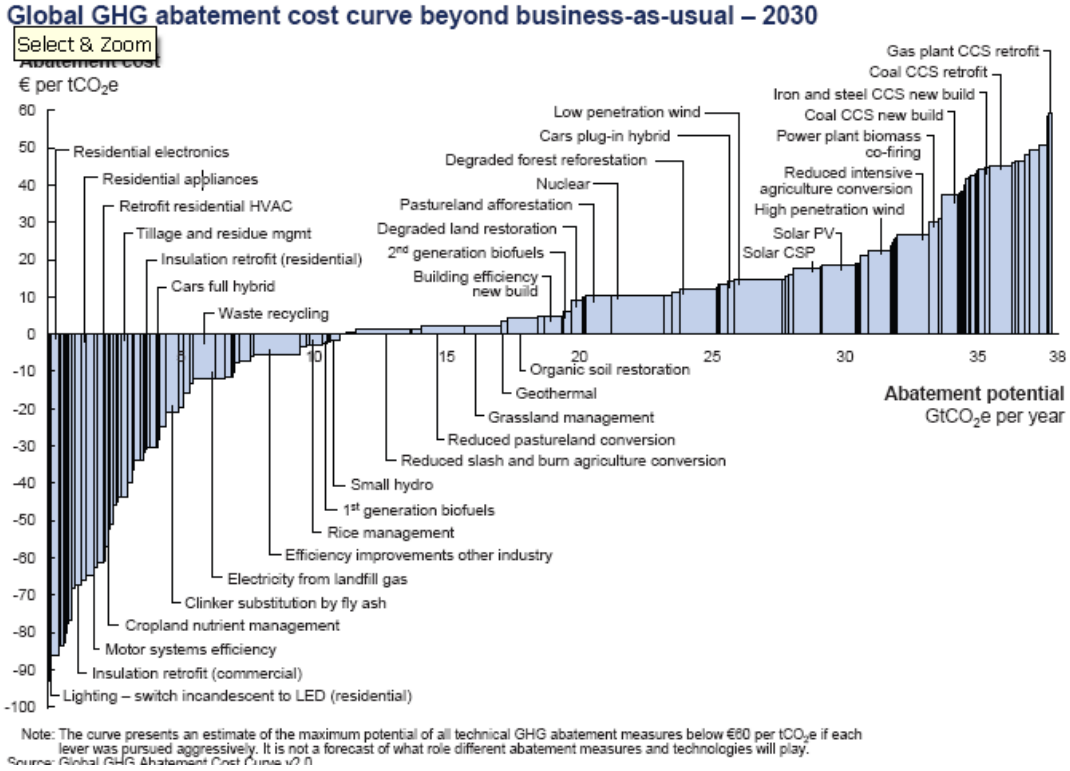
Australia's CO_2 emissions were 578 million tonnes in 2010 and with the measures in place are expected to be 621 million tonnes in 2020. Even in 2050, with all the optimistic assumptions about new technologies, industry restructuring and a carbon tax of $131 Australian emissions are forecast to be 545 million tonnes. The proposed penal taxation measures are expected to reduce emissions from the 2050 business-as-usual level of 1008 million tonnes to 111 million tonnes; even so the modelling assumes that half Australia's emission reductions will be purchased from other countries (largely Asia and Russia). This involves Australia paying countries to abate their own emissions. It also entails the overseas sources being able to abate more cheaply, something that, 40 years hence, it is inconceivable we could know.

Verification would require a comprehensive policing to ensure payment is for genuine savings.

Assuming Treasury's price estimates are accurate, Australia will be paying overseas carbon dioxide credit suppliers annual sums that range from just under $3 billion in 2020 to $57 billion in 2050. These are massive sums – the 2050 bill is greater than the value of our current exports from coal and more than twice the value of all our current agricultural exports.

The Opposition's approach is limited to a 2020 target by which date it seeks to reduce emissions by the same amount as that planned by the Government by focussing on the most promising areas. This "Direct Action" approach is founded on the cost bases for emission reductions that McKinsey's have developed for many jurisdictions across the world. That for the EU is as follows.

Figure 5



Some pitfalls of uncritically accepting these theoretical savings is illustrated by the Australian experience with a subsidised retrofit of ceiling insulation (estimated by McKinsey in Figure 2 to provide a saving of €30 per tonne of CO_2). The Australian scheme was originally estimated to make savings of 50 million tonnes of CO_2 at a total cost of $A2.5 billion. In fact the over-hasty, now discontinued roll-out has led to four deaths of contractors and over a hundred house fires. And the estimated 50 million tonnes of saving is now considered to be more like 20 million tonnes[6]. This increases the estimated cost of the savings to some $200 per tonne of CO_2.

[6] http://www.theaustralian.com.au/news/features/woolly-claims-on-insulation/story-e6frg6z6-1225834522839

Under scrutiny, many claims that expert guidance improves individuals' decision making are found to have little merit.

One mooted approach in Australia is to buy out the 'most polluting' power station, Hazelwood in Victoria, resulting in an estimated annual saving of perhaps 14 million tonnes of CO_2. However this outcome is only possible as long as Hazelwood's production is not replaced by other production involving high emission generators. To ensure that would require placing caps on the output of all similar generators. At the very least such approaches would lead us back into the inefficient centrally planned systems we escaped from in the 1990s.

Seeking bids for retiring of coal based electricity capacity and replacing it with gas would see us replacing electricity with an average cost of $40 per MWh with electricity at over $50 per MWh at current gas prices. Such a strategy would require government guarantees that the new gas generation investment would not be undercut by cheaper coal fuelled generation.

The Opposition's policy in seeking to reach the same five per cent reduction in 2020 emissions as the government's target is said to cost $3.2 billion over four years. It may, if the government is a perfect "winner picker", be possible to get the outcome much more cheaply but this is doubtful. Although few would see much chance of it achieving its stated goals, its costs are less than 10 per cent of those imposed by the Government's proposals.

Concluding comments

Fuel is a pervasive element in all economic activities and at the present juncture only one source of power that is abundantly available, nuclear, can be produced at costs that are comparable to existing electricity costs. Nuclear has well known shortcomings.

Present-day energy consumption is highly reliant on carboniferous fuels. Energy itself is, second to food, the basic building block of all human activities. We have only the flimsiest of experience on which to model the effects of a carbon tax. Unlike the case with oil, which experienced a form of new tax in the OPEC supply restraint in the 1970s, substitutes do not exist, except for nuclear, and it is difficult to envisage how this might replace oil for motor vehicles, ships and aircraft.

In addition to such considerations, the modelling assumes a steady state movement from one pattern of the economy to another—it assumes that we simply move from coal to gas to some as-yet-undiscovered renewable, carbon capture, or nuclear. Such a movement is unlikely to occur without, at the very least, considerable transitory turmoil.

The Australian Treasury's 2011 estimates[7] are that the carbon tax will bring a loss of average income per person of $2700 per annum (in 2010 dollars) by 2050. This amounts to 5 per cent of income in that year, with a cumulative loss by 2050 of $40,000 per person.

[7] Strong Growth, Low Pollution, The Treasury, Australian Government 2011

The latest estimate is significantly less than the annual cost of $4300 per head in 2050 estimated in the 2008 modelling. Treasury maintains this is because world governments have now signed on to emission reductions. Such an interpretation of world government commitments is not widely shared and in any case it is hard to see how it affects the models since then, as now, the numbers assume unanimity of action, without which very different outcomes would emerge.

Treasury estimates of the net cost of the cap-and-trade tax measures to GDP are based on assumptions that include:

- a very rapid technological development of carbon capture and storage (the feasibility about which is questioned by many - including Al Gore);
- non-hydro renewables comprising half of national supply by 2050, up from less than one per cent currently; to achieve this means not only massive subsidised investment but resolving the many issues associated with the intermittent nature of wind and other solar based power;
- a rapid replacement of the energy based businesses with others of similar productivity and an inertia that prevents a rapid relocation of current facilities to lower energy cost locations;
- a continued expansion of coal and other energy exports in spite of carbon restraining measures overseas; and
- that Australian labour productivity growth will continue (in fact increase) from the 1.4 per cent a year 2000-2010 to 1.6 per cent thereafter.

This final assumption means that the key input to future income levels is given rather than estimated. This makes it even more difficult to attribute any merit to the forecasts, especially since policy decisions are to close down the industries which enjoy the highest levels of productivity. These include the 80 per cent of electricity that is coal based, as well as smelting, and iron and steel. And the policy is to replace these high productivity industries with low productivity industries like wind and solar.

It might be argued that energy cannot be that important since it is only 5 per cent of GDP and rather less than this if its distribution costs are excluded. But much the same can be said of food, which in rich countries comprises only some 12 per cent of GDP and most of this is accounted for by distribution and value-added features. Reducing food consumption by 80 per cent would see major consequences, far greater than those that might be modelled in a simple demand switching model that assumes no losses of productivity.

It is often said that we should "give the planet the benefit of the doubt" by acting to radically reduce greenhouse gas emissions even if the necessity is unclear. Such a risk-averse approach is often associated with the "precautionary principle".

However risk has symmetrical features. Focusing only on the possible damage to the environment fails to consider the risks that people – especially in the third world – will, as a result of forcing lower emissions, fall short of the living standards they seek and which would otherwise seem to be available. We can never be certain about the future and its possibilities and if feasible we should avoid foreclosing opportunities for higher living standards that people appear to want.

Moreover, based on the 2008 Treasury modelling (the data is not readily accessible in the published 2011 modelling) the cost involved in deferring action to 2020 and then catching up beyond that date is 0.3 per cent of GDP by 2050. This would seem to be a reasonably priced insurance policy given the uncertainties surrounding the science, questions concerning the modelling cost estimates and the behaviour of other countries in implementing the measures said to be necessary.