Safety first: Climate policy for Australia

What policies are needed for Australia to effectively address climate change?

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ABSTRACT

This paper draws on recent climate science to outline the latest evidence on the effects of anthropogenic climate change on the Earth's systems and the associated effects on the species which populate it.

It considers current climate policy options and critiques current and proposed policy in Australia in light of the scientific evidence. The emissions reduction mechanisms of emissions trading and a carbon tax are compared for effectiveness and the need for complementary measures considered. Implications for policy are considered. Conclusions are drawn with respect to the necessary time frame and policy measures proposed to achieve emissions reductions consistent with avoiding catastrophic irreversible climate change.

WHAT IS THE SCIENCE TELLING US?

Climate change is occurring extremely rapidly with the Earth's climate now changing faster than in any time in the last 10,000 years during which human civilisation has flourished.[1] Projections regarding its effects are now well beyond the predictions of the 2007 Intergovernmental Panel on Climate Change (IPCC)* report and its worst case scenarios.[2,3,4]

Increasing emissions from the use of coal, oil and gas and burning of wood and charcoal has led to an accumulation of greenhouse gases being trapped in the Earth's atmosphere, with global atmospheric concentrations of CO_2, methane and nitrous oxide higher than at any time in last 800,000 years.[5,6]

Despite a global agreement to cut emissions,[7] there has been an increase in global greenhouse gas emissions of 29% over the last eight years.[8] Australia's emissions are rising about 20% each decade.[9]

Ice cores data spanning many thousands of years show atmospheric CO_2 now far exceeds pre-industrial times, when it was around 280 parts per million (ppm).[10] Since the industrial revolution atmospheric CO_2 has risen rapidly to its current level of 387ppm and is rising about 2ppm each year.[11,12] The rapidity of this increase is demonstrated by ice core records which reveal that over the last million years, an increase of 30ppm has always taken more than 1000 years to occur.[13]

Global warming directly correlates to the increasing concentration of greenhouse gases in the atmosphere, with the result that average global temperature has increased almost 1°C over the last century. [14,15] Irreversible climate change has already occurred with the current global average level (0.8°C) of warming.[16]

Temperature increases from anthropogenic climate change have already led to rapid melting of the ice on the Earth's surface.[17] Melting glaciers and ice caps are evident on every continent and are contributing to sea level rise and freshwater shortages.[18]

The reduced ice cover from the melting of Artic sea ice is leading to a loss of 'albedo' – the reflective capacity of ice that reflects solar radiation back into space.[19,20] The loss of ice habitats further threatens the viability of many species, with loss of glacier and sea ice

expected to threaten the wellbeing of one-sixth of the world's population who depend on seasonal melt for water.[21]

Warming of the oceans is contributing to increases in the intensity and frequency of extreme weather events and impacting on the viability of many already threatened species.[22] Severe impacts are already evident from climate change on weather systems, with events such as Hurricane Katrina considered attributable to rising oceanic and global temperature,[23,24] and recent bushfires in Victoria and California associated with anthropogenic climate change.[25,26]

While flooding will dominate in some parts of the globe, drought and desertification characterises climate change in others – and now affects large areas of Australia, Africa, Mediterranean Europe and western USA.[27,28,29,30] This is leading to a transformation of forests from 'carbon sinks to carbon sources' [31] as forests die from drought and as they break down, contribute to further emissions.[32]

All parts of the ecosystem are affected by climate change. There are dramatic effects on biodiversity, with the rate of extinction now 100-1000 times its natural rate (based on fossil records), and extinctions now occurring at a rate not seen since the last global mass-extinction event.[33] Food production and water supplies are being affected by rising temperatures and increasing demand, with a lack of water in some the world's biggest grain-producing nations likely to dramatically impact on global food security over the next few decades.[34]

Australia is considered particularly vulnerable to climate change, and a failure to mitigate further increases in temperature is expected to lead to a severe decline in food production, increased water insecurity, and an unprecedented wave of extinctions over the next century.[35] The recent Garnaut report warns unmitigated climate change could lead to a fall in agricultural production in Australia by over 90% by 2100.[36,37]

Two degrees is the level of warming that, based on scientific predictions of the effects is considered to be the global warming "guardrail" beyond which warming must not occur to 'avoid dangerous anthropogenic interference with the climate system'.[38] This limit has been accepted by a large majority of countries globally who accept the advice of the vast majority of scientists that if warming exceeds 2°C it will "lead to dangerous, irreversible and practically uncontrollable consequences for both nature and mankind".[39]

A recent review of some 400 major scientific contributions to Earth system science by the United Nations Environment Program suggests that the planet will warm by more than three degrees Celsius by the end of this century even if the most ambitious climate policy pledges are enacted.[40,41] This is supported by the modelling released by the UK Met Office which suggests that greenhouse gas emissions continue to rise unchecked, it is likely that global warming will exceed four degrees as early as 2060.[42] Regional variability in warming means that a global average rise of 4°C by 2060 could see some regions such as Africa warm by up to 10°C and the Arctic warm by up to 15°C.[43,44, 45] These updated predictions demonstrate that the broadly agreed global political goal[46] of reducing emissions by 80% of 1990 levels by 2050 to keep global warming within a 2°C "guardrail" will substantially fail, with warming likely to be much higher.[47]

The distribution of negative impacts where the majority of people and species are adversely affected by climate change becomes a severe risk beyond 2°C warming.[48,49] A high risk of "large scale discontinuities" accompanies a scenario of more than 3°C warming.[50]
The interdependence of all the different parts of the Earth's climate system means these changes are non-linear. Once a particular threshold is reached, it could lead to a cascading of abrupt and irreversible change to the Earth's climate.[51]

One of the greatest risks associated with feedback loops lies in the massive stores of carbon and methane (a much more powerful greenhouse gas than carbon dioxide) being released from permafrost and thawing soils beneath melting sea ice, with the volumes of these gases exceeding many times those already in the atmosphere.[52] Release of carbon from under the Artic sea ice and the loss of the Greenland ice sheet are considered the most significant tipping points for a sudden transition from the Earth's previously stable climate to one in which catastrophic and irreversible change occurs.[53,54,55, 56] The ice sheet in Greenland ice sheet is losing almost 300 thousand million tonnes of ice each year – the total loss of which has the potential to raise sea levels globally by about seven metres and flood many of the world's major cities.[57,58, 59,60] The volume of methane under the Arctic Ocean (predicted to be mobilised as the Arctic atmosphere and Ocean warms) is estimated to be about 1.5 trillion tonnes, around twice the amount of greenhouse gases already in the atmosphere.[61]

It is increasingly considered likely that unless climate change can be reversed through rapid reductions in greenhouse gas emissions and direct cooling of the planet, the loss of the Artic summer sea ice may soon occur[62,63] - some say within the next decade.[64]

The associated sea level rise is anticipated to be associated with the threat of displacement to more than hundreds of millions people as land is lost, fresh water is contaminated and environmental degradation and hunger force people to migrate.[65] Coastal development and infrastructure will be significantly affected, as every 20cm rise is expected to be associated with massive flooding events that might have previously occurred once each century happening several times a year.[66,67]

Of the nine identified planetary boundaries identified by Earth System scientists as the limits beyond which humanity cannot safely exist, three have already been transgressed.[68] These are: climate change (the boundary for which is described as atmospheric CO_2 above 350ppm); biodiversity loss; and changes to the global nitrogen cycle. The risks of crossing any of these interdependent boundaries are profound, the authors say:

> *"Transgressing one or more planetary boundaries may be deleterious or even catastrophic due to the risk of crossing thresholds that will trigger non-linear, abrupt environmental change within continental- to planetary-scale systems."*[69]

As atmospheric CO_2 rises, the ability of the ocean to absorb excess CO_2 also diminishes, leading to a significant decline in the effectiveness of the ocean as a carbon sink.[70] It is thought around 30-40% of the CO_2 emitted over the last two centuries has been absorbed by the ocean.[71] Uptake of CO_2 in the ocean is now known to be slowing and, as a result of warming surface water and influx of fresh water from melting ice, may cease in the near future.[72] At the same time, oxygen depletion in the ocean linked to fossil fuel combustion is

increasing mortality rates in marine species, as warming leads to large “dead zones” in the ocean.[73]

The absorption of increasing concentrations of CO_2 in the ocean has led to its acidification.[74] This is threatening marine ecosystems as the corrosive effects of acidification prevents the development of calcium carbonate in the shells and skeletons of marine organisms, threatening their development and the viability of the ecosystems of which they are part.[75]

The world’s science academies have warned ocean acidification is irreversible, and that the corrosion of coral reefs and loss of marine species has significant and imminent implications for food production for millions of people.[76]

International ocean science experts called a crisis meeting in London in July 2009 to identify the thresholds of atmospheric carbon dioxide that would allow the world’s coral reefs to remain viable. They said current plans to stabilise atmospheric CO_2 at 450ppm would cause the catastrophic loss of coral reefs, and that urgent stabilisation of atmospheric carbon dioxide at less than 350ppm was necessary.[77] They called for urgent and massive cuts to greenhouse gas emissions and active removal of CO_2 from the atmosphere.

The final paragraph of the Royal Society report plainly summarises the dangers:

> *“The Earth’s atmospheric CO_2 level must be returned to <350ppm to reverse this escalating ecological crisis and to 320ppm to ensure permanent planetary health. Actions to achieve this must be taken urgently. The commonly mooted best case target of 450ppm and a timeframe reaching to 2050 will plunge the Earth into an environmental state that has not occurred in millions of years and from which there will be no recovery for coral reefs and for many other natural systems on which humanity depends.”*

If emissions continue at a “business-as-usual” level, it is predicted atmospheric CO_2 will reach 1000ppm by the end of the century.[78]

Recent efforts to ascertain the total volume of greenhouse gas emissions that can be emitted between 2000 and 2050 to have a 50% chance of avoiding a two degree rise is one trillion tonnes of carbon – an amount that, at the current rate, would be emitted in the next 40 years.[79,80] The chances of voiding a two degrees rise could be improved to 75% if the total volume was reduced to 750,000 billion tonnes – but since we have already emitted 500,000 billion tonnes, this leaves us just 250,000 tonnes over the next forty years before emissions would have to cease altogether.[81] If there is no significant decline in the rate of global greenhouse gas emissions, the world’s carbon budget could be used up in the next 20 years.

There is now significant scientific research and support for a target for the stabilisation of atmospheric CO_2 at less than 350ppm.[82] The 2009 level is 387ppm. The committment to this target reflects widespread concern that a failure to stabilise atmospheric CO_2 below 350ppm and prevent more than 2°C warming will be realised by such large-scale carbon emissions from the melting permafrost under the Arctic sea ice that abrupt, catastrophic and

irreversible climate change would result, and further mitigation efforts would be futile.[83,84,85,86,87]

Atmospheric physicist and leading climate change scientist James Hansen from the NASA Space Goddard Institute and co-authors of their widely cited 2008 paper: "Target CO2: Where should humanity aim?" spelled out the dangers on failing to act when they said:

> *"If humanity wishes to preserve a planet similar to that on which civilization developed and to which life on Earth is adapted, atmospheric CO_2 should be reduced to less than 350ppm."*

In September 2009, more than fifty Nobel Laureates gathered in London to call for strong action on climate change, saying "political leaders cannot possibly ask for a more robust, evidence-based call for action".[88] As well as a committment to the two degrees guardrail, the meeting called for global emissions to peak by 2015.[89] A conference of leading international climate scientists in Copenhagen in March 2009 produced a Synthesis Report which stated "inaction is inexcusable", and called for "immediate and drastic emission reductions of all greenhouse gases are needed if the 2°C guardrail is to be respected".[90]

It is now forty years since the leading intellectual group, the Club of Rome, published their famous book, *Limits to Growth*, warning of global economic and social collapse from the combined pressures of economic and population growth and profligate consumption of natural resources. The group's 2009 Global Assembly called for urgent action to "achieve a stable climate with atmospheric concentrations of CO_2 not exceeding 350ppm", adding that:

> *"Governments have directed trillions of dollars to stabilize the financial system: we call for the required levels of finance to salvage the future of the planet."*[91]

It is now two years since Hansen and his colleagues wrote that:

> *"Continued growth of greenhouse gas emissions, for just another decade, practically eliminates the possibility of near-term return of atmospheric composition beneath the tipping level for catastrophic effects."*[92]

The responses of governments to this evidence in coming weeks and months will clearly be critical to our collective future.

INTERNATIONAL ACTION

Despite the longevity of global discussions on the need for emissions cuts to reduce global warming, economy wide climate policy internationally is still in its infancy.

Policy action to date has been driven by the obligations articulated by the Kyoto Protocol, an international agreement which came into force in 2005. This agreement established binding targets for 37 industrialised countries and the European community to reduce emissions from six greenhouse gases.[93]

The ratification* of the Protocol by 188 [94] countries means they each recognise that "developed countries are principally responsible for the current high levels of greenhouse gas emissions in the atmosphere as a result of more than 150 years of industrial activity",[95] and accept that Protocol places a heavier burden on developed nations under the principle of "common but differentiated responsibilities".

The main mechanisms that have been implemented so far internationally in response to the Protocol are that of targeted strategies to cut emissions in specific sectors; however increasingly policies are being considered to drive economy wide emission cuts, using mechanisms such as emissions trading schemes and/or a carbon tax.

There are a range of other complementary mechanisms in place in a number of jurisdictions. These vary from legislated targets, strategies aimed at high emissions sectors, renewable energy targets, taxes, tax incentives, trading schemes, subsidies and loans.

Many of these are implemented in isolation however, or as a minor suite of policies – few jurisdictions have comprehensive climate policies that aim to cut emissions across the whole economy, and few have achieved significant emissions cuts.

Isolated examples exist of significant emissions cuts, such as that of Denmark;[96] however this has been driven more by a desire to reduce dependence on (imported) fossil fuel than in response to climate science and the global cooling imperative. [97] California too has acted to cut emissions over a decade ago and has done so effectively through tight controls on transport emissions, largely in recognition of the need to improve air quality by reducing pollution.[98]

Other countries, including several in Europe, have taken deliberate steps to meet their Kyoto emissions reduction targets through renewable energy targets and gross feed-in tariffs to incentivise investments in low or zero emissions technologies.[99]

While some emissions reductions have been achieved recently, this is considered to be a by-product of reduced consumption linked to the global financial crisis.[100]

Countries such as Brazil are relying on deforestation programs to reduce emissions.[101] Japan has relied on energy efficiency measures;[102] while Germany has successfully relied on its gross feed-in tariff, with emission reductions of 21% from 1990-2007.[103] The United Kingdom has also achieved significant emission reductions due to fuel switching from oil and coal to gas.[104]

* Ratification/acceptance/approval/accession

California has achieved significant emission reductions through the regulation of transport emissions and a renewable energy target. Mandatory reporting of greenhouse gases has commenced for its biggest sources of greenhouse gas emissions,[105] and a cap and trade emissions trading scheme is expected to be introduced in 2012.[106]

The European Union established the world's best known example of an emissions trading scheme in 2005 in order to meet its Kyoto targets. It has been extensively criticised however for a range of flaws, including the over-allocation of permits, which led to a price collapse, the availability of international credits which allowed countries to claim emission reductions without domestic cuts, and the failure to establish an EU wide cap.[107,108] This scheme is being still being introduced however, and revisions to its structure are expected.[109] The EU has committed to emission reductions of 20% of 1990 levels by 2020, increasing to 30% if a new global climate change agreement is achieved. It also includes a renewable energy target of 20% by 2020.[110]

The UK has recently passed comprehensive legislation in the form of a Climate Change Act which relies on carbon budgeting to place a limit on annual emissions that are not currently covered under the European Union Emission Trading Scheme (EU ETS), and to reductions in public estate emissions.[111] It commits the UK to a cut of at least 34% below 1990 emissions by 2018-22, and 80% by 2050, with at least 50% of emission reductions to be achieved domestically.[112]

This was followed by the passing of legislation in the Scottish Parliament in June 2009 which established an emissions reduction target of 42% of 1990 levels by 2020 and 80% cut by 2050.[113] The Scottish Act also establishes carbon budgets and requires 80% of emissions cuts to occur domestically.

The eyes of the world have been on the United States since the election of Barack Obama and the subsequent passage through the US Congress House of Representatives of legislation to regulate greenhouse gases and establish an emissions trading scheme.[114] The proposed *American Clean Energy and Security Act of 2009* (ACESA) has however been broadly criticised amid concerns that the targets mean emissions reductions will not occur until 2027.[115] There are also concerns that the Bill will replicate the shortcomings of the European Union (EU) emissions trading system, with offsetting of emissions predicted to fail to deliver significant emissions cuts or boost renewable energy technology.[116] The Bill is likely to face a difficult passage through the Senate, with several key Republican Senators opposed to its passage.[117,118]

While some countries in the European Union will meet or even exceed their Kyoto targets,[119] large emitting countries such as Canada will not. In terms of examples of effective policy on addressing global warming (i.e. consistent with the science), leading sociologist and political scientist Anthony Giddens recently observed:

> *..."There is no nation that gets even close to what might be regarded as an effective performance in terms of reduction of greenhouse gases."*[120]

Comparisons of targets

Figure 1: The following table provides examples of international emissions reduction targets

Target year	Australia	UK	California	EU	USA	France	Canada	Germany	Scotland
2020	5%-25% - the upper limit conditional on a global agreement	26%-32% by 2020	Reduce to 2000 levels by 2010; to reduce to 1990 levels by 2020	20-30 % by 2020	20% of 2005 levels by 2020 (6% below 1990 levels)	Cut in transport emissions by 20%; reduce energy use in buildings by 38%	20% of 2006 levels by 2020	40% by 2020	42% by 2020
2050		80% by 2050	80% by 2050	80-95% by 2050	83% by 2050 (equivalent to 80% below 1990 levels)	Aims to reduce emissions by 75% between 1990 and 2050	60-70% of 2006 levels by 2050	80% by 2050	80% by 2050

If the committment from existing pledges were implemented, they would collectively add up between 10-24% emission reductions below 1990 levels, well short of the 25-40% range outlined in the IPCC report, and demonstrably short of what is now known to be necessary to stay within the two degrees guardrail.[121]

As yet, none of the proposals outlined in terms of legislation or proposed policy commitments from any jurisdiction will be enough to achieve the emissions reductions necessary to restore a safe climate.[122] Current commitments fall short of the reductions necessary to gain even a 50% chance of achieving a stabilisation of atmospheric CO_2 at 450ppm – essentially only a 1 in 2 chance of achieving a level that we are already warned is quite unsafe.[123]

CURRENT POLICY IN AUSTRALIA

The relatively recent ratification of the Kyoto Protocol by Australia (in late 2007) has led to a delay in the implementation of policy action to reduce greenhouse gas emissions in Australia.

While development of national climate policy is underway, significant measures to achieve effective national emissions reductions are yet to be implemented.

Carbon Pollution Reduction Scheme (CPRS)

The Rudd Government has indicated it intends to make an emissions trading scheme its central mechanism in climate policy. The current approach is a proposal to establish a cap and trade emissions trading scheme, known as the Carbon Pollution Reduction Scheme (CPRS). Passed by Australia's lower house in June 2009, where the government has a clear majority, it is yet to achieve support from the upper house, where the Greens party and independent senators hold the balance of power. Amendments put forward by the Greens in October 2009 were rejected, and negotiations continue with the Opposition on proposed amendments (as at 23 November 2009). A failure of the Senate to pass the Bill will provide a trigger for a double dissolution election.

Legislation for the establishment of the scheme is made of 11 bills, and creates mandatory compliance obligations for 1,000 entities considered responsible for 75% of Australia's greenhouse gas emissions. The largest proportion of emissions (50%) come from the stationary energy sector, with coal the dominant fuel source for electricity (about 80%).[124] The scheme establishes medium-term national targets for emissions reductions of between 5% and 25% of 2000 levels by 2020 (the upper limit being contingent on a global agreement), and a 2050 emissions reduction target of 60% below 2000 levels. It will cover the six greenhouse gases listed in the Kyoto Protocol. The targets are based on a long term stabilisation goal for atmospheric concentrations of listed greenhouse gases at or below 450ppm CO_2 equivalent.[125]

The Bills contain provisions to establish a national regulatory authority which will issue pollution permits, and be responsible for monitoring, reporting on and auditing the allowable emissions from each liable entity. This will entitle the permit holder to emit a specified volume of greenhouse gases in a specified time period. Permits will be issued by the Australian Climate Change Regulatory Authority and (in theory) the number will be limited each year by a reducing 'cap' on the scheme, which will be set every five years.[126]

The legislation also allows for financial assistance in relation to emissions-intensive trade-exposed industries (EITE) and coal-fired electricity generators ($750 million)[127], and provides for the development of regulations for the scheme. It will provide free permits as well as compensation to EITE industries and electricity generators, ostensibly to avoid carbon leakage and assist the transition to a carbon price.[128] A climate change action fund of $2.75 billion will also be established, of which $200 million will be directed to energy efficiency measures.[129,130] The legislation also provides for international trading linkages, and allows for national emissions reductions to be "achieved at lower cost" through the trading of emission reductions permits overseas.[131] The scheme is scheduled to start in July 2011, with the price set at $10 per tonne.[132]

National Renewable Energy Target (RET)

A national renewable energy target that had lapsed was renewed by legislation passed in August 2009, established to increase to 20% by 2020 the proportion of Australia's electricity supply to come from renewable sources. This target is considered a transitional measure, as the government has indicated it hopes that the establishment of a carbon price within the CPRS scheme will create incentives for investment in the development and deployment of renewable energy technologies. In the meantime, it is intended that the RET create a "guaranteed market for renewable energy", and the target will be in effect until 2030.[133]

Other national measures

The 2009 federal budget included $1.5 billion in funding to support the development of four solar power plants and established a body to promote renewable energy development.[134] Additional measures include rebates for solar hot water, water efficiency measures, loans for household sustainability measures and a scheme to encourage the installation of solar power in schools.

PUTTING A PRICE ON CARBON: KEY POLICY OPTIONS

There are essentially two mechanisms being considered and or implemented globally to put a price on carbon to achieve broad emissions cuts across the economy: emissions trading schemes (ETS) and/or a carbon tax.

This section will look at the relative strengths and weaknesses of each of the options.

Emissions trading

Much of the appeal of emissions trading is in its nature as a market-based mechanism. In theory it is designed to capture the so-called efficiency of the market and its ability to deliver lowest cost emissions reductions as the price of carbon fluctuates according to the availability of cheap emissions reduction options.[135]

Thus the cheapest emissions reductions occur first, and as their availability declines, the price of carbon rises, making zero carbon technologies cheaper relative to high carbon emissions technologies, such as the use of fossil fuels for energy and transport infrastructure.[136]

Most emissions trading schemes in place or being considered are those known as a "cap and trade" scheme. In this mechanism, a limit is set on the total allowable emissions over a specified period, and permits issued to polluting entities that allow them to emit up to the "cap". This establishes a limit on the amount of CO2 to be emitted in a given year, but leaves the price to be set by the "market".[137] In order to deliver ongoing emissions reductions, provision is made to reduce the cap progressively over time.[138]

The most significant example of emissions trading is that of the European Union (EU), where a scheme has been in place for several years, and is credited with contributing to the development of more effective systems for evaluation and monitoring of emissions.[139] Its direct effect on emissions reductions in the EU however is unclear.[140,141] Like the proposed Australian scheme it is not economy wide, and the EU scheme applies only to certain sectors, covering only about 40% of EU emissions.[142] Like the proposed Australian scheme, elements of it have been criticised for introducing distortions that effect the functioning of the market mechanism – in the case of the EU by the issuing of too many free permits, causing a price collapse which substantially reduced the incentive for industries to cut emissions.[143,144]

The EU scheme is a 'downstream' system, regulating the industries that are 'downstream' users of fossil fuels as well as power generators (e.g. iron and steel, cement, glass, ceramics, pulp and paper);[145] while in the proposed US and Australian schemes emissions are limited 'upstream'; i.e. the regulations apply to suppliers of fossil fuels (coal, oil and gas producers). The 'upstream' method limits the number of entities required to be covered, and removing the administrative burden of evaluating emissions from a large (almost infinite) number of sources.[146]

Much of the support for emissions trading and its early selection as a mechanism for carbon dioxide emissions reductions is linked to the effectiveness of a trading scheme to reduce acid rain from sulphur pollution from coal fired power stations in the north-eastern United States in the 1990s.[147]

The success of this scheme is considered to be the availability of relatively straightforward solutions: i.e. the reduction of sulphur emissions was achieved by switching to another readily available fuel source - low sulphur coal; and the implementation of inexpensive (and readily available) 'scrubbing' technologies to remove sulphur from emissions.[148]

As indicated above, the EU carbon trading scheme was adopted as the main mechanism for realising EU targets under the Kyoto Protocol.[149] However the lack of an EU wide cap, early over-allocation of permits and abundant availability of credits for emissions reductions for purchase through the Clean Development Mechanism scheme[*] led to low carbon prices which considerably reduced incentives for abatement, and has led to widespread criticism of the scheme.[150,151,152] In recognition of these shortcomings, a single, EU wide cap is to be established, and no CDM credits will be allowed after 2013.[153]

It is also important however to note that emissions trading is just one of a suite of measures being implemented in a broader climate change and energy policy framework in the EU.[154,155] Therefore while on some measures EU greenhouse gas emissions are showing signs of reductions,[156] it is considered likely that this has less to do with the effectiveness of the EU ETS than the domestic strategies of major emitting countries - such as the UK (which made a substantial switch from coal to natural gas) and Germany (due to the implementation of incentives for renewable energy technologies, and the modernisation of industries in East Germany).[157,158,159,160]

Much of the support for carbon trading is ostensibly related to its ability to achieve "certainty" in terms of a carbon price, allowing businesses to factor it in to ongoing economic decisions and that it offers flexibility in terms of allowing businesses to choose the lowest cost options to achieve emissions reductions.[161]

How price certainty will be achieved in a market system however is unclear. Many commentators point instead to the volatility of prices in trading schemes,[162,163,164] and the lack of stability that this can engender, potentially putting at risk a steady trajectory of emissions reductions.[165] Achieving long term emissions cuts with an emission trading scheme is considered problematic – for while early, low cost reductions can be easily achieved through energy efficiency measures, once these are obtained, reductions become more costly as more substantial structural change is required.[166] As carbon prices are expected to be low in the early stages of a trading scheme, as permits flood the market, this can lead to a lack of incentives to make the larger investments required to drive ongoing reductions.[167] In the same way, the price of carbon is expected to fluctuate during periods of slow economic growth, leading to a decline in investments that will continue progress to a low carbon economy.[168]

The complexity of the processes that are required to implement, monitor and maintain carbon trading leave are considered to provide opportunity for the scheme to be fraudulently manipulated, undermining its effectiveness.[169] Emissions reductions can only be achieved if there are effective institutions to govern their regulation - for emissions cuts to be effective, robust institutions are needed.[170] However despite the fact that the opportunity for international links often cited as one of the key advantages of a trading scheme, there are

[*] The purchase of credits through the Clean Development Mechanism allows for the offsetting of domestic emissions through investing in abatement projects in third countries.

significant concerns that any certainty in achieving cooperation and compliance with an international scheme will be almost impossible.[171] There is emerging evidence of fraud in some international carbon offsets programs, raising concerns that developing nations in particular lack the resources and governance frameworks necessary to ensure the integrity of an international regulatory regime.[172] As one economics commentator recently wrote: "International trade in permits will mean the integrity of a permit is only as good as the weakest supervisory regime."[173]

The difficulties in regulating a market mechanism made so apparent in the recent (and ongoing) global financial crisis are leading to concerns about the effectiveness of using a market mechanism to regulate the "largest commodities market of all".[174,175] This is especially poignant, given the problem being addressed is the result of "the greatest market failure of all time".[176] Another potential risk, being demonstrated in the proposed Australian scheme, is its vulnerability to political pressures, such as affected parties seeking compensation for the price being imposed;[177,178] or lifting of the cap in the event of price rises, ultimately compromising the aim by reducing the incentives to seek emissions abatement.[179,180] Political interference or the influence of vested interests is considered to be one of the major threats to the integrity of emissions trading.[181,182]

Significant challenges exist in ensuring market integrity when the complexity of the system leads to information asymmetry among participants in the system, and concerns this will lead to fraud.[183] While one of the claimed key advantages of emissions trading through a market mechanism is that offers less administration than a more prescriptive regime, the converse argument is that a lack of control can mean less certainty in achieving the scheme's aims – that of cutting emissions.[184] Some emission trading critics argue that there is no evidence yet that the scheme can reduce greenhouse gas emissions.[185]

The establishment of the 'cap' in a cap and trade scheme is designed to set an upper limit beyond which participants cannot emit.[186] This limit is reduced over time so emissions reduce. Critics of the scheme say the concept of the cap is incompatible with early emission reductions – both because establishing a scheme takes time, and because emissions are ever reduced *up to the cap.*[187] The establishment of the cap is that achieves an effective environmental outcome is vital. The experience in Europe and in proposed schemes in Australia and US however suggests there since there are significant political pressures that lead to compromise on the cap and its rate of its reduction, there is a risk that reductions will fail to reduce at the rate indicated by the science.[188]

Current and proposed models for emissions trading schemes limit coverage to specific sectors and/or high emitters only, meaning that emissions reductions that take place as a result of voluntary action by households, businesses and government agencies are not taken into account.[189,190] It is argued that this creates a disincentive for voluntary action and has led to concerns that emissions reductions that occur outside of an ETS will fail to impact overall reductions,[191,192] and may negate voluntary action.[193]

Unless ambitious targets are set and enforced, there are serious concerns that emissions trading cannot deliver the emissions reductions indicated as necessary by the science.[194] Vulnerability to distortions to the scheme's effective functioning through exploitation of offsetting and demands for compensation from vested interests in existing schemes demonstrate its potential weaknesses.[195]

Tax

An alternative approach to pricing carbon is that of a direct carbon tax. Essentially a carbon tax operates as a tax on carbon dioxide pollution that arises from the burning of fossil fuels. It creates a levy which can be applied to the production, distribution or use of fossil fuels and is based on how much carbon dioxide is emitted when the fuel is burned.

A carbon tax establishes a price for each tonne of carbon emitted. This will mean products that are carbon intensive become more expensive as producers of carbon intensive goods and services are forced to take the cost of carbon into account. This creates an incentive to reduce emissions, as at a certain point it will be more cost effective to undertake abatement and/or adaptation than incur the tax.[196]

The price increase creates an incentive to reduce the consumption of carbon intensive energy as well as increase energy efficiency. As with a carbon price under an ETS, a carbon tax aims to make clean renewable energy technology cost-competitive with energy produced from fossil fuels, thereby incentivising investment in clean energy technologies.[197]

The tax can be levied at a number of points in the production, supply, distribution and consumption of carbon intensive fuels, although most advocates propose its application "upstream" i.e. focussing on its on emissions intensive industries and/or sectors to reduce administrative costs.[198]

A carbon tax can be phased over several years, with increases varied according to the jurisdictional emissions profile.[199]

Scandinavian countries such as Denmark, Sweden and Finland have been using a carbon tax for decades to successfully lower emissions.[200,201] The introduction of a carbon tax in Sweden in 1991 is attributed to the subsequent expansion of its renewable energy sector,[202] where emissions were cut by 8% while GDP rose about 44%.[203]

The application of a carbon tax is expected to be extended in Europe, with the European Union calling for all member states to introduce a carbon tax on all emissions that are not covered by the EU ETS.[204] France has indicated that it will introduce a carbon tax on the use of oil, natural gas and coal, to be set initially at €16 per tonne.[205]

One of the advantages of a tax is considered to be its simplicity and the transparency it affords investors with regard to a clear price signal.[206,207] Despite the rhetoric about price certainty under an ETS, it is commonly advanced that a tax provides greater certainty about the costs of mitigation as the carbon price is understood in advance, while there is likely to be considerable price volatility in a trading scheme.[208,209] A tax however can provide consistent rewards for reduction regardless of the cost of reduction, while an emissions trading scheme provides incentive for low costs reductions but provides less reward for longer term (higher cost) structural changes.[210] As a result a tax is considered more likely to achieve the significant structural changes needed for transitioning to a low carbon economy more effectively than carbon trading.[211]

It is often suggested that one of the advantages of a cap and trade scheme is the certainty with respect to environmental outcomes as emissions can occur only up to the cap – however it is also argued that a tax affords greater control for government over the

achievement of an environmental outcome as the price of carbon can be adjusted in order to ensure emissions do actually reduce.[212,213] In this way, just as ongoing reductions in an ETS are achieved by a declining cap; ongoing reductions are achieved through progressive increases in the tax.[214]

One of the advantages of a carbon tax is its ability to generate a steady flow of revenue that can be used by the government to lower the costs of further emissions reductions.[215,216,217] While the sale of unused permits can provide revenue for polluting industries and/or speculators under an ETS, it is considered unlikely that this revenue would be spent on further emissions reductions.[218] A carbon tax however, since revenue would accrue to the government, would mean the revenue could be utilised to reduce the impact on the community of a carbon tax by a reduction in other taxes and/or through the provision of rebates to smooth the politics of the transition to increased energy prices.[219,220,221] Alternatively, to achieve a better environmental outcome, revenue could be channelled into direct investment in zero emission technologies, hastening the price equalisation between clean and fossil fuel based energy sources, or funding for research and development, feed-in tariffs, subsidies or rebate schemes for energy efficiency measures or micro-generation schemes.[222,223]

The administrative costs of a carbon tax are thought to be lower than emissions' trading and the legislation and regulations much simpler.[224] Emission trading effectively requires the establishment of a carbon central bank, with accounts for participants, a facility for trading, mechanisms for monitoring and compliance, and fees for financial institutions as they mediate trading transactions.[225,226] A tax, on the other hand, is simple – and after all, governments have been collecting taxes for centuries.[227,228]

Due to the stable nature of the price, it is thought a carbon tax will act more smoothly than a cap and trade scheme through varying economic cycles;[229]and be less disruptive to the economy than a volatile permit price under an ETS.[230]

While the opportunities for international linkages between emissions trading schemes are often advanced, advocates of a carbon tax argue that there are equal or perhaps greater opportunities for international linkages with a carbon tax.[231] This could be achieved if major emitting countries agreed on a common carbon price,[232] but it would also be possible for a carbon tax to link with trading schemes if the tax rate was set each year at a rate "roughly comparable to the expected price" of permits.[233]

In terms of delivering emission reductions, it is considered likely that greater reductions could be achieved under a carbon tax.[234,235] While a cap and trade emissions trading scheme creates an upper limit (and a "floor") for emissions reductions, this does not apply to a carbon tax, which has no upper limit in terms of reduction potential.[236] Emissions can therefore reduce below the stated target, and since there is no floor, voluntary action is taken into account.[237]

In contrast to emissions trading, a carbon tax will promote voluntary action across all sectors since its central effect is that of encouraging voluntary action through embedding a carbon cost in all goods and services.[238]

It is also argued a tax will provide greater opportunity for the community to exercise choice and eliminate the risk of powerlessness that may accompany emissions trading for those individuals and entities outside the scheme.[239]

When the economic efficiency, ease of implementation, and opportunities for interaction with other countries of the mechanisms of emissions trading and a carbon tax are taken into account, a carbon tax is considered superior.[240,241] A 2008 study from the US Congressional Budget Office found that on economic efficiency measures, the net benefits of a tax were roughly five times that of a cap, with reductions achieved at a fraction of the cost.[242] A tax would be easy to implement, as it offers a consistent incentive for emissions reductions, and since it does not require a complex regulatory system would be more transparent, and could better facilitate the achievement of a global target for emissions.[243,244,245]

The political issues for both emissions trading and a carbon tax are complex. While there has been considerable criticism of the emissions trading scheme in Europe with respect to the distribution of free permits and the availability of cheap offsets,[246] it is also argued that political pressures can also be brought to bear on a carbon taxes, as polluters seek exemptions to reduce their costs.[247] One of the concerns about advocacy for a carbon tax by certain industries is that it is yet another example of the "delay or deny" tactic being employed by the fossil fuel lobby.[248,249] This concern is perhaps offset somewhat by the support for a carbon tax among leading scientists such as NASA's James Hansen, whose advocacy is free from claims of vested interests, other than an effective environmental outcome.[250] Other notable supporters of a carbon tax include Nobel prize winning economist, Joseph Stiglitz[251] and CSIRO ecological economist Clive Splash.[252]

The choice of instrument must also be considered in light of its ease of implementation (and removal). On the latter point, Harvard climate governance researcher Bettina Wittneben argues that while a tax can be established and removed according to political demand, the establishment of an emissions trading scheme (in particular one that is intended to link internationally) is a huge undertaking, and one that generates "rent" for the large number of parties involved in administering, monitoring and servicing the system.[253] Wittneben argues that an emissions trading scheme is likely to supported by the many participants who benefit from servicing the system, but this exemplifies the risk of distortions under emissions trading.[254] While a carbon tax would also require agents to assist in its administration, this is to a much lesser extent than with emissions trading.[255] And since there are no "rights to pollute" with a carbon tax, it would not generate any of the compensation claims and buyback costs associated with an emissions trading scheme.[256]

Much of the support for a carbon tax over emission trading is on the grounds that it would be more direct, more transparent and more effective.[257,258,259] A recent comparison of the tax versus emission trading on the grounds of potential for emission reductions, costs, risk of distortion from vested interests, and stability, came down firmly in support of a tax on each aspect.[260] This is based on the experience to date of the EU ETS which it is argued has cost a lot of money but has not reduced emissions.[261] Wittneben asserts the only achievement of the EU ETS is that it has been: "incredibly successful in transferring money [70 billion euros] from taxpayers and consumers to governments and large utilities, yet so incredibly unsuccessful in reducing greenhouse gas emissions".[262] It is suggested this demonstrates

the risks inherent in emissions trading, in that its sheer complexity can lead to corruption, and a failure to achieve its stated aims i.e. to reduce emissions.[263]

Conclusion

While often posed in opposition to each other, emissions reductions mechanisms such as taxation on carbon emissions and carbon trading schemes are not necessarily mutually exclusive.[264] In the time remaining to effectively mitigate against irreversible climate change, no single policy will be enough.[265] A suite of policies will be required, and they may vary across sectors.[266]

While emissions trading has many supporters and has received considerable attention with the establishment of a scheme in Europe and legislation being proposed in the United States and Australia, the alternative option of a carbon tax is being implemented in jurisdictions such as Denmark and Sweden, and its adoption as a central mechanism being advocated by scientists, governments, business and policy commentators around the globe.[267,268,269,270]

Regardless of the mechanism chosen, it is most important that a "consistent economy wide signal" is provided.[271] It is also vital that the mechanism can work effectively with complementary measures such as higher energy efficiency standards, renewable energy targets, feed-in tariffs, transport emissions standards, and reafforestation.[272,273,274,275]

The bottom line however, is that putting a price on carbon must essentially discourage the production of carbon emissions by making fossil fuel based energy production more expensive relative to clean energy technologies. Whatever the mechanism chosen, unless it is effective in ensuring zero carbon energy technologies are price competitive with energy produced from fossil fuels, it will be not be achieving its aim.

CONCERNS REGARDING CURRENT POLICY

There has been considerable recent debate about climate policy in Australia.[276,277,278,279,280,281,282]

Despite a committment to addressing climate change and demonstrating leadership to the global community from the federal government, policy options to date however have fallen well short of the recommendations of both scientists and economists, and there are concerns that a lack of committment from high emitting countries such as Australia to achieve effective emission reductions in Australia will compromise the development of a global treaty.[283,284,285]

The central policy to date is the proposed establishment of the national Carbon Pollution Reduction Scheme to set a price on carbon. As it currently stands however, the Carbon Pollution Reduction Scheme, and according to the Federal Treasury modelling, the scheme is not expected to achieve any emissions reductions until 2035.[286, 287,288,289]

The CPRS has been widely criticised as having inadequate targets;[290,291] for modelling an unsafe atmospheric CO2 stabilisation goal;[292] for providing excessive compensation to polluters; and for allowing 100% of emissions cuts to be achieved through the purchasing of permits from overseas.[293,294,295,296] There is widespread disquiet that the billions o dollars being provided in subsidisation to emissions intensive industries will remove any incentives for investment in alternative energy technologies and delay emissions reductions.[297,298,299,300,301,302] Despite the compensation, fossil fuel industries are calling for further compensation and the postponement of the introduction of the scheme.[303,304]

Compared to the recommendations of both economists [305,306,307] and scientists,[308,309,310,311,312] the emissions reductions targets in the CPRS are set far too low.[313,314] The scheme's effectiveness is considered to be compromised by policy 'capture' by vested interests which has led to the issuing of free permits and excessive compensation to polluters.[315,316] The availability of international credits to allow outsourcing of emissions reductions has been criticised as creating little incentive for domestic reductions.[317] There is also widespread concern regarding the failure of the scheme to account for voluntary action to reduce emissions by individuals and/or entities not covered by the scheme,[318,319,320] and unease at the potential costs of the scheme (and its vulnerability to rorting) due to its complexity.[321,322]

The atmospheric stabilisation target implicit in the scheme is also being criticised. The modelling behind the CPRS is aimed at a stabilisation target of 450ppm, which is inconsistent with scientists' recommendations and is predicted to lead to catastrophic and irreversible climate change.[323,324,325] There is now extensive international scientific support for a target of less than 350ppm and growing support for a return to pre-industrial levels of between 280-320ppm as a safer target.[326,327,328] It is therefore likely that any scheme that is predicated on a higher stabilisation level will be ineffective in achieving the reductions that are necessary to restore a safe climate.[329,330]

There are serious concerns that the selection of the CPRS targets has failed to take into the scientific evidence,[331,332,333,334] and that stabilisation at 450ppm will provide just a 50% chance at avoiding catastrophic, irreversible climate change [335,336,337] and possibly much less.[338,339]

The current unconditional target for emissions reductions for a 5% cut of 2000 levels is considered so low as to be meaningless in setting an example of leadership in the global community.[340,341] The baseline of 2020 is inconsistent with the 1990 baseline adopted under the Kyoto Protocol, and which is currently the international standard baseline. The adoption of a 2000 baseline by Australia means the unconditional target of 5% actually amounts to only a 3% cut from 1990 levels. This is well short of Australia's obligation under Kyoto (as an "Annexe 1" or developed country) of between 25-40% below 1990 levels by 2020.[342,343]

A recent evaluation of the targets set by Australian under the CPRS by international consultant ClientEarth found the current targets mean Australia is also likely to be in breach of other international treaties unless higher targets are specified.[344] The proposed targets may breach the World Heritage Convention and the International Convention on Biodiversity to which Australia is signatory.[345]

Other criticisms are that the scheme has been established with "minimal attention being paid to the lessons from other regulatory regimes".[346] Unlimited access to international offsets in the scheme, the failure to incorporate a mechanism to reduce the cap, low targets, free permits for polluters, and no provisions for the phasing out of free assistance are inconsistent with international experience in other emissions trading schemes and policy advice.[347,348] With respect to revision of targets, there are also concerns that there is no provision in legislation to revise the targets as climate and Earth system science is updated.[349] Given the pace of change and rapidly changing predictions, it has been suggested that, like the UK and Scottish climate change legislation, the CPRS needs a mechanism to provide for future revision of targets in response to evolving climate and Earth system science.[350,351]

This is expected to seriously diminish the effectiveness of the scheme's aims – to reduce emissions.[352]

Much of the criticism with regard to compensation is linked to the view that funding should not be rewarding polluters but should instead be invested into hastening the development and deployment of renewable energy technologies to progress Australia towards a zero emissions economy.[353,354]

The provision of millions of dollars in compensation to electricity generators in particular is considered a perverse incentive which works in opposition to emissions reduction goals. It is expected to keep renewable energy at a disadvantage as the effect of a carbon price will be minimised, delaying its deployment and compromising emissions reductions.[355,356] Even the federal government's chief economic advisor Ross Garnaut who designed the scheme is opposed, saying: "never in the history of Australian public finance has so much been given without public policy purpose, by so many, to so few".[357] Coal-fired power generation is responsible for 11 billion tonnes of CO_2 globally each year (around 41% of all fossil fuel CO_2 emissions).[358]

One of the central arguments for emissions trading is that it brings the 'efficiency of the market' to emissions abatement. Critics say however the distortions introduced through the compensation and free permits available in the CPRS remove the opportunity for the market to operate effectively, and increase the risk of rorting.[359,360] The softening of price signals through compensation and the lack of a reducing cap on emissions is considered to have

significantly compromised the market driven nature of the scheme, and diminished its likely effectiveness.[361,362,363,364]

It is estimated that more than $10 billion annually is provided to the fossil fuel industry in Australia using through a range of state and federal subsidies.[365,366] This federal government's own report highlights the dangers of "shielding" i.e. compensating emissions intensive industries to protect them from the full effect of emissions pricing. It also revealed that putting a price on carbon in Australia is not expected to lead to carbon leakage (where emissions intensive industries move offshore). [367] Despite vigorous assertions from industry, it seems this fear has been "overplayed".[368]

The low targets, large amounts of compensation and allocation of free permits under the proposed CPRS are widely considered to be the result of 'capture' of federal government policy by vested interests.[369,370,371,372,373,374,375,376,377]

Former government insiders and fossil fuel industry executives say coal, oil and gas companies are dictating Australia's climate policy.[378,379] There are widespread concerns that this influence and a deliberative effort to "delay and deny" has led to the failure to develop and implement policy to reduce emissions, and the compensation and exemptions obtained within the CPRS mean the scheme will have now have little or no impact on reducing emissions.[380,381,382,383] There are also concerns that this may lead to a perception in the community that the federal government is failing to address climate change, and lead to a decline in voluntary emissions reductions.[384,385]

The claims from fossil fuel industries that they need time to adapt to a carbon price are seen as false.[386] It has been twelve years since the development of the Kyoto Protocol before action has been taken to implement climate policy in Australia. For most industries around the world, the ratification of the Protocol by over 90% of nations provided a clear signal to international business that a carbon price was inevitable and emissions reductions needed.[387,388,389,390,] A failure among business leaders to prepare is a failure to fulfil their fiduciary duties according to former coal, oil and gas executive Ian Dunlop.[391] This criticism is also being extended politicians, with suggestions that the government is failing to act in the long term national interest and in their fiduciary responsibility to protect the wellbeing and security of citizens by failing to implement effective policy to mitigate against climate change.[392,393]

The exclusion of agricultural emissions in the CPRS, while difficult to measure, is increasing being considered an oversight, and there are now calls for its inclusion on the credit side at least, so that famers and land holders can capitalise on the carbon offset value of reafforestation and biodiversity preservation, further encouraging carbon sink development and discouraging land clearing.[394,395,396] Australia has massive potential for sequestering carbon in agricultural soils according to soil scientist Christine Jones,[397] who says we could sequester more carbon that we emit each year on by increasing soil carbon by just half of one percent on only two percent of Australia's farms.[398] If soil sequestration was undertaken on all Australian farms, the entire world's carbon emissions could be sequestered, according to Jones.[399]

On the overall rationale for market scheme, there is also scepticism. Given that 'the market' failed in the past to account for externalities such as excessive carbon emissions,

commentators (economists among them) are wondering about the logic of the application of market solutions to the problem so famously created by the “greatest market failure of all time”.[400,401,402] According to US economists Nordhaus and Shellenburger, the result of allowing the market to decide the energy future so far has been “serial political failure, skyrocketing emissions and stagnation of energy technology”.[403]

Another of the shortcomings of the CPRS has been described as an “unimaginative use of revenue”, which has diminished the (theoretical) effect of the trading scheme to drive emissions abatement.[404] Less than 10% of the revenue generated by the emissions trading scheme will be directed to emissions abatement, compared to 50% of the EU ETS revenue and 19% under the current proposed US legislation.[405] It has been suggested that the CPRS be amended with mandatory criteria developed for the allocation of funding from the CPRS so it contributes to further abatement activity.[406] Increasing the proportion of funding directed to abatement activity such as zero carbon technologies[407] and protection and restoration of the native forests and vegetation would enhance the environmental and social benefits of the scheme.[408]

The structure of the cap and trade emissions trading with regard to the setting of a ‘floor’ as well as a cap is considered to be a flawed element of the scheme. [409,410,411,412,413] That means that once the emission reduction target is established and permits are issued for pollution up to that level, this will impose a ‘floor’ below which emissions cannot fall.[414] This has led to concerns that individual lifestyle change contributions to emissions reductions facilitate increased industry emissions within the cap, invalidating (and potentially discouraging) voluntary action on the part of those not covered by the scheme.[415,416,417,418]

The option within the CPRS for purchasing overseas credits as a means of offsetting 100% of domestic emissions reductions has drawn criticism, [419,420,421,422] amid concerns that it will allow Australian emitters to avoid expensive domestic abatement efforts, as they will most likely seek to achieve their emissions reductions through the cheaper option of purchasing overseas permits.[423] It is considered likely that, as a result of this provision, there will be no emissions cuts in Australia for decades.[424,425] There are also widespread concerns about the effectiveness of these reductions, with increasing evidence that international permits are only as good as the home countries regulatory regime, which in many cases is poorly resourced and lacks scrutiny.[426,427,428]

Beyond the market driven approach to zero emissions technology development and deployment in the planned Carbon Pollution Reduction Scheme there are few significant incentives for renewable energy technology in Australia beyond the Renewable Energy Target.[429]

Designed to cover electricity coming from sources like solar, wind and geothermal, the scheme to deliver the national renewable energy target has come under criticism for its provision of government assistance to energy intensive industries, and the inclusion of energy sources such as coal seam gas, a by-product of coal-fired electricity - not considered ‘renewable’ in the sense of being a clean energy source such as those listed above.[430,431] Another amendment to offer additional permits (aka renewable energy certificates, or RECs) to domestic solar hot water installations, known as the “five times multiplier” in which each MW of these sources receive five times as many tradable certificates as energy from other sources, has quickly led to an oversupply of certificates and a subsequent price fall.[432,433,434]

There are concerns that the 'phantom' solar credits available from solar hot water will mean the target could be met in just a few years, but without any major renewable energy infrastructure being built.[435]

Even without its current flaws, a renewable energy target of 20% by 2020 will be an insufficient decarbonisation of our energy supply, and further measures will need to be considered such as direct investment.[436] A $1.5 billion fund has been proposed to support the construction and demonstration of large scale solar power stations, but the total budget and the specific requirements for it to be spread evenly over four separate projects are considered obstacles and it is yet to demonstrate any tangible stimulus;[437] while the proportion of funds directed to the renewable sector from the CPRS of $5.8 billion over the next decade is considerably less than the sums being proposed by the US ($52.1billion) and China ($41.2 billion).[438]

Recent reports from the Nous Group,[439] McKinsey and Co.,[440] CofFEE,[441] and Climate Risk[442] demonstrate that there is a considerable potential for strong emissions reductions in Australia, with increased employment opportunities in a low carbon economy, particularly in the regions currently dominated by fossil fuel power generation. This evidence suggests it is possible and affordable to substantially reduce our greenhouse gas emissions in a relatively short time without major technological breakthroughs or even major lifestyle changes – if governments, business and the community act quickly. Modelling on the transition to a zero emission economy from Melbourne consultancy Beyond Zero Emissions suggests a shift to a 100% renewable energy economy could be achieved in ten years, with 60% of power provided by concentrated solar thermal power with storage, and the remaining 40% from wind with biomass back-up.[443]

One of the major concerns of failing to reduce emissions in the short term is that it raises the costs of making a transition to a low carbon economy, as well as leading to increased costs from adaptation and dealing with climate impacts.[444,445,446]

The Australian Government's 2008 report on the economics of climate change clearly reiterated what Nicholas Stern said two years earlier: early action is cheaper than delayed action.[447] This report notes that without policy action atmospheric concentration of CO_2e will rise to 1,560ppm by 2100, more than five times pre-industrial levels, and that "these concentrations are associated with very high risks of large-scale irreversible climate change".[448] The report says delaying mitigation will "increase climate change risks, lock in more emission-intensive industry and infrastructure, and defer cost reductions in low-emission technologies".[449] If emissions reductions are further delayed, it may make stabilisation at low levels impossible.[450] This reveals the falsity of any argument that the costs of a higher target are too high - the costs of failing to cut emissions effectively will be much higher later.[451,452]

Conclusion

For emissions trading to provide effective emissions reductions in Australia, significant reform of the current CPRS proposal is required. Reform would need to create much stronger targets; deliver much greater transparency in the distribution of permits (e.g. ensure permits are conditional on the achievement of best practice benchmarks);[453] include a committment to phase out free allocation of permits so that they rise quickly in value and

there is no risk with 'lack of scarcity' leading to price falls;[454] provide far greater allocation of revenue towards funding innovation, the development and deployment of zero carbon technologies, and energy efficiency improvements;[455] and include in the legislation an annually decreasing cap as in the EU and proposed US models.[456]

The development of this policy and the political negotiations that have surrounded it ignore the scientific advice that climate change has now reached a point that catastrophic tipping points are very near or may have even been passed.[457]

It appears however that the former Howard and present Rudd Government has placed more weight on the concerns of the biggest polluters, than those of climate and Earth system scientists, policy advisors, environmentalists, and Australian public in developing its climate policy and emissions reduction targets.[458]

The adoption of the CPRS as a central mechanism to reduce emissions and failure to reform the RET will likely delay Australia's transition to a low carbon/zero emissions economy, and may contribute to the serious and increasing risk of catastrophic and irreversible climate change.

IMPLICATIONS FOR POLICY

In policy parlance, climate change poses a “wicked” problem.[459] It is not only wicked; it is also largely invisible to the much of the increasingly urbanised global population.[460] This is further complicated by the fact that the science that informs it is enormously complex and rapidly evolving.

Addressing the challenges poses by global warming and the subsequent changes to the Earth’s climate is a completely unprecedented task. It will require the implementation of comprehensive global policy, the extent of which will be largely based on national policy commitments from almost every nation on Earth.

Those who argue Australia should display leadership on emissions reductions do so from compelling viewpoints - given per capita emissions, historical contribution, intergenerational moral obligation, and strong potential for reductions - a serious committment to immediate action on climate change could provide an important contribution to securing an effective global deal on emission reductions, as well as put Australia in a strong position to take advantage of the opportunities offered in a low emissions economy.[461]

In considering policy responses it is important to consider community views; as well as moral and legal principles; financial, human health, and security implications; risk management; and fiduciary responsibility.

The evidence presented here and available more broadly suggests that climate change is moving so rapidly that it is now necessary to consider dramatic policy solutions to not only cut emissions but also to reduce atmospheric CO_2 by drawing down carbon to a safe climate level (i.e. less than 350ppm).[462]

The extent to which governments have responded to climate change to date however has failed.[463,464,465,466] There are serious concerns that many people are either uninformed or in denial about the nature and extent of the problem and possible solutions which,[467,468,469,470,471,472,473] coupled with a comprehensive misinformation campaign funded by the fossil fuel industries,[474,475,476,477,478,479] has so far led to little electoral risk for governments that fail to act.[480,481,482,483]

Little is really known about what the community truly understands about current climate science. Over 80% of Australians do not feel sufficiently informed about the proposed CPRS legislation to be able to make an informed decision about it.[484] This is a major concern for effective policy action, as it is difficult to achieve political support for the changes that are required unless the community is well informed about the nature and urgency of the climate crisis. While there is evidence some sections of the community acknowledge the “climate emergency”,[485] only 48% of Australians consider global warming a “serious and pressing problem”,[486] and public concern about climate change in general in Australia has dropped up 20% in the last two years,[487] despite increasingly urgent warmings from scientists.[488,489]

There is evidence of the Australian public’s desire for policy action on climate change, including a willingness to bear some of the costs of action, but the scale of the response suggests the scale and urgency of the emissions reductions necessary are not well understood.[490,491,492,493]

Risk management

There is a longstanding principle that has underpinned public policy decision making for decades in relation to difficult or wicked problems - that of the precautionary principle.[494]

Adopted by the United Nations in Rio in 1992, essentially the precautionary principle requires that where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

It is this risk management approach that has driven action on climate change to date, and as evidence of the risks increase, it must also drive appropriate policy responses.

Therefore it is expected that, just as individuals take action to reduce their risk from harm such as changing their behaviour or buying insurance, in the same way governments should act to ensure society is protected from collective catastrophic harm.[495]

As outlined above, leading climate scientists concur that a stabilisation level of 450ppm of CO2e has only a 50% probability of keeping global temperature within two degrees. By anyone's estimation, that is an enormous risk and not one we need to accept. While mitigation is an enormous challenge, climate scientists and experts predict effective mitigation and restoration of a safe climate is possible – if the world acts quickly.[496,497,498,499,500]

As the Senate Select Committee recently concluded:

> *"Prudent risk management balances the risk of doing nothing if the scientists are right – which would involve very severe and irreversible danger to human welfare – against the outcome if action is taken unnecessarily.... Even, acknowledging the possibility that the majority view on the science could be totally wrong still leaves a powerful case for a 'no regrets' policy. Taking action amounts to 'giving the planet the benefit of the doubt'. It is a sensible insurance policy'.*[501]

For the world to act quickly individual nations must first commit to act. The development of a global agreement is hinging on the public commitments of individual nation states as to their willingness to make emissions reductions. These actions will not only assist in the development of a global agreement – along with assisting developing nations, it may be one of the only things that will bring about an effective global agreement.[502,503,504,505,506,507] Therefore countries such as Australia must make the strongest committment possible to achieve a satisfactory global outcome.[508,509]

Moral dimension

The moral dimensions of the issue make climate change a unique problem, and add to its complexity. The extent to which this affects responses to it is summed in this comment from Nicholas Stern in his 2006 report that: "if you care little about future generations, you will care little about climate change".[510]

There are however 192 countries, including Australia, who are party to the United Nations Framework Convention on Climate Change (UNFCCC) which came into force in 1994. This

places an (almost universal, given its membership) obligation on countries to 'protect the climate system for the benefit of present and future generations of humankind on the basis of equity and common but differentiated responsibilities and respective capabilities'.[511]

Professor Glenn Albrecht, an environmental philosopher from Monash University, put it very plainly when he presented to the Senate Select Committee on climate change in 2009, saying: "it is ethically repugnant to force on innocent and non-consenting communities, particularly our children and all future children, a deliberate decision to increase greenhouse gas emissions or a calculated failure to reduce them to safe levels."

Historical responsibility and capacity

As indicated above the principles of precaution and equity are implicit in the UNFCCC that underpins the Kyoto Protocol. These obligations are also predicated on the principles of "common but differentiated responsibilities and respective capabilities" which refers to the collective understanding there developed nations have a particular historical responsibility for the emissions that have already occurred, and their developed status and relative wealth provides them a capacity to act to reduce emissions that is not equally shared by developing nations.

As a developed nation, Australia has a strong historical responsibility due to its profligate per capita emissions and possesses the capability to pay given its secure economic status. Australia is the highest per capita emitter of CO_2 in the world, having recently overtaken the US with a record of average per capita emissions of 20.58 tonnes of carbon dioxide a year.[512]

Despite this however, Australia has not delivered on its part of this global committment, ratifying the Kyoto Protocol only in 2007, and subsequently failing (to date at least) to develop a climate policy that will effectively cut emissions.[513]

While it is true Australian has higher mitigation costs than some developed nations due to its current dependence on fossil fuels, it also has the greatest potential to make the biggest cuts due to high potential for energy efficiency gains, abundant renewable energy resources and high carbon sequestration potential from forests.[514,515,516]

Increased future costs

The future costs of failing to address global warming and climate change rise exponentially with each year that no action is taken.[517,518] The 2006 Stern Report warned that a failure to act may lead to costs equivalent to 5% of GDP each year, and could rise to 20% of GDP or more.[519] By the 22nd century, according to some estimates, unmitigated climate change could be costing 70% of global GDP.[520]

As discussed above, mitigating the effects of climate change is an act of risk management. Not managing it is not an option - as Ross Garnaut concluded in his 2008 climate change review: the costs of well designed mitigation will not end economic growth in Australia, but unmitigated climate change probably would.[521]

Effects on human health

While emissions cuts and removal of CO_2 from the atmosphere remain a priority, efforts to protect the global community from the harmful effects of climate change are also vital. The international medical journal *The Lancet* recently devoted the entire issue to the topic of the risks to human health posed by climate change, describing climate change as the "biggest global health threat of the 21st century".[522]

An increase in climate-induced morbidity (illness) and mortality or illness is expected to have significant effects not only on individuals but on national health budgets and economic productivity.[523] There is an urgent need for more evidence and projections on the human health effects of a severe rise in temperature.[524] Such evidence will play an important part in preparing to address the profound health and economic implications of anthropogenic climate change as well as boost advocacy efforts in securing the necessary political will to achieve urgent and drastic cuts in emissions.

Legal issues

There are also legal imperatives for action – there is increasing evidence of demands for accountability with respect to governments who will be held accountable for their failure to protect their citizens from the dangerous effects of climate change.[525]

A recent Human Rights and Equal Opportunity Commission paper suggests that, under common law, as well as international human rights law, Australia has an obligation to act to protect its citizens from the effects of climate change.[526] This could mean that Australia's failure to meet its obligations in the climate change context could mean Australia is in breach of international law.[527,528]

University of Oregon law Professor Mary Wood argues that protection of natural resources is the responsibility of governments, and that the atmosphere, like all natural resources, belongs to the people as a 'natural trust' administered by the government.[529] A failure to protect the atmosphere from climate change is a violation of the "fiduciary duties" of government as the guardian of a nation's natural resources, says Wood.

Threats to national security

Unmitigated climate change poses significant threats to national security from severe weather events, food and water insecurity, and the forced relocation of millions of climate refugees.[530,531,532]

Military agencies are worried and are calling for urgent global action and "an ambitious and equitable international agreement".[533] A meeting of international military experts in October 2009 warned that "climate change is resulting in an unprecedented scale of human misery, loss of biodiversity and damage to infrastructure with consequential security implications that need to be addressed urgently".

A failure to recognise the implications of climate change on national and international security, and adequately mitigate is considered likely to be "very costly" in terms of providing an adequate military response as nations become destabilised and human suffering increases.[534]

A POLICY 'SUITE': OPTIONS FOR AUSTRALIA

So, what is needed?

In his landmark 2006 report, Sir Nicholas Stern outlined four strategies necessary for cutting emissions: reducing demand for emissions-intensive goods and services; increasing efficiency; avoiding emissions from non-energy sources, such as reducing deforestation; and switching to lower-carbon technologies for power, heat and transport.[535] He identified three elements as necessary in policy development to achieve this: putting a price on carbon pricing, stimulating the development and deployment of a wide range of low-carbon technologies, and the creation of incentives for behavioural change through the development price signals, provision of information, and the setting of standards.[536]

These elements continue to have strong support as an important part of the policy framework to reduce emissions; however very few have been implemented in concert, their implementation has been slow and often compromised by political disagreement and/or the influence of vested interests.

To effectively address the problem, policy options for Australia must include strategies to achieve a rapid transition to zero emissions technologies, reduce energy demand and reduce emissions from non-energy related sources.[537,538,539,540]

Consistent with this framework (as well as putting a price on carbon to achieve urgent deep cuts in emissions by creating a disincentive to pollute), is the need to consider direct public investment in renewable energy technology and in reafforestation programs.[541,542,543]

Environmental policy researchers and authors Ted Nordhaus and Michael Shellenberger believe there must be "dramatic and uncompromising investment in clean energy to achieve an urgent transformation of the world's energy systems". They argue that the development of clean energy technologies will not progress rapidly until clean energy it is "cheaper than dirty energy at point-of-use by the consumer".[544] This should be achieved by the direct public financing of stimulate research, development and deployment of clean energy technologies that will reduce the costs of alternatives to fossil fuels.[545]

Nordhaus and Shellenberger are unequivocal about a failure to do so, saying:

> *"If we are to bequeath to future generations anything other than a combative, scarcity-ridden, degraded and wildly unstable world, this is the right approach."*[546]

The development of effective legislative tools is clearly necessary to achieve the changes required. Voluntary action programs have been in place for decades in some jurisdictions and emissions continue to rise exponentially.[547] Other policy instruments such as direct public funding, and the creation of financial incentives and/or disincentives will be necessary to complement, or be implicit in, legislative provisions.

There is strong support in the literature for a suite of policy responses.[548,549,550] It is suggested that broad climate change legislation be developed, with specific targets identified within the legislation, including a price on carbon that will achieve an effective environmental outcome, and targets for strong complementary measures such as energy and fuel efficiency standards, emissions standards, reafforestation programs, improved land use,

biosequestration, investment in low emission transport infrastructure, and investment in zero emissions energy technology development and deployment.[551,552,553]

In addition to positive measures to regulate emissions, it will also be necessary to remove perverse incentives that exist in current policy, such as the current subsidies to fossil fuel industries.[554]

Establishing the right targets

Achieving an effective environmental outcome requires that targets are established according to the science, and domestic targets will need to be much more specific. How the global burden is shared will also be critical.[555,556]

The work of Meinhausen[557] and Schellnhuber[558] in developing data on the global carbon budget is important as it identifies specific limits to CO_2 emissions that are based on comprehensive science. While this raises uncomfortable realities for high emitting nations, in the interests of a global agreement and commitments to effective emissions reductions, the utilisation of this approach in determining a global per capita allocation of carbon emissions will be very important. Used in conjunction with the Greenhouse Development Rights Framework approach, which calculates the cost of each nation's obligation based on population, income, capacity, and historical contribution to greenhouse gas emissions,[559] this could provide a transparent, equitable, and environmentally effective pathway to a global agreement on emissions reductions.

Increases in global average temperature take decades to respond to increases in atmospheric CO_2. Even if we stopped emissions immediately, those that have already occurred will likely lead to a global average warming of 2.4°C - beyond the two degrees guardrail.[560,561,562]

The evidence therefore strongly supports 100% reduction in emissions and drawdown of excess CO2 to stabilise atmospheric CO_2, to be achieved as quickly as possible.

A number of initiatives are underway both internationally and in Australia to develop comprehensive transition plans that provide a framework to guide reductions of this scale.[563,564,565]

A plan outlining the changes necessary to cut global net emissions by 80% by 2020 has been developed by the Earth Policy Institute (EPI).[566] Despite a global increase in energy demand by 2020, EPI's *Plan B* outlines how through improving energy efficiency and energy conservation in buildings, industrial processes and transport, global demand could be substantially reduced.[567] Emissions could be further reduced through investing in reafforestation and improving agricultural land management.[568] Investing in renewable energy such as wind, solar, geothermal and hydro power would allow coal to be phased out, and for the world's energy requirements to be entirely met with clean renewable energy by 2020.[569]

Another example is the Repower Roadmap, which details how through improving energy efficiency and shifting to clean energy for power, heat and transport, the USA could move to 100% clean electricity within 10 years.[570]

A full costed transition plan for the stationary energy sector in Australia being developed in Victoria suggests it is possible for Australia to shift to 100% renewable energy power generation in ten years.[571] If this plan were to be implemented, it would be see the development of 20 concentrated solar power stations at geographically dispersed locations nationally providing of almost 50,000MW of power, and additional wind power generation providing an additional 60,000 MW of wind by the end of the next decade (i.e. by 2020).[572] Upgrades and extension of the national transmission network is part of the plan. Further emission reductions outlined in the plan are possible through reductions in energy demand, the electrification of transport, use of heat pumps to replace gas, and modal shifts in transport use (i.e. from private cars to public transport).[573]

While the scale of this transition seems enormous, it *is* possible. Work is already underway in Australia on a plan that will guide the full economic and social transition necessary to achieve the emissions reductions required to restore a safe climate.[574,575]

Establishing a carbon price

This paper has outlined two approaches to pricing carbon emissions – an emissions trading scheme or a carbon tax. Whatever the mechanism chosen, there is widespread agreement that a price on carbon is necessary to drive cuts in emissions. It is less clear however whether disincentives to pollute (through top down approaches) will be enough. There is a an emerging view that the development and rapid deployment of clean energy and zero emissions technology will be best served by positive incentives and that, in addition to a price on carbon, significant investment in these technologies will be required to assist them to quickly reach the economies of scale that will allow them to compete on price with older carbon intensive technologies.

Consideration should be given, either to the substantial revision of the emissions trading scheme to ensure it will deliver emissions cuts more quickly, or to the alternative of a carbon tax, in addition to strategies that will positively contribute to the rapid development and widespread deployment of proven technologies to substitute existing carbon intensive technologies.

Relying solely on emissions trading in Australia however runs the risk we hasten too slowly to our goal. If we are to reduce emissions quickly through shifting to clean energy technologies, the price of carbon would need to rise quickly and substantially to achieve cost competiveness for alternatives.

The potential for emissions trading to engage more in the exchange of in illusory financial products (like the role of derivatives in the recent global financial crisis) raises many questions about the ability of such a scheme to cut emissions in the time frame indicated by the science. While both can be employed, on the basis of the evidence outlined in this paper, it is argued that the introduction of a carbon tax would provide greater certainty, be more transparent and would achieve a better environmental outcome than emissions trading. Care must be taken however that the introduction of such a measure does not allow it to fall hostage to the same vested interests that have distorted the development of the emissions trading scheme.

But a carbon tax alone will not be enough. Decarbonisation of our energy supplies will require the direct public funding of low or zero emissions technology. A carbon tax can help

raise revenue necessary to fund the deployment of zero emissions technologies but additional direct investment will be needed.[576,577,578]

Review of existing policy

In addressing emissions reductions it will also be necessary to look at existing perverse incentives that work in opposition to this goal. For example, it is estimated that there is currently around $10 billion annually being provided in public subsidies to the fossil fuel industries in Australia that is distributed via a range of state, territory and federal programs.[579,580] Decarbonising the economy clearly required that these subsidies cease and are applied instead to development and deployment of zero emission technologies.

Energy production from fossil fuels must be phased out as quickly as possible, with a ban on new coal fired power stations to include refurbishments and/or expansion to existing facilities.[581,582] Existing high emissions power generation should be scheduled for the earliest possible retirement and direct public investment in clean energy generation scaled up to replace it.

The development of a nationally integrated “intelligent” grid for electricity distribution is needed to facilitate the contribution of decentralised renewable power generation.[583] The installation of “smart” meters in all buildings and homes would also help raise awareness of energy use and cost and drive reductions in energy consumption.[584]

Regulatory standards

The development of international best practice national energy efficiency regulations to reduce energy demand and lead to substantial emission reductions is necessary. The creating of incentives for the purchase of energy efficient appliances and retrofitting and construction of energy efficient, sustainable buildings will help reduce energy demand. Many of these measures can be realised initially as savings to the economy, given that evidence suggests that the first 25% of emission reductions possible through energy efficiency measures of appliances and buildings are cost positive.[585,586]

Achieving emissions reductions through fuel switching will also require measures such as a national gross feed-in tariff and a significantly expanded renewable energy target.[587]

The development of mandatory strong national emissions standards for all transport is necessary to encourage the maximum fuel efficiency of all vehicles, as well as direct investment in the production of clean energy powered electric vehicles. Immediate and major investment in low emissions public transport is necessary to encourage a shift away from private cars to public transport and bicycles in metropolitan areas, increased use of and investment in electrified rail to replace much of the heavy haulage of road transport, and development of a national fast electric rail network to reduce emissions from domestic aviation.[588]

Restoring carbon sinks

Halting deforestation and reducing emissions from land use offer some of the most significant opportunities for emission reductions.[589] Logging of native forest should be banned,[590] and incentives created to expand existing responsible land use practices to

substantially increase the potential for biosequestration of carbon through careful management of soils and utilisation of biochar.[591]

Emissions reductions that are achieved by offsetting through the recognition of the value of land use and forestry also require the development of high and uniform regulatory standards and robust accounting rules to ensure the reductions are real and additional to fuel switching or energy efficiency reductions.[592]

Research

Investment in research to hasten the development and deployment of innovative technology to reduce emissions should be scaled up immediately. This should include research into zero emissions technology, energy efficiency improvements, biosequestration, transport technologies,[593] and the drawdown of carbon emissions from the atmosphere.[594]

Improving climate literacy

While state and local governments in Australia are undertaking programs to promote energy efficiency and encourage the voluntary reduction of emissions, little has been done at a national level to promote climate science literacy to ensure the wider community understand the scale of the threat of global warming and urgency of climate policy action.

A national 'climate literacy' educational campaign, using a wide variety of communication tools to reach all sections of the community, is needed to inform the public about the immediate dangers posed by global warming in order to build support for action of an appropriate scale and urgency.[595,596]

A series of deliberative citizen engagement programs should be undertaken to assist this process. This will help build understanding about the available policy choices and lead to a greater sense of ownership about the decisions and the policy solutions that follow.[597]

To ensure these activities translate into climate literate communities of the future, the development of the new national curriculum should include core modules on environmental sustainability and climate change.[598]

Getting a global agreement

Commitment to the type of policy action described here would provide an important example by Australia to the worlds that it is prepared to demonstrate responsible leadership and contribute effectively and in an equitable manner to the global task of addressing anthropogenic global warming. Strong domestic policy action and leadership that acknowledges historical responsibility as well financial and technological capacity from developing nations in particular is needed.[599] As the Club of Rome recently said: "In this spirit of trust, every country must act on the firm assumption that all others will also act."[600]

In addition, developing nations must commit to contributing to a pool of resources to fund decarbonisation in developing countries.[601,602,603]

Without this type of firm political leadership it may not be possible to achieve a global agreement.

And not achieving a global agreement is unthinkable. The final words of the Garnaut report outlines the risk of a failure to do so very succinctly: “On the balance of probabilities, the failure of our generation would lead to consequences that would haunt humanity until the end of time.”[604]

What needs to be achieved?

The aim of the actions outlined above is the development of policy that if implemented, would contribute to Australia’s fair share of the global responsibility to reduce emissions, remove carbon from the atmosphere and contribute to a global commitment to prevent catastrophic irreversible climate change and restore a safe climate.[605] A safe climate is defined as one in which, there are: “no systemic, unsustainable, or unstable conditions driving global temperatures; greenhouses gases do not accumulate in the atmosphere; concentrations of greenhouse gases in the atmosphere are stabilised at levels which are ecologically sustainable; climate related factors do not cause economic, political, and social conditions which undermine the capacity for people to meet their needs; and value can be created from natural energy and land resources without systematic degradation of the complex systems that continue the ecology of the planet and its climate”.[606]

A sense of wartime urgency

The scale and urgency to reduce emission and halt global warming is prompting serious calls for governments to acknowledge the climate crises as a global emergency and to move to a “war-like” footing to address it.[607,608,609]

The Institution of Mechanical Engineers in the UK has called for the British government to act as if it were at war and move to a reindustrialisation strategy that includes mitigation adaptation and geo-engineering.[610] Their November 2009 report: *Climate Change: Have we lost the battle?* says emissions reduction targets are unachievable without a radical overhaul of strategy and more political support.[611]

A recent report on the rate of reindustrialisation necessary to avoid runaway climate change found that investment in low carbon resources would need to commence immediately.[612] These resources and industries need grow between 24% and 29% in every subsequent year if runaway climate change is to be avoided. The ‘point of no return’ is identified as 2014, beyond which market based options will be inadequate and there will be no alternative other than to move to a “war footing”, but the report authors warn this final option offers no guarantee of success.[613]

Given that unmitigated climate change is predicted to be costing as much as 70% of global GDP by 2300,[614] a commitment to a significant share of GDP to mitigate against climate change is warranted. It is estimated that a committment to between 3-4% of GDP now, each year for the next ten years could transform Australia’s energy supply and transport systems.[615]

Compared to the proportion of resources nations have in the past devoted to military expenditure in the event of a world war (perhaps in this case however to avert one) of between 30-50% of GDP, this might seem like a good investment.[616]

Conclusion

Commitment to the type of policy action described here would provide an important example by Australia to the world that it is prepared to demonstrate responsible leadership and contribute effectively to the global task of addressing anthropogenic global warming.[617] In addition it will be necessary to contribute to a pool of resources to fund decarbonisation in developing countries.[618,619,620]

The aim of the actions outlined above is the development of policy that if implemented, would contribute to Australia's fair share of the global responsibility to reduce emissions, remove carbon from the atmosphere and contribute to a global commitment to prevent catastrophic irreversible climate change and restore a safe climate.[621]

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