Submission to Senate Inquiry into Climate Extremes

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2 January 2013

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Summary

If we are to drive climate adaptation and abatement effectively, we need to build consensus on the existence of climate change and the role of human behaviour, particularly burning fossil fuels. Claims that warming has stopped over the past sixteen years are superficially correct. But this is driven by short term effects such as La Nina. However, over the past four decades, periods of rapid warming have exceeded the effects of periods of cooling, so that the coldest years have become warmer and the hottest years even hotter. Renewed warming in 2012 and predicted further warming in 2013 seem likely to confirm that ongoing temperatures are consistent with the trends of the past four decades.

Comparison of trends in fossil fuel use and warming trends show a strong real-world correlation over the past four decades, consistent with climate science. The imbalance between carbon dioxide

emissions from humans and the natural systems is reflected in the statement by Lord May that each year's emissions from fossil fuel burning took the earth a million years to store.

The most difficult challenges in adapting to climate change will be social and psychological. The unpredictable nature of extreme events (in the short term) will create extreme uncertainty, ongoing dilemmas and increasing costs for increasing numbers of people and businesses. Temporary and permanent migration within and between countries will build social pressures and physical housing and infrastructure challenges.

Adaptation should not be treated separately from emission abatement. They are deeply interwoven, and there are potential synergies from pursuing both in an integrated way. Further, many adaptation and abatement measures can contributed multiple benefits beyond climate change response. These are often worth more than the climate-related benefits.

Policy also needs to recognise that adaptation must also occur to policy responses. New regulations, pricing, economic development and planning policies will have both winners and losers. We must proactively encourage strategies that empower and support community action, to avoid creating a 'victim' mentality and social polarisation.

Our policy approaches also need to adapt. The carbon pricing and trading scheme will require ongoing fine-tuning, while other response measures will need to be enhanced and optimised through experience, not culled and closed down.

Recommendations

1. Develop and market test a range of ways of communicating climate change to the community, especially putting the temperature trends of the past two decades into context.
2. Place greater emphasis on addressing the psychological and social challenges that will be faced by people and businesses due to the combination of uncertainty and inevitability of climate change.
3. Identify links between climate adaptation, emission abatement, adaptation to climate response policies and measures, and other benefits and costs, so that synergies can be captured to maximise benefits and minimise costs.
4. Adapt climate policies based on our experience, to enhance outcomes. In particular adapt carbon pricing so that energy-related voluntary action by state and local government, businesses and households is additional, through cancelling permits to match their actions.

Introduction

Our ability to gain broader consensus on the need to adapt to climate change or cut emissions underpins effective action. Consensus is heavily influenced by the public debate about whether climate change is happening, and the extent to which it is caused by human activity. The adverse implications for Australian society of allowing climate change to grow are generally understated in policy discussions. At the same time, the opportunities from acting to limit climate change – to save money, improve lifestyles, develop our economy and improve equity are drowned out by powerful vested interests, conflict-focused media, conservative policy analysts and people fearful that they will suffer. There are positive stories, such as the large businesses saving a billion dollars a year through energy efficiency measures driven by programs such as Energy Efficiency Opportunities, businesses that are innovating and expanding while cutting emissions or helping people to cope with

climate change, or people who are cutting their energy costs and improving their comfort through improved efficiency and use of renewable energy. But these receive little promotion.

In particular, claims from sceptics that warming has stopped or reversed over the past 15 years or so have undermined community support for effective response. This submission provides a discussion of how acceptance of climate change can be reconciled with a relative lack of warming since 1997. It also shows how global temperature change correlates to global fossil fuel use and other contributors to warming. The submission also discusses the social challenges Australians will face as climate change accelerates, as well as the relationship between adaptation and abatement of emissions.

Recent 'reduced' warming trends and climate change

Many climate sceptics claim that global temperatures have not risen over the past fifteen years or so, and that this shows climate change is a lot of hot air. In response, many climate scientists have rejected the sceptics' claims, but have not presented a clear and understandable explanation of the basis for their position. While many other arguments are put forward by sceptics, this seems to be the most obvious and powerful one.

Recent data shown in Figure 1, from one of the world's recognised climate data sources, the UK Hadley Centre, superficially seems to provide some support for the view that there has been little warming since 1997 (shown by the blue line in Figure 1). Indeed, if the Hadley trend had been calculated from the very hot November 1997 to the end of 2011 instead of from less warm August 1997 to warmer August 2012, it may well have shown a net cooling, as claimed by some climate sceptics.

But it doesn't show that global warming is not happening.

What it does show is that, if you choose a time period that starts with a strong El Nino and finishes with a La Nina period (or other short term effects that can occur such as volcanic eruptions or increased air pollution, which create short term masking of warming), the long term warming trend can be masked for quite a few years. The exceptionally strong El Nino in 1997, followed by another which drove Australia's long drought in the first decade of this century, have been followed by a strong La Nina cooler period, as shown in Figure 2. This combination has contributed to the perception of a short term 'lack of warming' by boosting the temperatures early in the period and damping them in the later part. But even within the recent La Nina period, we experienced the hottest La Nina year on record in 2011 (Prof Will Steffen, Prof Matthew England and Prof David Karoly 2012 Climate Commission paper).

The Hadley Centre graph in Figure 1 looks back to 1975. What it really shows is that, since the 1970s, the 'cold' years have consistently become warmer (shown by the dashed blue line added by the author) and the 'hot' years have consistently become hotter (shown by the dashed red line added by the author). And the average temperature has followed a similar trend. But there are several periods of five to fifteen years where it could be claimed that the earth was cooling. Typically these start with an El Nino and finish with a La Nina. The trend in the ENSO Index is shown in Figure 2, which shows El Nino as a positive value, and La Nina as a negative value of the index. The El Ninos match

fairly well with warm periods, and the La Ninas with cooler periods shown in Figure 1. Of course, there are other factors at work, too.

Unfortunately for humanity and the global environment, the periods of cooling are outweighed by periods where warming was stronger, so the overall average since the mid-1970s is a substantial warming effect.

While scientists have attempted to respond to the 'lack of warming' argument by showing that decadal average temperatures have consistently increases (the pink lines in Figure 1), the reality is that most people find such an argument too subtle – they don't really understand averages. So highlighting the real trends in the extremes is more tangible and easier to explain. And it is obvious that we are still within the range of variation seen since the 1970s.

Another interesting factor in the Hadley data is that it shows a return to warming during 2012. If a data series that ends in 2011 is used, the graph would show less warming or even slight cooling. But if 2012 data is used as the end of the period analysed, the trend from 1997 begins to shift towards more net warming. Given that the British Meteorological Office has been reported as predicting 2013 will be among the hottest years on record (Ben Cubby, the Age 22/12/12), sceptics may find that their claims of a recent cooling trend evaporate quite soon.

The key point here is that claims of a decline in warming are made using data over relatively short periods of time, and are very sensitive to the exact start and end of the time period considered. A change of a few months or a year can reverse the observed trend. This highlights the importance of looking at longer term trends, rather than short term ones.

Figure 1. Hadley Centre temperature change data for 1975 to August 2012 (dashed blue and red lines added by the author) downloaded from www.realclimate.org 9/11/12. Clearly the graph shows the hot years are becoming hotter and the cold years are becoming warmer at about the same rate as average temperature is increasing.

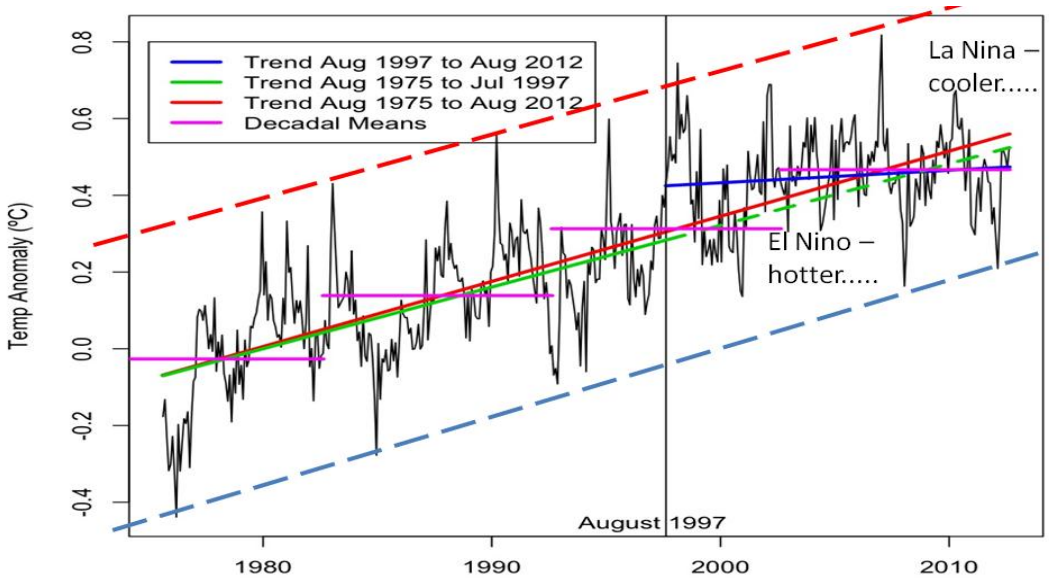
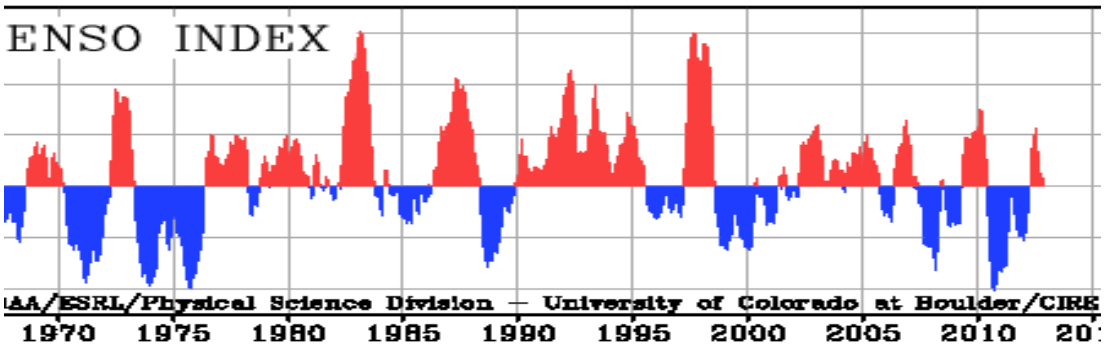
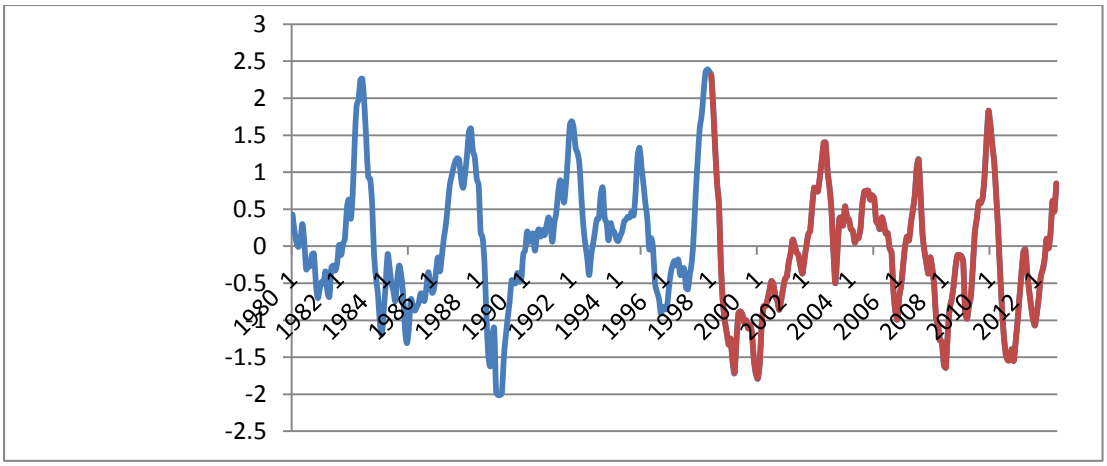


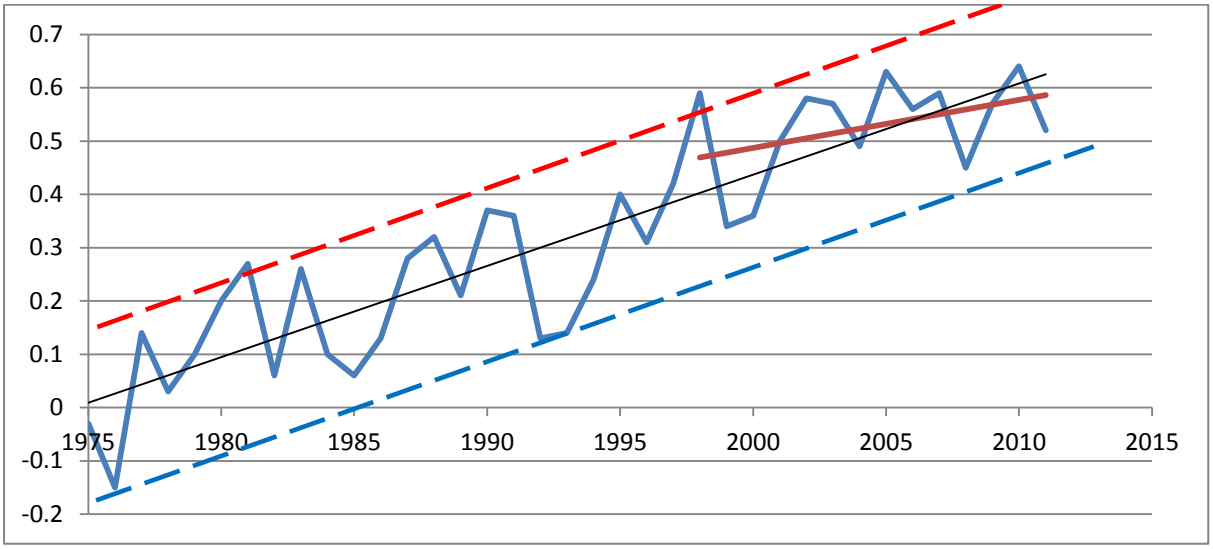
Figure 2a, monthly ENSO Index from http://www.esrl.noaa.gov/psd/enso/mei/ (adjusted so that the years align with the first graph in Figure 1. The El Nino (red) and La Nina (blue) events can be matched against year to year temperature trends. **Figure 2b** is the quarterly ENSO Index using data from http://www.cpc.ncep.noaa.gov/data/indices/ersst3b.nino.mth.81-10.ascii (accessed 17/12/12) - El Nino periods are positive values, and La Nina periods are negative. It shows the same trends.





The Hadley Centre temperature data is one of three sets of data used by the World Meteorological Organisation. The others are prepared by NASA and NOAA. They show slightly different warming trends over recent years. For example, the NASA Data is shown below in Figure 3a. It shows a slightly stronger warming trend from 1998 to 2011 than the Hadley data, but it is still half the average from 1975 to 2011. The difference between the NASA and Hadley data is also partly due to use of monthly data in the Hadley graph and annual data in the NASA graph, which smooths the variation.

Figure 3a. Trend in annual average global surface temperature using the NASA GISS dataset from http://data.giss.nasa.gov/gistemp/graphs_v3/Fig.A2.txt accessed on 17/12/12. **Figure 3b** shows trends for all three temperature data sets used by the World Meteorological Organisation from http://www.wmo.int/pages/prog/wcp/wcdmp/GCDS_3.php . Both show ongoing increases in the temperatures of 'cold' and 'hot' years over time.



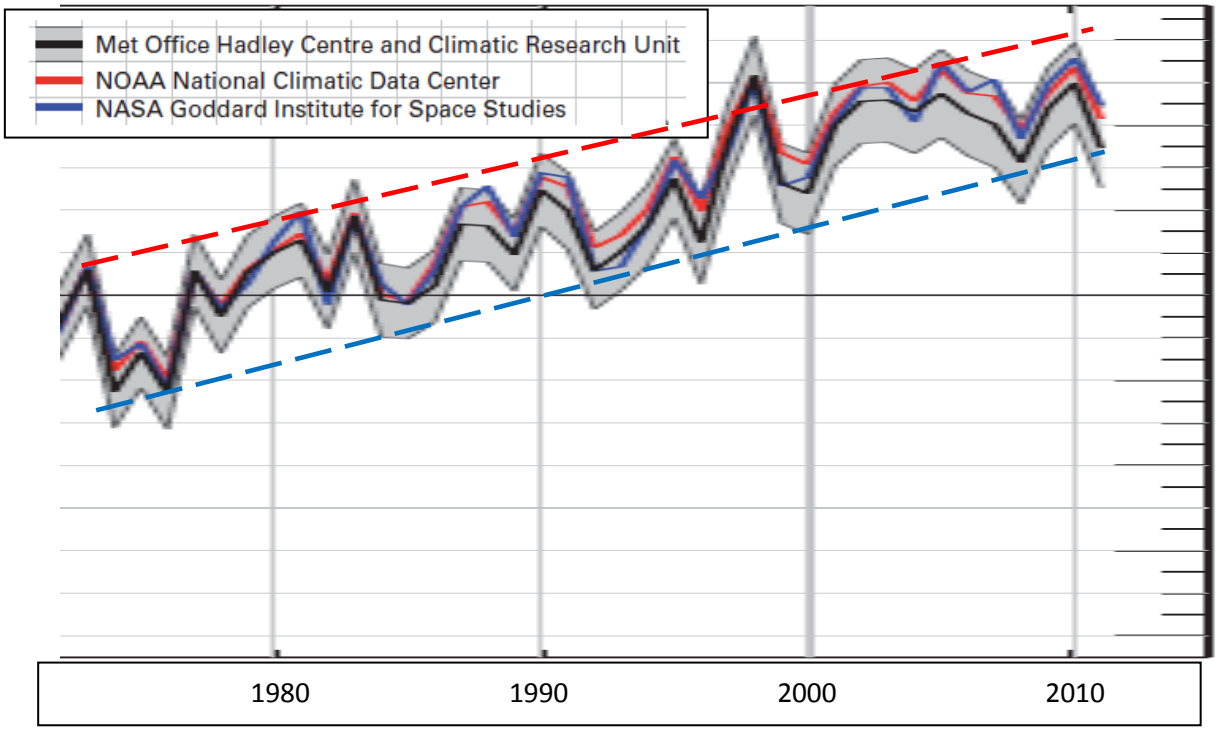


Figure 3b shows temperature trends since 1975 from the three main datasets of global temperatures used by the World Meteorological Organisation. It shows that the Hadley Centre estimates of temperature change have tended to be lower than the NASA GISS and NOAA estimates. In particular this leads to a lower warming trend over the past two decades. This reflects differences in their networks of monitoring stations and differences in adjustments due to correct for data errors. Nevertheless, the trends of the hot years getting hotter and the cold ones getting warmer

apply, for all three recognised data sets. Note that the one exception, 1997-98, was an extreme El Nino year (as shown in Figure 2), which pushed it outside the 'hot' trend line.

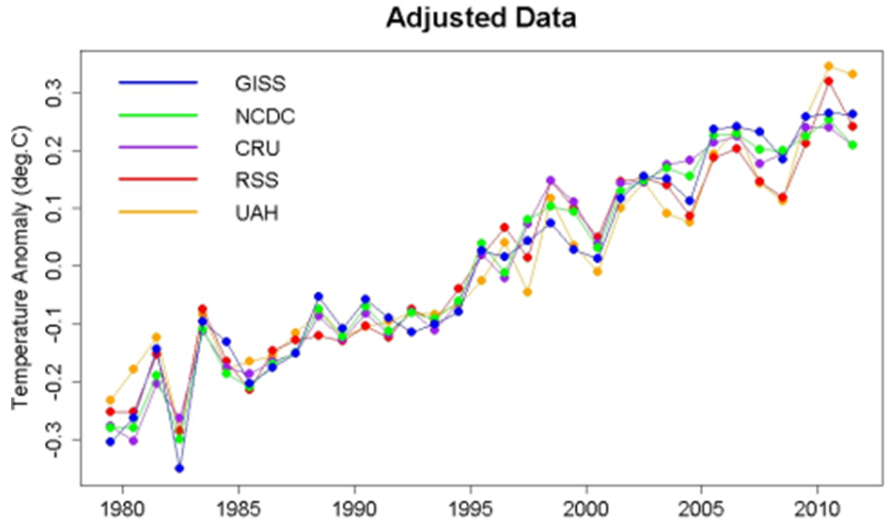
Clearly, figures 3a and 3b show similar trends to figures 1 and 2: the cold years are getting warmer and the hot years are getting hotter, in line with the increase in average global temperature. When 2012-13 data is added to these graphs, the message will be even stronger.

A graph from other researchers in Figure 4, published in 2011, shows that removing the effects of El Nino and La Nina leaves a much clearer and more consistent warming trend. This is the underlying global warming, with short term effects other than ENSO still present.

Figure 4. Global temperature trends with effects of El nino and La Nina removed.

Temperature trends from five climate models with the effect of El Nino/ Southern Oscillation removed

(G. Foster, and S. Rahmstorf, "Global temperature evolution 1979–2010", *Environmental Research Letters*, vol. 6, pp. 044022, 2011. http://dx.doi.org/10.1088/1748-9326/6/4/044022) downloaded from www.realclimate.org 9/11/12



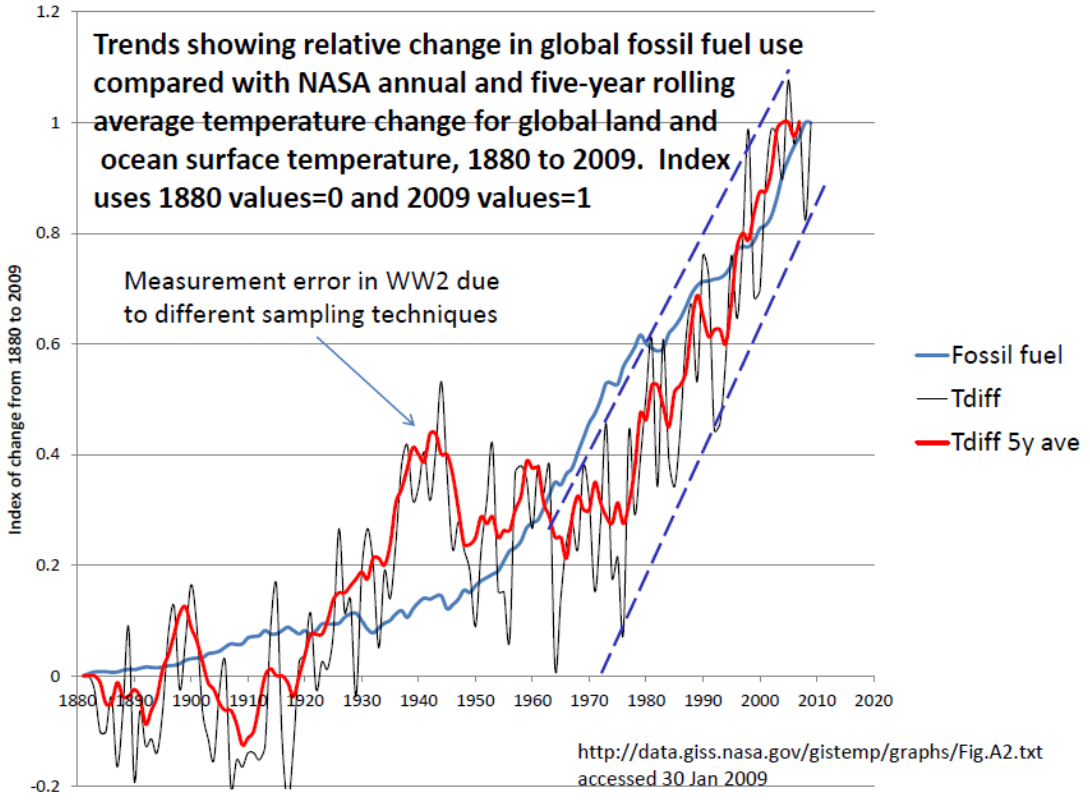
Conclusion

Clearly, the global warming trend that drives climate change is continuing. However, by carefully choosing the start of a time period to coincide with an El Nino and the end with a La Nina, it is possible to present the impression that warming has slowed or even reversed. The recent and projected return to warming, and the increasingly extreme and frequent weather events, seem likely to undermine efforts to suggest that global warming has stopped or slowed.

Correlation between fossil fuel use and global warming

Emission of carbon dioxide from the burning of fossil fuels is considered by scientists to be the main driver of global warming and resultant climate change. Yet many argue that it is not significant. Figure 5 shows a comparison of the growth in global fossil fuel use with the global temperature trend to 2010, prepared by the author using energy data from the *BP Review* from 1960 and UN data earlier. The global temperature trend is from NASA data.

Figure 5. Comparison of changes in global temperature and fossil fuel use (adjusted to the same scale).



This long term picture offers some interesting insights:

- Global fossil fuel consumption only started to grow to significant scale in the 1950s, and it has tripled since the mid 1960s. Also, the quality of temperature measurement was variable until the 1970s and 1980s, when scientists began to seriously study climate change. So it makes sense that clear indications of global warming really only became visible above the 'noise' in the 1970s. This is the reason why the earlier graphs in this submission focus on the period since 1975.
- In recent decades, the rate of increase in warming has been faster than the growth in fossil fuel use. This is consistent with other factors, including the increase in emissions of other greenhouse gases, as shown in Figure 6, as well as the acceleration of land clearing.
- The variability of the rate of warming pre 1960s reflects many factors, including lack of quality data, the much smaller impact than today of fossil fuel emissions relative to other effects, high emissions of air pollutants that mask warming post world war 2, etc. One paper has pointed out that part of the variation in measured temperature during WW2 was because British ships took fewer readings of sea temperature, so the data from US ships, which used a different method to measure sea temperature, dominated. This led to higher temperature data.

Climate physics tells us that higher concentrations of CO_2 should drive warming, and the comparison in Figure 5 between actual warming and the main source of CO_2 shows a strong correlation. Further, as Lord May (former president of the Royal Society) pointed out in 2010, the amount of CO_2 released each year by burning fossil fuels took the Earth around a million years to store (talk at Lowy Institute,

seen on www.slowtv.com.au May 2011). No wonder the Earth's natural systems cannot cope with the changes humans are driving, although they are absorbing some of the CO_2. Scientists also point out that there are many other indicators of global warming and resulting climate change, such as increasing humidity and sea level rise, that are also changing in ways that confirm climate change. So it is difficult to reject the link between CO_2 emissions and global temperature increase using credible arguments.

Figure 6. Contributors of various gases to global warming over time.

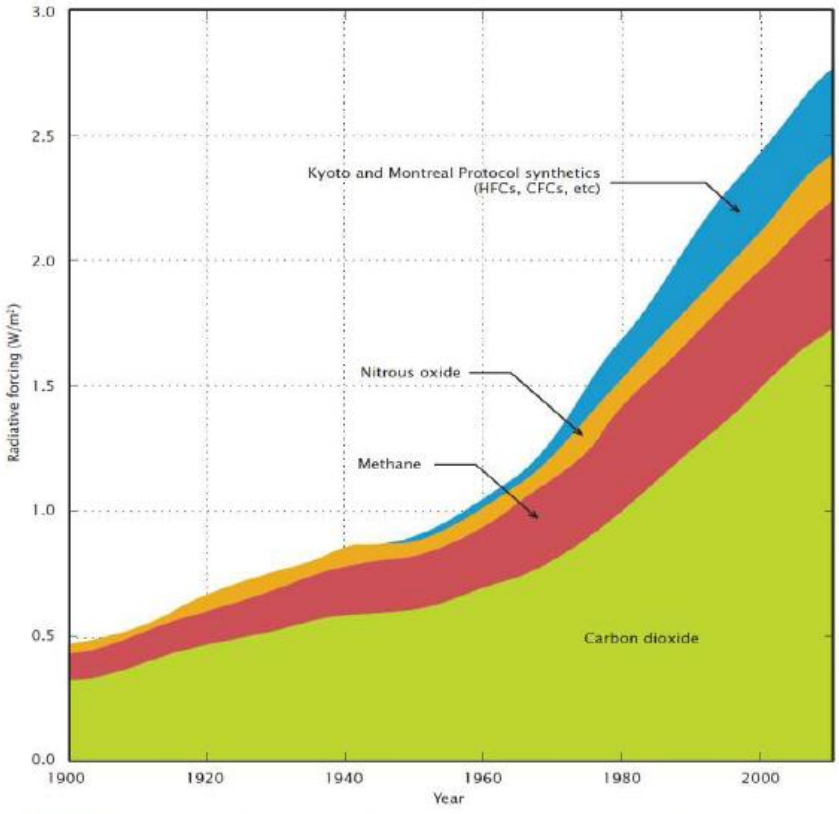


Figure 2.2: Global radiative forcing due to long-lived GHGs from 1900 to 2009 assessed from data measured in the CSIRO[2] and AGAGE[3] networks, which are archived annually in international GHG data archives [World Meteorological Organization World Data Centre for Greenhouse Gases, WMO-WDCGG: http://gaw.kishou.go.jp/wdcgg/ and US Dept of Energy Carbon Dioxide Information Analysis Center (CDIAC): http://cdiac.ornl.gov] and from CSIRO measurements on air trapped in Antarctic ice[4] and firn.[5]

Trend in global radiative forcing (ie warming) by gas From p22 CSIRO (2011) *Climate Science*

shows contribution of each gas on a year-by-year basis

The challenge of coping with climate change

Clearly the stronger our global and local efforts to reduce greenhouse gas emissions, and even remove these gases from the atmosphere, the less climate change we will have to adapt to.

Most studies of climate change focus on the actual physical changes that may occur and the impacts on physical infrastructure. This is certainly important, but in my view, the social challenges of adjusting to climate change will be much more significant.

The nature of climate change is that it is unpredictable in the short term. But the frequency and intensity of extreme events is increasing.

How will individuals and communities cope when the frequency of extreme heat and bushfires increases, but is still variable, while the intensity of fires increases? How often will an area

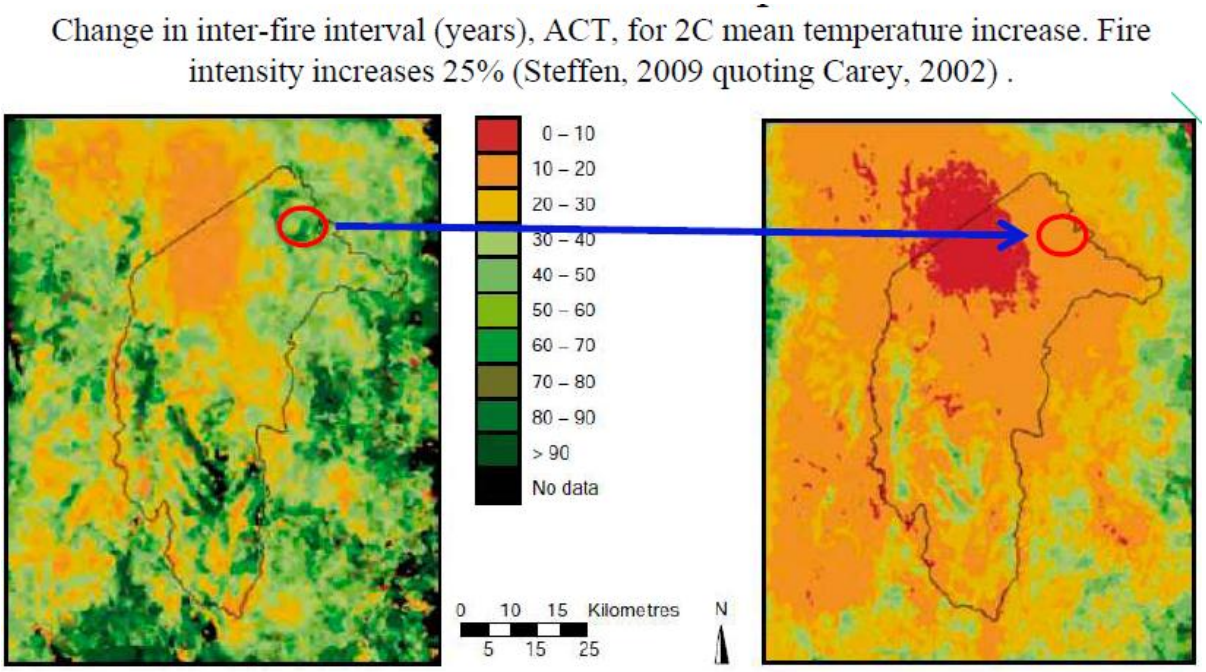
experience repeated fires and extreme fire danger before people give up trying to cope with the disruption to their lives and the increasing cost (or lack of availability) of insurance? How will they cope with the reduction in value or loss of their main assets such as their homes? How will volunteer firemen juggle work and increasing time spent fire fighting? How will parents cope if schools and child care facilities close on high risk days? Where will people evacuating from affected areas stay if they don't have friends or relatives in nearby safe locations?

How will businesses such as tourism in increasing fire risk areas cope, when tourists are kept away during high fire risk periods of increasing frequency, and as natural attractions and land productivity are lost or changed by climate change?

The uncertainty will play on people's minds, as well as hitting their bank accounts.

As an example, Figure 7 shows how, over a sixty year period, the frequency of fire in one part of the Australian Capital Territory will increase from once every 60 years or more to once every ten to twenty years and fire intensity will increase significantly.

Figure 7. Changing frequency of fires in the ACT. What will be the social and economic impacts?



At the same time, people in safer areas will face an influx of climate refugees, both temporary and permanent from other parts of Australia and overseas, so pressures on urban infrastructure, housing and services, as well as social structures, will increase.

Links between adaptation and abatement action

Policy makers tend to view climate adaptation and emission abatement as separate, yet they are often deeply interwoven. For example:

- Improving the energy efficiency of buildings makes them more capable of providing adequate comfort in climate extremes and when energy supply infrastructure fails

- Provision of access to services that minimises car dependence reduces fossil fuel use, but also reduces living costs, saves travel time, reduces injury and reduces dependence on road infrastructure that may not function effectively at times of climate extremes.
- Development of some kinds of distributed energy systems, especially those with some local energy storage and demand management capacity, that can operate independent of the electricity grid, can reduce vulnerability to network failures caused by extreme climate events and avoid the cost of underground cables.
- When buildings, equipment and infrastructure must be rebuilt after damage caused by climate events, there is opportunity to more cost-effectively incorporate energy efficiency, renewable energy and improved urban organisation and consolidation.
- Pursuit of cost-effective energy efficiency measures frees up funds for adaptation and other activities.
- The need to develop industry and business capacity to cope with climate crises provides an opportunity to structure those businesses in ways that can provide lower emission solutions for ongoing mainstream activities, for example:
    - Establishment of manufactured housing/building businesses can provide replacement housing quickly after fire or flood, but they can also provide thermally superior and lower cost buildings for mainstream housing and buildings. This approach also reduces adverse noise and other impacts on neighbouring homes when infill construction is being undertaken to increase urban density.
    - Energy efficient public buildings and commercial buildings (such as supermarkets) with on-site energy systems can provide refuges and community services during climate crises and reduce loss of perishable food by providing refrigerated storage

Further evaluation would undoubtedly identify many other potential synergies between adaptation and abatement. It is more economically efficient and socially preferable to capture such synergies. Indeed, many abatement measures deliver multiple benefits beyond adaptation, and these are often more valuable than the energy savings or other direct climate related benefits. For example, many energy efficiency measures reduce peak electricity demand and the need for large investments in additional supply capacity, while energy efficient housing reduces health costs.

Adapting to policy responses to climate change

The focus of adaptation policy and measures is usually on response to and impacts of actual change in climate. A second aspect of adaptation is the response to policy measures and actions implemented to achieve emission abatement. Such measures can impact on specific groups or regions, who may need assistance to adapt.

Several of the Inquiry's Terms of reference seem to allow scope for this to be discussed:

(b)(iii) the availability and affordability of private insurance, impacts on availability and affordability under different global warming scenarios, and regional social and economic impacts;

(f) progress in developing effective national coordination of climate change response and risk management, including legislative and regulatory reform, standards and codes, taxation arrangements and economic instruments;

(g) any gaps in Australia's Climate Change Adaptation Framework and the steps required for effective national coordination of climate change response and risk management; and

(h) any related matter

The reality is that proactive efforts to encourage adaptation to emerging policy directions, regulations and other abatement actions offers potential to minimise costs and maximise benefits. Adapting policy approaches to empower and support action by society, including all levels of government, business and households is also critically important. Failure to take these approaches risks development of a disempowered 'victim' mentality that will increase opposition to change, polarise the community and fail to seek innovative paths forward.

Learning from experience of carbon pricing

While Australia's carbon pricing scheme is an important step towards internalising a previously unpriced environmental impact, it is important to learn from our experience, and to fine-tune both the carbon pricing scheme and other policy measures.

Key lessons so far include:

- The failure to incorporate a mechanism for voluntary energy-related abatement measures taken by state governments, local government, business and households has undermined progress on abatement. Conservative state governments have used this situation as an excuse to cut climate abatement programs, on the grounds that it is now a problem for the Commonwealth government. Local government abatement programs have also been cut, and they have been advised that their main role is in adaptation. The outcome is that substantial action at state and local government levels has been undermined. Businesses that wish to go 'carbon neutral' or cut emissions are shifting to purchase overseas abatement credits (via Gold Standard emission credits or other activities) and forestry or agricultural credits recognised under the Carbon Farming Initiative, because they cannot gain formal abatement credit for support of renewable energy or energy efficiency action. Households who wish to implement abatement action have their motivation undermined by the reality that their actions simply free up more permits for others to pollute more. While the government has claimed it will recognise Green Power purchases as additional, it has developed no methodology that would meet carbon accounting standards. Other renewable energy and energy efficiency measures may be recognised in some way at some time in the future, but the government has 'passed the buck' to the Climate Change Authority to develop proposals for methodologies, and no progress has been made.
- Provision of adjustment assistance to some emission intensive industries and selected electricity generators has created distortions that will continue for many years. Further, the design of the mechanism for providing free permits has mixed outcomes. If a business reduces its emissions below the sector average emission intensity, it will be able to sell excess free permits, effectively capturing windfall profits. However, this does provide an incentive for these businesses to cut emissions more aggressively. Allowing these businesses to limit their net emissions by buying and surrendering international credits (CERs) instead of with free permits provided by the Australian government may provide an alternative that

keeps their compliance cost low in early years, helps to mop up the excess of CERs in the market, and links their carbon costs to global markets in the longer term.

- Government and the regulator have very limited scope to adjust the cap if the permit price falls below the expected price for extended periods. This undermines certainty for investors in abatement.
- The review of many climate abatement programs and projects using the 'complementarity to a carbon price' test is creating serious uncertainty and disruption, as funding is cut and programs cancelled. As Prof Garnaut has pointed out, the expected relatively low carbon prices mean that we have effectively committed ourselves to a need for a combination of carbon pricing and other intervention measures. The approach being used at present is undermining our capacity to respond to climate change by reducing our response capacity. While there is indeed merit in reducing duplication and evaluating project and program performance, these need not be done with a 'sword of Damocles' hanging above them. Indeed, the approach should be to identify the core objectives of each program (including non-climate objectives) and look to improving and building upon existing actions. The reality is that the duplication and shortcomings of many existing programs result from lack of political commitment and opposition of powerful interest groups, rather than inability to implement effective measures.

The initial design of the carbon trading scheme was heavily influenced by vested interests and political fears. It will need to be adapted if it is to deliver its intended outcomes. The review of existing abatement and adaptation programs needs to be reframed as a positive process rather than being a culling and closure approach.

Conclusion

We must communicate information about the reality of climate change and the benefits of pro-active response more effectively, and empower our community to respond both through adapting and reducing emissions. We must also move towards more sophisticated policy responses based on learning from our experience and actual outcomes of policies, not ideology.