

# **Climate Change**

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The term “Climate Change”, as used by environmental activists, is an Orwellian abuse of the language. Climate change is largely a natural phenomenon – day follows night, winter follows summer and long ice age periods follow shorter inter-glacial periods – so who can argue with it.

The more precise and meaningful title for the activists “climate change” is the cumbersome “Anthropogenic Global Warming Thesis (AGWT)”.

In essence the AGWT is based on three interdependent propositions:

- i) the Earth is warming up;
- ii) the main cause of this warming is human activities;
- iii) if we continue on our present course, the effects of this warming for life on Earth, including the human species, will be catastrophic. (Consequently we should drastically reduce greenhouse emissions without delay).

The AGWT relies on all three propositions being valid.

If i) is not valid then the AGWT loses relevance;

If i) is valid but ii) is not (e.g. its solar or other natural activity causing warming) then forget about expensive carbon mitigation and concentrate on living with warming - adaptation;

If both i) and ii) are valid but not iii) then what’s the problem?

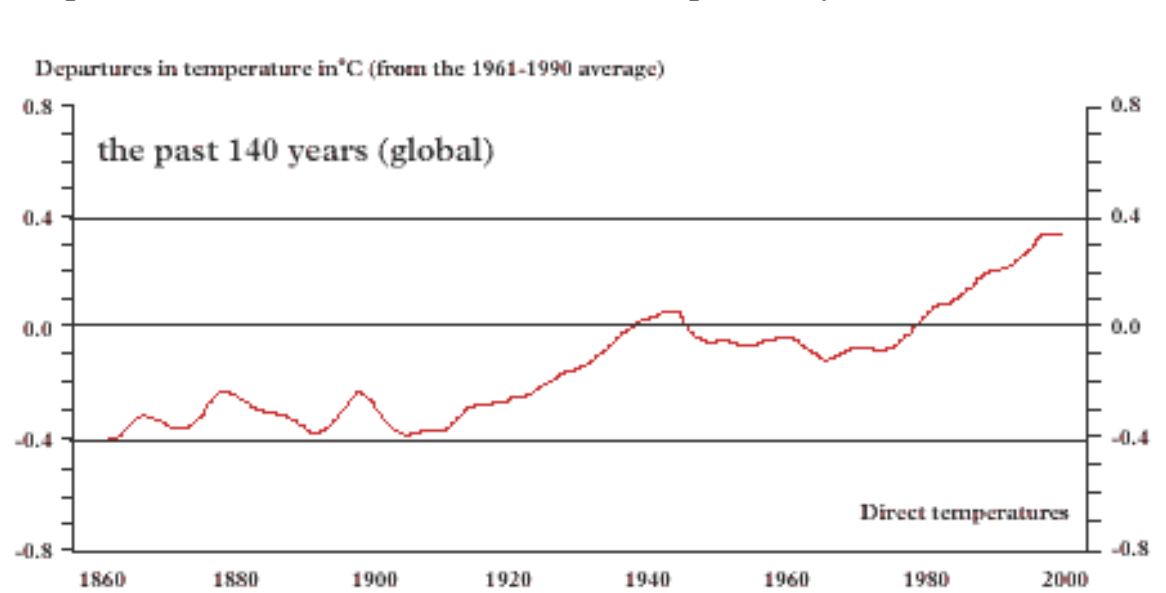
On the other side of the debate, there is a long list of climate scientists, including world experts, who believe that the AGWT thesis is not proven, that much more research is needed to understand how the climate works, and that the proposed very costly policies to decarbonise the world’s energy system lack scientific foundation.

Let us examine the evidence:

## Proposition 1 - Is the Earth warming up?

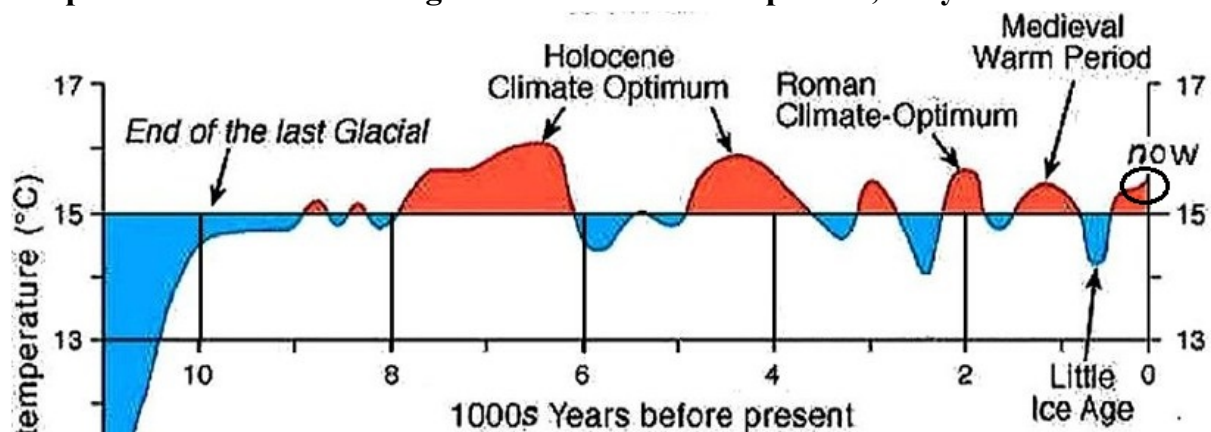
The following temperature records are generally agreed between the competing groups of climate scientists.

### Graph 1 – the Modern Warm Period over the past 140 years



Graph shows that temperatures rose by an overall 0.7 °C over the past 140 years. The pattern was no discernible trend in the period 1860 to 1920, followed by continuous warming from 1920 to 1945, by a period of "cooling" from 1945 to 1970, continuous warming then to about 2000, followed by no trend increase since 2000. (During the recent 50s and 60s cooling period, books were written about how society must respond to the coming ice age!)

### Graph 2 – the Current Interglacial Period over the past 11,000 years



*Average near-surface temperatures during the past 11,000 years*

(Please note the scale of these graphs is very different – G1: +/- 0.4 C over 140 years; G2 above: +/- 2C over 11,000 years; and G3 below: +/- 20F over 450,000 years.)

G2 gives some perspective by tracing the Current Interglacial back 11,000 years to the last Glacial or Major Ice Age. About half of the above graph lies within recorded human history - back to the early days of the Sumerians.

The last glacial/major ice age, finishing about 10,000 years ago, was followed by the Holocene Climate Optima 8,000 to 6,500 years ago, the Minoan/Holocene Warm Period about 4,500 years ago, the Roman Climate Optimum 2,000 years ago, the Medieval Warm Period and again the Current Modern Warm Period. These warm periods were interspersed with cold periods – some approaching little ages. Graph shows the Earth currently in a warming trend since around 1800 - coming off the back of the late medieval Little Ice Age. To give perspective the Modern Warm Period of Graph 1, indicated as the small circle in the right hand of Graph 2, is seen as a short (about 300 year) interlude in the current Interglacial period (about 10,000 years to date).

In the Minoan/Holocene, the Roman Climate Optimum and even the Medieval Warm Period the planet was hotter than today. Recall that, around 100 AD during the Roman Optimum, the Romans grew grapes in Britain. Around 1100 AD during the Medieval Climate Optimum Viking settlers prospered on small farms in Greenland for several centuries, before the Little Ice Age drove them out, froze over the Thames etc.

For reference, the industrial revolution, the start of significant man made greenhouse emissions, began about 1760 in the midlands of England.

### Graph 3



Showing the last 4 major glacial/ice ages occurring about every 100,000 yrs interspersed with four inter-glacial - during much of which the temperature was much hotter than current times. To give perspective, the current Interglacial period of graph 2 (about 10,000 years to date) is indicated in the small circle in the right hand of Graph 3 – as a comparatively short period in the preceding Ice Age cycles.

Only 1% of the above graph lies in recorded history – the rest is the prehistory of our species. For perspective, early man came out of Africa in waves from about 170,000 to 70,000 years ago, following which our species survived an extreme glacial/major ice age.

#### Points to note:

The current Modern Warm Period has seen a comparatively modest 0.7 C warming over the past 140 years. (To put this in perspective in typical daytime hours Sydney can go through temperature variations of 3 – 5 C.)

It is said that the earth is warmer now than at any time since direct instrumentation readings began. True - but direct instrumentation only began in the mid 1800s. The earth has in fact been warmer (up to 1 C warmer) many times during recorded history, and much hotter (up to 8 C hotter) many times during the long prehistory of our species

Man has experienced at least two extreme cold glacial or major ice ages.

The climate has changed many times in the past with no help from mankind.

#### **Proposition 2 - Are humans the main cause of this warming?**

The following is generally agreed between the competing groups of scientists:

The earth is habitable only because of the greenhouse effect. Without it, average global temperature would be around minus 18°C.

The major greenhouse gas is water vapour, and the major anthropogenic (human caused) greenhouse gas is carbon dioxide (CO<sub>2</sub>).

The global mean atmospheric concentration of CO<sub>2</sub> has increased from a pre-industrial concentration of about 280 parts per million (ppm) or 0.028% to a current about 405 ppm/0.0405%. In other words, CO<sub>2</sub> is a rare trace gas in the atmosphere - it is not present in any appreciable proportions.

Carbon dioxide cycles naturally through the earth's atmosphere, land mass and oceans. There is about 730,000 million tonnes of carbon (730 GtC) in the atmosphere. About 210 GtC is exchanged annually by natural forces – much more when earthquakes or volcanoes occur. For comparison, human activities supply only about 7 GtC annually - less than 1 per cent of the total atmospheric carbon mass, and less than 4 per cent of the natural exchange from land and oceans. Small variations in the natural CO<sub>2</sub> exchange dwarf any changes in human contributions.

Whilst increasing the level of CO<sub>2</sub> in the atmosphere will warm the earth's climate, there is considerable uncertainty and dispute about the extent of such warming.

#### AGWT scientists claim:

It is not the natural greenhouse effect that gives rise to concern. It is the fact that in the relatively short period in the world's history since the Industrial Revolution has seen significant increases in the emissions of greenhouse gases, especially carbon dioxide.

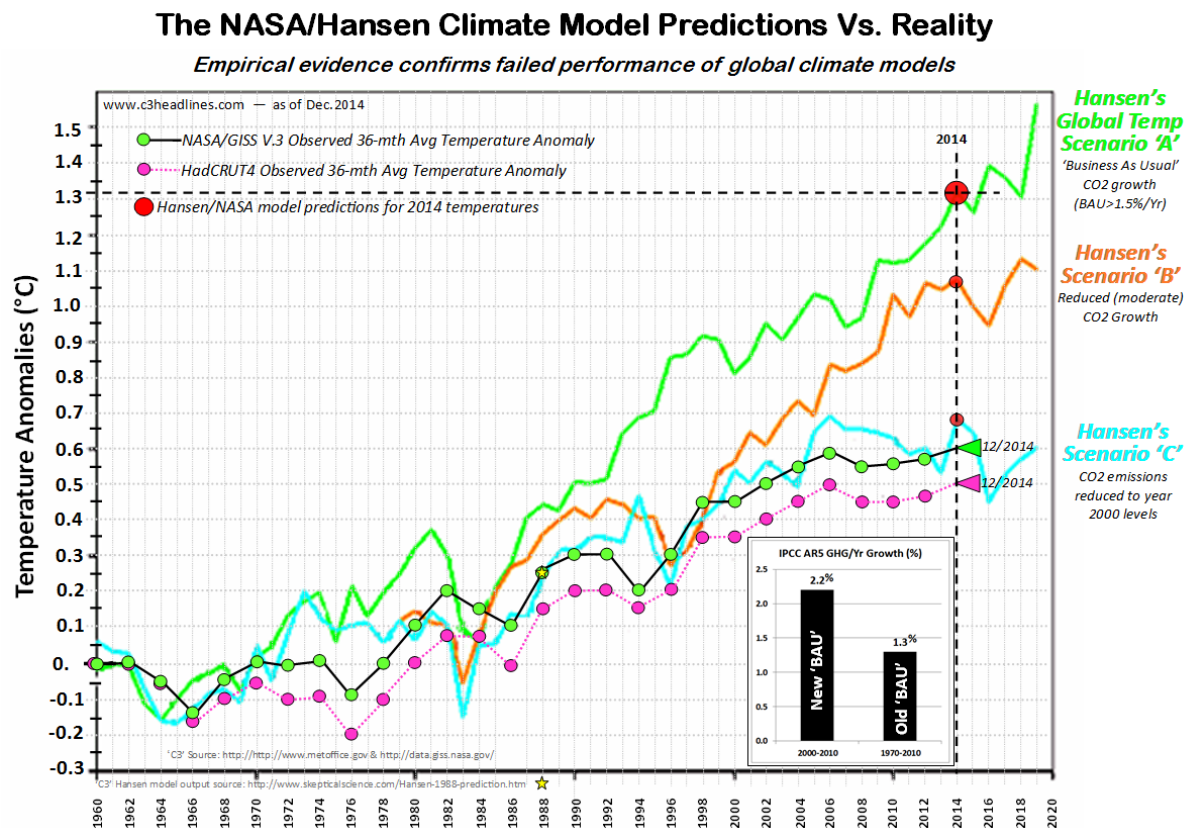
Sophisticated and complex mathematical models of the Earth's climate (general circulation models or GCMs) have been developed and run on the most powerful computers. These GCMs mimic the forces at work that change the Earth's climate. They are a good fit with the observed temperature record from the recent past. The models predict that, with continuing emissions of greenhouse gases, the Earth's temperature will rise at very significant and alarming rates e.g. 2C to 6C over the next few decades.

#### Dissenting scientists:

The ultimate test for a climate model is the accuracy of its predictions. "If you can't predict then your science is faulty" (Richard Feynman and others).

The principal charge against the AGW proposition then is that the GCMs, when they were developed, consistently failed in predicting future global temperature changes. The GCMs have essentially been an exercise in "curve fitting" to recent historic data – however they have failed to capture the key features determining changes to the earth's temperature.

## Graph 4



This chart depicts the famous global warming predictions presented by NASA's chief climate scientist James Hansen in 1988 at a hearing before the U.S. Senate.

Hansen declared that if the world did not change its way, and kept emitting CO<sub>2</sub> in the 'business-as-usual' manner, global warming would skyrocket, threatening all of civilization. This is the top (green) line/Scenario 'A' plot on the chart.

The top line shows Hansen's global temperature forecasts for an assumed emissions growth rate of 1.5% pa - it predicts an increase of 1.3°C over the 55 year period from 1960 to 2014. Now the actual average emissions growth rate over this period was 3.7% pa (China etc growth), implying a Hansen/NASA temperature rise forecast much in excess of 1.3°C. The actual increase over this period was only 0.55°C – as shown by the green and purple circles above. This is an error significantly in excess of 135%.

A similar pattern may be seen from other GCMs – consistently and significantly overestimating global temperature increases.

There is obviously something more happening here than is captured by Hansen/NASA and other GCMs.

Other concerns expressed about the GCMs and possibly behind their failure to perform include:

- as noted earlier, the Earth has experienced much more significant climate changes than the Modern Warming Period - all without any help from mankind. The forces causing this presumably are still there, but they have not been adequately represented in GCMs to date – the GCMs do not adequately model the natural factors affecting climate variability, e.g. variation in solar output, variation in the earth's orbit and tilting etc;
- consequently, it is not surprising that the GCM's fail to explain the long term past;
- the manner in which the GCMs are adjusted until they align with recent observed data ("fudge factors");
- the models do not adequately model the role of water vapour and cloud cover in the atmosphere – the most important part of the greenhouse effect. All models fail "miserably" to replicate observed distributions of cloud cover.
- further, the models assume the atmospheric water feedback is positive (implying runaway temp rise), while satellite observations suggest that the feedback is zero or negative (self stabilizing);
- a number of world experts in the fields of fluid mechanics, numerical modelling of complex systems, and climate science contend that the GCMs fall well short of finding all nonlinear feedback mechanisms in the complexity of the Earth's atmosphere/ocean/land system, and consequently cannot generate realistic simulations of climate and couldn't possibly forecast with any confidence.

Consequently dissenting scientists contend that the model predictions and proposed painful energy policies are ultimately based on defective science.

**Proposition 3 - If the Earth warms significantly (e.g. by a further 2°C - as AGWT scientists warn may happen) then will the consequences for humans be catastrophic?**

The following is generally agreed:

The direct effects of increased carbon dioxide levels are harmless and indeed beneficial.

Carbon dioxide (CO<sub>2</sub>) is essential to all life on earth. Increasing atmospheric concentrations are beneficial to plant growth, particularly in arid conditions.

As noted earlier current atmospheric CO<sub>2</sub> levels are about 405ppm/0.0405%. For perspective – i) commercial greenhouse operators often adopt 1,000 ppm CO<sub>2</sub> in their greenhouses – indeed plants, and our own primate ancestors evolved when atmospheric CO<sub>2</sub> was about 1,000 ppm; ii) US submarines limit CO<sub>2</sub> levels to 8,000 ppm - few adverse effects are observed at even higher levels.

It is the indirect effects (warming) that are in contention. If the earth warms by a further 2°C then there will likely be changes with significant dislocation costs. The key questions in this debate is - will the net effect of a significant global warming, should it occur, and any other effects of increased atmospheric CO<sub>2</sub> - be good or bad for humanity?

Getting a concise picture of warming impacts is difficult, not least because the science of impact forecasting and assessment is more uncertain than the science of climate change itself. The following claims and counter-claims are largely speculative and conjectural.

#### AGWT scientists claim:

An artificial greenhouse effect could generate countless tribulations - glaciers melting, rise in sea levels with coastal cities and cultivated regions inundated, ocean currents disrupted, widespread drought and farming regions parched, more frequent devastating storms, tropical diseases spreading, etc. Rising world temperatures might throw Indonesia, Mexico, Nigeria, and other low-latitude nations into generations of misery.

Whilst in general the science of forecasting impacts is largely speculative, the effect most confidently forecast is sea level rise (SLR) due, in the main, to the thermal expansion of the oceans. The IPCC projects a mean global SLR of 0.20 to 0.88 m by 2100. SLR threatens low lying islands and deltaic regions in countries such as Bangladesh, Egypt, small island states of Tuvalu (Polynesia) etc.

#### Dissenting scientists:

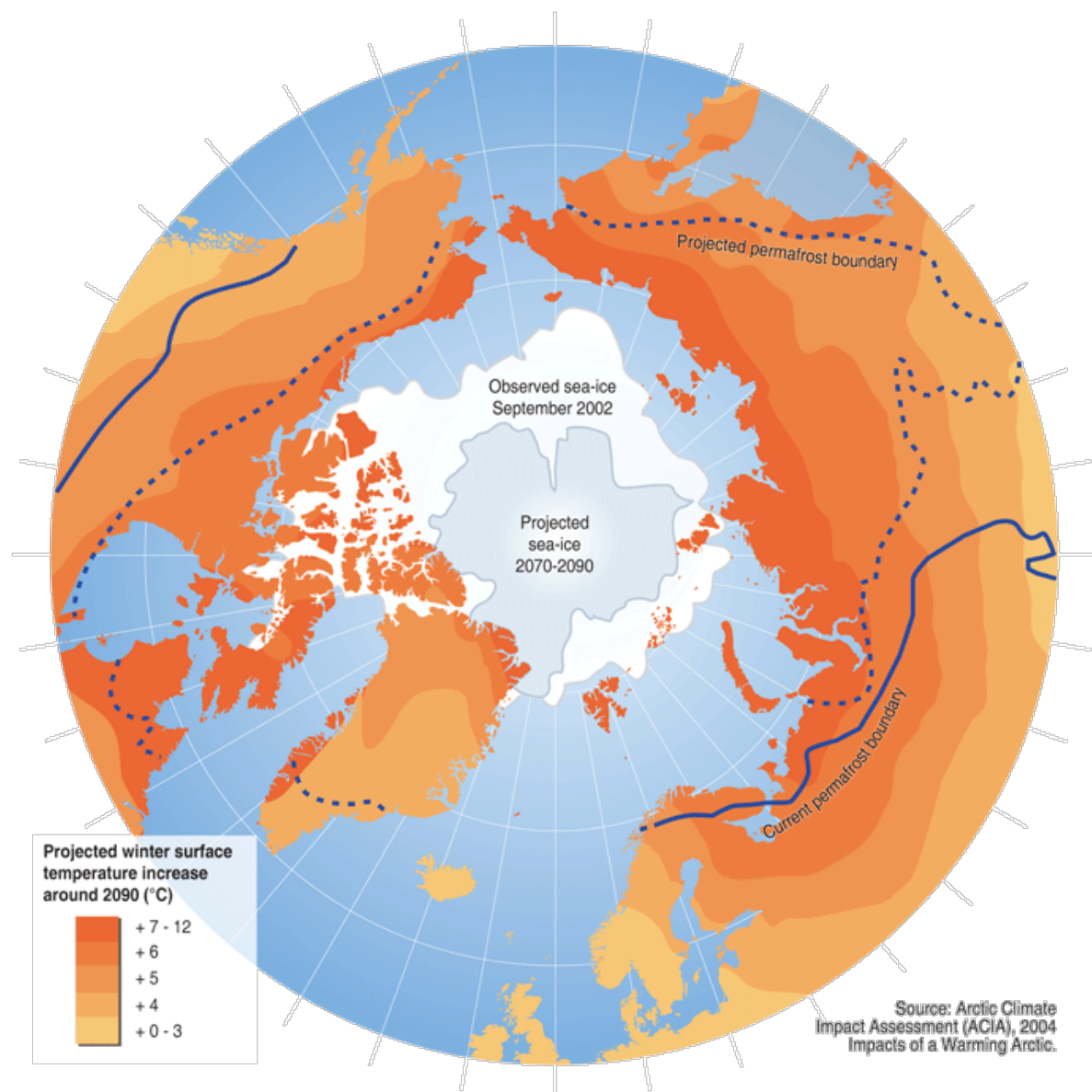
We seldom hear about the benefits of global warming and increased CO<sub>2</sub> – but there will be winners as well as losers.

The greatest benefit from climate change comes not from temperature change but from carbon dioxide itself. The increase in average carbon dioxide levels over the past century, from 0.03 per cent to 0.04 per cent of the air, has had a measurable impact on plant growth rates, is responsible for a startling change in the amount of greenery on the planet, has translated into a 14 per cent increase in agriculture and ecosystem productivity of ecosystems, and reduces plant vulnerability to drought. Atmospheric CO<sub>2</sub> levels over cornfields have been measured to drop toward zero ppm at day's end during the growing season. They have been starved of CO<sub>2</sub> at the present levels.



Significant global warming will push permafrost back toward the poles. As the following image shows big winners will include in order Russia, Canada, US/Alaska, Denmark/Greenland and other Scandinavian countries, as vast areas of tundra may turn into arable lands and food baskets. It is estimated that the benefit to Russia of global warming could exceed those of all other nations combined.

The Arctic becomes a valuable shipping route, and its possibly vast oil resources become accessible. The United States, Russia, Canada, Norway, and Denmark are already asserting legal claims to parts of the Arctic.



Potentially the most significant of all - the Antarctic may turn into a vast arable and accessible resource rich continent – a “land release” comparable to the discovery of North America.

There will be fewer winter deaths. It is a little-known fact that winter deaths exceed summer deaths in both temperate (e.g. UK) and warm countries (e.g. Greece).

Claimed increases in vector diseases (e.g. malaria), thunderstorms, tornadoes, hurricanes and tropical cyclones, drought, and reduced biodiversity are strongly disputed by dissenting scientists.

### **Some concluding observations:**

I am not qualified to judge between the claims of the competing groups of climate scientists. That said, the following observations suggest themselves from this review of the evidence, the common ground and the competing claims.

The earth has warmed by a modest about 0.7C over the past 140 years. This is not a catastrophic change.

The “impending catastrophic change” reported in the media only exist as forecasts from the GCMs. But these GCMs have, so far, failed the key test of predicting the future – the models don’t incorporate all the important factors affecting the earth’s temperature.

For much the same reason, the models have failed to demonstrate that the major cause of the (modest) warming to date is human induced CO2 emissions.

By the standards of the scientific method itself, it cannot be said that the science of global warming is settled – too many unanswered questions. (The science including earth’s orbit, solar cycle and AGWT need to be developed further and firmed to avert the risk of very costly and wasteful decisions).

Even if such warming occurs then it won’t be all gloom and doom – there will be significant benefits as well as costs. We are in the area largely of conjecture here and it is not possible to say whether there will be a net benefit.

If we believe risk of significant warming, for whatever reason, then the bulk of our effort should turn to adaptation (e.g. Dutch dykes, Thames barrier etc) – rather than mitigation of a theorised but unsubstantiated cause (i.e. AGWT). (Note environmentalists don’t like talk of adaptation, as it implies making our peace with a warmer world.)

The Earth has been significantly hotter many times during the life of the human race. This suggests that humanity can survive significant warming (e.g. a further 5C of warming – or 7 times the temperature increase over the past 140 years).

So why then is the “gloom and doom” impending disaster scenario so rampant and seemingly accepted in the public space in many countries?

A possible explanation:

The AGWT movement cites the Intergovernmental Panel on Climate Change (IPCC) reports as the gospel on climate change science. But serious concerns have been raised by many reputable bodies and individual scientists about the IPCC’s ability to produce “good science” (e.g. UK House of Lords expert committees, etc).

The IPCC was set up by the UN to develop a consensus - to help government policy makers. This may be laudable for policy formation, but “consensus is the stuff of politics, not science - science proceeds by observation, hypothesis and experiment.” The IPCC focus on developing consensus has resulted in its processes becoming deeply flawed and problematic (according to the UK Lords etc).

The IPCC process involves 195 governments and hundreds if not thousands of experts. The experts working in teams review the literature – note the IPCC doesn’t “do” any original science. Each technical review chapter then has an “executive summary for policy-makers”, designed for those who need a fairly rapid guide to what the chapter has said. However, there is a stark contrast in the way the chapters and the summaries are written. The former is written by the science experts. The latter is overseen by government representatives who scrutinise them on a line-by line acceptance basis – analogous to the line-by-line negotiation of complex legal agreements. Each word can count, and the process can actually collapse, if governments will not accept a particular phrasing or word. The summaries, which don’t always accurately reflect the underlying chapters, are published some time before the underlying chapters. If the summary is not supported by the chapter then scientists are told to change their papers to fit with the relevant summary. A number of world leading scientists have disowned “their” summaries, and resigned in protest from the IPCC for publishing reports which misrepresented their findings.

The focus on consensus:

- opened the way for climate science reports to be determined, at least in part, by political requirements rather than by the evidence;
- shut out voices dissenting from the party line- encouraging “group-think”;

- resulted in the UN prematurely articulating a preferred policy position in the early 1990's, and issuing statements about the need to deal with the problems the consensus identified. This marginalized research on broader issues surrounding climate change and stifled the development of a broader range of policy options.

Further problems arose:

- an "industry" evolved dedicated to preserving the consensus and addressing problems identified by the consensus;
- the scientific establishment came to depend on research grants, which are most easily obtained if research projects appear to deal with accepted problems;
- consultants geared their efforts to advise on these same issues;
- the media (parts thereof) ran stories that reinforced the consensus, whilst in general indulging their penchant to cherry pick the bad news/alarmist scenarios.

For all these reasons the consensus turned into a working paradigm and became highly resistant to change by the normal processes of scientific challenge.

Unfortunately the propagation of the AGWT already has had significant impact and has the potential for further very serious effect on world economic development, industries and asset prices.

Members will have their own views.

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*Paul Butler worked as Principal Energy Advisor, engaged in the NSW Dept of State and Regional Development, Premier's and Treasury. He worked on climate change and related industry policies for up to twelve years. Relevant work included designing emissions trading schemes, renewable energy targets, clean coal technologies and emission intensive industries. The foregoing is his address to the Royal Sydney Yacht Squadron on 13 May 2019.*