COP28: GROUP THINK CLIMATE CRISIS OR OPPORTUNITY

The annual Climate Conference, this one is COP28, will take place in the UAE from November 28 to December 10, 2023. It is an invitation to "Join the World of Actionism" or Activism and take stock of progress in meeting the Paris Agreement. The agenda includes:

*Gender and Inclusion
*Education and Skills for children and youths
*Global Tolerance and Co-existence
*Human Mobility (refugees, displaced persons and migrants)
*Green Law Enforcement (Grexit)
*Accountability and Regulation for Net-Zero
*Finance (how to get the Developed World to pay)

These 2 weeks of discussion are the latest step in the largest scale example of Group Think in human history. A simple correlation between Temperature and CO2 has been compounded and exaggerated into Cause and Effect, no contrary evidence is considered, those who question the assumptions are villainized as deniers and the bandwagon is kept rolling by activists who dismiss the implications for the World Economy and its inhabitants. Politicians, supposed Leaders, follow like Lemmings the activists and loudest voices, virtue signalling their Canutish saving of the Planet in the knowledge that they won't be around to pick up the pieces and the bills.

COP28 will use the IPCC AR6 Report published in 2022 as its base, the next full report not being until 2027. The conclusions from the AR6 Report were that:

Temperatures are warmer by 1.09degC than pre-industrial levels.

CO2 is up 47% since 1750, CH4 156% and N2O up 23%

Sea Levels are up 0.2M since 1990.

Artic sea ice coverage at lowest levels since 1850

With more tentative indications that extreme weather events are more frequent and intense since 1950.

In terms of attribution, the conclusion was that “it is unequivocal that human influence has warmed the atmosphere, ocean and land with 1.07degC attributed to human activity”.

As for the future, a 1.5degC increase since pre-industrial levels is seen as already baked in by 2050 with potential increases thereafter unless “net-zero” is reached by 2050. Increases of 2degC and beyond are all seen as worse than 1.5degC in terms of adverse climate impacts.

Looking behind the numbers and conclusions, a more nuanced picture emerges. The positions taken in the Report are summarized in Figures SPM.1 and SPM.2:

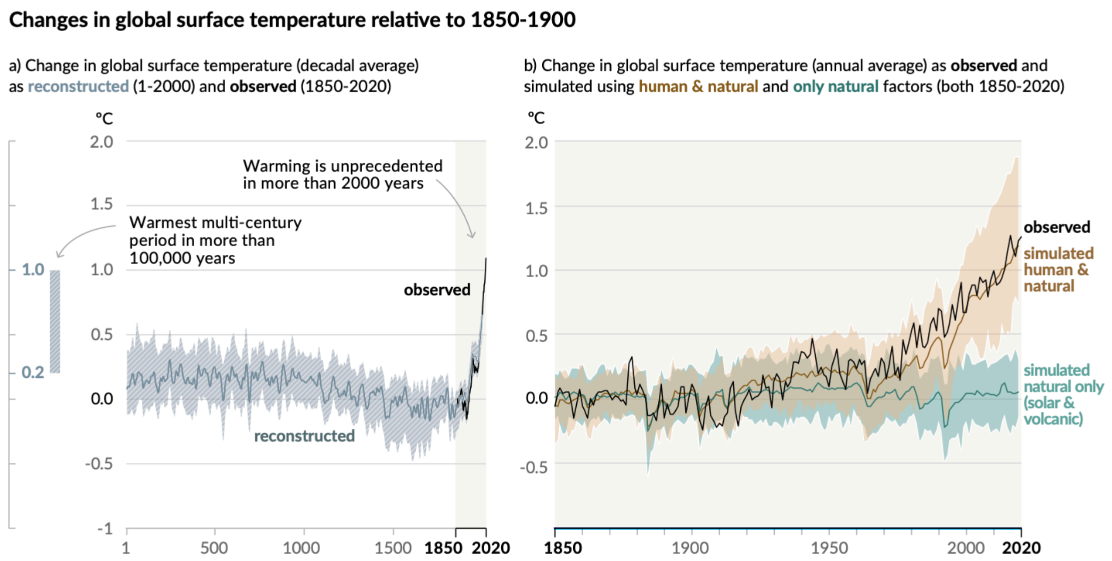
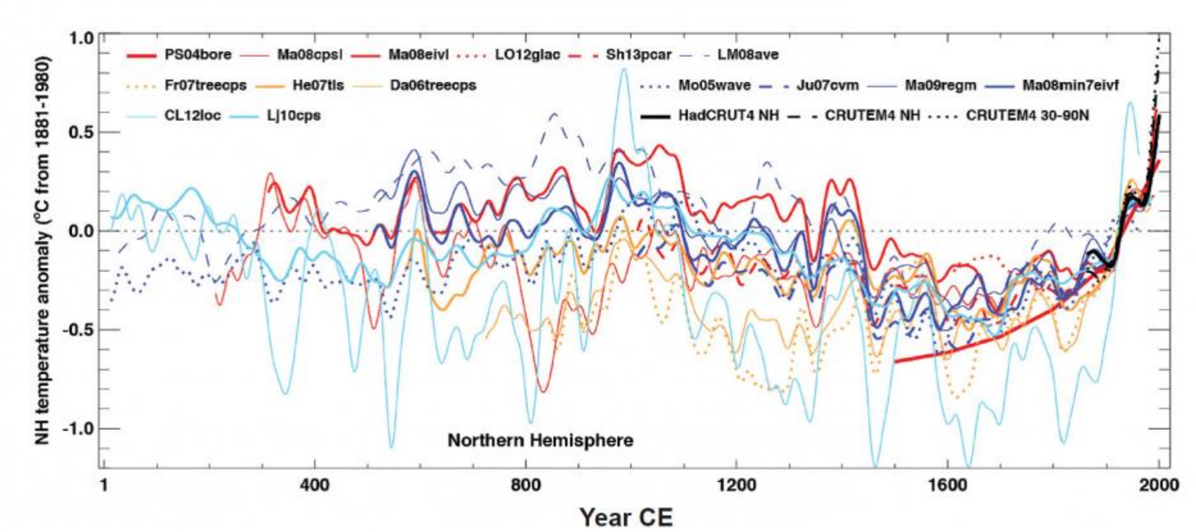


Figure SPM.1: History of global temperature change and causes of recent warming.

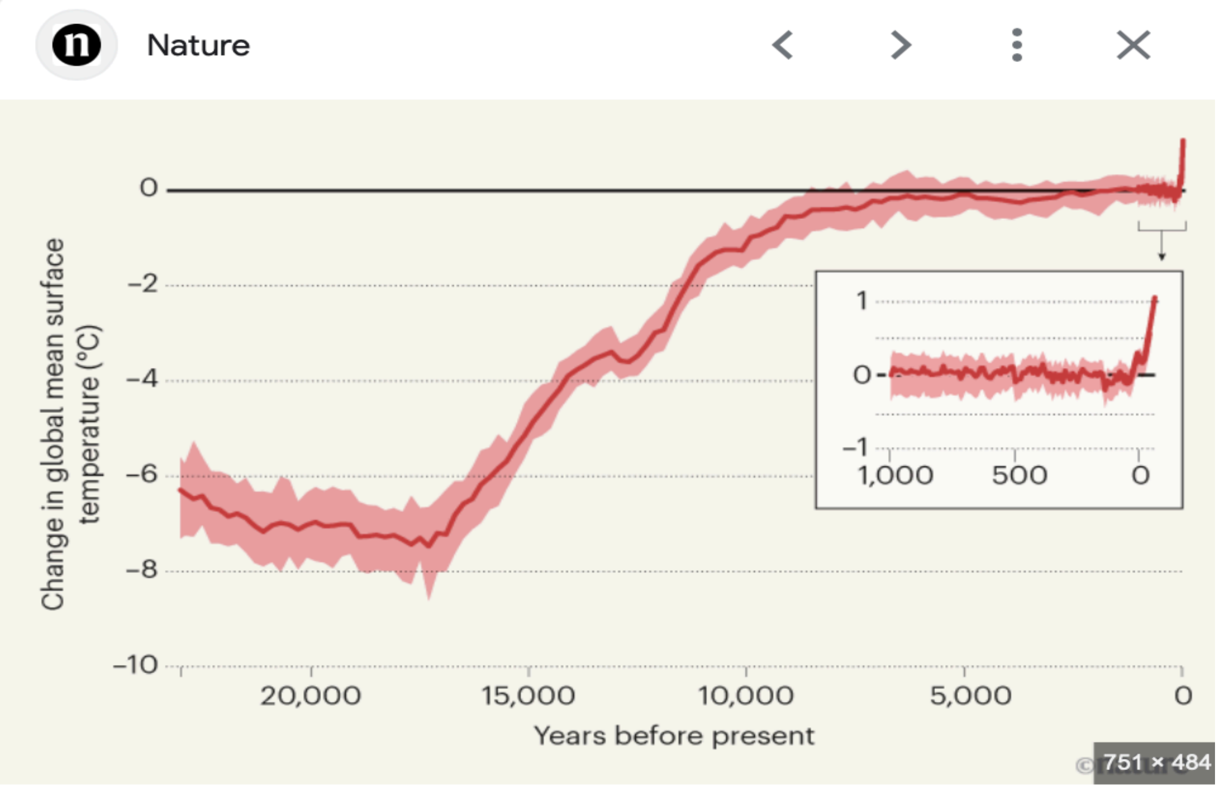
In SPM.1, the temperature profile, “reconstructed” for the last 2000 years, gives an impression of a very stable climate until recently. However. it totally ignores, or has smoothed out, the Roman Warm, the Medieval warm and The Little Ice-Age which saw temperature changes and extreme weather events arguably more severe than any in recent times. This looks a lot like manipulation of numbers and graphics to make a point in the same way as the infamous “hockey stick” graph used in earlier Reports.

A chart from the IPCC's previous Fifth Assessment Report shows a different picture with a more volatile recent climate including the Medieval Warm and The Little Ice-Age.

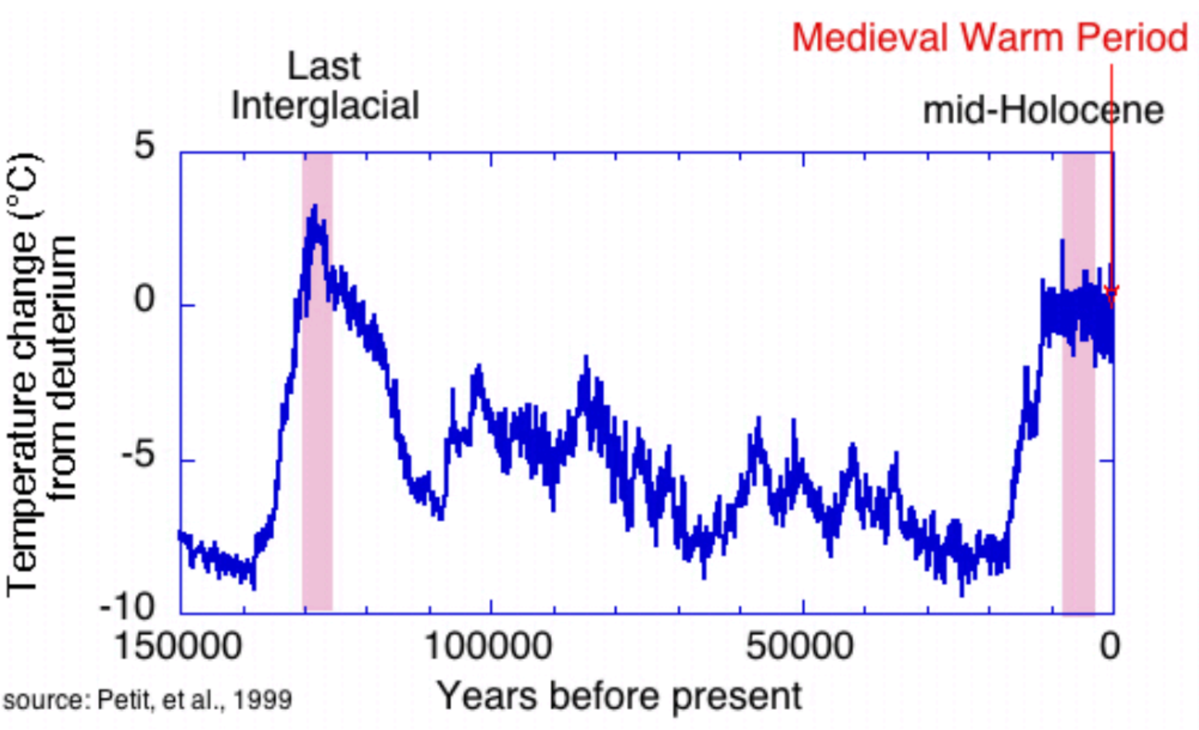
Paleoclimatic data for last 2000 Years (NCEI)



Looking further back to the start of the current inter-glacial about 15,000 years ago provides more perspective:

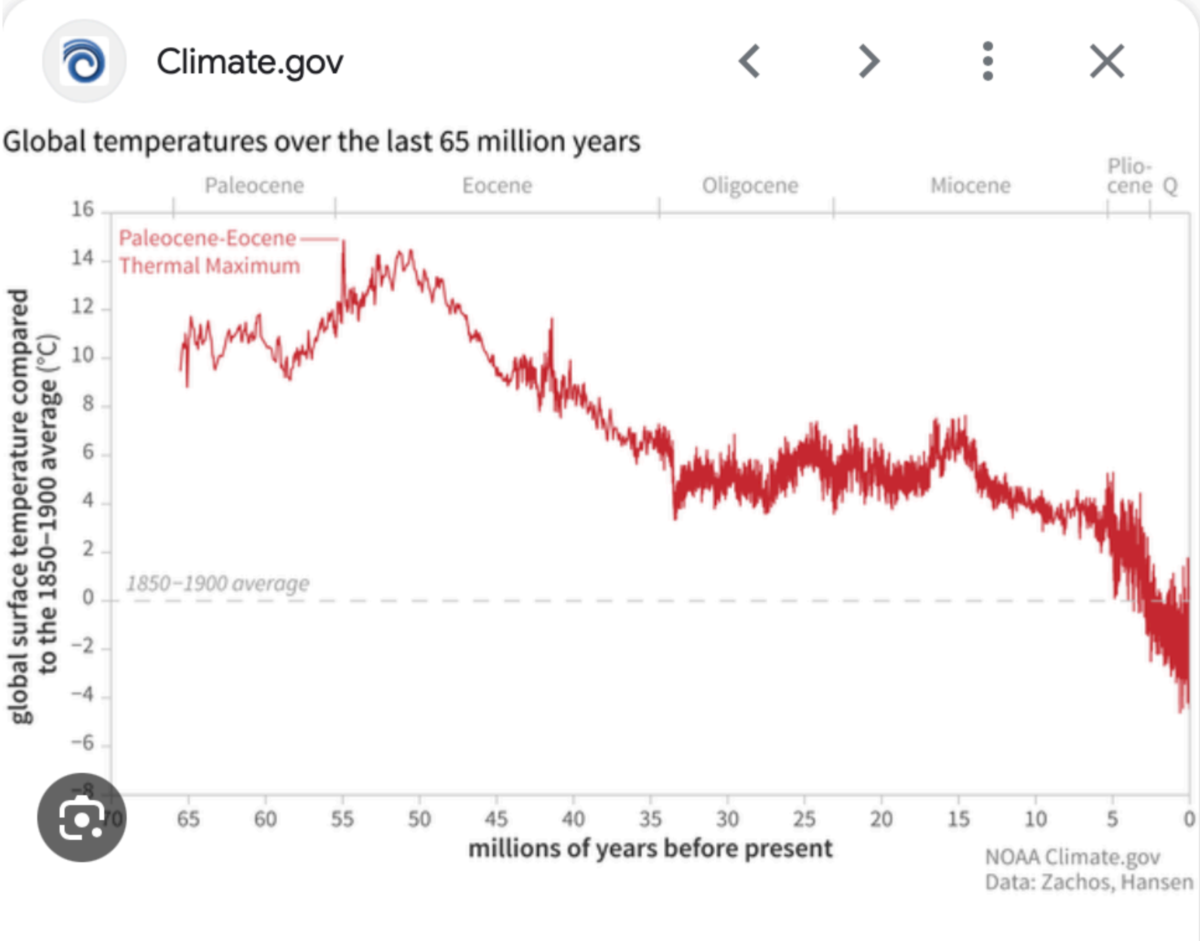


And further still to the last inter-glacial some 120,000 years ago

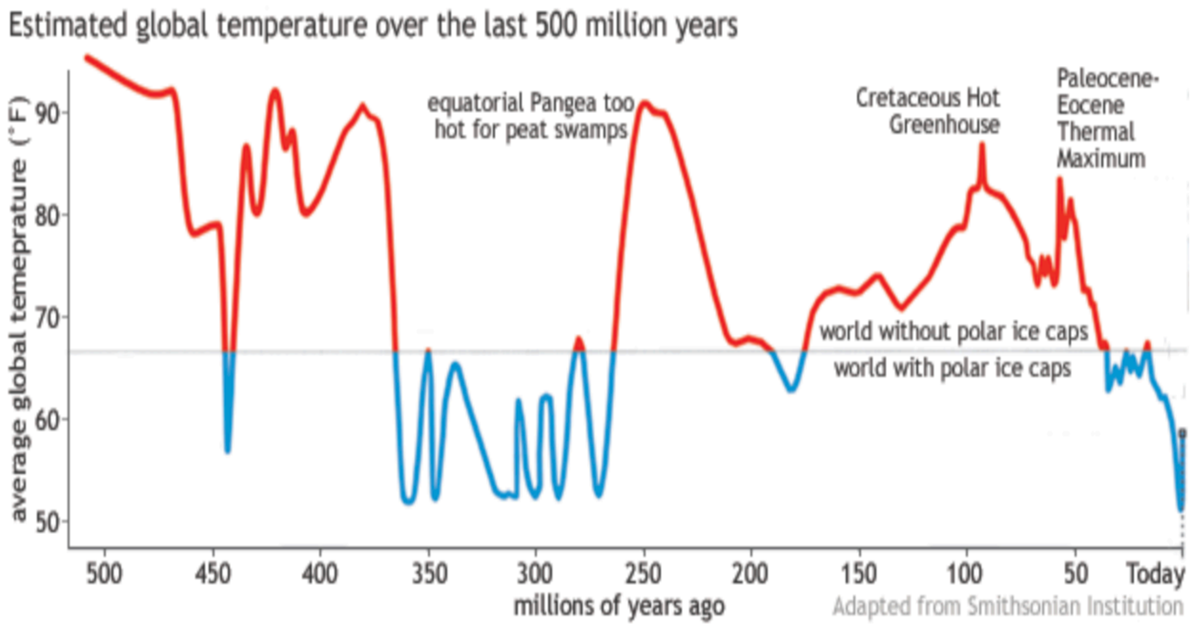


The Report and SPM.1 imply that current temperatures are the highest in over 100,000 years, forgetting to context that with the fact that more than 85,000 of those 100,000 years were a glacial period with much of Northern Europe, Asia and North America under kilometres of ice. The Minoan, Roman and Medieval Warms had similar temperatures to today while the Holocene Optimum was almost certainly warmer than today. In a nutshell, the Report is making the obvious conclusion that to find similar temperatures to the current interglacial, one must go back to the previous inter-glacial some 100-125,000 years ago.

To give a true geological perspective, one needs to go back 65 million years:



Even 500 million years:

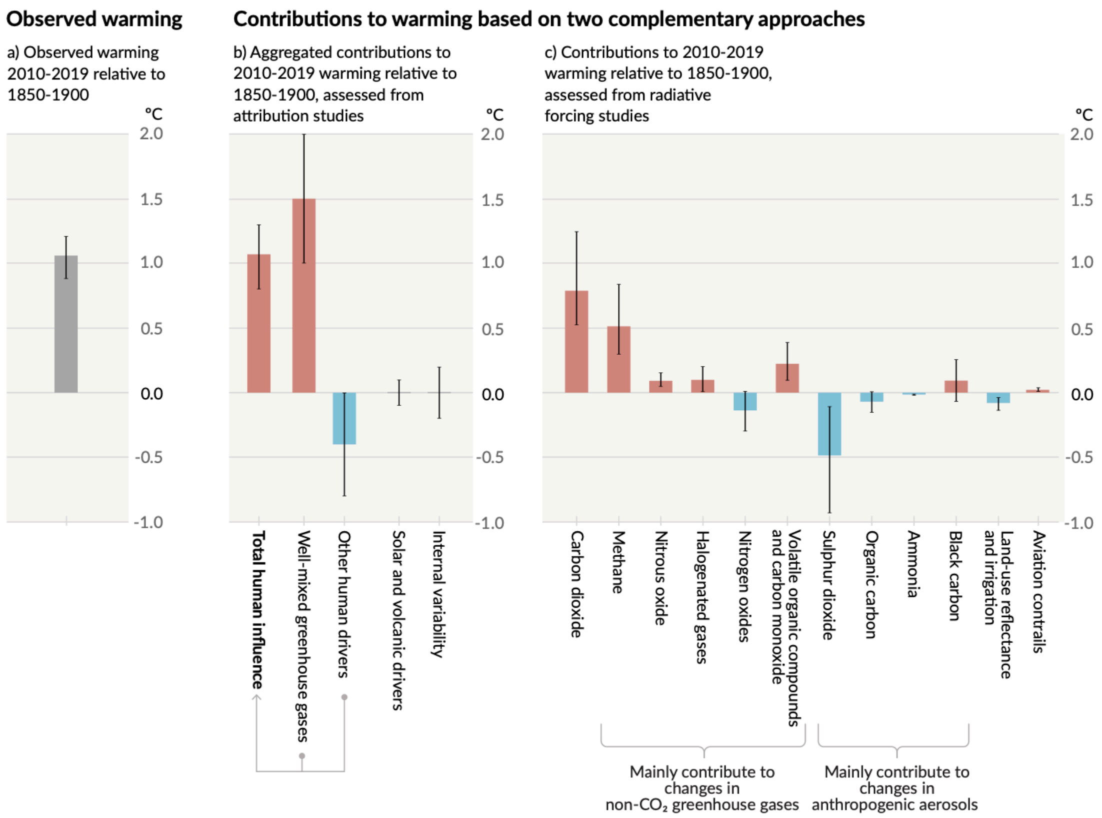


In the words of David Hume, “a wise man proportions his belief to the evidence”. From the evidence of global temperatures over hundreds, thousands and millions of years, any conclusion of imminent climate apocalypse requiring mitigation through economic ruin would be to thunder against evidence and reason. These perspectives show that temperatures change, that current temperatures are no different than those prevailing during previous inter-glacials, that temperatures have been trending significantly lower over the past 250 million years, and that the exceptional cold of the Little Ice Age may not be the best base from which to extrapolate.

It should require a very high burden of proof to extrapolate a temperature recovery of 1.09degC from a Little Ice Age to a prospective of Global Apocalypse and the need to spend Trillions of Dollars for humanity to end up poorer.

It is the nature of Group Think that one piece of the picture, the correlation between temperature and CO_2, without the dimension of cause and effect, can be taken by activists to support an argument while dismissing any contradictory evidence or the implications of the actions necessary to resolve the argument. However, it also takes, at best, a passive audience to allow itself to be railroaded into self-harm or, at worst, a leadership succumbing to lobbyists, single issue activists and populist myths. The antidote to Group Think is to follow Descartes advice that “doubt is the origin of wisdom” and Einstein’s dictum NOT to “listen to the person who has the answers; listen to the person who has the questions.”

SPM.2 shows the various assessed contributors to observed warming with noticeable changes in emphasis from previous Reports.



Methane is seen as having a greater warming influence while aerosols, particularly SO2, a greater cooling influence. What is not mentioned is that the cooling by SO2 aerosols would have been much greater had the SO2 levels not been substantially reduced since 1970 by government regulation in response to activist concerns about acid rain. The other major omission is H2O vapor which by itself accounts for over two thirds of the Greenhouse effect because of its wide spectrum of absorption and much higher concentrations in the atmosphere. The Report treats it as a purely positive feedback for further warming although the same chicken and egg argument could be applied to CO2. The underlying assumptions in the Report are that Global Warming is bad and the CO2 which is blamed for Global Warming is also bad. There is no context of Carbon as essential to all life on Earth or of the Carbon Cycles that have retained Earth in a habitable zone for most of its 4.6 billion years of existence.

Correlation does not mean causation and there are a lot of assumptions and unanswered questions in the Report, not least the implication in much of the literature that GHGs warm the earth by re-radiating heat back to earth in defiance of the second law of thermodynamics. GHGs do not heat the planet, they prevent it cooling to the extent it otherwise would in their absence, to a minus 18degC Snowball Earth.

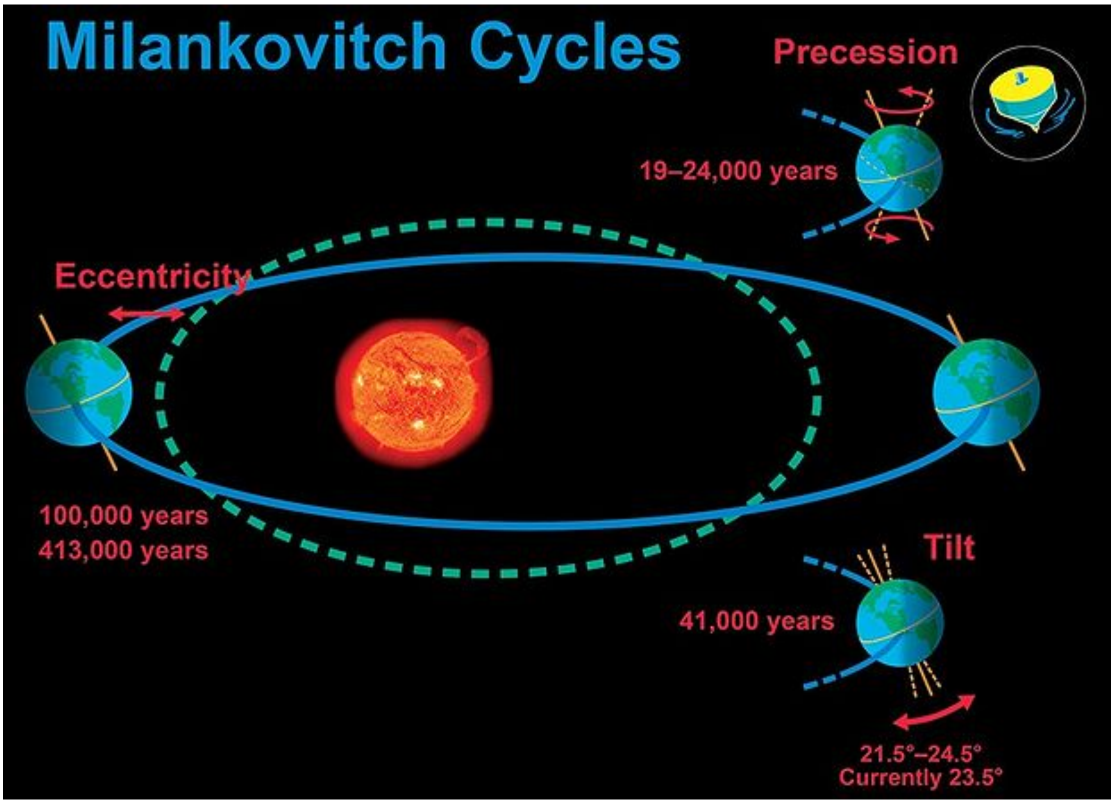
All this is part of a debate about whether there are fundamental changes in the Earth's climate and if so, why? The real answer is that of course there are changes in the earth's climate and there always have been. The patterns today are the same as those evident throughout most of the 4.6 billion years of Earth's history and the changes in the last 200 years need to be examined in the context of those patterns and a much wider and longer geological and climate history.

CLIMATE DRIVERS

There are three determinants of the Earth's climate, the Sun as the central heating furnace, the Earth as the radiator and the Atmosphere as the blanket. All the rest, ocean currents, wind patterns, El Nino's and North Atlantic Oscillations etc are driven by these three primary determinants, or by continental drift over longer geological timescales, and give us Green-House Ages and Ice-Ages, regional climates and shorter-term weather changes.

Solar Insolation

Almost all Earth's energy comes from the Sun and the amount received depends on the distance from the sun, the tilt of the earth's axis, and the direction of the tilt. The Earth's orbit round the sun is elliptical so sometimes it is closer than others. The tilt of the axis changes a couple of degrees round the average of 23.5deg changing the length of the seasons. The direction of the tilt changes so that midsummer which is now June in the Northern Hemisphere would be in December 13,000 years later if not for the inbuilt corrections in the Gregorian calendar. These “Milankovitch” cycles combine to produce an approximate 100,000-year pattern of climate with 80-85,000-year cold glacial periods interspersed with 15-20,000-year warm inter-glacial periods. The last warm period started around 12,000 years ago. Within the "Milankovitch" cycles there are many other cycles such as the 11-year sunspot cycle and 60 year and 1000-year cycles driven by the interplay of the major planets in the solar system and the moon with the Earth which complicate the climate impact.



Source: eoearth.org

The earth orbits around the "sun's furnace" and absorbs some of the heat, reflects some, sweats a bit to cool down and uses the blanket of atmosphere to keep it warm. The average energy received from the sun is 340W/M2, of which 102W/M2 or about 30% is reflected back into space by clouds, dust and aerosols in the atmosphere and by the earth's surface, particularly snow and ice. Of the remaining 70%, 78W/M2 (23%) is absorbed by the atmosphere and 160W/M2 (47%) is absorbed by the land and oceans, heating them up like radiators and driving ocean and atmospheric currents. In turn the earth's surface radiates out this heat as infrared radiation into the atmosphere and on out into space.

In comparison to the 340W/M2 solar insolation, the total energy produced by humans is 0.036W/M2 or about 0.01%.

Earths Albedo

The earth and its atmosphere reflect about 30% of incoming solar insolation via atmospheric particles, clouds and surface reflectivity. Reflective atmospheric particles include sea-spray, dust, and SO2 while black carbon is an absorbent. Humans can do little about sea-spray and only marginally impact dust through land use. However much of black carbon results from burning wood, peat and animal dung by the 3 billion people without access to clean burning fuels or electricity for cooking. SO2 is a natural output of volcanic activity and of fossil fuels and in Earth's early history, Sulphur seepages in the ocean depths may have seen the origins of life. SO2 not only reflects incoming solar radiation, but the particles also act as condensation nuclei in cloud formation which in turn further increases reflectivity. Since the introduction of regulations controlling SO2 emissions in fossil fuels, atmospheric SO2 levels have declined by over 30% on average with large regional variation such as Europe and North America down 70-80% while Asia is up 80%. As SO2 is a short-lived gas in the atmosphere, these large regional differences can result in large regional reflectivity and hence temperature differences.

The reflectivity of the Earth's surface ranges from 80% for fresh snow, 40% for desert sand, 25% for green grass down to about 10% for conifer forests and 4% for fresh asphalt. Black carbon can significantly reduce the reflectivity of snow. Human land use tends to increase reflectivity except in the case of cities and road networks where the use of dark absorbent materials and surfaces reduce reflectivity and lead to heat islands. Use of reflective roofing, lighter colours and light-coloured asphalt all would increase reflectivity.

A 0.05% change in reflectivity, or the Earth's albedo, is the equivalent of the entire human production of energy.

Atmosphere and Greenhouse Gases

The Earth's atmosphere is largely transparent to incoming short-wave solar radiation (sunlight). For outgoing long-wave radiation, the Oxygen, Nitrogen and Argon which make up 99.7% of the atmosphere are transparent but the remaining 0.3%, largely made up of CO_2, CH_4 (Methane) and H_2O (water vapour) absorb some of outgoing long-wave radiation. Water vapour averages around 0.25% but varies significantly on a local basis from zero to 3% and is concentrated in the lower Troposphere while CO_2 and CH_4 together account for less than 0.05%

These are the so called "Greenhouse Gases".

In the absence of greenhouse gases in the atmosphere, the outgoing radiation from the earth would result in a global average temperature of MINUS 18degC, colder than even the deepest ice age. However, the "greenhouse gases" absorb some of the radiant heat from the Earth's surface and act as a blanket to keep the Earth habitable at between 10 and 32deg.C with an average over geological time of around 18deg.C. Today's average temperature of 14.8degC is below the geological average.

The amount of greenhouse gases in the atmosphere is largely dependent on temperature and this is where the chicken and the egg come in. Both CO_2 and H_2O have huge reservoirs in the oceans and as temperature increases, both CO_2 and H_2O vapour are released from the oceans. Conversely, as temperature decreases, the ocean absorbs more CO_2 and H_2O. Both gases act as positive feedback to changes in temperature whether those changes in temperature are initiated by solar insolation or by changes in atmospheric concentrations, the chicken or the egg. The difference between the two gases is that CO_2 additions to the atmosphere can come from other than the oceans by way of volcanic eruptions or the burning of fossil fuels and hence increase temperatures whereas H_2O is largely cycled through oceans. On the other hand, H_2O is a condensable gas on Earth and hence, with aerosols, acts as the feedstock for cloud formation and cooling temperatures. The other difference is that, while CO_2 stays in the atmosphere for longer, over the longer term the carbon cycle gradually reduces CO_2 concentrations to, eventually, a level incapable of supporting life whereas H_2O evaporates in and precipitates out of the atmosphere relatively quickly.

Greenhouse gases are not toxic, they are essential for life and together with aerosols are key to balancing inward and outward radiation and maintaining a habitable climate. Indeed, early in Earth's history when the sun's intensity was thought to be around 30% less than today, an atmospheric concentration of greenhouse gases some 1000 times higher than today would have been necessary to allow liquid oceans on the surface of the earth.

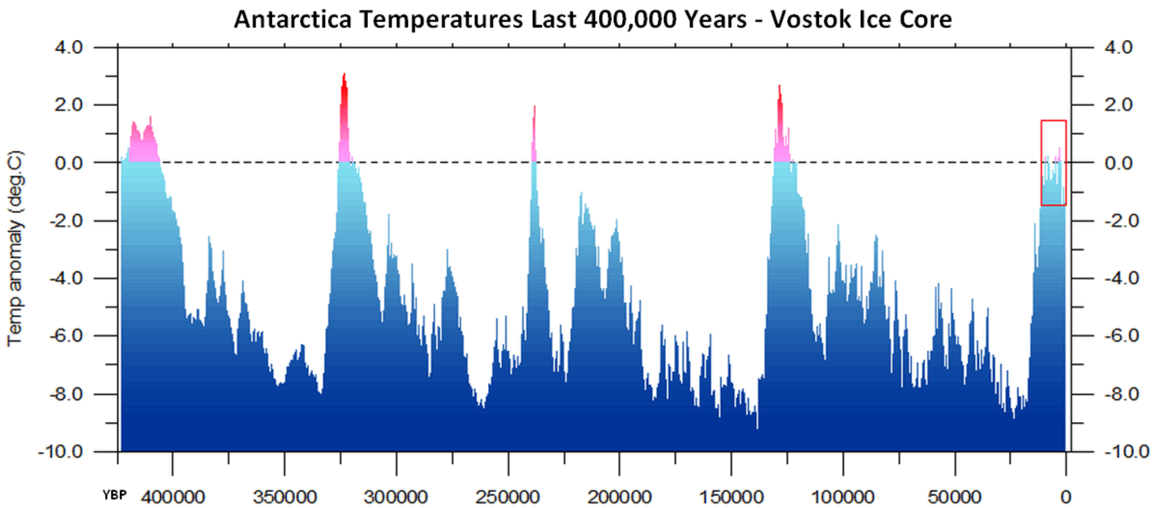
There is nothing sacred about the Earth's temperature and CO2 levels in the pre-industrial period other than it was a colder than average. If one was to start with the question of "what is the ideal goldilocks temperature for the Earth and its inhabitants to best prosper" the answer would be a CO2 concentration of 600-800ppm and a temperature 2-3degC above pre-industrial levels. Enriching the atmosphere with CO2 enriches plant and tree growth by 30-50% for a 300ppm increase. Enrichment with CO2 also leads to plants using water more efficiently as they do not open their stomatal pores as much. Finally, the benefits of CO2 enrichment generally increase with higher temperatures.

WE LIVE IN AN ICE AGE

Mother Nature does a superb job of balancing all the complex drivers of the global climate, ensuring that the 340W/M2 incoming solar energy is roughly matched by 340W/M2 outward radiation, and maintaining a habitable earth.

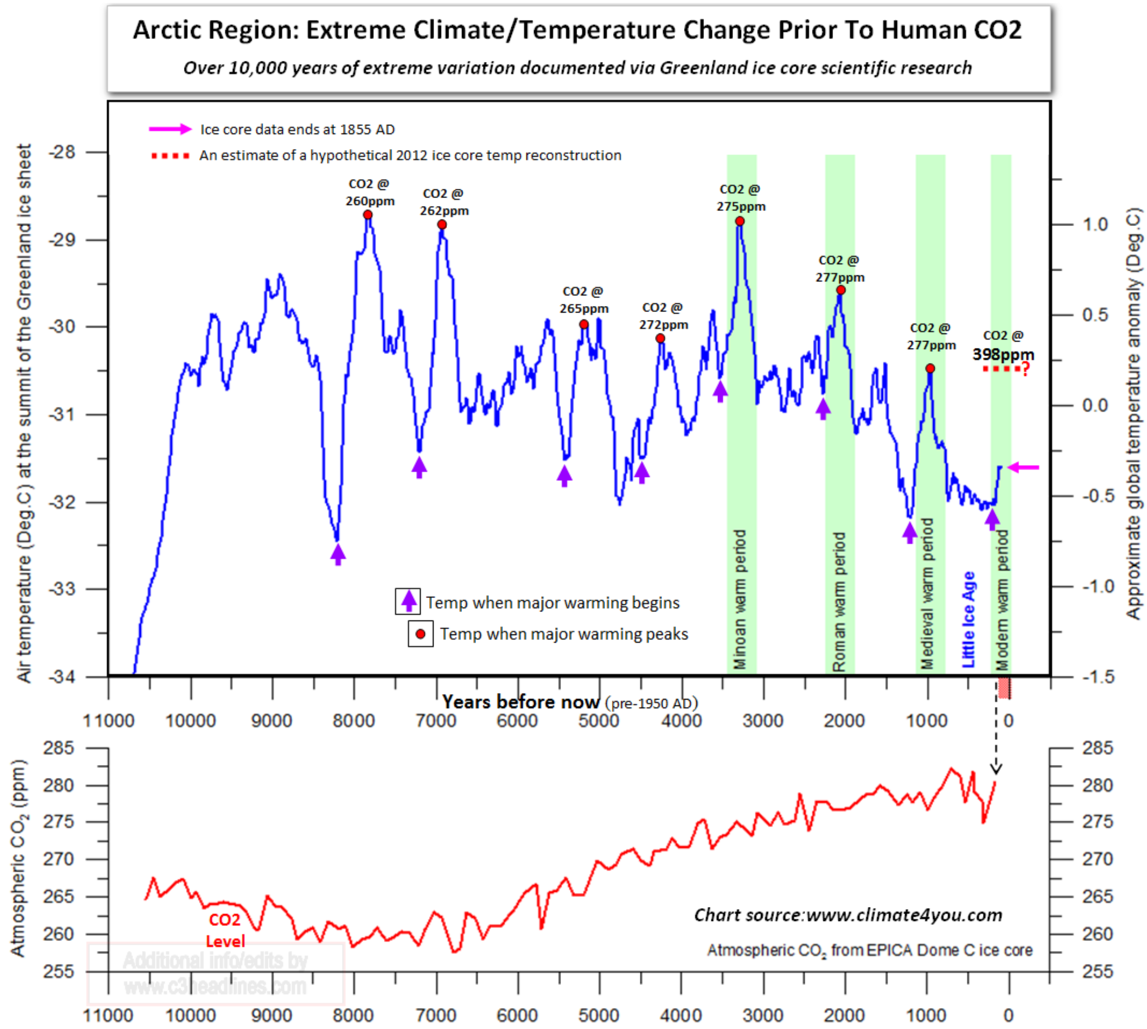
Today, we live in an ICE-AGE (defined as permanent ice at both Poles), the Quaternary, which began about 2.35 million years ago. As the saying goes, "not a lot of climate worriers know that". There have been five or six major Ice-Ages in the 4.6 billion years of Earth's history, representing about 15% of that history. The "normal" status of Earth for 85% of its existence has been an ice-free GREENHOUSE-AGE climate with ocean levels about 70 metres above today's levels.

Each Ice-Age is characterised by periods of cold glaciations and warmer inter-glacials. Over the last 500,000 years glacials have lasted about 80-85,000 years and inter-glacials about 15-20,000 years. The last glacial ended about 12,000 years ago.



Source: climate4you.com

We currently live in the Holocene Inter-Glacial which began about 12,000 years ago and since then, Human civilisation has evolved. It is no accident that all the advances of Human civilisation have occurred during a warm inter-glacial period when conditions were more suitable for agriculture, more land and rainfall were available, and less energy was needed just to keep warm. Overall, the trend since the end of the last glacial repeats previous patterns of a rapid early warming followed by a gradual cooling. The trend for the last 5000 years has been towards a cooler earth and, if past patterns persist, we could be in the last quarter of the “goldilocks” climate which has seen human civilisation develop and flourish.



Source: climate4you.com

After that the next glacial may intervene to make the planet unable to sustain a population anywhere near today's levels or we revert to a "normal" Greenhouse climate with the sort of explosion of growth and diversity experience during the Cambrian explosion, albeit with sea levels 70 metres higher than today. Either way, adaption rather than mitigation will be the priority.

PRE-INDUSTRIAL BASE PERIOD

Any trend depends on the base period being used. Much of the Climate debate is focussed on the period 1850 to the present in comparison to the "pre-industrial" period, partly because of underlying assumptions about the role of humans and the industrial revolution and partly because of the availability of

more “accurate” temperature and atmospheric data (In geological time, the last 170 years represents the last three- thousandths of a second in the 24 hours since the earth was formed – a blink of an eye). Graphs are drawn to show Global warming from 1850 to the present and the amount of CO2 in the atmosphere and these are then extrapolated and modelled into the future using various assumptions.
The “pre-industrial” period coincides with a period climatologists refer to as the “Little Ice-Age” stretching in waves from 1300 to 1850 when temperatures were typically 1-2degC colder than today and 4-7degC colder at its harshest in some areas. This was a period in which Thomas Hobbes described life as “solitary, poor, nasty, brutish and short”. Life expectancy was less than 40 years, infant mortality was over 25%, famines were common and with famines came diseases associated with malnutrition and plagues which wiped out large portions of the population. The recent 9% hit to UK GDP because of Covid was widely reported as the worst in over 300 years, more specifically the worst since the Great Frost of 1709 which wiped out 23% of UK GDP. The freezing weather of 1741/42 across Europe killed a greater proportion of the Irish population than the Potato Famine of the 1840’s. The colder climate shortened the growing season by 3-6 weeks which meant that crops did not ripen in the marginal lands of NW Europe, vineyards disappeared from England and even the canals of Venice froze over as did the Baltic Sea, the River Thames and most of the European rivers which in those days were the arteries of trade. The weather was much colder and more volatile with great storms (one wiped out the Spanish Armada of the west coast of Ireland in 1588), periods of incessant rain and floods or droughts much more extreme than today’s variations attributed to global warming. It was not just Europe; the drought and then cold almost wiped out the first permanent English settlement at Jamestown in North America in 1607-10 and the Ming dynasty in China fell in 1644 after years of harvest failures.
In the Little Ice-Age, the weather was blamed on the wrath of the gods and some 80,000 witches were burned at the stake in Europe between 1500 and 1700 for bringing calamity and famine into their communities. Today the witches are the climate deniers, the energy companies, the meat eaters, the global travellers, the petrol heads or anyone who questions the “settled science”.

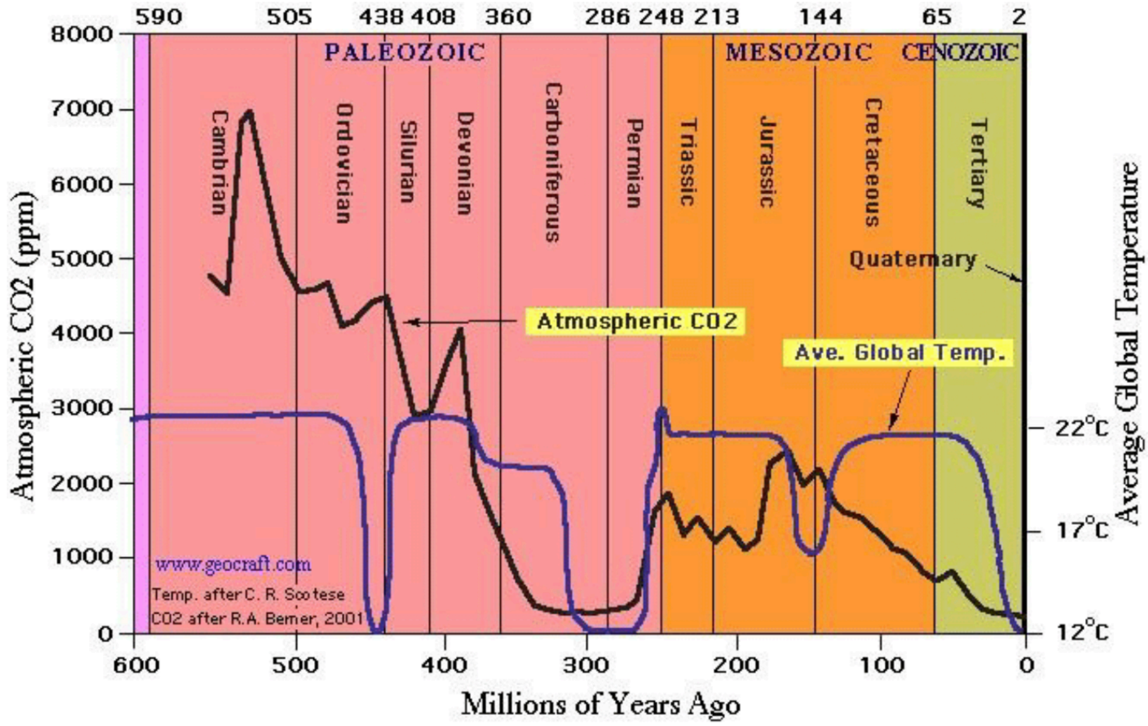
There is a hidden assumption in the Climate debate that warm is bad and cold is good. Try living in the Little Ice-Age. Earths greatest surges of diversity and species growth have been in the Green-House ages rather than in the Ice-Ages. Even in Human history, advances in civilisation correlate with periods of warm and stable weather, the Neolithic revolution and the Holocene Optimum, the Minoan Warm the Roman Warm. There is another assumption, or blinkered smoothing, that the climate, absent human interference, is stable and that we can continue in the “goldilocks” zone indefinitely but again history shows that humanity emerged out of an Ice-Age but adapted and thrived in a warm inter-glacial. Unfortunately, we humans cannot see past the 2 seconds of history we have occupied in the 24 hours of Earth’s existence.

THE DEVIL CARBON - CARBON CYCLES

Carbon is the source of all life on earth and we humans are roughly 65% Oxygen, 18% carbon, 10% hydrogen and 7% made up of nitrogen and other elements such as calcium, phosphorus, potassium and sulphur. CO_2 is the food of plants and algae and those in turn, directly or indirectly, are the foods of all the creatures on the planet.

There are two Carbon cycles that balance Carbon on Earth, the ORGANIC and INORGANIC. The organic cycle extracts carbon from the atmosphere through plant photosynthesis of CO_2 and then cycles it through decomposition, respiration and combustion back into the atmosphere. The minimum atmospheric CO_2 to maintain the organic carbon cycle is about 150ppm; below that plants die, above that plants increasingly thrive. Ideally CO_2 levels of 600-800ppm would enrich the atmosphere and plant productivity to the extent that less fertilizer would be required for the same output.

The inorganic cycle is the combination of CO_2 with H_2O to form Carbonic Acid in the atmosphere and the mildly acidic rain combines with silicate in rocks to form limestone etc. This is the Earth’s thermostat and operates over cycles of thousands and millions of years. Some 99.6% of the Earth’s carbon has been laid down over time in sedimentary rocks and if all the remaining CO_2 in the atmosphere was now laid down, it would form an additional layer of rock about 5mm thick. If all the CO_2 in the Oceans was laid down it would form an additional layer of rock about 0.5metres thick. Carbon sequestered into sedimentary rocks is recycled through subduction of the Earth’s crust into the hot mantle at the edge of tectonic plates and then spewed out into the atmosphere and oceans via volcanoes and seepages. However, there is a net loss of CO_2 from the atmosphere through this cycle that over time has reduced CO_2 levels to where they are today. Indeed, some recent studies have suggested that only about a third of the carbon being subducted is recycled back to the atmosphere and a recent Japanese study suggests that the world will run out of CO_2 and then oxygen in less than a billion years. Longer term then, the potential issue could be too little rather than too much atmospheric CO_2.



Global Temperature and CO2 levels over 600 million years (Source: MacRae, 2008)

Much is made of CO_2 levels in the atmosphere (an increase from 290 parts per million to 400 parts per million in the last 170 years) but over geological time, there has been a gradual de-carbonisation of the atmosphere as rocks are weathered by CO_2 induced acid rain and laid down as carbonates, plants transform CO_2 into vegetation which in turn becomes coal, and sea life is transformed into chalk or oil and gas.

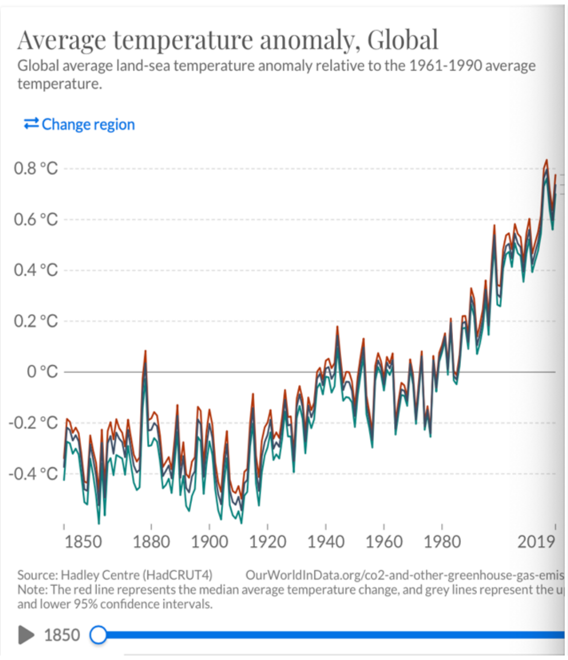
Burning fossil fuels van be viewed as an acceleration of the inorganic cycles of subduction and volcanic emissions in that we are extracting material, fossilised and stored solar energy, that would eventually be subducted and recycled. Given that the longer-term trends for CO_2 are towards levels that endanger the organic carbon cycle, adding some CO_2 to the atmosphere may be no bad thing. We may be doing it too fast and using fuels inefficiently, but we know that the warming impact of CO_2 is logarithmic where each addition of CO_2 has a diminishing effect.

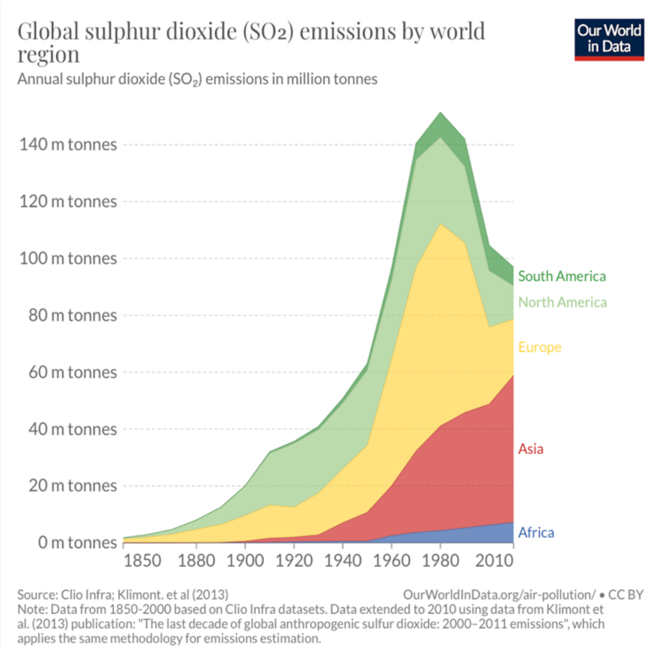
The other Greenhouse gases like CH_4 have sources in fossil fuel production but more so in ruminant animals, rice cultivation and land fill waste. While molecule for molecule more potent as a greenhouse gas than CO_2, the lower concentrations, shorter lifespan and the logarithmic effect make CH4 more amenable to reduction with much less impact on economic well-being.

THE UNSPOKEN AEROSOL – SO2

What is rarely mentioned is the impact of SO2 levels in the atmosphere. That is maybe because atmospheric aerosols, the other side of the equation offsetting the effects of GHGs, were the subject of the biggest human climate intervention in history. In the 1970's, Governments, in response to activist promoted fears about acid rain, mandated that all the sulphur from fossil fuels be extracted before burning. As a result, we are extracting the equivalent of 2-3 Mount Pinatubo volcanic eruptions EVERY YEAR from the atmosphere and reducing SO2 aerosols which, at 0.02degC cooling per 1MT of SO2, would more than offset all the global warming we have seen from GHGs.

The chart shows anthropogenic production of SO2 from 1850 to 2010 compared to temperature variation. Before 1970, with increasing SO2 emissions, the concern was about the next Ice-Age. After mandatory reductions in SO2 from the 1970s onwards and increases in global temperatures, the concerns reversed to the imminent apocalypse of Global Warming.



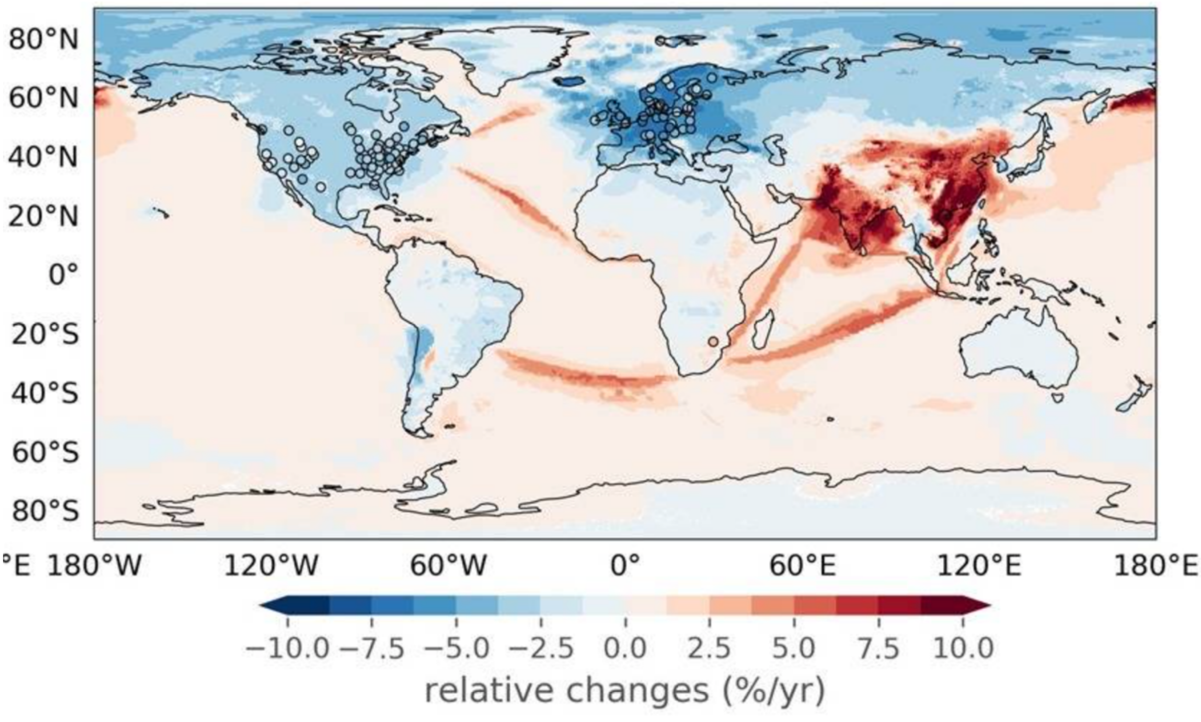


Source: Our World in Data

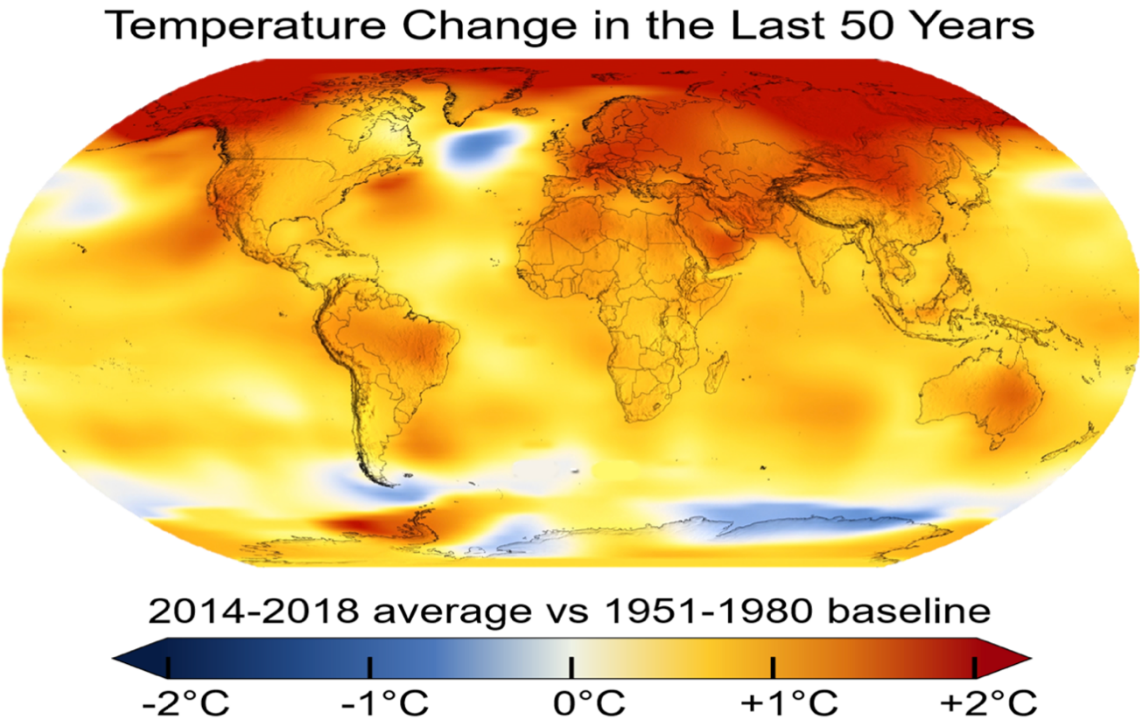
SO2 concentrations in the atmosphere can vary significantly by region partly because of geographic variability of anthropogenic emissions and partly due to the relatively short cycle time of SO2 in the atmosphere. As a result, global cooling by aerosols varies by region whereas long cycle times for CO2 mean that its' impact is more evenly dispersed.

Most of the increases in Global temperatures since 1850 have been in the last 50 years as the efforts to reduce sulphur emissions have taken effect and the largest temperature increases have been in those regions of the Northern hemisphere such as North America, Europe and Artic Asia where the SO2 reductions have been earliest and greatest. If CO2 was the main determinant of temperature increases, then those increases should have been relatively evenly distributed and over a longer time period. In reality, there is a distinct inverse correlation between SO2 concentrations and temperature as the dark blue reductions in SO2 concentrations match the dark oranges of temperature increases in the charts below.

Changes in SO2 concentrations 1990-2015
Source: Source:



Source: NCBI



Source: NASA Climate Change

Some recent studies by Myhre G et al. published in Nature showed increased positive radiative forcing because of reduction in aerosols compared to that used in the IPCC analysis and indicated figures as high as 3-4WM2 in the 1990-2015 period for Europe. That compares to an overall "human caused radiative forcing of 2.72W/M2 in 2019 relative to 1750" in the AR6 Report. In other words, the reduction in aerosols more than accounted for all the increase in temperatures in Europe.

It may indeed be unequivocal that human influence has warmed the atmosphere, ocean and land, not so much by adding CO2 but by removing SO2 and its cooling benefits.

SO2 in the atmosphere is a natural phenomenon, mostly from volcanic activity, forest fires and biogenic emissions from such as phytoplankton. Sulphur is the 3rd most abundant mineral in the human body and is essential for the synthesis of key proteins. It is anti-microbial, antioxidant and anti-inflammatory. Dietary intake provides the sulphur necessary for healthy life and is released by living organisms as a by-product of their metabolism. Plants in turn intake Sulphur

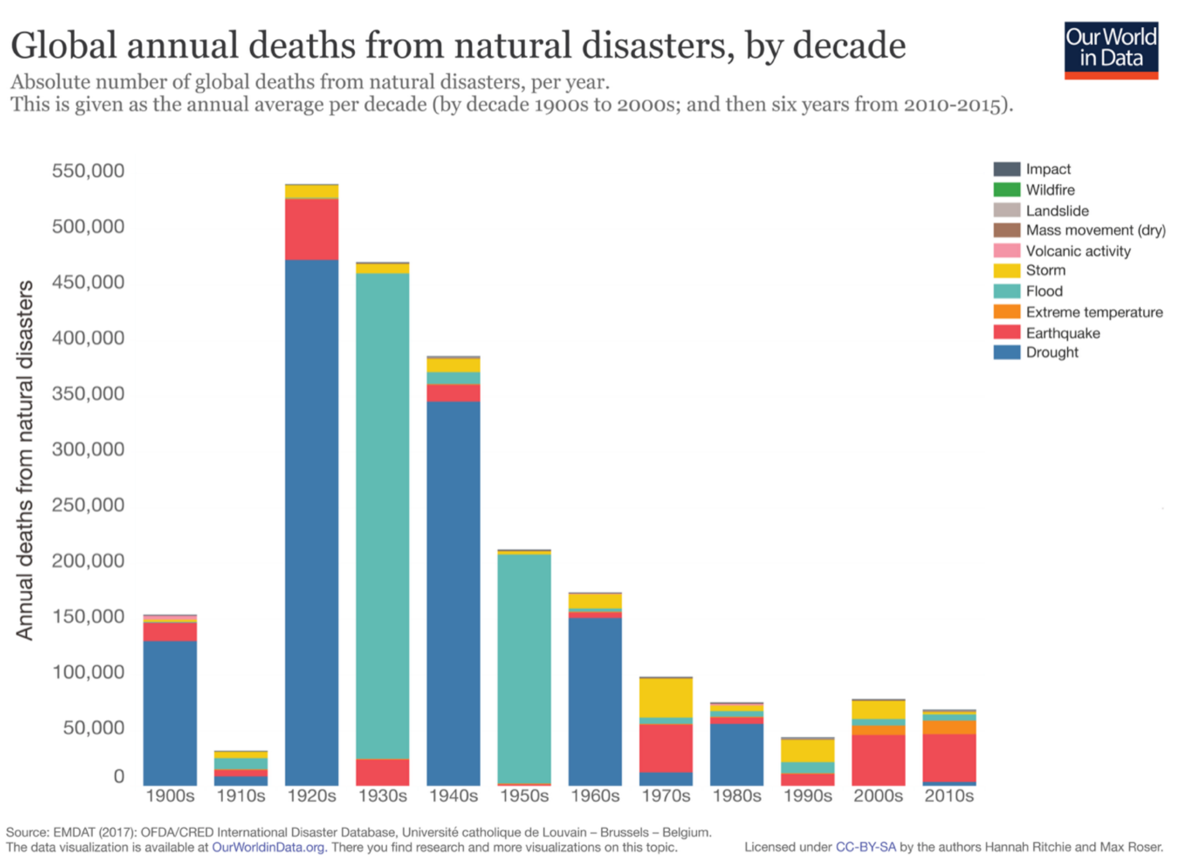
from atmospheric SO_2, from “acid rain” and from decaying plant matter. However, SO_2 in higher concentrations can cause respiratory problems and on reacting with water to form “acid rain” can be detrimental to plant life if concentrations are too high. Like most things in nature there is a healthy balance which offsets global warming, encourages plant growth and reduces microbes and allergens while avoiding adverse respiratory effects.
SO_2 has a short residence time in the atmosphere, days in the troposphere and weeks to months in the stratosphere, but emission from fossil fuels, unlike volcanic eruptions, is on a continuous basis. Therefore, any policies to reduce emissions has an accelerated effect on temperatures while policies to increase emissions can have the opposite effect and be easily modified or reversed. The IPCC models assume that SO_2 concentrations will be further reduced from a base of today as desulphurisation measures are adopted more widely. There is therefore an in-built bias in their models which accentuate global warming projections. As a minimum IPCC should model sulphur concentrations up to a maximum consistent with a balanced air quality standard based on the 0.02degC cooling per Mt of SO_2 evident from the Mount Pinatubo eruption.

ATTRIBUTION OF EXTREME WEATHER EVENTS

The AR6 Report indicates increasing confidence in attributing “extreme” weather events” to global warming, particularly temperature and precipitation and some regional changes in droughts. With temperatures 1.09degC higher relative to pre-industrial levels, one would expect a normal temperature distribution curve to show more hot days and less cold days and an atmosphere capable of holding and cycling more H_2O.

The Report recognises that there is no real definition of “extreme events” and that the evidence for more fires, storms, floods or droughts driven by climate change is limited. While higher temperatures imply more energy in the climate system, extreme events are driven by temperature, pressure and saturation differentials as much as by absolutes as evidenced by extreme weather events recorded during the Little Ice-Age.

Extreme weather events such as forest fires, floods, storms, droughts or heat waves attract headlines and forecasts of calamity but need to be placed in context. Deaths from natural disasters have seen a large decline over the past century and now account for 0.1% of deaths.



In a longer historical context, the greatest natural disasters in history all occurred before the 1950 baseline used in the AR6 Report:

Wildfires:	1871: Peshtigo/Michigan/Chicago fires killed 2500
Floods:	1931: China (Yangtze/Yellow/Huai) killed 1-4 million
Drought:	1876-79: Northern China killed 9-13 million
Storms:	1839: Coringa Cyclone, India killed 300.000
Heatwave:	1936: North American killed 5-6000

There is little or no statistical evidence for a long-term increase in extreme weather events. M J Kelly from Cambridge University demonstrated that "there is much evidence of NO CHANGE over the last 100 years" and that, if anything, the weather was more extreme between 1900 and 1960.

Why then did the AR6 Report use 1950 as a base for extreme weather?

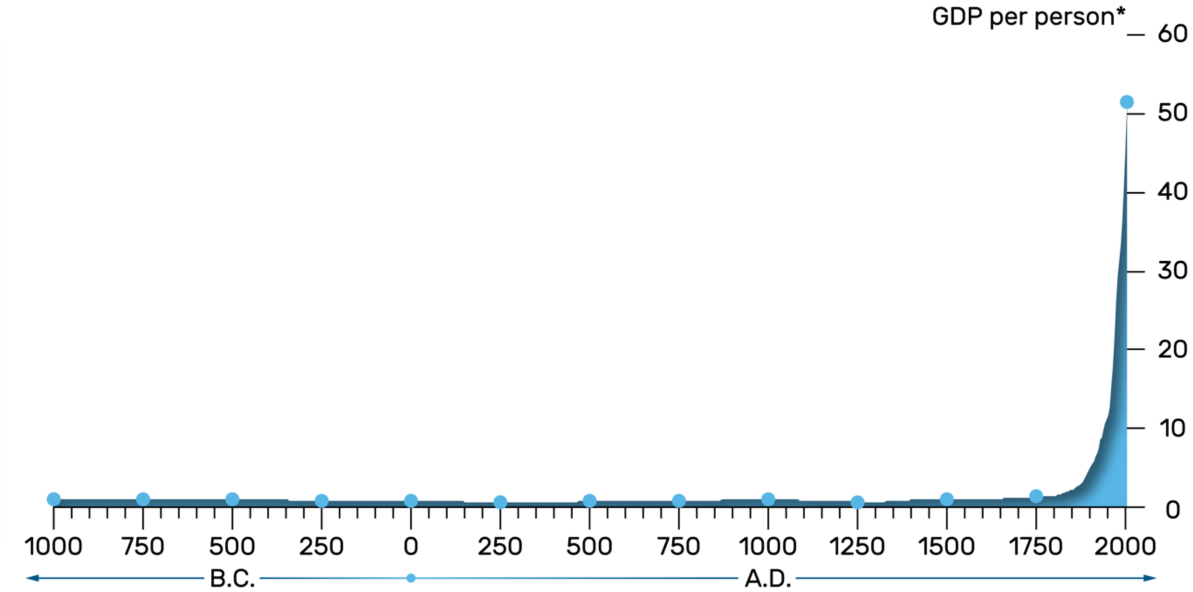
While attribution of extreme events to climate change may continue to make headlines, the focus should be on adaptation through modern fire management rather than suppression, investment in infrastructure to manage floods and higher ocean levels, water management and irrigation to manage drought, and building construction standards and insulation/ventilation to manage temperatures.

PRE-INDUSTRIAL AND POST INDUSTRIAL IN CONTEXT

And of course, all the debates about "climate change" take place within the much larger context of the planet, its resources, and how the human species can live and develop in harmony, or at least sustainably, with nature.

It took all human history until around 1800 for the World population to reach 1 billion. Up until then the world was in a "Malthusian trap" where any improvements in technology or productivity resulted in population increases but not in standards of living. Economic growth was asymptotic with the limiting factor usually being the land from which food and energy were produced and with every cycle of improvement, feast was followed by famine. Between 1600 and 1800, the age of enlightenment and the emergence of science saw the discoveries (Descartes, Boyle, Newton and Hook, Black and Priestly, Newcomen and Watt, Lavoisier and Thompson) that underpinned the so-called "industrial revolution". However, not even those scientific discoveries, nor the technical advances in textiles, metals, machine tools and chemicals production, nor the new-found inputs from Asian spices, South American silver, Caribbean sugar or North American cotton and tobacco were sufficient to lift human existence out of never-ending struggle and poverty.

GDP/Person over 3000 years



Source: BOE: Data from DeLong (1998).

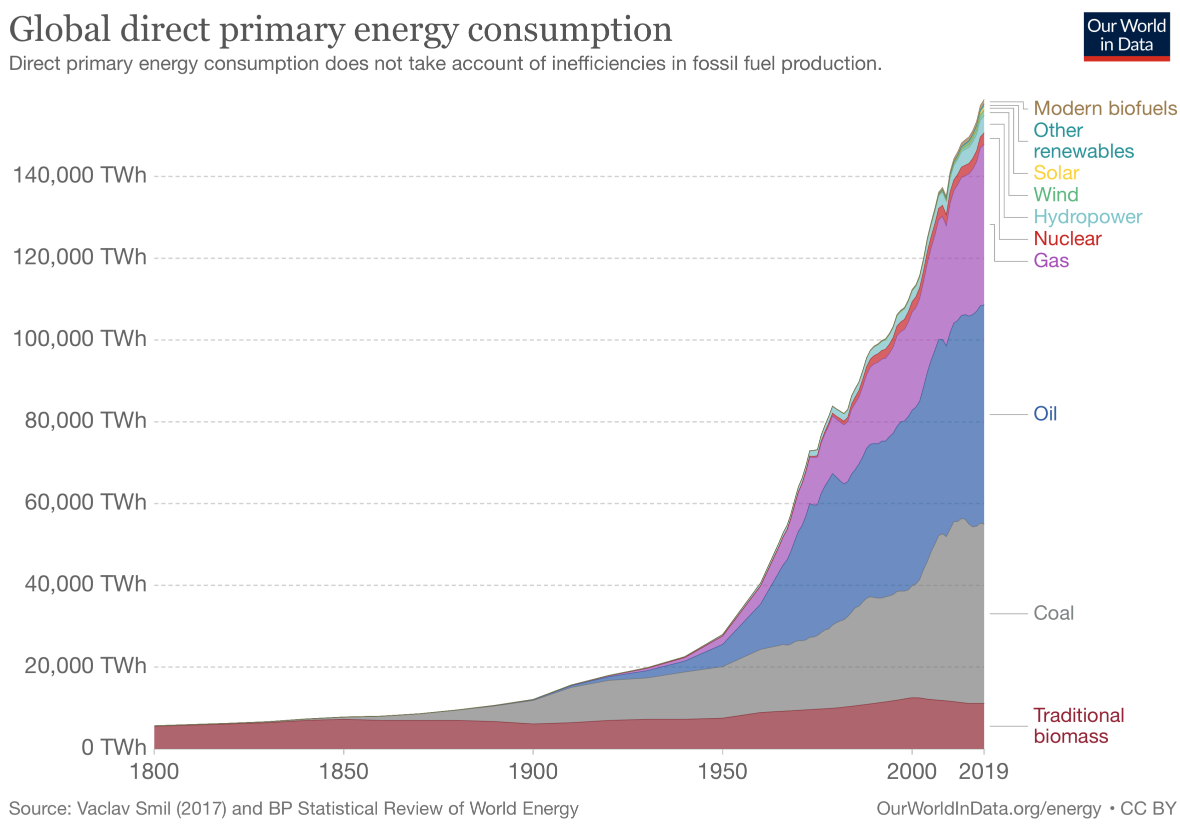
In 1800, some 95% of humanity still lived in extreme poverty and, even in England, Holland, and Spain with their East India companies and New World colonies, standards of living had only marginally improved.

What changed towards the end of the 18th Century was the application of abundant and low-cost energy to the scientific discoveries and technological advances of the previous 200 years – an "Energy Revolution".

Up until then the energy available to humanity was largely organic, the result of the continuous conversion of solar energy through plant photosynthesis to supply human and animal muscle power or to produce wood and charcoal for heat. Mechanisation could only improve productivity so far with wood, wind and water, and charcoal could not provide sufficient combustion heat to keep pace with advances in metallurgy. In any event, wood and charcoal were becoming scarce with deforestation.

The answer, initially in the UK and then across Europe and North America, was "stored photosynthesis", the readily available supplies of coal which had been deposited over previous geological eras.

As a Royal Society Paper asserted, "a necessary condition for the move from a world where growth was at best asymptotic to one that it could be, at least for a period, exponential was dependent upon the discovery and exploitation of a vast reservoir of energy that had remained untapped in organic economies". (Energy and the English Industrial Revolution; 2013)



The "necessary condition" was an "Energy Revolution".

Abundant supplies of energy leveraged scientific and technical advances to produce unprecedented increases in productivity. In cotton spinning output per worker increased 500-fold, weaving 50-fold; in iron works, energy efficiency increased 10-fold; Watt's steam engine used 20% as much coal per horsepower-hour as Newcomen's and the same productivity increases applied across all industries such as cement, glass paper and into agriculture with seed drills and Dutch ploughs.

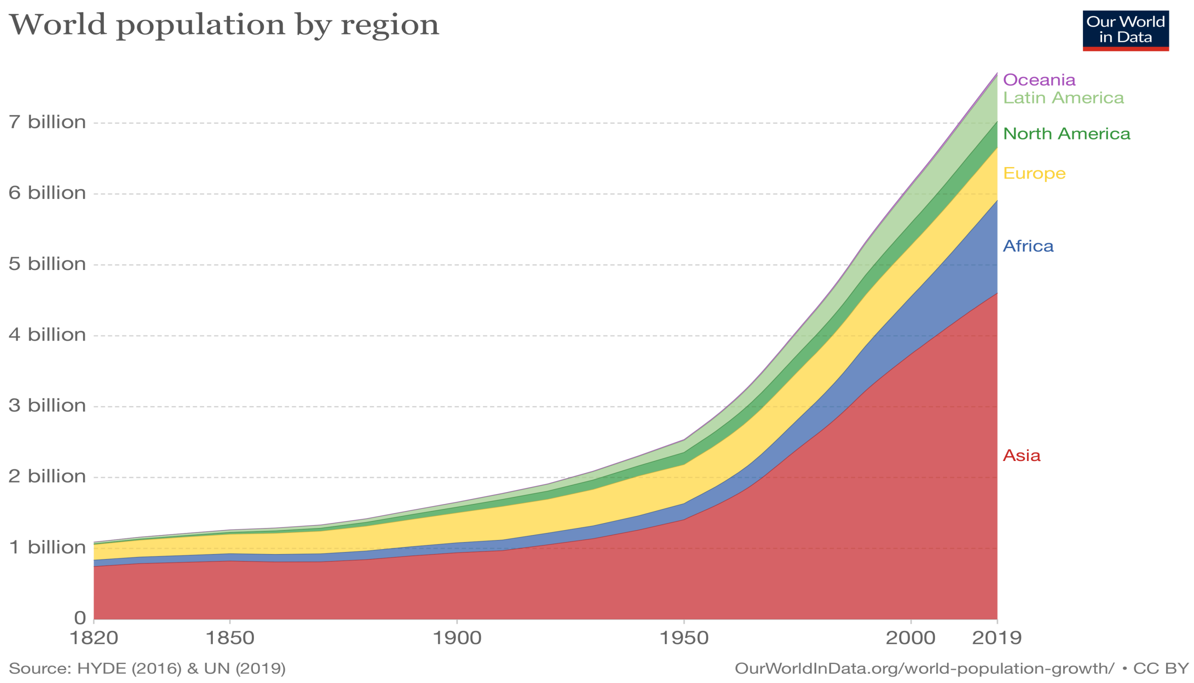
In the second half of the 19th century, further availability of energy inputs in the form of oil and electricity fuelled a new wave of productivity and economic expansion supported by continuing advances in pure and applied science. (Davy, Dalton, Joule, Kelvin, Maxwell, Faraday, Einstein). Hot blast furnaces and the Bessemer process made iron and steel available for railways, bridges and tower blocks, electricity brightened and lengthened the day, and petroleum not only provided light, but eventuality transformed human mobility from motor cars to road, rail, air and marine transportation and became the building block for the chemical industry.

And into the late 20th /early 21st centuries, a new wave of scientific discoveries and technical innovations have driven the digital age, a newly connected world where human productivity based on computers, information exchange, programmable control and artificial intelligence has taken further leaps forward and provided the potential for a more resource efficient world.

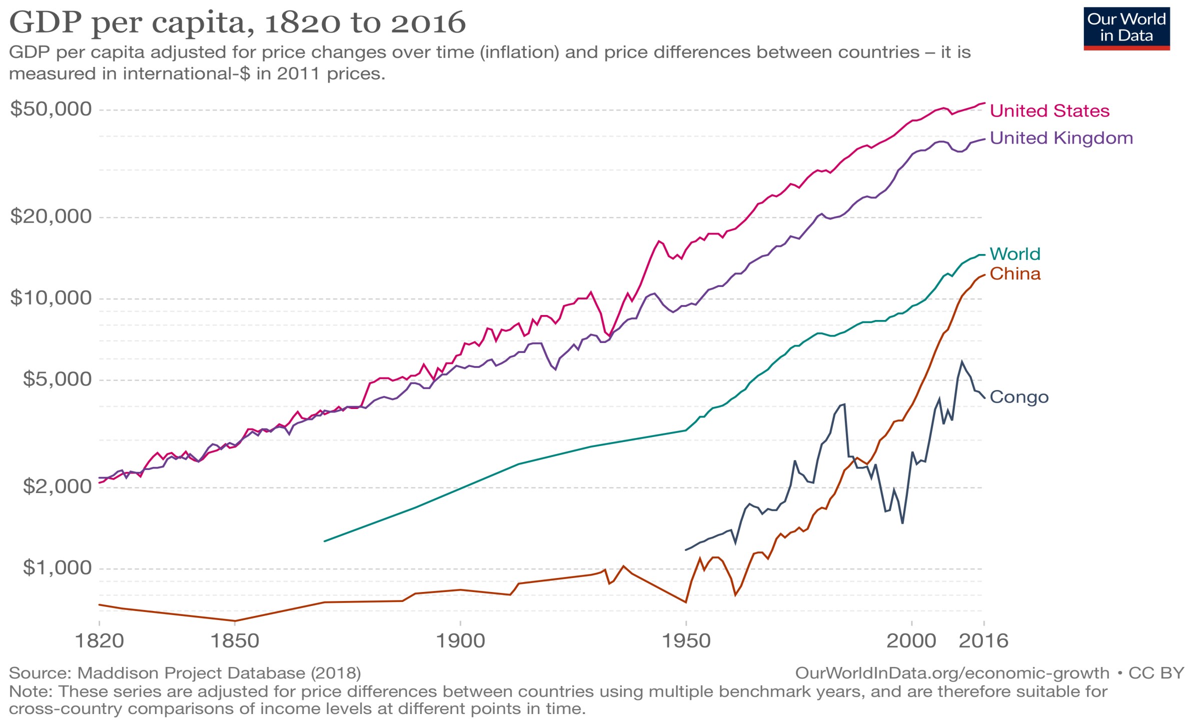
For the first time in Human history, economic growth led not only to increasing population but to sustainable increases in living standards.

After 10,000 years of almost no growth and a World population of 1 billion largely living in poverty, the next 220 years saw:

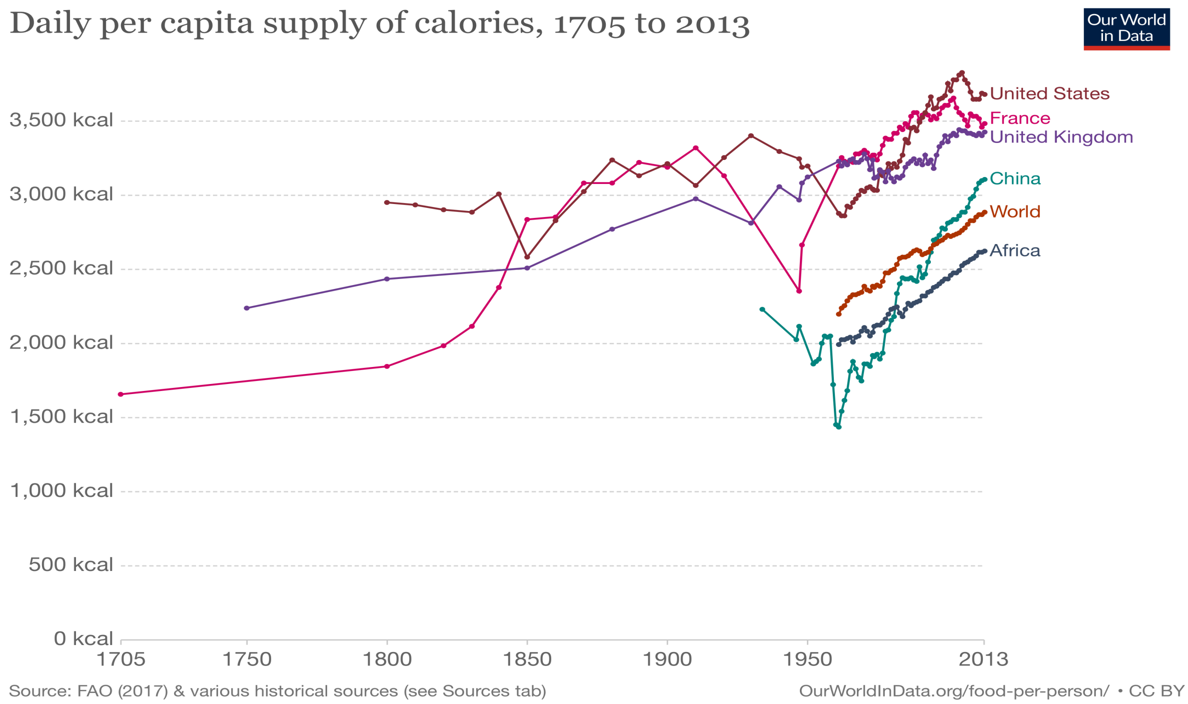
World population increase 8-times.



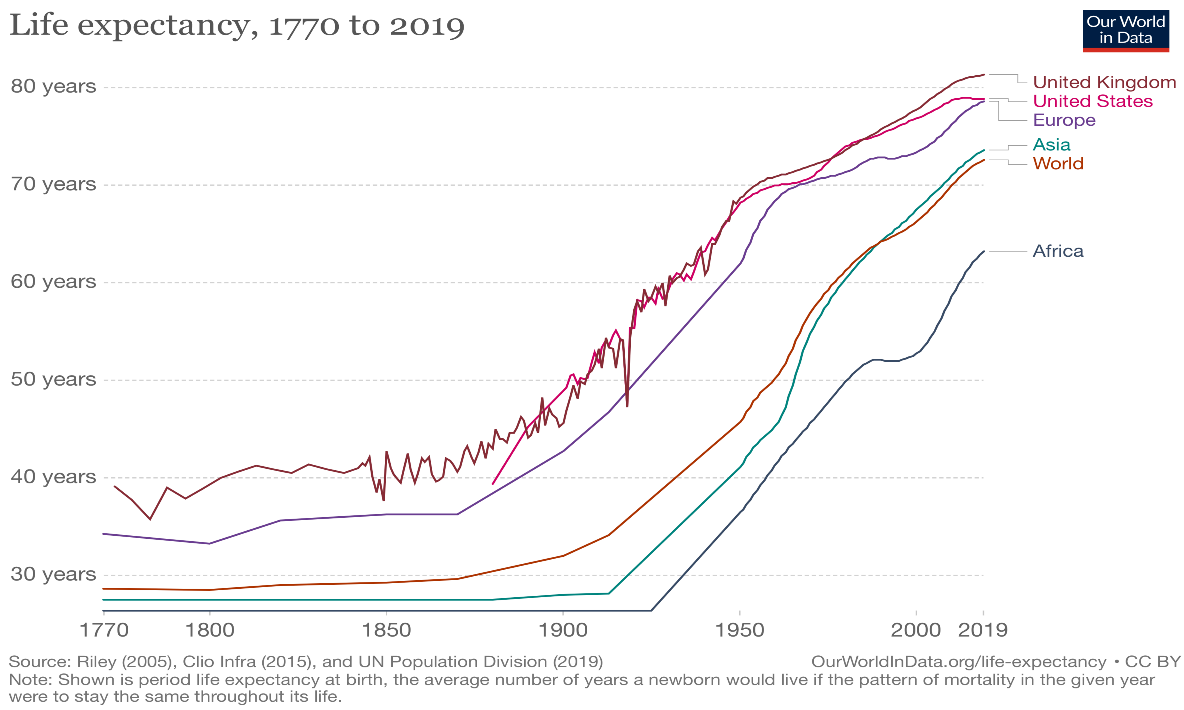
World GDP per capita increase 15-times



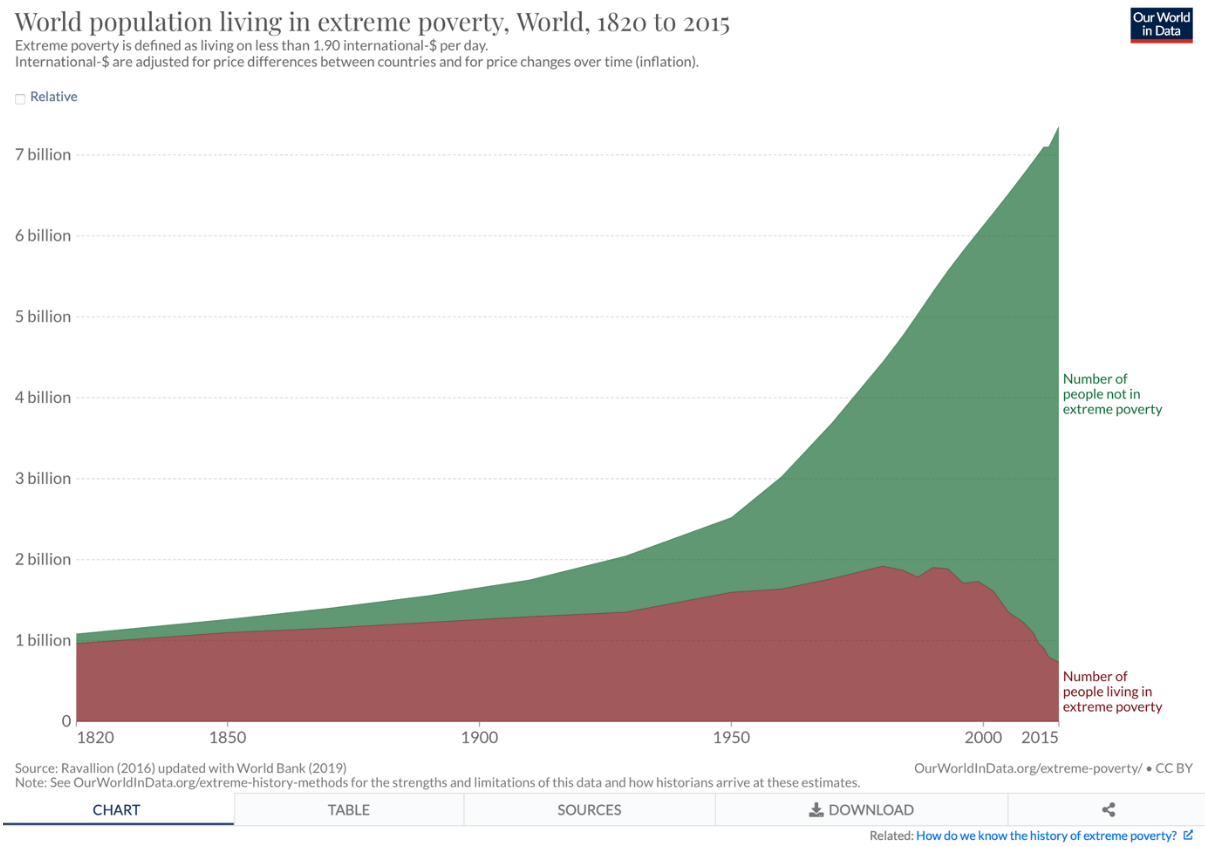
World Calorie/Capita increase 2-times.



World Life Expectancy increase 2.5-times.



Extreme poverty reduce from 95% to 8%



Although the “Energy Revolution” fuelled unprecedented growth and improvements in the human condition, those improvements were not evenly spread across the World as different regions and countries began the development cycle at different times. However, catch-up growth can be very fast with the spread of technologies and the availability of energy as can be seen from Japan, South Korea, China and Southeast Asia. Nevertheless, many countries in Africa, Asia and South America have still a lot of catching up to do.

Across the World:

*GDP/Capita is 75 times higher in rich versus poor countries

*Life expectancy is 30 years more in rich versus poor countries

*Infant mortality is 25 times higher in poor versus rich countries

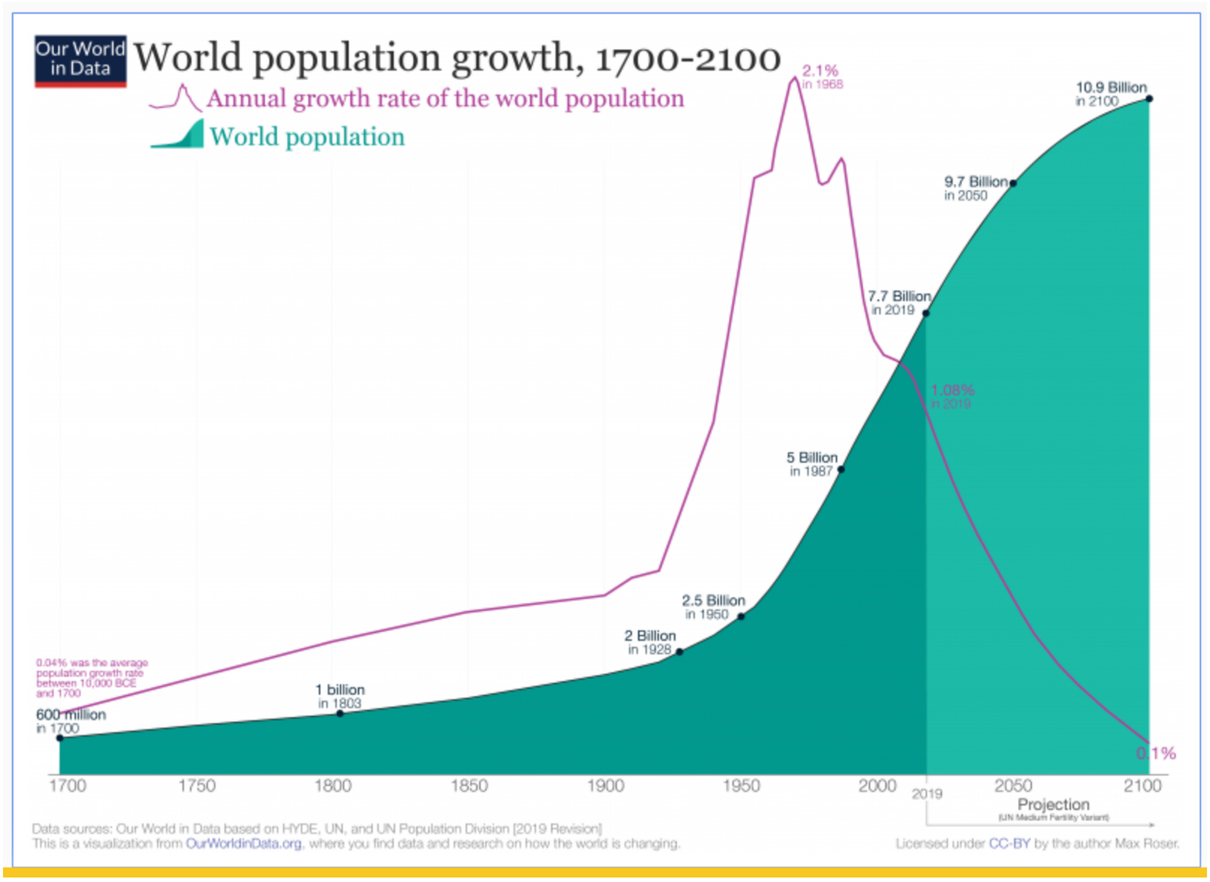
*800 million people in the World are under-nourished

*900 million people do not have access to electricity

*3 billion people do not have access to clean fuels for cooking. Indoor air pollution is a leading factor in premature deaths with between 1.6m (IHME) and 4.3m (WHO) deaths per year.

Nor was the unprecedented growth and improvement without its’ costs in terms of the environment or the mental and physical well-being of humanity with 10% of the population with mental health issues, 1.4% of deaths from suicide, and 13% of adults obese. The World HAS GOT better but the World COULD BE much better and there is still a long way to go to level up and provide a much better life for all.

Looking forward, the current outlook is for 11 billion people by the end of the century. However, the pace of growth has been slowing since 1950 and by 2100 will have declined to close to zero. Beyond the end of this century, the overall trend will be decline. Europe's population is already in decline, China will follow by 2030 and India and the Americas by 2060. After that all the future growth is in Africa where the population is projected to grow from 1.3 billion to 4.3 billion by 2100 and half of all babies born worldwide will be born there. Whether countries like Nigeria with a land area 40% larger than France can support a population larger than all of Europe or the African continent can support a population 10 times larger than North America is, at the very least, questionable. Nevertheless, we have seen over time and in other regions what rapid economic growth on the back of population growth can do for the demand on resources and energy.



Source: Our World in Data

These population trends have profound implications for the interaction of humanity with the planet and its resources, whether preservation of rain forests in the face of encroaching populations, the increase in ruminant numbers and wetland agriculture to feed them, or the energy to heat, cool and transport them. The demographic transition between 1900 and 2100 from LOW to PEAK to LOW population growth and then DECLINE and from YOUNG to OLDER implies that this century is critical to humanity's place on the planet.

The reality is that, if the world is to sustain the steady improvements in the human condition experienced in the last 200 years and level up living standards across the globe, energy demand will be some 100-125% higher in 2100 than in 2020, even assuming a doubling of energy efficiency improvement over that period versus recent history. That is roughly 100GJ/Capita compared to the current global average of 76GJ/Capita, the current OECD average of 179GJ/Capita or the current US average of 288GJ/Capita. It will be a demand for more efficient, cleaner energy services with the locus of demand growth shifting south to the developing nations of Africa, India, South Asia and South America.

The only question is HOW that energy demand is to be met and sustained into the 22nd century with the minimum impact on the planet. The alternatives of returning to 18th century Malthusian traps and permanent poverty or to the OECD with 16% of the World's population, 66% of GDP and 40% of energy consumption denying the developing world the same opportunities it has enjoyed over 200 years are morally, socially and economically unthinkable. Those whose concern about potential climate change leads them to believe that the "have-nots" will forgo access to electricity, clean cooking, mobility and the energy-rich lifestyles that they see being enjoyed by the "haves" fly in the face of a history where the upwardly mobile human race continues to work, aspire, agitate and migrate to improve theirs' and their families' quality of life.

In addressing the question of HOW that energy demand can be sustainably met, we should remember what drove the earlier energy/industrial revolutions. They were Science-based, Technology-enabled and Economics-driven in a liberal free market.

As for the SCIENTIFIC basis of climate change, E N Lorenz, the meteorologist and father of "chaos" theory and much of modern atmospheric physics and mathematical modelling, defined a complex adaptive system such as the global climate as one where “the present determines the future, but the approximate present does not approximately determine the future” In other words, even minute differences or changes in starting assumptions or rounding’s can yield widely different outcomes or predictions. He concluded that “in view of the inevitable inaccuracy and incompleteness of weather observations, precise very long-range forecasting would seem to be non-existent”.

The IPCC does not carry out original research or monitor climate phenomenon but carries out assessments of Climate Science and knowledge available which tend to be driven by research funding and climate activism. In today’s environment, funding of research and publication of results is almost impossible if the focus and outcome is not in line with “accepted” assumptions about global warming. Whatever happened to Robert Oppenheimer’s dictum that “there must be no barriers to freedom of enquiry. There is no place for dogma in science. The scientist is free, and must be free to ask any question, to doubt any assertion, to seek for any evidence, to correct any errors”. While its various reports indicate where further research is needed, there is no concerted effort to pursue research to resolve issues. For example, none of the Reports, including the “Special Report: Global Warming of 1.5degC” of 2018 or the AR6 Report of 2021, include any assumptions on SO_2 reductions or increases other than business as usual. As Lorenz implies, this gross approximation of the present could have profound implications for outcomes and pathways.

“Truth is to be found in the simplicity and not in the multiplicity and confusion of things,” said Isaac Newton. There are simple alternatives to the current paradigm of CO_2 driven climate change. Naturally occurring warming from increased solar activity increases H_2O and CO_2 in the atmosphere. These GHGs lead to further warming which would gradually be offset by increases in cloud cover and the Earths albedo (a 0.05% increase in albedo is equivalent to the total human energy consumption) but mandated reductions in SO_2 not only reduce earth’s albedo but inhibit the formation of clouds. As a result, the warming continues unchecked until higher H_2O saturation levels increase cloud cover.

The truth is we don’t know for sure and in the face of uncertainty, the only thing more dangerous than ignorance is arrogance. What we can be reasonably certain of from climate history is that the Earth is entering a Millennium Warm period with temperatures a couple of degrees higher than those of the Little Ice Age, probably for the next 300-400 years. The implications of that outlook and what we can do to capture the benefits and mitigate against the negatives are what we should be addressing rather than adopting Canute's vain strategy of holding back the forces of nature.

There are two parallel strands to address:

1) MITIGATION: the science and technology to provide sufficient energy with the minimum impact on the environment.
2) ADAPTATION: capturing the benefits of a new Millennium Warm and infrastructure investment to adapt to a new reality.

The priority is to increase confidence in the underlying SCIENCE and for that, the Science Community need to be freed from political, funding and lobbyist interference and recommend what further research is needed and what questions need to be resolved before Governments around the World adopt far reaching policies and commit enormous funds. Funding for that research should be made by Governments, independent of any special interests and the research results should be independently validated and peer reviewed before publication by the various science bodies such as the Royal Society. A "$ butterfly to spur a hurricane of research". For example:

*What is an agreed base of historical climate records without homogenization. Get the bases right!

*What would an ideal temperature/CO2 combination be to best facilitate Earth's progress

*What are the impacts of different levels of GHGs on temperature

*Why in past geological eras do increases in CO2 seem to lag temperature increases

*What are the impacts of different levels of aerosols such as SO2 on temperature

*What is the relationship of temperature/CO2 concentrations on plant growth

*What levels of CO2 would prevail in the atmosphere over time in the absence of any fossil fuel or biomass burning and what would be the impact on the biosphere

*Does the temperature of the Sun's Photosphere and its luminosity increase directly with core temperatures

*What are the sensitivities of the various assumptions in Climate Models and do Models fit with retrospective records

Some of the enabling TECHNOLOGIES such as wind and solar are already in place and being utilised but more development and breakthroughs are needed in transmission and energy storage systems to overcome the mismatch between insolation and demand density and in intermittency. Nuclear, once seen in the 1970's as the future of almost free energy to offset the pending ice age, needs front end support, development and scale if it is to be the emission free energy of the 22nd century. What is needed for Nuclear is a "Manhattan" style project to bring to fruition nuclear based fission or fusion energy that is safe and economic. Hydrogen is another potential if conversion costs can be overcome. All these supply side technologies take time and in the interim, the marginal generation of electricity still comes from coal as lower carbon fuels and renewables are base loaded. The secret will be to match the application of supply side technologies with those on the demand side such as electric transportation, heating, cooling and industry so that the overall cycle is lower carbon. In the meantime, there are multiple opportunities from redesign of processes and engines to carbon capture, use and storage, to solar radiation modification and general energy productivity to be pursued in a climate of innovation and entrepreneurship, all with the purpose of supporting rising living standards and quality of life across the globe.

A new Millennium Warm brings opportunities as well as threats. Warmer climates result in more land within the productive agricultural zone, longer growing seasons and more varied crops. It also means more need for irrigation and moving water from high to low rainfall areas and addressing all aspects of water management from storm water to river flows to sewage handling to coastal protection. In polar and temperate climes, it means less dependence on heating and more attention to building and insulation standards.

In tropical and desert climes, the same issues of water management apply but the issues of temperature management become much more important with the need to provide different solutions for cities versus rural settlements.

Faced with 300-400 years of a Millennium Warm, we may finally make some progress on the infrastructure investments necessary for a sustainable future, infrastructure investments which have been sadly neglected in the developed world and which are fundamental to lift the quality of life in the developing world.

What is needed to bring together Science and Technology is not a populist and centrally “planned” set of directives and grandiose gestures. The past record of short-term fixes and platitudes as substitutes for policies would not bode well for the future. The unintended consequences of responding to the SO2 acid rain lobby was the removal of the equivalent of 2-3 Mount Pinatubo eruptions per year from the atmosphere that probably could account for most of the 0.5 to 1.0degC temperature increase since 1970. Mandated oxygenates led to contaminated water tables while mandated ethanol has driven up food prices and directionally increased poverty.

Rather we need a framework and a marketplace where the opportunities and incentives for a cleaner and sustainable pathway are clear. On the one hand, putting a price on harmful impacts combined with front end support for new technologies will set the direction and encourage the invisible hand and animal spirit to come up with the solutions. On the other hand, the issues need to be addressed not from the comfort of the well-fed, well-heeled and energy profligate “Haves” and “Posh Protesters” but from the 50% of the World’s population “Have-Nots” who live on less than $5.50 per day or the 650 million “Have-Nothings” who try to survive on $1.90 per day.

There are 17 Sustainable Development Goals adopted by all UN Members in 2015:

1)No Poverty

2)Zero Hunger

3)Good Health and Well-being

4)Quality Education

5)Gender Equality

6)Clean Water and sanitation

7)Affordable and Clean Energy

8)Decent Work and Economic Growth

9)Industry, Innovation and Infrastructure

10)Reduced Inequalities

11)Sustainable Cities and Communities

12)Responsible Consumption and Production

13)Climate Action

14Life Below Water

15)Life on Land

15)Peace, Justice and Strong Institutions

17)Partnerships for Goals

Assessing Global Warming in the context of those Goals and from the perspective of the bottom 50% on $5.50 per day, the 3 billion people without clean energy for cooking or the 950 million without access to electricity, you are likely to prioritise them somewhat differently than if you were in the top 1% with 44% of global household wealth or just an average OECD citizen with a daily income of $85 per day.

It is time for the “Haves” to look at Climate policies and sustainable development in the round and proselytise less about some utopian escape from the materialistic world they reluctantly inhabit and focus more on lifting the great majority of humanity out of the daily grind of survival.

That does not mean we should do nothing now. At the very least we should immediately adopt common sense or “no regret” steps to mitigate our impact on the environment. More than that we should place our development support and infrastructure investment in those places where early adoption of planet friendly and energy efficiency policies could support economic development with the minimum adverse environmental impact. In Africa for example, mass transit in cities, cross continent railways, renewable energy, electricity infrastructure, electric vehicles, water and irrigation, waste management, high productivity farming, protection of forest CO2 sinks or whatever is sensible for developing countries to avoid the mistakes made in developed countries over the past 220 years.

Let’s be practical:

MIIGATION:

IMMEDIATE:

1)Initiate INDEPENDENT Government funded research effort to increase confidence in the underlying science, establish a broad consensus on the science and predictive models and get everyone on the “same page” without dogma, vested interests, or unsubstantiated theories.

NOW:

1) Stop extracting all SO_2 from fossil fuels.

   Set an interim standard of 1.0%S for fuel in electricity generation, cement, heavy industry and marine and 0.5%S for aviation and long-haul transportation to restore the CO_2/SO_2 balance in the transition to a lower carbon energy mix. Combine with push for electric vehicles for personal transport.

   Monitor impact on atmospheric temperature and rain acidity.

2) Stop the Waste

   Food waste from farm to fork is 30% and contributes 8-10% of GHG emissions.

   Municipal Waste is 2.3 billion tons and generates 5% of GHG emissions.

   Energy efficiency to meet 3%/annum IEA target would generate 12% per annum GHG reduction.

3) Tackle Methane

   Do a Montreal on fugitive CH_4 emissions from oil and gas production and flaring and use the energy productively.

   No land fill installtio0ns without CH_4 capture and use.

   These two would reduce CH_4 emissions by up to 45%

4) Clean energy for cooking for 3 billion people.

   Gas cookers and bottled gas available to the 3 billion people without access to clean cooking; the modern equivalent of free kerosine lamps to China.

   Would cost about $300 billion, eliminate most of Black Carbon, and reduce temperatures by reduced IR absorption and a higher albedo. Would also save 1.6 to 4.3 million deaths per year from indoor air pollution.

5) Phase out all subsidies for fossil fuels.

   currently about $300 billion per year

Together these 5 focus areas would offset most of the 1.09degC temperature increase since pre-industrial times, stimulate economic growth, reduce world poverty and save lives.

SHORT-TERM

1) Establish a "Manhattan" style project for the development of advanced nuclear options including Fission and Fusion, economic design parameters, safety protocols etc to be made available to constructors and generating companies.

2) Encourage solar and wind generation where economic and support development of energy storage and low-cost transmission grids.

3) Deploy high-speed digital infrastructure to encourage decentralised work and reduce commuting and resize mass transport to match.

4) Encourage regenerative forestry and sustainable agriculture with use of more productive strains of cereals, better ruminant management, rice crops without wetlands and better waste management to reduce GHGs and save water.

5) Use Development Aid to tackle root causes such as poor infrastructure, lack of electricity, lack of clean cooking fuels, water availability and irrigation, waste management, lack of digital infrastructure and availability of education for all.

These are all "no regret" steps to take assuming the climate alarmists are right, and even if they are wrong. But what if indeed we are simply moving from an abnormally cold Little Ice-Age to another Millennium Warm, like those in geological history, with 300 to 400 years of average temperatures around 2degC warmer than we have experienced for 700 years.

What lessons can we learn from history, from climate, from environmental development, from agriculture and from human development that will allow us to develop further while enhancing the planet we inhabit?

ADAPTION:

We know that:

*The growing season in more polar climes will be up to 6 weeks longer thus providing for a wider range of crops across a greater geography and, if accompanied by higher CO_2 concentrations, more productive crops.

-more productive use of land with less fertilizer

*In more tropical and continental climes, the challenge will be lower precipitation and access to water.

-better irrigation infrastructure and water management

-more drought resistant crops

*Rainfall will be higher and more intense.

-infrastructure to manage run-off and floods

-water management to move water from high to low precipitation areas

-river flow management for transport continuity

*Temperatures will be higher

-building construction standards

-insulation/ventilation to manage temperature ranges

-modern fire management versus suppression

*Sea levels will rise

-better coastal protection infrastructure

-better flood management systems

In many ways, the challenges facing the planet and humanity over the next 300-400 years are less daunting than those facing our predecessors during the Little Ice-Age. We now have the technology and the capacity to look at these challenges positively and address them rather than folding our tents and retreating into another period where life is “solitary, poor, nasty, brutish and short”. We need to move on from a “Canute” belief that we can stop change and turn back the forces of nature and move on to determine and implement what we can do to take advantage of the opportunities and mitigate against the challenges that change will inevitably bring.

Climate on Earth is a complex adaptive system with multiple input variables from the sun and the solar system and complex interactions between the land, oceans, biosphere and layers of atmosphere. In short, difficult to understand, never mind predict. The longer-term trend has been towards cooler temperatures and within that trend, man-made additions to green- house gases and reductions in reflective coolants may have helped offset the trend for a while. We know that today’s global temperature is higher than it was in 1850 but whether it, or CO_2 concentrations, are too high or too low is unclear. If you are a farmer, warmer weather and more CO_2 and accompanying higher rainfalls usually means better crops. If you live in more polar climes, higher temperatures and CO_2 concentrations mean longer growing seasons, a wider range of crops and a more liveable climate. On the other hand, warmer tropical climates become more challenging and coastal areas pose more risk. The question is that with so much uncertainty, should we trust politicians with 5-year attention spans to have either the capability or good sense to avoid special interests or populist idealogues, re-engineer the Global climate and out-think Mother Nature. Will they manage to reduce greenhouse gases to the extent that they accelerate our decent into the next ice age or even worse, reduce CO2 levels below the 150ppm threshold needed to support plant life? Or will they inadvertently restore temperatures to their previous geological average of 18deg.C or worse, to the 23deg.C+ in past geological periods when dinosaurs roamed the earth?

Bottom line is to do the proper scientific research and build consensus around what needs to be done and, in the meantime, take practical steps to continue the gains of the last 200 years in terms of standards and quality of life, spread those gains more widely across the world, and ameliorate any adverse impacts on the environment and climate.

To paraphrase Stephen Hawking:

I don't fear Climate Change, I fear its Believers.

Nosautempopulus 2023