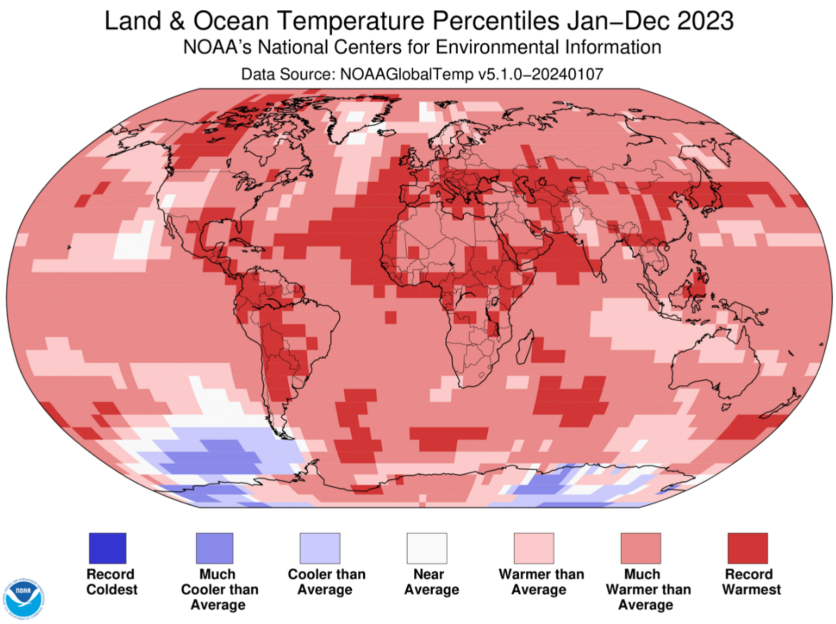
CLIMATE CHANGE: STATUS & TRAJECTORY IN 2025



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CLIMATE CHANGE:
STATUS & TRAJECTORY IN 2025

CONTENTS

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1. Introduction

There is a growing concern that the period following 2030 is likely to witness widespread deterioration in the world environment because of climate change.

The upheaval that follows will never before have been encountered in the annals of human existence.(*Ripple W).* Opportunities to prevent it are diminishing.

The purpose of this briefing is to address three environmental issues facing the world's population:

- the way in which the planet is heating, and its environmental and social consequences
- the nature of the greenhouse gas emissions driving the phenomenon and their future patterns
- concerns about measures that use land management projects to capture and sequester greenhouse gases as an alternative to preventing their emission in the first place.

2. Background

The international scientific community has warned about the causes and trajectory of climate change for over 35 years. But the next decade appears likely to be the forerunner of a catastrophic path for both the natural and human settings across the planet.

Heightening concern is the fact that not only was the period 2022-2024 the hottest on record, but the planet now has its highest surface temperature in 2000 years. Its average over the past century was warmer than at any similar period in the past 11,700 years (*Hansen).*

A consequence is that recent extreme summer heat events led to more than a dozen countries in multiple regions sweltering through temperatures of 48-52 degrees Centigrade. Night-time temperatures often stayed above 25 degrees.

There were an estimated 24,000 heat related deaths in the 2025 EU summer, three times the historical prevalence.

There is now sufficient energy in the lower atmosphere to underpin more frequent extreme climate impacts. They will be widespread, unanticipated and abrupt. Much of the damage will be irreversible.

Notwithstanding, the greenhouse gas reduction plans declared in 2025 by the countries who are signatories to the Paris Agreement 2016, will fail badly to reduce emissions by 2035 to the level needed to protect the planet *(Srouji)*.

The recent decision by the current US Administration to walk away from climate change management is very significant in this context, especially because of its position as the world's second largest greenhouse gas emitter.

2.1 Verifying the data accessed

There is a daily flow of international data and commentary on the current and future impacts of global heating.

The *References and Further Reading* section at the end of this brief lists the material that has been consulted, but priority has been given to key authoritative entities including:

Copernicus (EU)
CSIRO Australia
Forster P. (and 60 others), 19 June 2025
Global Carbon Project 2025 (interim)
National Aeronautics & Space Admin (USA)
National Climate Risk Assessment (Australia)
UN International Panel on Climate Change
UN Environment Program 2025
World Economic Forum 2025
World Energy Outlook 2025
World Weather Attribution
World Meteorological Organisation
World Resources Institute

The multidisciplinary nature of climate science makes it complex, especially when its focus is on the degradation of the lower atmosphere across the whole planet over a period of 200 years (namely 1900 -2100).

Added to this is the problem that not all countries have adopted the metric system in the *Standard International Units* of measurement for monitoring climate change.

- For example, one *SI* tonne is 1000 kilograms. But in the US it weighs 907 kg, and 1016 kg in the UK. The terms "ton" and "tonne" appear to be interchangeable as well.

This inconsistency may seem trivial. But as will be discussed, it is relevant when the mass of greenhouse gases and melting ice is measured in billions of tonnes.

This paper is written in Australia, which long ago adopted the metric system.

3. Human-Induced Global Heating: The Concept

The concept is essentially a simple one. The rays from the sun transfer energy into Earth's atmosphere, much of which is expressed as heat. The energy is either retained there; absorbed by the land and oceans; or reflected back out into space and lost.

A natural energy equilibrium was established across thousands of years between the surface of Earth and the lower atmosphere. This supported the evolution of all forms of life currently on the planet. The flux between two is estimated to be 15 billion tons of greenhouse gases.

But the dynamic started to change when nations industrialised with a heavy reliance on their burning of three natural resources - coal, oil and gas - for their energy.

Their dependency grew to the point at which human-generated energy was being released from Earth quickly enough to force an imbalance in the lower atmosphere. More was building up than was being dissipated.

The period before 1900 is recorded as having a zero energy imbalance. Human-generated excess energy changed relatively little from 1900 until 1980, but then grew quickly.

The UN International Panel on Climate Change (IPCC *AR6 2021*) has characterised the relationship between the energy imbalance and temperature increases at the Earth's surface from 1900.

The energy build-up increased the global *average* surface temperature by +1.52^{0}C in 2024. This makes it the warmest year on record, exceeding that in each of its prior 10 years. The land surface recorded +1.90^{0}C while the ocean surface recorded +1.0^{0}C *(Forster)*,

The 195 countries that ratified the *Paris Agreement on Climate Change 2016* have since agreed that the safe maximum temperature increase was to remain below +1.5^{0}C out to 2100. It also considered that hazardous outcomes were highly likely if +2.0^{0}C was exceeded in any single year before 2100 *(IPCC, 2018)*.

There are however, various ways in which the global temperature can be calculated. The method approved by the Paris Agreement excludes shorter term climate influences such as wildfires. The planet reached +1.36^{0}C in 2025 using the Paris approach *(Global Carbon Budget)*.

3.1 The impacts

Vital systems such as freshwater management, food production, biodiversity conservation, and ocean dynamics are already being disrupted.

As explained below, the continued heating during the period 2025-2029 is highly likely to extend the climate destabilisation, and will hasten adverse outcomes that include:

- a progressive loss of the polar ice caps and glaciers across many regions;
- thousands more people dying each year in areas where heat extremes prevail;
- significant agriculture and freshwater losses that will threaten food security, especially in less developed regions;
- a surge in losses from wildfires, violent storms and flooding;
- the exposure of millions of residents of low lying coastal communities to inundation from rising seas, and especially in the Pacific Ocean;
- a devastating loss of natural ecosystems.

Each additional 0.1°C above the +1.5°C will create its own new threat profile. Modelling points to the planet reaching between +2.6°C and 3°C in 2100 if appropriate carbon emissions reductions are not achieved and the current business-as-usual prevails (*National Climate Risk Assessment)*

4. The greenhouse gases

The excess build-up of energy is being driven by human activities releasing greenhouse gases that exist transiently in the atmosphere, or accumulate and persist indefinitely.

Universally accepted scientific projections about the pace of climate change have centred on one key variable, namely, the sensitivity of the lower atmosphere temperature to the addition of the next tonne of greenhouse gases that has been emitted from human sources.

The dominant greenhouse gas is carbon dioxide. It constituted 87% of the net 42 billion tonnes emitted by humans in 2025, and is released predominantly by the burning of coal, natural gas, and oil - the fossil fuels (*Global Carbon Budget interim)*

Carbon dioxide caused 73% of the global heating in that year, with methane 14%. The two differ in that, whilst methane and other greenhouse gases are relatively short-lived in the atmosphere, carbon dioxide accumulates over very long periods.

Climate change modelling for the period 1900 to 2100 establishes that the atmosphere initially had the capacity to absorb 3800 billion tonnes of carbon dioxide before its temperature would reach +2.0^{0}C. And that it would remain at that level until the end of the century if no further greenhouse gases were emitted *(Global Carbon Project)*.

The UN IPCC modelling shows that 2750 have already been emitted, leaving 1050 billion tonnes. But the remaining portion in 2025 for the more sustainable +1.5°C target to remain stable until 2100, is only 170 billion tonnes.

This creates an obligation to reduce emissions to below 20 billion tonnes per annum by 2030, *(IPCC 2018,;Forster)*, which is now impossible.

Business as usual for the planet will cause the emissions in 2035 to be 26-30 billion tonnes greater than the target for remaining below +1.5°C in that year *(Production Gap; Sirologi;*

4.1 The stickiness of fossil fuels

Solar and wind provided 15% of the world demand for energy at the end of 2024, while hydropower and nuclear provided a further 19%.

Photovoltaic solar energy generation is now enjoying an enormous increase in production across many countries, and in 2024 attracted US $559 billion *(IRENA)*.

However, 90% of the total spend on renewable energy and the supporting infrastructure was concentrated in advanced economies and China,

The partly explains why coal fired energy represents 40% of the global energy mix. But while it is declining, oil and gas have a very sound future.

Oil demand is expected to be 15% higher in 2035 than now, and another 300 billion tons of natural gas will be available to the market by 2030. Each is largely to cater for world population growth *(IEA)*.

In fact, a full conversion to a carbon-emissions-free world is unlikely to occur before 2070 *(IEA)*, because of factors such as:

- Investment during 2025 by large and medium-sized oil, gas and coal companies will reach US$2,000 billion. This includes maintaining and expanding existing carbon fuel supplies *(McKinsey)* .
- Record subsidies of US$7,000 billion are paid annually from public sources. They include financial incentives for new production facilities and subsidies for consumers to meet fossil fuel market prices (*Black; Global Subsidies Initiative)*.
  - A survey of oil and gas trade group allies reported that the fossil fuel industry spent

more than US$3 billion on lobbying and marketing in the decade up to 2018. Even if this outlay has decreased in more recent times, the scale and scope of promotions sustaining the sector remains substantial *(Downie and Brulle, 2023)*.

Coal power generation is controversial, not the least because it has the highest carbon emissions intensity of the three fuels.

The G7 countries agreed in May 2024 to phase out coal power plants by 2035, but its implementation is questionable. Prior to that, 69 billion Watts of new coal electricity capacity had come online in 2023 when only 21 billion was retired.

A evolving policy issue relates to the emergence of new high energy demand sectors across the global economy. Until recently the tertiary industry sector had been a less intensive energy consumer, but electricity and gas producers are now trying to come to grips with an enormous and rapid change occurring in OECD countries.

Growth over the past 5-7 years in new activities such as artificial intelligence, video streaming, bitcoin transactions, EV charging, online shopping, and work-from-home arrangements, is driving the construction of massive data storage centres that operate continuously.

A study in the US published in March 2024 estimated that by 2030, electricity demand by data centres in that country could triple, using the same power as 40 million homes (*Plumer&Popovich*). This has since been substantiated by the estimate that global investments in data centres will be US580 billion this year alone *(IEA)*.

The shortfall in renewable electricity and the transmission systems needed to connect its widely distributed sources, will cause natural gas to underpin power generation for the tertiary sector for years.

Yet this demand growth has not been factored into the modelling for global carbon emissions in 2030.

5. The greenhouse consequences

It is possible to view the small atmospheric temperature increase over a 125 year period from 1900 as trivial. The scepticism could be justified if it were not already for:

- The level of greenhouse gases in the atmosphere is higher now than at any time in the past 2 million years. Most human-induced emissions occurred after 1980.
- The global temperature increase was faster in the last 50 years than at any time in the past 2,000 years (*Rockstrom*). 2024 was the hottest in the 175 years for which records are available *(WMO, 2025)*.
- The frequency of extreme wildfires across the globe more than doubled during the past 20 years. Recent devastating and widespread incidents occurred in Australia, Greece, Turkey, Siberia, Canada and California.
- Destructive flooding also occurred in Australia, Florida, Pakistan, China, and Europe. Much was on a scale and intensity never before experienced.

The potential for future environmental degradation includes:

(a) The oceans:

90% of the excess energy created by humans since 1900 has been absorbed by the top 2,000 metres of the world's oceans. This prevented a hike in the planet's temperature great enough to eliminate all life as we know it.

But the oceans are now stressed as well. Marine heatwaves occurred across 96% of the world's oceans in 2023, and lasted 4 times longer than the historical average.. Then in 2024, the ocean heat content reached the highest point in its 65-year observational record.

The heat gain could be accelerating since the oceans are now warming at twice their recent historical rate *(Cuff, Jan 2025)*, If so, this challenges their ability to continue to perform their supportive role of moderating climate impacts in the longer term. (*WMO, 2025, WRI 28 Feb 25*), An immediate implication is the impact on the health and resilience of coral reefs across the planet. One school of thought is that they could face extinction within 25 years unless global heating is constrained. If so, one of the predominant nurseries for ocean wildlife would disappear.

For example, the last 12 months saw a marine heatwave across the 1500 km of coral reefs along the north west coastline of Australia. The heritage-listed Ningaloo Reef within in it experienced extensive coral bleaching and death.

The loss of corals at Ningaloo was part of the fourth and worst global mass bleaching event on record. It exposed more than 80% of reefs in more than 80 countries to temperatures high enough to cause bleaching *(Redfearn).*

There is evidence however that some species could evolve to adapt to the warmer water. Experimentation is continuing to determine if and how the accommodating strains could prevail. But.

The Australian experience with marine heat waves is interesting. The southern kelp forests in the seas near eastern Tasmania in the south of Australia have effectively disappeared under the progressive influence of warm water travelling south from the Great Barrier Reef.

There is also a massive algal bloom in South Australia's waters currently causing a devastating impact on a wide range of marine species.

The algal bloom demonstrates a further impact of marine heatwaves, and that is their role in triggering and amplifying damage from other ocean stressors.

In this case it appears to include nutrient pollution from nearby land and river sources, but a broader concern is its amplification of the global threat from ocean acidification that is progressing insidiously.

The potential scale of these cascading and compounding impacts could mean that biodiversity loss from marine heatwaves will be greater than for terrestrial species losses, and could materialise in the near term.

(b) The diminishing cryosphere

An immediate impact of the heating of the oceans is an acceleration of the melting of the Greenland and Antarctic ice sheets.

The Greenland ice sheet in the Arctic Circle is warming at four times the rate of the rest of the planet, and the Antarctic continent at twice the rate. Together they are losing more than 400 billion tonnes of ice each year.

The scale of the disappearance is impossible to visualise, or it was until NASA in the US offered a graphic comparison:

They estimate that the ice lost each year would cover New York City to about 380 metres, which is as high as the Empire State Building.

But that is only half the story. The glaciers in countries outside the ice caps across multiple mountain ranges, are losing a further 335 billion tonnes annually (*The Gambie Team, Feb 2025).*

Collectively, water from the melting ice is contributing to a sea level rise that is faster than during any other century in the last 3,000 years.

This is a serious concern for the one billion people who now occupy land that is less than 10 metres above current high tide lines *(Forster 2025)*.

The rising seas are causing saline water intrusion into low-lying coastal freshwater rivers and aquifers. Storms and high-wave events push the seas further up rivers and into wetlands as well.

- Data tracking the pace of the rising seas is often expressed as global averages over decades, but this down-plays the uneven distribution of the rise across the globe, and the greater exposure to its impacts by intensely populated urban centres.
- Low lying cities such as New York, Shanghai and London are already investing heavily in strategies to adapt to their increased vulnerability, and many other coastal communities will need to follow them urgently as the scale of the potential damage from the melting polar ice caps materialises.

(c) Food Security

The world will gain another 500 million people by 2030, and this will add to the competition for the land needed to feed the 675 million who are currently under-nourished.

But the quest for arable land is competing with investments within international financial markets pursuing plantations that attract carbon emissions reduction credits.

Broad-acre crops such as soy bean and palm oil have had sufficient profitability to warrant the destruction of arable land and its future food production.

The changes have also had marked impacts on regional watersheds vital for subsistence farming.

At the same time, a global increase in the extreme heat and changed rainfall patterns associated with climate change is already reducing efficiency in growing food staples. Further heating will progressively eliminate the horticulture adapted to less hostile circumstances.

(d) Negative emissions?

Not only is there a need for all fossil fuel emissions to be halved by 2030, but negative emissions are required after 2050 if the planet is to remain habitable in the second half of the century *(IPCC, 2018)*.

Negative emissions require processes or technologies that remove carbon from the lower atmosphere, and lock it permanently. This is to occur at a rate faster than that being emitted by humans.

It is not clear exactly how net negative emissions can be achieved by 2050 when fossil fuel burning is expected to continue well past then, most likely out until 2070 *(Schleussner C)*.

This topic is discussed further in # 8: *Net Zero 2050*.

5.1 Social and economic impacts

It is already clear that there will be increasing inequality in the capacity of different demographic groups to adapt to climate change as it unfolds. Only those regions with the capital to invest in measures to protect against significant loss and damage will escape the worst of the impacts.

But there is another social risk that is already playing out, and that is the position of the insurance industry worldwide.

This industry has the option of using differential pricing for climate risks based on the location and exposure of an applicant for an insurance policy, or on the nature of the hazards expected to be experienced in their region.

In the worst case, any insurance firm can decline to offer risk cover anywhere, or for an activity it considers to would be unprofitable for the insurer. In the interim though, insurance policy premiums in many regions are escalating to levels that their customers are progressively finding difficult to cope with.

Global re-insurers such as Munich Re and Swiss Re are fundamental to the financial sustainability of the world's insurance industry. Each has developed a sophisticated platform for monitoring climate threats and their expected trajectory, and are using these to determine which of the circumstances they will cease to insure and when.

For example, it is estimated that up to 2 million homes across Australia could be exposed to losses from flooding after mid century. There may well be many circumstances where local adaptation measures reduce their risk, but meanwhile many will face significant increases in their insurance costs *(National Risk Assessment)*.

Allianz, a major international insurer based in Germany, has argued that climate change is a systemic risk for the very foundations of the global financial sector. Loss and damage at +3.0^{0}C would be so great that neither governments nor markets would be able to respond effectively *(Carrington D)*.

The next 5-7 years could therefore see a growing influence of decisions by this industry on the economy of many regions.

In addition, global economic losses from extreme-weather-related events are estimated to climb, and be accompanied by a major decline in labour productivity due to exposure to extreme heat. A pressing question is the portion of the losses incurred that will be covered by the insurance industry.

The answer could be informed by the fact that while global natural catastrophes in 2024 inflicted US$417 billion in economic losses. only US$263 billion. was covered by insurance. This left a gap needing to covered by public finances and private asset owners *(Risk and insurance)*.

6. Freshwater security

One of the most widespread and immediate impacts of extreme climate events is the evolving threat to freshwater supplies for urban or agricultural consumption, and for the conservation of wildlife. Climate change is a 'risk multiplier" that adds a layer of complexity to already intricate water systems.

Precisely when water stress will occur in a specific region is determined by the timing, frequency, intensity and duration of rainfall events, and similarly for the prevalence of extreme heat events.

Human societies and natural ecosystems have evolved within historically consistent patterns of each, but climate change is already disrupting them in unpredictable ways.

Foremost is the acute risk of dwindling drinking water supplies that rapidly growing populations in many large cities face. This can be from the depletion of surface water or aquifer systems in their catchments. The risk is compounded by**:**

- Many regions will progressively experience a failure of rain because of a significant redistribution of water vapour travelling from the oceans to land, often under the influence of changing high atmosphere winds.
- Where intense and prolonged rainfall occurs on land, high velocity run-off can cause flash-flooding and destroy infrastructure. The damage is compounded when the rain is accompanied by high force winds.
- Freshwater supplies in urban and agricultural settings are degraded by either sewage effluent discharges or land based run-off, each of which can be polluted by nutrients, silt, salt or toxic chemicals..
    - The cumulative effect on aquatic ecosystems is not only devastating, but is also multiplied by two features of climate change: extreme heat that stimulates alien algal overgrowth of a river or lake; or the low flow conditions in droughts that concentrate the toxicity of salt or chemicals for the aquatic ecology.
- River flows in various regions are being diverted to hydropower electricity generators as part of the energy transition away from fossil fuels. This can cause a significant reduction in drinking water availability in the affected catchments.
    - But the reliability of both the drinking water flows and the amount of electricity generated are both challenged by extended drought or extreme heat conditions.
- Severe storms with high strength winds can reduce the integrity of water storage infrastructure. Flash floods upstream increase silt deposition in a dam, which reduces its capacity. But far more dangerously, there appear to be many dams with walls that lack the structural strength to resist the power of the storms that are likely to be more frequent in a warmer world.

6.1 International security concerns

Collectively, the social impacts of these threats can compound to create local political instability, or in some circumstances international security concerns. Two potential international conflict zones that demonstrate the type of factors that need to be managed are :

The Mekong River Basin in SE Asia:

Climate change will directly challenge existing agreements requiring "reasonable and equitable" water-use among riparian countries along the Mekong River, namely Cambodia, Laos, Thailand and Vietnam.

Higher temperatures and greater unpredictability of the weather patterns will necessitate more intense real-time data-sharing by the Mekong River Commission to adapt to existing problems such as:

- lower dry season flows that not only make parts of the river impassable, impacting regional trade and navigation agreements, but also accelerates saltwater intrusion into agricultural lands and freshwater sources
- the exposure of the two largest water consumer sectors, agriculture and hydropower, to increasingly variable weather conditions
- the loss of the natural flood pulse from the failure of the annual monsoon season, which is vital for the viability of a wide range regional ecosystem services across the Basin.

India and Pakistan:

The water sharing agreement between India and Pakistan (*The Indus Water Treaty 1960*) over the six major rivers of the Indus Basin has long been regarded as highly successful.

But there are now three circumstances that could challenge the future of the agreement, namely:

- there has been an increase in the total projected water demand from 163 km^3 in 2015 to 225 km^3 in 2050.
- climate change has caused significant changes in rainfall precipitation patterns, making predictions less reliable; and
- climate change is causing decreased water inflows as the receding Himalayan glaciers that feed the water storages accelerates.

Perhaps these emerging issues would have been managed within the normal negotiations under the Treaty But political tensions between the two countries were reported in April 2025 that could make its future response to the climate impacts more complex.

The relevance of water stress to international security is discussed at *Department of Defense (USA) and National Climate Risk Assessment (Australia),*

In summary, our critical dependence on reliable and safe drinking water limits our ability to survive even relatively short-term supply interruptions. Climate change is clearly established as a threat-multiplier for this risk, which will materialise progressively over the next 10-20 years.

In the interim, water shortage crises are appearing without clear solutions. The issues confronting the residents of Tehran in Iran provides an important case study *(Sanam & Shokri)*

7. Carbon Offsets - friend or foe ?

The transition from a carbon-intensive world to one with low carbon emissions relies heavily on the immediate reduction of fossil fuel consumption.

Current approaches for a sustainable transition focus on achieving higher energy efficiency in urban and industrial settings; fully utilising low-carbon electricity generation from renewable sources; and linking clean energy generators to storage systems such as lithium batteries and pumped hydro.

Other means, such as replacing fossil fuels with hydrogen from “green energy” may be available to industry in the longer term. But by 2024, fewer than 5000 tonnes of hydrogen had been produced globally, of which only 150 were from green sources *(Brown,S)*.

Future generations of safe nuclear energy technologies may be available for small to medium scale production after 2040, but whether or not it is cost-competitive is questionable.

It would then take a further decade before their output can make a meaningful contribution to resolving the climate threat *(CSIRO)*. This is far too late to be considered an option for reducing increasingly hazardous carbon emissions.

Two further but highly contentious approaches are being debated that aim to ameliorate the inevitable prolongation of fossil fuel consumption.

Their intention is to compensate for substantial ongoing emissions by offsetting them with:

Carbon capture and storage *(CCS or geosequestration)*, where carbon dioxide emissions are usually buried underground, or

Biosequestration, where vegetation and soil are exploited to extract the gas from the atmosphere and incorporate it into their living and growing matrix.

Extensive literature is available on the pros and cons of each, but essentially:

Carbon capture and storage has not yet worked at a required scale, despite trials over 20 years at great expense largely from public sources.

Only 375 million tonnes of carbon dioxide were captured over the past decade. During this time, 375 *billion* tonnes were released to the atmosphere from fossil fuel burning (ie 0.1%).

In other words, the CCS projects reduced some of the carbon emissions associated with the extraction, processing and distribution of the fossil fuels, but offered no relief for the emissions caused by their burning. This represents a wasted opportunity for investments that would have sponsored carbon-neutral renewable energy.

CCS remains very expensive, technically complex, and in many circumstances creates unacceptable environmental risks. Nevertheless more than 50 new projects are in the pipeline around the world.

The topic is the subject of two recent reviews at *Gaurav , & WRI (16 May 2025).*

Biosequestration, which utilises the uptake of carbon by vegetation and soil, faces other issues.

The terrestrial environment is neither a reliable nor efficient entity for the wide-scale or long-term capture and storage of greenhouse gases because *(Doolan):*

- measurable carbon capture and retention can take up to a decade to start after planting native vegetation, during which fossil fuel combustion continues unabated.
- biosequestration effectiveness can be fickle. Variable microclimates; sporadic threats like bushfires, alien species invasion; and floods, all reduce its long term efficiency and resilience.
- the suitability of the plant species nominated for a site may be inappropriate, and especially in the face of a changing climate that could be more hostile to its growth.
- human activities such as clearing or burning native forests for agriculture, mining, and wood harvesting further threaten standing forests, as do drought, pests and pathogens. Each can turn sustainable ecosystems from carbon sinks to emitters, sometimes rapidly.

The scale of these challenges has already materialised. Carbon flows between land and the atmosphere resulted in a *net* 4 billion tonnes of carbon dioxide being emitted from all vegetation, freshwater and soil sources in 2024 (*Global Carbon Project).*

Compounding this negative impact, tropical primary rainforests lost 6.7 million hectares of cover in 2024, the highest loss in the last two decades *(Goldman).*

It isn't clear though, if land-based emissions are a short-term phenomenon influenced by recent and extensive wildfires, or a structural change. On the other hand, recent data suggests the sequestration efficiency of high-value tropical forests may be declining as their local atmosphere warms (*Zeppel, M)).*

Sustainable investment funds are investigating the credibility of supporting the conservation of native forests. But to be effective, they need a long term commitment to their management. This can be difficult for private capital that is often mobile across international markets.

Projects that regenerate degraded agricultural lands to their original natural state may be able to achieve reasonable carbon sequestration in the medium term.

However, they do require complex science-backed planning to manage all of the relevant environmental variables at a specific location, and especially regarding reliable water availability.

In fact it is technically difficult to quantify and then verify the carbon sequestration performance and resilience claimed for either forest conservation or land improvements. Audits of the value of both have repeatedly found them to be questionable at best, and controversial on occasions.

Overarching these concerns is the fact that carbon credit trading is being be used as a substitute for reducing emissions, and serves to postpone the closure of high carbon emission sources.

While it is now is clear that the +1.5^{0}C threshold is no longer avoidable, urgent measures must be implemented early to prevent the lower atmosphere reaching +1.6^{0}C, and certainly not +1.7^{0}C.

The frequency and severity of the climate impacts accelerate progressively as these levels are breached.

The world is on a path to emit at least 26 billion tonnes of carbon dioxide above the level needed to stay below +1.5^{0}C in 2035.

Continuing with the world's current emissions without further direct source abatement could see these higher levels reached by 2033 and 2037 respectively *(Zickfeld S).* There is now no time left for experimentation with alternative approaches.

8. Net Zero 2050

The future of fossil fuel burning appears to be assured for many years to come. And especially because of the massive investment occurring in new supplies of natural gas (McKinsey).

This conflicts with the understanding that carbon emissions must be reduced significantly before 2030 for the future health of the planet.

The hallmark response by governments and business is their highly publicised commitment to achieve "Net Zero" carbon emissions by 2050 as implied by Article 4 of the *Paris Agreement 2016*. This commitment increasingly represents a major part of the international environmental credentials of the signatories.

Common measures for delivering on the goal include shutting down high emitting activities; replacing fossil fuels with renewable energy plus electricity storage; or improving energy efficiency with the deployment of new process technologies.

The Agreement also acknowledges a future role for offsets in meeting this target, which is relevant for intensive energy industries such as steel and aluminium smelting that find it technically hard to abate their emissions.

A common approach for them is to participate in carbon markets where credits have been authenticated by governments. The Australian Carbon Credit Units Scheme is one such system where the trades are approaching AU$1billion annually *(ACCUS)*.

Unfortunately other credits are also traded in unregulated offshore voluntary carbon markets. The quality of many is questionable, notwithstanding the efforts of *The Integrity Council* to improve their reputation internationally *(ICVCM)*.

Perhaps it is not surprising therefore, that a preferred definition of Net Zero by some writers is for a reduction in fossil fuels before 2050, and to a level that natural systems such as the oceans and native forests can absorb from then on *(Gergis)*.

This option is no longer viable in the absence of quick and substantial emissions reductions.

9. Comment

The world has entered into one of the most significant climate shifts in the history of civilisation.

But unlike previous periods, our threat is being compressed into a few decades, and will include impacts that will be irreversible over centuries.

More frequent extreme and dangerous events will occur non-linearly across time and space, diluting the accuracy of predictions about their arrival. Their abrupt appearance will also challenge the capacity to protect exposed life and natural resources from loss and damage.

An early transition away from fossil fuel consumption to zero carbon alternatives could have provided a powerful response for protecting the planet.

But ongoing international political procrastination not only rendered that a luxury, but 2025 also witnessed a growing rejection by the body politic of the essential sciences underpinning the phenomenon. “Fake news” expletives are becoming commonplace.

And especially in the USA, the world’s second largest greenhouse gas emitter. It effectively dismantled its national scientific and legislative frameworks for reducing carbon emissions.

The USA’s prohibition on providing their extensive data on the progressive environmental deterioration of the planet, undermines disaster management and adaptation planning worldwide.

Projections are now recognising that the planet will need to cope with its atmosphere heating by +1.7^{0}C, and far sooner than expected.

There is little understanding about how this will be achieved.

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