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200 Years of Fossil Fuels and Climate Change (1900-2100)

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ABSTRACT

The geologic record shows that the Earth's climate has always been changing naturally during the past 600 million years in terms of CO₂ and temperature, without CO₂ emissions from Fossil Fuels by humans. There were both warming and cooling periods prior to the appearance of human beings on the Planet Earth. The Anthropogenic Global Warming (AGW) is attributed to the Industrial Age that commenced in 1760 in the Great Britain and later in the USA. The principal driver behind the Industrial Revolution has been Fossil Fuels (i.e., Oil, Natural Gas, and Coal). Since 1900, Fossil Fuels have been the single most important driver of the modern human civilization. If the Net-Zero CO₂ policy were to be implemented, large numbers of people would die and the modern human civilization would come to a sudden halt, and humans left alive would have to revert back to the lifestyles of the Neanderthals who lived 40,000 years ago without the benefits of Fossil Fuels. The failure of the Net-Zero policy is already evident by (1) the Germany's shift back to coal from unreliable wind to face the energy crisis caused by the Russia-Ukraine War on 24th February 2022, (2) the bankruptcy of Sri Lanka in 2022 caused by the ESG (Environmental, Social, and Governance) policy that banned chemical fertilizers, and (3) the major victory by the Dutch pro-farmers party (BBB) in the 2023 provincial elections in opposition to the Dutch government's climate policy to eliminate nitrogen emissions by reducing 30% of livestock in the Netherlands. A climate-change model for 200 Years (1900-2100) is proposed based on four basic parameters, namely, CO₂, Temperature, Population, and GDP per capita. The model shows a steady increase in all four parameters from 1900 to 2100. In this model, calculations based on the Max Planck's Curve by Van Wijngaarden and Happer (2020), an increase in CO₂ and Temperature by 2100 would be trivial and that would not hinder either the population growth or the GDP growth. Therefore, Climate Change is not an existential threat. The proposed roadmap for the future is to continue to use the Fossil Fuels as usual. The ultimate driver of the Earth's climate is the omnipotent Sun, not humans. The CO₂ in the atmosphere helps not only to modulate the Earth's Temperature suitable for human survival, but also to enhance Global Greening. Therefore, we should shift our resources and attention away from Global Warming and aim towards eliminating Global Poverty.

INTRODUCTION

The 2023 World GDP per capita is USD 13,920 (IMF, 2023), which is a 20-fold increase since 1900. During the same period, the

world population has increased nearly fivefold from 1.6 billion to 8 billion (Worldometer, 2023a). This remarkable and unprecedented transformation in human welfare can only be attributed to the omnipotent Fossil Fuels and related Industrial Revolution that began in 1760 (Fig. 1). In recent years, there have been attempts to villainize Fossil Fuels by various groups under the banner "Climate Change" (Epstein, 2022; Shanmugam, 2022). Such a critique is not only unfounded but dangerous, and it deserves a rigorous scrutiny. Therefore, the purpose of this review is to provide clarity to the ongoing debate on Climate Change. I have selected the following topics for consideration (1) Fossil Fuels vs. Renewable Energy, (2) Tropical Cyclones, (3) Climate Hypocrisy, (4) Governance, (5) CO₂ Coalition, (6) Bias and Flawed Scientific Methods, (7) Climate Change Model for 200 Years (1900-2100), (8) Lessons Learned, and (9) Roadmap to PEACE. This study integrates both geological and atmospheric sciences, with copious empirical datasets, in providing conceptual clarity. Additional information is included in the Appendix.

Fossil Fuels vs. Renewable Energy

An important objective of this review is to emphasize the benefits of Fossil Fuels (i.e., Oil, Natural gas, and Coal) to humanity when compared with renewable energy types (Wind and Solar) (Table 1). In practice, Fossil Fuels are cheap, reliable, and necessary, whereas Renewable Energy is expensive, unreliable, and a luxury. At present, 80% of the world's energy comes from Fossil Fuels, whereas only 3% comes from wind and solar. Fossil Fuels are the only energy source for critical areas, such as, agriculture, production of fertilizers, heavy machinery, aviation, shipping, trucking and other ground transportation, sanitation, and road construction. There are over 6,000 petroleum products that constitute the underpinning of modern living (e.g., smart phones, soap, tooth paste, shoes, toilet seats, N-95 masks, etc.; Ranken Energy Corporation, 2022). Wind and solar do not have hydrogen and carbon molecules, and therefore they cannot be a substitute for Fossil Fuels in vital areas (e.g., aviation, petroleum products, etc.). Products from a barrel of oil affect every facet of our life on a daily basis (Fig. 2).

Tropical Cyclones

Epstein (2022) writes about weather extremes born of carbon usage. In the U.S., whenever a cyclone hits the Gulf of Mexico, the first you hear from the weather forecaster on TV is that tropical cyclones are the result of anthropogenic global warming and related carbon emission. Epstein (2022, his page 277) tackles this fallacy head on by noting that "Long before significant CO₂ emissions, storms were taking tens and even hundreds of thousands of human lives in the

Table 1. Fossil fuels vs. Renewable energy. Modified after Shanmugam (2022)

Serial Number	Property	Fossil Fuels	Renewable Energy
1	Types	Oil Natural gas Coal	Solar Wind Hydro* Geothermal* Biomass*
2	Percentage of world's energy	80%	3%
3	Usage in critical areas, such as agriculture, production of fertilizers, heavy machinery, aviation, shipping, trucking and other ground transportation, sanitation, road construction, pipeline construction, military complexes, war machines, space industry, healthcare industry, among many others.	Yes	No
4	Petroleum products critical to modern living	>6,000 syringes, medical equipment, gloves, N-95 masks, Aspirin, antibacterial, cough syrups, lubricants, ointments	0 (Zero)
5	Energy density	Very high (Concentrated) composed of hydrocarbons	Low (Dilute)
6	Occurrence	Subsurface	Subaerial
7	Reliability	Very high. Continuous supply.	Low Sun and the wind are intermittent, uncontrollable, unreliable, sources of energy (Lawson, 2022; Schreiber, 2022)
8	Energy storage	Cheap and efficient	Expensive and inefficient
9	Emission of CO ₂	Low (Happer, 2022)	Zero
10	Damage to environment	Ninety percent of the internal combustion engine (ICE) lead-acid batteries are recycled (Eberling, 2022). Minimum Emission of CO ₂ (Lindzen, 2012; Happer, 2022)	Only five percent of the EV lithium-ion batteries are recycled (Eberling, 2022). Yes (e.g. killing of birds by wind turbines)
11	Group think	Low	Very high
12	Influence by International Organizations and Social Media	Accentuate the negative and ignore the positive attributes	Accentuate the positive and ignore the negative attributes
13	Research funding	Low	Very high. German funding for renewable energy research reaches 1.31 billion Euros (Meza, 2022)
14	Availability	Unlimited reserve with potential for new discoveries (CNOOC, 2002). Fracking of shale gas.	Unlimited
15	The ultimate effect of the Net-Zero policy (IEA, 2021; Lee et al. 2023)	Planet Earth with Neanderthal-like humans, and with real-world earthquakes, volcanic activities, meteorite impacts, tropical cyclones, and tsunamis	Not applicable
16	Operation	Ethical Methods of extraction of Fossil fuels do not employ renewable energy	Hypocritical Methods of extraction of renewable energy do utilize Fossil Fuels. 1. Wind turbines and Solar panels – the means of collecting renewable energy – are made with petrochemical products (Hockstad, 2016) 2. The green-energy elites, such as, Al Gore, Leonardo DiCaprio, and Bill Gates, fly to Davos in Switzerland to attend the World Economic Forum, where they promote renewable energy. However, their private jets consume enormous amounts of jet fuels emitting CO ₂ .

*Not the focus of this review

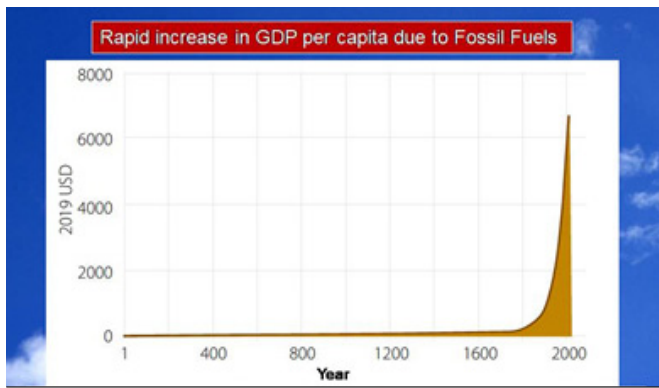


Fig.1. Chart of the GDP per capita for the last 2,000 years. Note that GDP has dramatically increased since the industrial revolution that began around 1760. Fossil fuels have been the key factor for this increase in GDP. Diagram from Darwall (2020). Additional labels by G. Shanmugam.

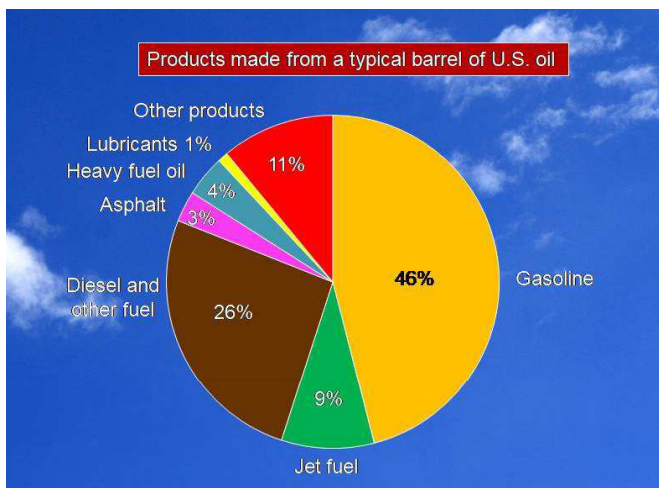


Fig. 2. Products made from a typical barrel of U.S. oil. Credit U.S. Energy information Administration. Public Domain

unempowered world, such as the 300,000 lives lost in an 1839 India cyclone”. Importantly, empirical data show that there is a decrease in storm-related deaths during the past six decades (Epstein, 2022, his Fig. 7.5).

The popular belief that Anthropogenic Global Warming (AGW) is the cause of tropical cyclones is wrong. A basic review of the aspects of tropical cyclones is in order (AOML, 2007a, b, c). Tropical cyclones are meteorological phenomena. A tropical cyclone is the generic term for a non-frontal synoptic scale low-pressure system over tropical or subtropical waters with organized convection (i.e., thunderstorm activity) and definite cyclonic surface wind circulation (AOML, 2007a, based on Holland, 2007, p. 1). The term “subtropical cyclone” is used for a low-pressure system that occurs anywhere from the equator to about 50°N. The term “extratropical cyclone” (also known as mid latitude or baroclinic cyclone) is used for a system that primarily gets its energy from the horizontal temperature contrasts that exist in the atmosphere (AOML, 2007b).

Structurally, tropical cyclones are large, rotating systems of clouds, winds, and thunderstorms. In the Northern Hemisphere, the rotation is counterclockwise, but in the Southern Hemisphere, the rotation is clockwise because of the Coriolis force. Necessary conditions for the development of tropical cyclones are (Gray, 1979; AOML, 2007c; Shanmugam, 2008) (1) a minimum distance of at least 500 km (311 mi) from the equator, (2) warm ocean waters of at least 26.5°C (80°F)

to a depth of about 50 m (164 ft), (3) an unstable atmosphere that cools fast with height, (4) relatively moist layers near the mid atmosphere (5 km; 3 mi), (5) a pre-existing near-surface disturbance with sufficient vorticity and convergence, (6) low values (less than about 10 m s⁻¹ [33 ft s⁻¹]) of vertical wind shear (i.e., the magnitude of wind change with height) between the surface and the upper troposphere, and (7) the Coriolis force. Nonetheless, examples of disturbances that met these favorable conditions but failed to develop cyclones. Thus, our understanding of the formation of tropical cyclones is far from complete (Gray, 1979; Shanmugam, 2008).

A storm surge is a coastal flood or tsunami-like phenomenon of rising water commonly associated with low-pressure weather systems, such as cyclones. It is measured as the rise in water level above the normal tidal level, and does not include waves. An aerial photograph shows the total destruction of the Bolivar Peninsula (Texas) (Wikipedia, 2023). The main meteorological factor contributing to a storm surge is high-speed wind pushing water towards the coast over a long fetch. The deadliest storm surge on record was the 1970 Bhola cyclone, which killed up to 500,000 people in the area of the Bay of Bengal. The highest storm tide noted in historical accounts was produced by the 1899 Cyclone Mahina, estimated at almost 44 feet (13.41 m) at Bathurst Bay, Australia (Wikipedia, 2023). We should be more concerned about meters-scale storm surges every year than about cm-scale sea level rise during the next 100 years

Empirical Data

- Cape Verde Islands (Fig. 3), which are the origination point of all Atlantic Hurricanes that landfall in the U. S. Gulf of Mexico and Cuba have the meager population of 540,000 and ranked 177th in terms of CO₂ emissions with 600,000 tonnes in comparison to the Rank # 1 China with 10,432,751,400 tonnes of CO₂ emissions (WorldoMeter, 2023b). Such empirical data undermine the notion that tropical cyclones are the manifestation of Anthropogenic Global Warming.
- Empirical data for the U.S. Atlantic Hurricanes show that there is a decline in number of hurricanes from 1941 to 2004 (NHC, 2023).
- Chand et al. (2022) have documented that the frequency of tropical cyclones tends to decrease with increasing use of Fossil Fuels from 1900 to 2020 (Fig. 4).
- The world’s second most populated country India with a population of 1.3 billion people shows 9 cyclones per year in the Bay of Bengal, but only 2 cyclones per year in the Arabian Sea (Shanmugam, 2008). These two examples show that there is no correlation between population density and cyclone generation.
- Finally, the detection of cyclones on Saturn (Fig. 5) proves that cyclones can be triggered without humans.

Clearly, available empirical data from Earth and Saturn do not validate the notion that Fossil Fuels used by humans are the cause of tropical cyclones. Cyclones are products of meteorological factors. In short, humans can neither create nor stop cyclones.

Climate Hypocrisy

Reversal in Energy Policy

Germany is the leader in promoting renewable energy. The German government has approved 1.31 billion Euros in funding for research related to the country’s energy transition, according to the federal environment ministry. In its aim to become climate-neutral and less dependent on energy imports, Germany is striving to convert its supply systems to renewable energy (Meza, 2022). Because of the ongoing Russia-Ukraine war that began in February 2022, sanctions were

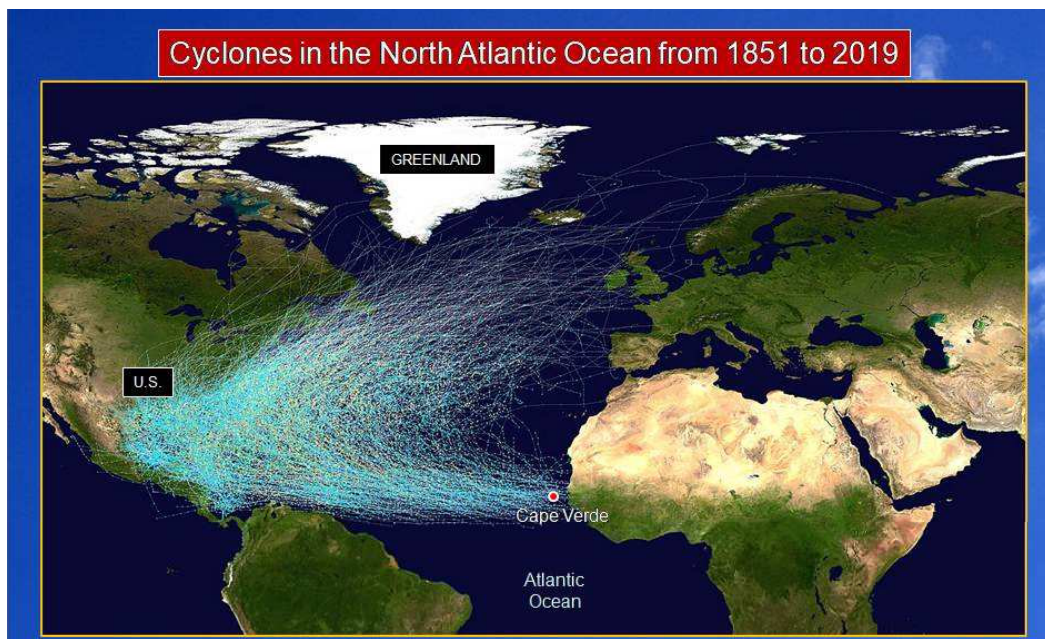


Fig.3. Tracks of all tropical cyclones in the North Atlantic Ocean from 1851 to 2019. Cape Verde Population 540,000. It is ranked 177th in CO₂ emissions. It is ironic that a small island nation with a meager population and trivial CO₂ emission could generate large number of cyclones! NHC NASA Wikipedia. Public Domain. Additional labels by G. Shanmugam.

imposed on Russia. Nord Stream 1 and 2 pipelines were destroyed due to sabotage. This led to shutting down of both Nord Stream Pipelines 1 and 2 that were built to supply gas from Russia to Germany (Fig. 6). However, under precarious war conditions, the only reliable energy sources are the Fossil Fuels (Oil, Coal, and Natural Gas), not renewable energy (Solar and Wind) (Eckert and Sims, 2022). More than a third (36.3%) of the electricity fed into the German power grids between July and September came from coal-fired power plants, compared with 31.9 percent in the third quarter of 2021, according to German statistics office Destatis. Long demonized by Germany's Green party, which leads some of the government's top ministries, coal was set to be phased out by 2030, but Russia's war with Ukraine and gas export curbs, brought coal back into favour (Eckert and Sims, 2022).
When their own energy security came under threat due to the

Russia-Ukraine war, western countries like Germany, the Great Britain, France, Austria, the Netherlands, Finland, Belgium, Italy, Spain, and Greece were swift to abandon their climate promises to adopt wind and solar, and went back to coal (Sharma, 2023). However, before the Russia-Ukraine war, at the 2021 United Nations 26th Climate Conference (COP26) in Glasgow, Scotland, most of the same western countries were admonishing India and China for not agreeing to "phase out" coal altogether in reducing CO₂ emissions (Ellis-Peterson, 2021). The lesson here is that the Russia-Ukraine war has blatantly exposed the inherent double standard or climate hypocrisy of the western countries!

Media Attention

In all, there were four underwater pipelines because each Nord

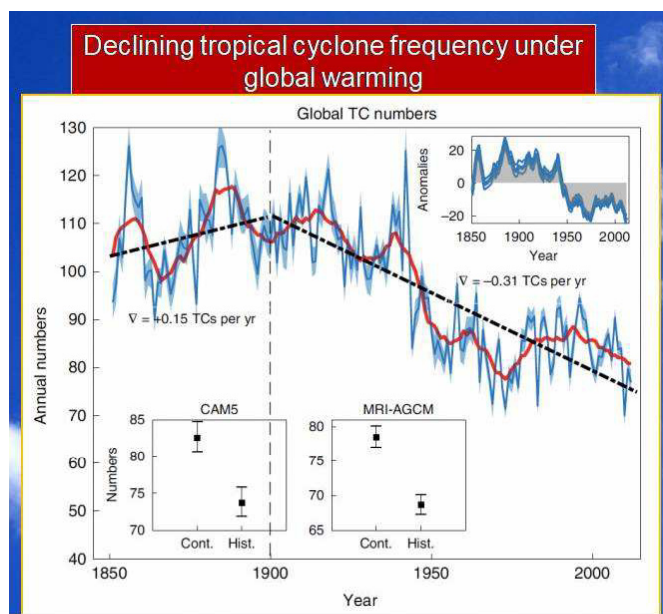


Fig. 4. Decline in frequency of tropical cyclones from 1900 to 2020 (dashed line). Diagram credit Chand et al. (2022).

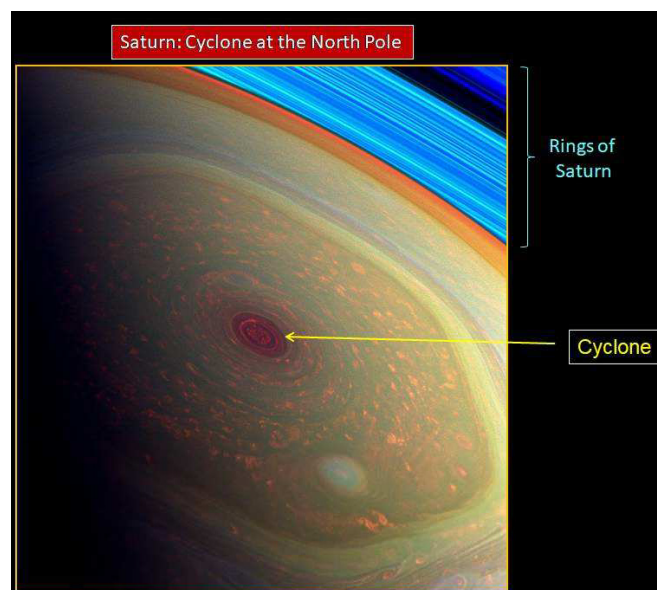


Fig. 5. Cyclone detected in the North Pole of Saturn. Image credit NASA Casini Mission, http://www.nasa.gov/mission_pages/cassini/multimedia/pia14946.htm



Fig. 6. Map showing the Nord Stream Pipelines 1 and 2 from Russia to Germany via the Baltic Sea. Map Credit: Gazprom, BBC. Additional labels by G. Shanmugam.

Stream pipeline contains two. Sabotage of Nord Stream 1 and 2 pipelines (Fig. 6) destroyed a total of three underwater pipelines. This led to sudden mega natural gas leaks in the Baltic Sea from late September to early October 2022, releasing huge amounts of methane into the atmosphere. Jia et al. (2022) studied the methane emissions

of this event based on surface in situ observations using two inversion methods and two meteorological reanalysis datasets, supplemented with satellite-based observations. They concluded that approximately 220 ± 30 Gg of methane was released from September 26 to October 1, 2022.

Although the sabotage of Nord Stream pipelines is still being investigated (e.g., Hersh, 2022), the fact that the emission of 220,000 tonnes of methane in six days (i.e., 36,000 tonnes/day) is the single largest anthropogenic emission of a greenhouse gas into the atmosphere in human history cannot be ignored. And yet, the Nord Stream story is getting only a minimal attention from the Media in comparison to a trivial increase of 20 ppb methane in 17 years (i.e., 1.17 ppb/year), as reported by the World Meteorological Organization (WMO, 2022) (Fig. 7).

Paris Climate Agreement

The objective of the Paris Climate Agreement of 2015 (UNFCCC, 2021; Schlessner, 2022) is to make all countries accountable to limit the increase in Global Temperature to 1.5°C (2.7°F), by reducing CO_2 emissions, in order to achieve the Net-Zero CO_2 by 2050. This agreement can be meaningful only if all countries are committed to follow the policy. This is because the Earth's Atmosphere is an open system (Fig. 8A). There are no barriers to prevent CO_2 emissions from spreading globally in the Atmosphere from China, which is ranked # 1 in CO_2 emissions (Fig. 8B). In short, the Paris Climate Agreement is of no practical value in reducing Carbon emissions until all countries participate in the Agreement.

World Economic Forum

Every year, the Global Elites arrive at Davos in Switzerland to attend the World Economic Forum in Private Jets (Sharma, 2023), emitting enormous amounts of CO_2 , to devise policies on reducing CO_2 emissions by the world's population.

The Net-Zero Ultimatum

The most recent *AR6 Synthesis Report: Climate Change 2023* (Lee et al. 2023) states that "B.5 Limiting human-caused global warming

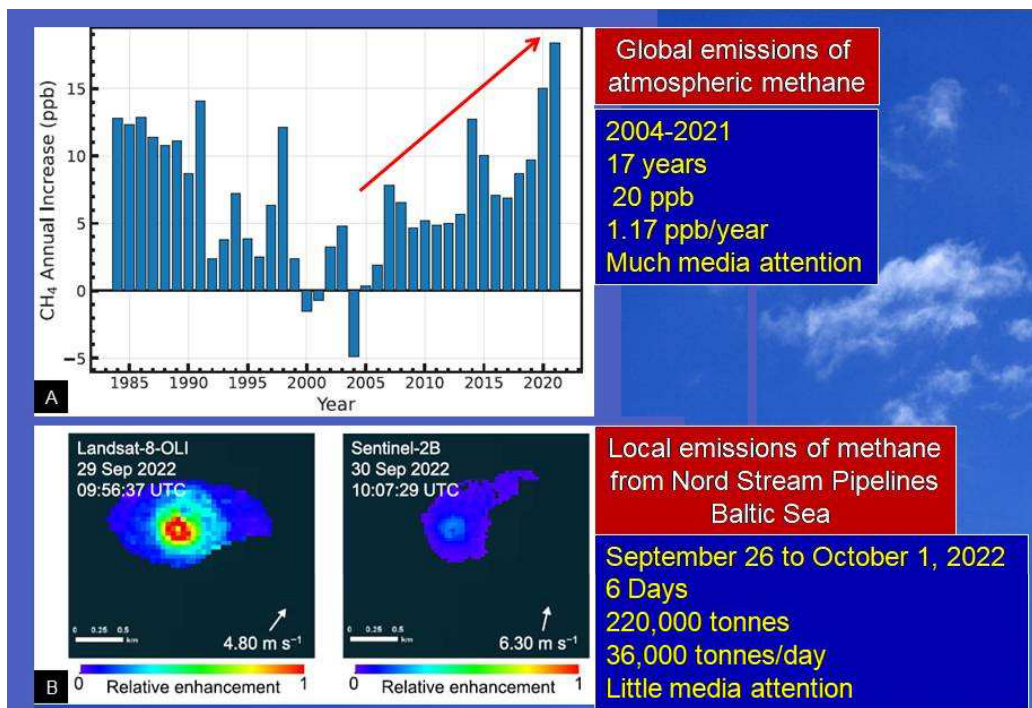


Fig. 7. Comparison of global (A) and local (B) methane emissions. A. Increase in emission from 2004 to 2021 (arrow). Image credit: WMO (2022). Arrow by G. Shanmugam. B. Enhanced images of methane leaks during two days in the Baltic Sea. Image credit: Jia et al. (2022).

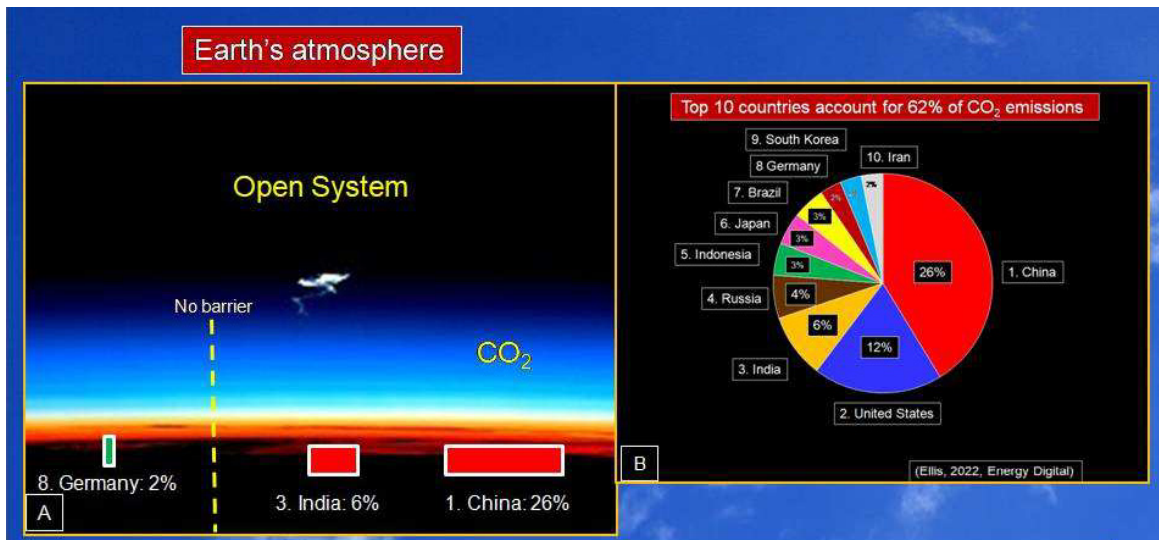


Fig. 8. A. Image showing that Earth's atmosphere is an open system. There is no barrier between countries that emit low amounts of CO₂ like Rank#8 Germany and countries that emit high amounts like Rank#1 China. The objects in the middle of the image is remnants of Soyuz capsule. Image credit: NASA. <https://www.nasa.gov/image-feature/the-remnants-of-the-soyuzs-fiery-plunge>. Additional labels by G. Shanmugam. B. Top 10 countries that emit high amounts of CO₂. Data source: Ellis (2022)

requires net-zero CO₂ emissions. Cumulative carbon emissions until the time of reaching net-zero CO₂ emissions and the level of greenhouse gas emission reductions this decade largely determine whether warming can be limited to 1.5°C or 2°C (*high confidence*). Projected CO₂ emissions from existing fossil fuel infrastructure without additional abatement would exceed the remaining carbon budget for 1.5°C (50%) (*high confidence*)."

Epstein (2022, p. 394) notes that "...President Joe Biden has made it a goal for the U.S. to have "Net-Zero" CO₂ emissions from electricity by 2035 and from all forms of energy by 2050— with unreliable solar and wind as the primary means of getting there."

This mandate, if implemented, requires 100% elimination of Fossil Fuels by 2050 in the U.S. Fossil Fuels is the underpinning of modern civilization that relies on petroleum products (Fig. 9). This policy can realistically be achieved only by eliminating the entire use of Fossil Fuels that emit CO₂. Renewable energy sources (wind and solar) cannot produce petroleum products (Fig. 9) because wind and solar energy sources do not contain hydrogen and carbon molecules. If the Net-Zero CO₂ policy were to be implemented, the modern human civilization in America would come to a sudden halt in 2050, and humans would have to revert back to the lifestyles of the Neanderthals who lived 40,000 years ago without Fossil Fuels.



Fig. 9. Nine examples of petroleum products that will be banned under the Net-Zero policy in 2050. These products cannot be manufactured or can functions without Fossil Fuels. Image source: Public domain.

Human Rights Violation

On February 27th, 2023, Greta Thunberg, a prominent Green Energy activist, joined protesters demanding the removal of 151 wind turbines from reindeer pastures used by Sami herders in central Norway. The protesters said that a transition to green energy should not come at the expense of Indigenous rights (Fouche and Klesty, 2023). The irony is that Greta Thunberg has been a strong advocate of Wind and Solar energy in the Green Energy movement!

Other Examples of Hypocrisy

- At present, humans cannot collect renewable energy without petrochemical-based wind turbines and solar panels (i.e. without emitting CO₂).
- There are 772 Pounds of petrochemical Plastics in each electric car (whipple, 2020). Eberling (2022) reported that “According to the International Energy Agency (IEA), an electric vehicle requires six times the mineral inputs of a comparable internal combustion engine vehicle (ICE). EV batteries are very heavy and are made with some exotic, expensive, toxic, and flammable materials. The primary metals in EV batteries include Nickel, Lithium, Cobalt, Copper and Rare Earth metals (Neodymium and Dysprosium). The mining of these materials, their use in manufacturing and their ultimate disposal all present significant environmental challenges. Ninety percent of the ICE lead-acid batteries are recycled while only five percent of the EV lithium-ion batteries are.”
- According to Chandrasekharam (2021), “For extracting, one ton of Li 6 tons of CO₂ is emitted. Li is used in the manufacture of Battery Electric Vehicles (BEV), Hybrid Electric Vehicles (HEV), plug-in hybrid electric vehicles (PHEV).”
- In protesting against the use of oil, student activists who glued themselves to the copy of Leonardo da Vinci’s classic painting ‘The Last Supper’ at the Royal Academy of Arts in London (Palumbo, 2022) must realize that all synthetic glues are made from petroleum products. In another example, the 16th century masterpiece “Mona Lisa” painting by Leonardo da Vinci was smeared with cream in a climate-protest stunt at the Louvre Museum in Paris (Reuters, 2022). These protests would not reduce CO₂ emissions, and the whole renewable-energy (Wind and Solar) movement is not only hollow but hypocritical.

Governance

Sri Lanka and ESG

In 2022, Sri Lanka declared bankruptcy (Bostock, 2022) following the adoption of ESG (Environmental, Social, and Governance) policy by banning chemical fertilizer in 2021. This climate-related policy resulted in drastic reduction in crop yields as well as nationwide shortage of fuels and food. Consequently, the country was facing the worst economic crisis in decades (Daily Caller News Foundation, 2022). According to Follett and Cochran (2022), “Over 90 percent of Sri Lanka’s farmers had used chemical fertilizers before they were banned. After they were banned, an astonishing 85 percent experienced crop losses. Rice production fell 20 percent and prices skyrocketed 50 percent in just six months.” Nationwide political unrest led to protests by the public against the government and the resignation of the Prime Minister. The lesson here is that developing countries like Sri Lanka should focus attention on the survival of humanity using Fossil Fuels at the present than the survival of the Planet in the future based on Utopia.

The Netherlands and Nitrogen Emission

In another example, a farmers’ party has stunned Dutch politics, and is set to be the biggest party in the upper house of

parliament after provincial elections. The Farmer-citizen movement or Boerbur Beweging (BBB) was only set up in 2019 in the wake of widespread farmers’ protests. The BBB aims to fight government plans to slash nitrogen emissions harmful to biodiversity by dramatically reducing livestock numbers by 30% and through buying out thousands of farms (Holligan and Kirby, 2023).

The “Nitrogen” emission is a complex issue. Some key aspects are as follow:

1. Nitrogen means the diatomic molecules N₂ that makes up some 78% of our atmosphere. There is not much anyone can do to lower the most abundant atmospheric N₂.
2. In the Netherlands, the main issue is ammonium, nitrite and nitrate ions in the soil and water, eutrophication of waterways, displacement of native plants adapted to “nitrogen starvation,” etc.
3. Another issue is the emission of nitrous oxide, N₂O, to the atmosphere. When the fixed nitrogen of the soil is finally broken down and returned to the atmosphere most returns as N₂, but around 1% returns as the greenhouse gas N₂O.
4. There is not much fixed nitrogen in cow dung. Most of the waste nitrogen from cattle, sheep, etc. is in their urine as urea CO(NH₂)₂.
5. Some of these issues are discussed in more detail in the paper entitled “Nitrous Oxide and Climate”, by de Lange et al. (2022) at this link: <https://arxiv.org/abs/2211.15780>.

For example:

- a) Higher concentrations of atmospheric nitrous oxide (N₂O) are expected to slightly warm Earth’s surface because of increases in radiative forcing.
- b) Radiative forcing is the difference in the net upward thermal radiation flux from the Earth through a transparent atmosphere and radiation through an otherwise identical atmosphere with greenhouse gases. Radiative forcing, normally measured in W/m², depends on latitude, longitude and altitude, but it is often quoted for the tropopause, about 11 km of altitude for temperate latitudes, or for the top of the atmosphere at around 90 km.
- c) For current concentrations of greenhouse gases, the radiative forcing per added N₂O molecule is about 230 times larger than the forcing per added carbon dioxide (CO₂) molecule. This is due to the heavy saturation of the absorption band of the relatively abundant greenhouse gas, CO₂, compared to the much smaller saturation of the absorption bands of the trace greenhouse gas N₂O.
- d) But the rate of increase of CO₂ molecules, about 2.5 ppm/year (ppm = part per million by mole), is about 3000 times larger than the rate of increase of N₂O molecules, which has held steady at around 0.00085 ppm/year since 1985.
- e) Therefore, the contribution of nitrous oxide to the annual increase in forcing is 230/3000 or about 1/13 that of CO₂.
- f) If the main greenhouse gases, CO₂, CH₄ and N₂O have contributed about 0.1°C/decade of the warming observed over the past few decades, this would correspond to about 0.00064 K per year or 0.064 K per century of warming from N₂O.
- g) Proposals to place harsh restrictions on nitrous oxide emissions because of warming fears are not justified by these facts.
- h) Restrictions would cause serious harm to humanity by jeopardizing world food supplies.

CO₂ Coalition

According to the “CO₂ Coalition”, a nonprofit organization (Happer and Lindzen (2022), there are fundamental issues surrounding the Climate Change paradigm:

- a) There is no climate-related financial risk caused by Fossil Fuels

and CO₂, but there will be disastrous consequences if fossil fuel use and CO₂ emissions are reduced to “Net-Zero.”

- b) Temperature Models tend to overhype the increase of temperature values with time.
- c) Geologic models have neglected to point out that CO₂ has been declining for 145 million years from about 2,800 ppm to today’s low 420 ppm
- d) Finally, there is no need for alarm due to increase in CO₂ in the future because even if the CO₂ content were to be nearly doubled to 800 ppm from the present, the temp will not exceed 1°C.

The Planck’s Curve

A brief introduction to Planck’s Curve (Fig. 10) is in order here because Van Wijngaarden and Happer (2020) used this curve as the basis of their calculation of temperature for CO₂ value of 800 ppm.

In 1900, in variance to classical physics, which assumed that radiation is emitted continuously by the matter with smooth continuous spectrum of all possible energy levels, Planck (1900, 1901, 1914) postulated that the electromagnetic energy is emitted not continuously (like by vibrating oscillators), but by discrete packages or quants, which resulted in the birth of modern Physics (Quantum mechanics). Planck’s Law states that the Spectral radiance of a Body (B) can be expressed as per unit wavelength (B_λ):

Planck’s Law

$$B_{\lambda}(T) = \frac{2hc^2}{\lambda^5} \frac{1}{e^{\frac{hc}{kT\lambda}} - 1}$$

Where B = Spectral radiance of a Body; T = Temperature; h = Planck’s Constant = 6.62x10⁻³⁴ Js; k = Boltzmann’s Constant = 1.381 x 10⁻²³ J/°K . λ = Wavelength; c = Speed of Light.

The Planck’s Curve (Fig. 10) clearly shows that radiated energy emitted at shorter wavelengths (Ultraviolet range) increases more

rapidly with temperature than energy emitted at longer wavelengths (Infrared range) (see Shao et al., 2019).

Related expressions are:

Frequency of radiation: E = hf

Or

Frequency of radiation: E = hf Quantum energy of photon

The Planck–Einstein relation (**E=hf**), a formula integral to quantum mechanics, says that a quantum of energy (E), commonly thought of as a photon, is equal to the Planck constant (h) times a frequency of oscillation of an atomic oscillator (ν, the Greek letter nu).

Where E = Energy; h = Planck’s Constant = 6.62x10⁻³⁴ Joule.Sec = 4.136 x 10⁻¹⁵ eV.s; f or ν = Frequency

van Wijngaarden and Happer (2020) Calculation (Fig. 11)

Van Wijngaarden and Happer (2020) emphasized that with respect to their calculation of future temperature increase caused by increasing CO₂ emissions using the Planck’s Curve (Fig. 11) (see also Happer and Lindzen, 2022):

- The area under the blue Planck’s curve is about 394 W/m². It is the total flux if the Earth would radiate to space if the surface were at a temperature of 60p F and there were no greenhouse gases to retard the escape of radiation.
- Without greenhouse gases, the total heat loss of 394 W/m² through a transparent atmosphere would soon cool the Earth’s surface to 16°F or -8.8°C, well below freezing. Most life would end at these low temperatures. We should be grateful for greenhouse warming of the Earth.
- Van Wijngaarden and Happer (2020) demonstrated that doubling CO₂ would result in a temperature increase of less than 1° C (Fig. 11). The reason is that the atmosphere is saturated with CO₂. In other words, there is no climate-related financial risk caused by Fossil Fuels and CO₂.

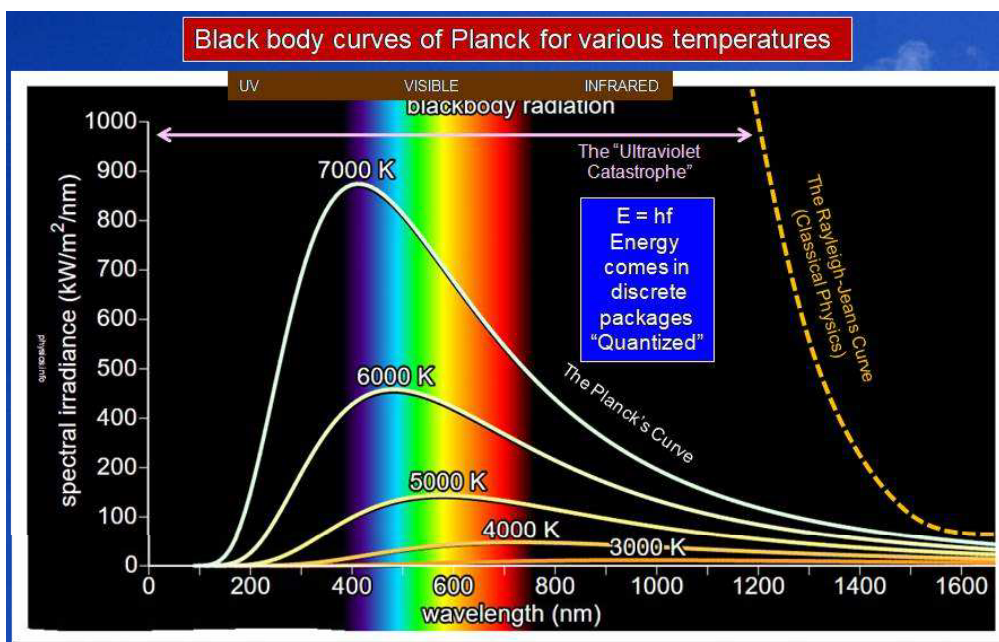


Fig. 10. Black body curves of Planck for various temperatures and comparison with classical theory of Rayleigh-Jeans. The Planck–Einstein relation (**E=hf**) a formula integral to quantum mechanics, says that a quantum of energy (E), commonly thought of as a photon, is equal to the Planck constant (h) times a frequency of oscillations of an atomic oscillator. Diagram source: Elert (1998-2022). Additional labels by G. Shanmugam. Note the peaks of Planck curves shift to lower wavelengths (leftward, from infrared to UV) with increasing radiation. Scale: 1 Nanometer = 0.001 Micrometer

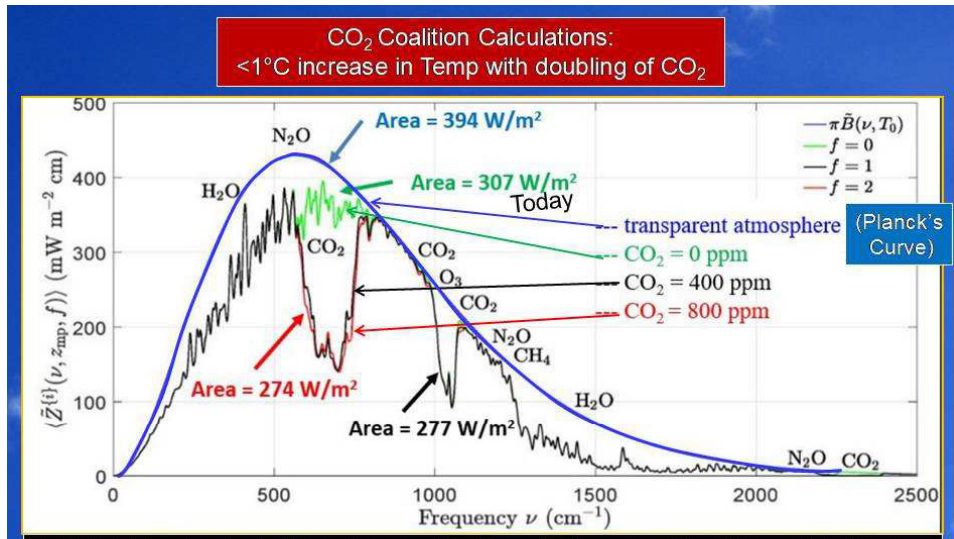


Fig. 11. Calculations based on the Planck's curve, reveal that temperature increase would be $<4^{\circ}\text{C}</math> even with doubling of CO_2 . Diagram from van Wijngaarden and Happer (2020). Additional labels by G. Shanmugam.$

Controlling Factors of Climate

Controlling factors of climate can be grouped in four levels.

- Tier 1. Sun's radiation.
- Tier 2. Earth's Atmosphere.
- Tier 3. Greenhouse gases: H_2O , CH_4 , CO_2 , N_2O , and O_3 .
- Tier 4. Fossil Fuels.

First, the supreme driver of climate in the Solar System is the Sun (Haigh and Cargill, 2015; Soon et al., 2015; Rossen and Egger, 2016; Soon and Baliunas, 2017). For example, the Insolation (W/m^2) is directly proportional to distance from the Sun (Fig. 12) (Rossen and Egger, 2016). However, the role of Sun in climate models is downplayed.

Second, the Earth's atmosphere is a critical factor in providing humans a comfortable climate for survival (Fig. 13), but humans cannot alter atmosphere to control climate.

Third, although water vapor is a more important greenhouse gas than CO_2 , the current emphasis is not on water vapor.

Fourth, Fossils Fuels are the least important factor in controlling climate, but most attention is given to Fossil Fuels.

Fifth, a major flaw with current Climate models is that they cannot take into account the role of clouds. The reason is that no one can predict the cloud patterns 50 years from now.

Sixth, the climate models cannot predict extreme weather events.

Finally, the current Climate models tend to exaggerate future Temperature increase (Van Wijngaarden and Happer, 2020; Happer and Lindzen, 2022).

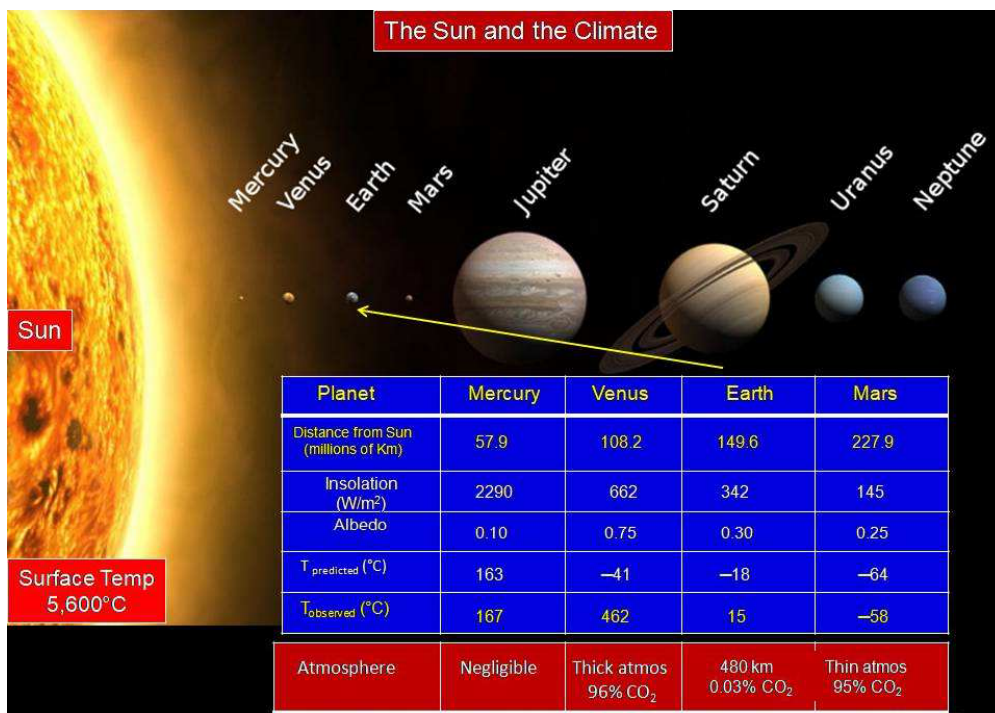


Fig. 12. The Sun is the supreme driver of climate. Blue Table: Rossen and Egger (2016); Red Table: NASA, <https://www.space.com/18527-venus-atmosphere.html>. Retrieved June 9, 2023; Image credit: NASA. <https://www.universetoday.com/15451/the-solar-system/>. Retrieved June 9, 2023

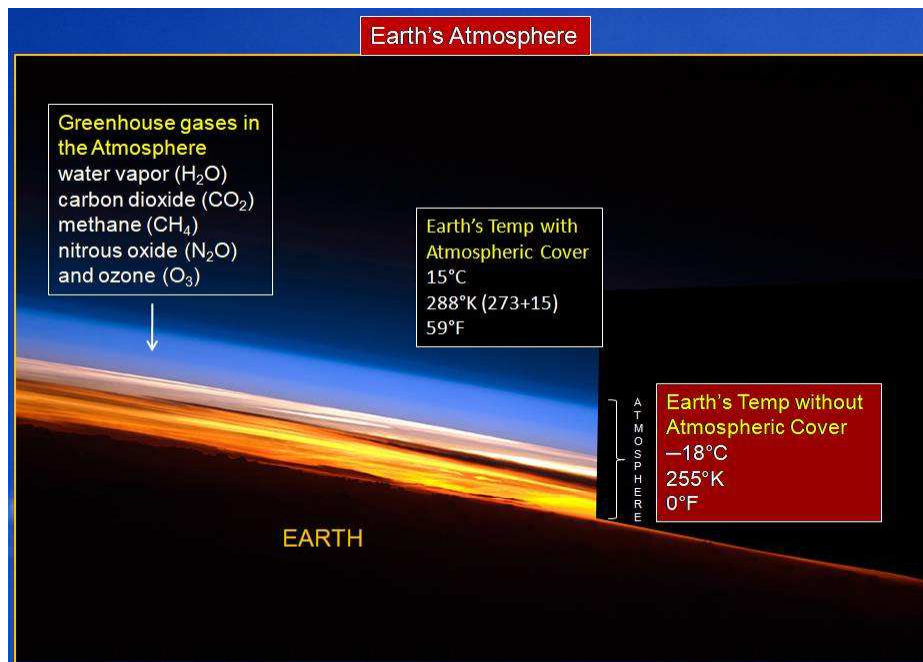


Fig.13. The importance of atmosphere in modulating temperature on Earth. Image credit: NASA. Buis (2019). Also see Hossenfelder (2023) and NASA (2023a). Additional labels by G. Shanmugam.

Bias and Flawed Scientific Methods

Renowden (2015) pointed out that relying on temperatures at the top of the Greenland ice sheet as a proxy for global temperatures is flawed. A single regional record cannot stand in for the global record. In short, the current use of regional datasets on CO₂ measurements near an active volcano from Hawaii by the Scripps CO₂ Program (2023) and on Temperature calculations from Greenland Ice Core as the underpinning for global climate models representing the human use of Fossil Fuels is problematic. Furthermore, the methane emission trend for the period 1983-2021 (WMO, 2022) does not show a steady increase analogous to CO₂ emissions.

Lomborg (2007) argued that rising temperatures could save more than 1.3 million lives per year, as more cold-related deaths than would be prevented than heat-related respiratory fatalities. According to Lomborg (2022), “Climate Change is a problem, not the problem”

Christy et al. (2010) noted out that IPCC model predicts a greater Global Warming than the measured Temperature data suggest (Fig. 14).

Wrightstone (2017) demonstrated less global warming for each additional 50 ppm by volume of CO₂, which disputes the claim by IPCC.

Curry (2023) pointed out that there are many uncertainties with

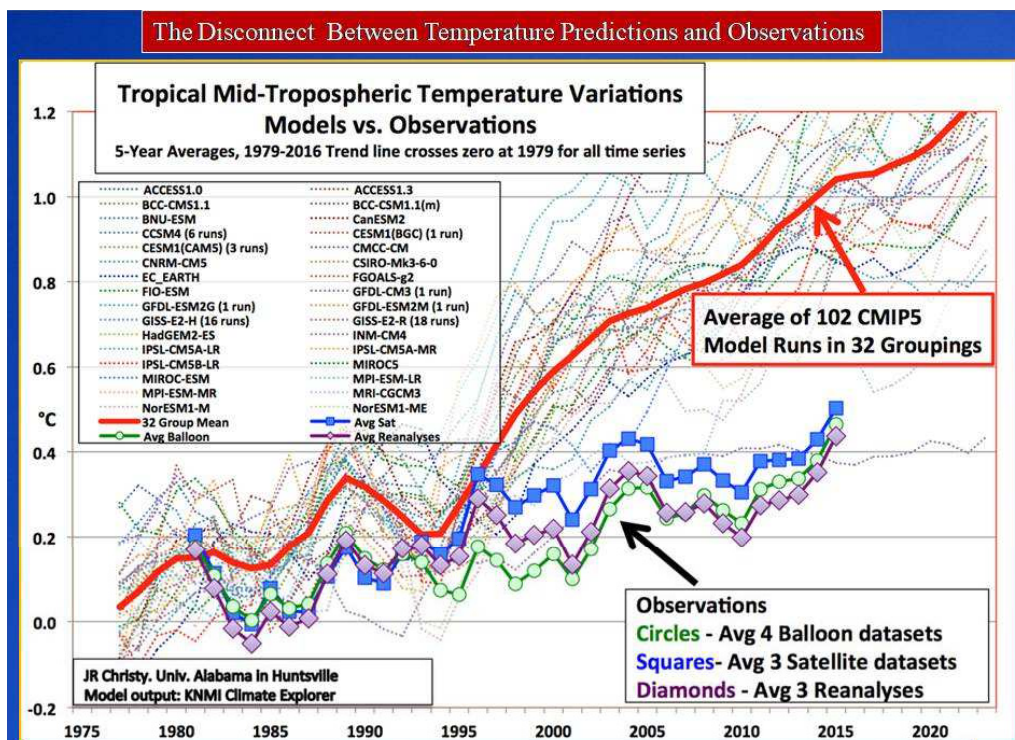


Fig.14. Exaggerated Temperature Prediction (Red Line) vs. Actual Data Observation. Diagram Source: Christy (2022)

Climate models that have never been addressed. For example, the role of ocean circulation, volcanic activity, and the impact of the Sun.

Epstein (2022, p. 63) emphasized under section “An Uncorrected Failure” that there are inherent problems and biases with climate scientists like James Hansen, Michael Mann, and Bill McKibben (see other examples by Van der Lingen, 2018; McKittrick and Christy, 2020; Koonin, 2021; Shanmugam, 2022).

Climate-Change Model for 200 Years (1900-2100)

Although the proposed model is for Climate Change (Fig. 15), Fossil Fuels are an integral part of the story. The Year 1900 is chosen as the starting point for the model for three primary reasons. First, the Standard Oil Company, Inc. was an American oil production, transportation, refining, and marketing company that operated from 1870 to 1911 (Tarbell, 2013). At its height around 1900, Standard Oil was the largest petroleum company in the world (now called ExxonMobil). ExxonMobil, which is the direct descendent of John D. Rockefeller’s Standard Oil, is still the world’s largest oil and gas corporation in 2023. Second, the Wright brothers, American aviation pioneers, were responsible for inventing (1903), building, and flying the world’s first successful motor-operated aeroplane. Third, Ford Motor Company was founded in 1903. It is worth noting that Standard Oil was founded in Cleveland, Ohio and the Wright Brothers were born in Dayton, Ohio. This 1900 time frame allows a full integration of CO₂ emissions from Fossil Fuels into the climate model. Incidentally, the CO₂-Temperature calculations (Van Wijngaarden and Happer, 2020) used in the model were based on Planck’s Quantum theory that was also introduced in the year 1900!

In developing a Climate Change model for 200 years (Fig. 15), I have examined the four basic parameters, namely

1. CO₂ (Lindsey, 2022; Van Wijngaarden and Happer (2020; Happer and Lindzen, 2022),
2. Temperature (Allen et al., 2018; Van Wijngaarden and Happer, 2020; Happer and Lindzen, 2022; Lee et al., 2023; Osborn, 2023), and Table 2),

Table 2. History of Changes in the Earth’s Temperature. Modified after Current Results (Osborn, 2023) with Lee et al. (2023). Note that projected Temperature in the 2100 would be 16.01°C or 60.81°F, which is the same temperature range that we experience today in 2023. There is no existential threat due to Climate Change in the next 100 years.

Decade	°C	°F	Comments
1880s	13.73	56.71	–
1890s	13.75	56.74	–
1900s	13.74	56.73	–
1910s	13.72	56.70	–
1920s	13.83	56.89	–
1930s	13.96	57.12	–
1940s	14.04	57.26	–
1950s	13.98	57.16	–
1960s	13.99	57.18	–
1970s	14.00	57.20	–
1980s	14.18	57.52	–
1990s	14.31	57.76	–
2000s	14.51	58.12	–
2100	16.01	60.81	14.51 + 1.50 = 16.0°C. This 2100 Temperature increase is based on IPCC Reports (Allen et al., 2018; Lee et al. 2023).
–	18.00	0.00	*Earth’s Temp without Greenhouse Gases would be 255°Kelvin
–	0.00	32.00	*Freezing/melting point of water
–	21.11	70.000	*Room temperature
–	37.00	98.60	*Average body temperature
–	100.00	212.00	*Boiling point of water

*Added in this study

3. Population (United Nations, 2023; Worldometer, 2023a), and
4. World GDP per capita (Long, 1998; Darwall, 2020; Future Timeline, 2023).

The strength of this model is that it incorporates trends of all four

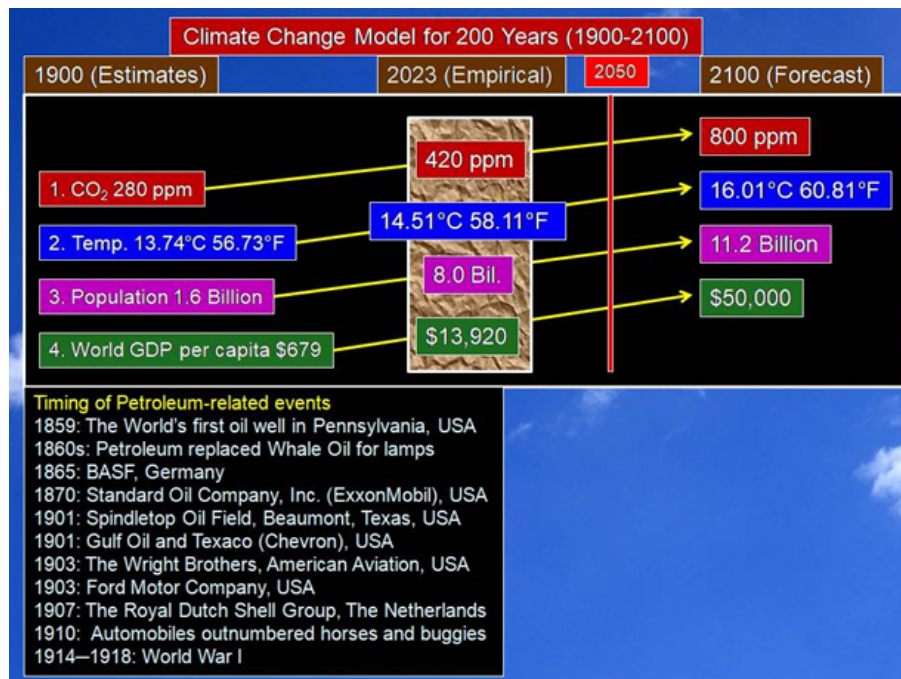


Fig.15. Climate change model for 200 Years (1900-2100) showing in crease in all four parameters with time. In other words, an increase in CO₂ will not hinder population growth or GDP growth in 2100. The Net-Zero 2050 marker is shown for reference. References: 1. CO₂ Lindsey (2022); Happer and Lindzen (2022); Scripps CO₂ Program (2023). 2. Temperature: Allen et al. (2018); Happer and Lindzen (2022); Lee et al. (2023); Osborn (2023). Table 2. 3. World Population in Billion. Roser et al. (2013); United Nations (2023); Worldometer (2023a). 4. World GDP per capita: Long (1998); Darwal (2020); Future Timeline (2023); IMF (2023).

factors for the 200 years. The model is within the limits of Temperature projections by the IPCC (Allen et al., 2018). Estimates, observations, and forecasts are fully referenced. The climate model coupled with other published information has provided the following incontrovertible lessons.

Lessons Learned

- 1) Climate Change is a Natural Phenomenon, not a crisis (Happer, 2014; Christy, 2022; Lindzen, 2023; Shanmugam, 2023b).
- 2) In 2100, the temperature increase would be trivial as to it would not affect the population and GDP growth (Fig. 15). The increase in CO₂ emissions is not going to be a climate or an economic catastrophe in 2100 (Christy, 2022). The global alarmists have turned a natural change in climate into an apocalyptic doomsday. It is worth noting that global alarmists in the 1970s also predicted a global cooling and an ice age that did not happen.
- 3) The AWI (Alfred Wegener Institute) (2019) proposed a new climate model for the IPCC. In this model, the Temperature and CO₂ values would be 19°C and 1142 ppm in 2100, respectively. In terms of humans living under higher levels of CO₂ concentrations than the present 420 ppm, it is worth mentioning two common examples, namely, (a) sailors operate in submarine naval vessels for a period of 90 days under CO₂ levels of 5,000 ppm, and (b) astronauts operate in the International Space Station (ISS) for a period of 3 years under CO₂ levels of 8,000 ppm (Moser, 2023). In classrooms of colleges and universities, CO₂ levels average about 1,000 ppm (Happer, 2014).
- 4) During the geologic past, CO₂ level was much higher than the present level of 420 ppm (Fig. 16). Mulhern (2020) reported CO₂ levels between 3,000 and 9,000 ppm during the Ordovician. However, pre-industrial CO₂ levels were around 280 ppm (Fig. 17).
- 5) The present level of CO₂ at 420 ppm is too low for plants because they need a minimum of 150 ppm for survival (Happer, 2014).
- 6) Throughout geologic history, there has not been any correlation between CO₂ and Temperature trends (Fig. 16).
- 7) The geologic record shows that the Earth's climate has always been changing naturally during the past 600 million years in

terms CO₂ and temperature, without CO₂ emissions from Fossil Fuels by humans (Fig. 16). Berner (2004) has reviewed this aspect in great detail. There were both warming and cooling periods prior to the appearance of human beings on the Planet Earth. However, NASA (2023a) has claimed that there is a cause for concern due to rapid rise in CO₂ from 1958 to 2023 (Fig. 17).

- 8) The Keeling Curve (Fig. 18) shows that in 65 years (1958-2023), the CO₂ has increased 107 ppm. At this rate, CO₂ would be only 634 ppm in 2153, which is 130 years from now in 2023. The point is that there is no cause for alarm about increasing CO₂ in the next 130 years, based on empirical evidence, to a cataclysmic level. Furthermore, the use of the Keeling Curve as the gold standard for anthropogenic CO₂ emissions is somewhat problematic (Fig. 18A). This is because CO₂ measurements have been made next to an active Mauna Loa volcano since 1958 (Fig. 18B). Although measurements are temporarily halted during eruptions, the instruments do not discriminate CO₂ from volcanic eruptions from CO₂ from Fossil Fuels. Volcanoes invariably emit greenhouse gases (e.g., CO₂ and SO₂) not only during periods of eruptions but also during non-eruptive periods through fumaroles and fissures on the ground. On a positive note, the high-altitude Mauna Loa site is ideal since it is well inside the trade wind inversion layer and has well mixed air that has subsided from the tropopause at more northern latitudes. There is a second Hawaiian CO₂ observatory closer to sea level, which gives complimentary data to that from Mauna Loa. Finally, there are about a dozen other observatories at latitudes ranging from the South Pole to Alert in Northern Canada. Their measurements of CO₂ are consistent with those at Mauna Loa (Scripps CO₂ Program, 2023).
- 9) Wind and Solar are unreliable alternative sources because they do not meet the demand (Fig. 19). For example, during Energy Crisis in 2022 as has been demonstrated by Germany that reversed policy from Wind to Coal. Therefore, future research should focus on finding alternative cheap energy sources to Fossil Fuels (e.g. Nuclear, Geothermal, etc.).
- 10) Political crisis in Sri Lanka is an affirmation that ESG is futile. Also, the Green Energy movement can trigger riots by the most

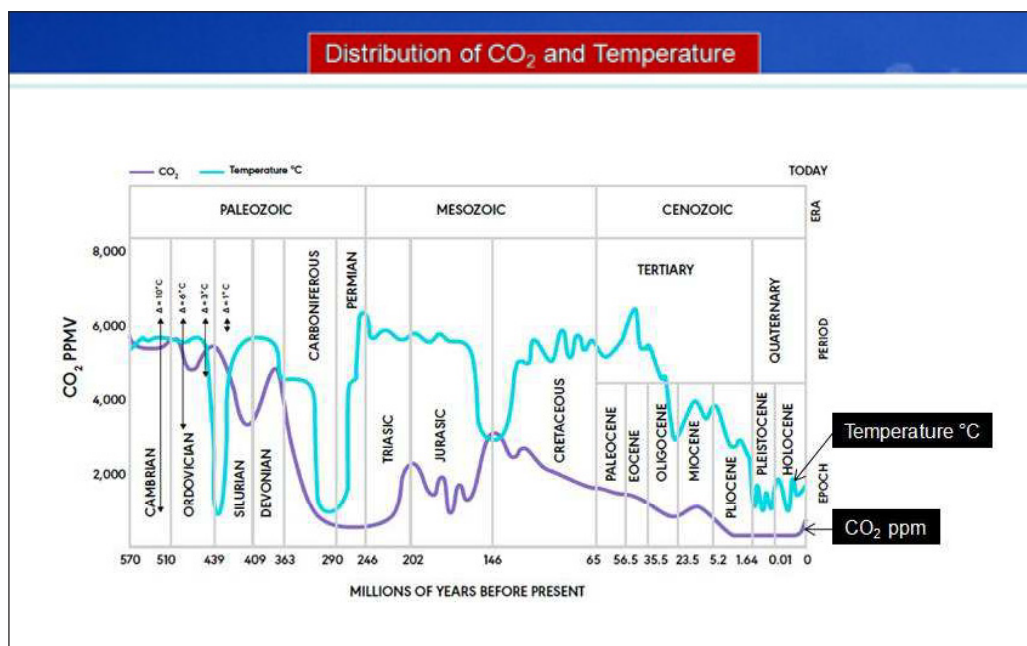
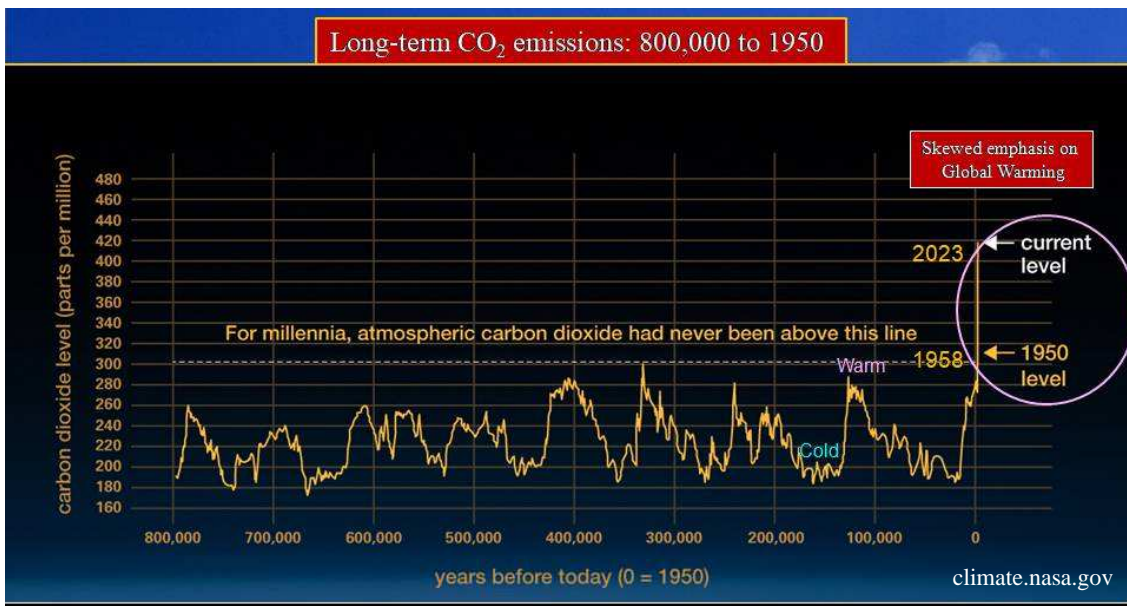


Fig. 16. Diagram showing that during the geological past CO₂ level was much higher than the present level of 420 ppm. Note that there is no correlation between Temperature and CO₂ trends. Diagram from Epstein (2022). Portfolio/Program. See also Berner (1991, 2004) and Scotese et al. (2021). Additional labels by G. Shanmugam.



https://climate.nasa.gov/climate_resources/24/graphic-the-relentless-rise-of-carbondioxide/

Fig. 17. Long term curve showing lower levels of CO₂ during cold periods and higher levels of CO₂ during Warm periods. During ice ages CO₂ levels were around 200ppm and during the warmer interglacial periods, they were around 280 ppm. Note rapid rise in CO₂ from 1958 to 2023 represented by the Keeling Curve. Source: NASA (2023a). Additional lables by G. Shanmugam.

passive religious people of Buddhism in Sri Lanka with 70% Buddhists.

- 11) In the Democratic Republic of Congo, Climate Change policies have resulted in slave-like conditions for child labours. For example, Gross (2023) reported that “Smartphones, computers and electric vehicles may be emblems of the modern world, but, says Siddharth Kara, their rechargeable batteries are frequently powered by cobalt mined by workers labouring in slave-like conditions in the Democratic Republic of Congo.”
- 12) In the 1860s, Petroleum (Oil) replaced Whale Oil for lamps. This was a turning point in saving whales. In the 2020s, Wind

farms all over the world are killing whales and birds. This is the high cost of going Green!

- 13) In 1910, automobiles finally out numbered horses and buggies in large metroplexes like New York City. Thus, Fossil Fuels truly rescued New York City from huge accumulations of horse manure, which was considered to be an uncontrollable environmental hazard.
- 14) The World War II (1939-1945) was won by the Allies mainly due to Fossil Fuels. Allied nations like the U.S.S.R. and the U.S. along with Venezuela had rich deposits of oil, but Germany did not.

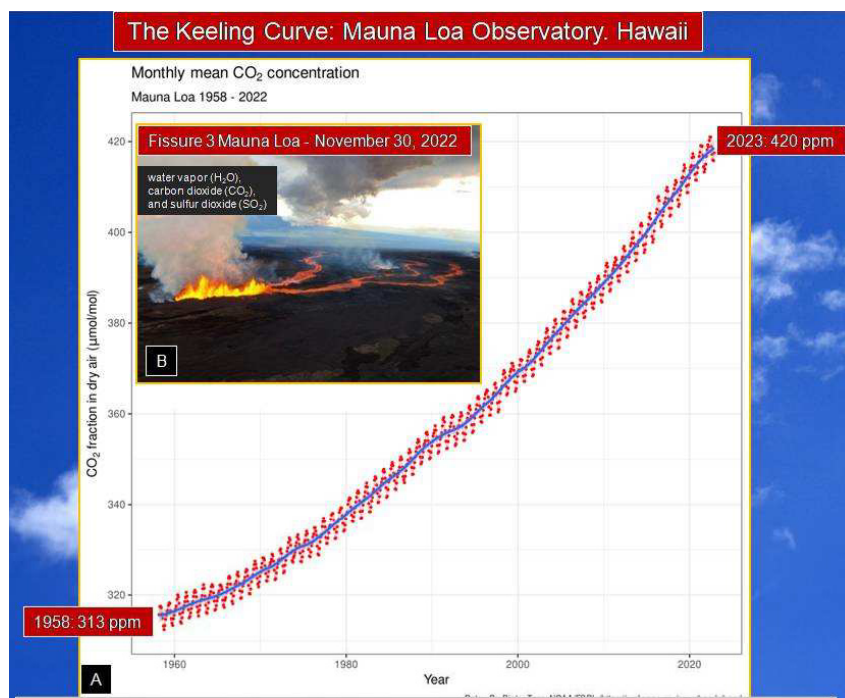


Fig. 18. A. The Keeling Curve: Mauna Loa Observatory, Hawaii. Source: Scripps CO₂ Program, 2023. Additional lables by G. Shanmugam. **B.** Eruption at Fissure 3, Mauna Loa on November 20, 2022. USGS. GOV

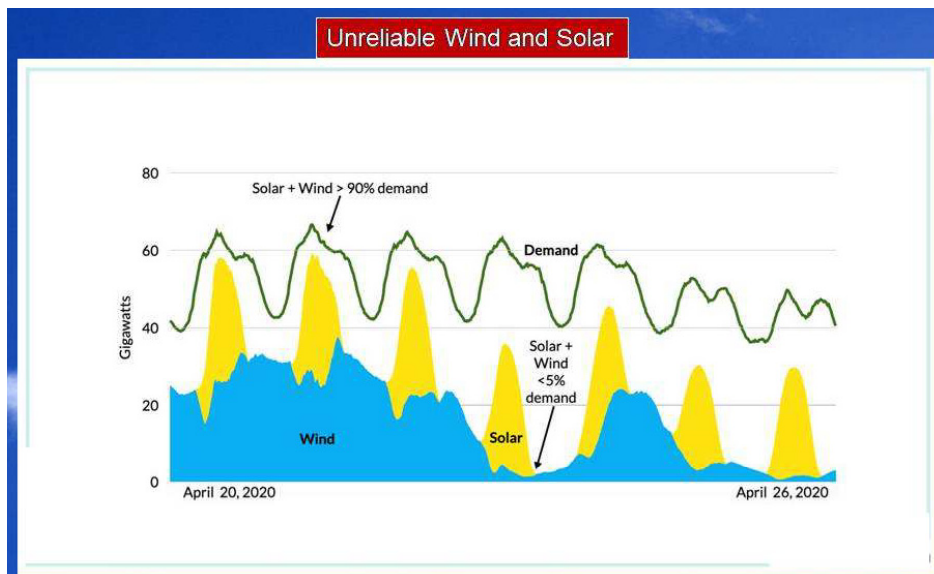


Fig. 19. Diagram showing showing unreliable nature of wind and solar energy sources that do not meet the demand. Note intermittent wind and solar can go to near zero for extended period of time. Diagram from Epstein (2022). Portfolio/Penguin.

15) In documenting the negative impact of Cement Industry on Climate Change, Nature (2021) pointed out that, “Versatile and long-lasting, concrete buildings and structures are in many ways ideal for climate-resilient construction. But concrete has a colossal carbon footprint — at least 8% of global emissions caused by humans come from the cement industry alone. We must decarbonize its production. Concrete is made by adding sand and gravel to cement, whisking the mixture with water and pouring it into moulds before it dries. Making the cement is the most carbon-intensive part: it involves using fossil fuels to heat a mixture of limestone and clay to more than 1,400 °C in a kiln. Also, when limestone (calcium carbonate) is heated with clays, roughly 600 kilograms of carbon dioxide is released for every tonne of cement produced (see [go.nature.com/3exhg82](https://www.nature.com/3exhg82)).” Under the Net-Zero policy, the production of cement must come to an immediate halt. This means no more construction of buildings, roads, and bridges. The irony is that concrete, which will be crucial for much-needed climate-resilient construction of structures worldwide, will be banned. Consequently, the

- Cement Industry will join the ilks of Oil and Coal Industries!
- 16) If the Net-Zero CO₂ policy were to be implemented, large numbers of people would die and the modern human civilization would come to a sudden halt, and humans left alive would have to revert back to the lifestyles of the Neanderthals who lived 40,000 years ago without the benefits of Fossil Fuels (e.g., Agriculture, Aviation, Trucking, Sanitation, etc.).
- 17) At present, 800 million (10%) of the world population still has no access to electricity (Fig. 20). Rescuing humanity from poverty using Fossil Fuels is our moral virtue, not vice (Epstein, 2014, 2022; Lomborg, 2007, 2022).
- 18) Nicholls et al. (2021) have quantified global-mean relative sea-level rise to be 2.6 mm yr⁻¹ over the past two decades. Even with addition of coastal subsidence, the rise only goes up to be a maximum of 9.9 mm yr⁻¹. At this rate, sea-level rise will be of no consequence to the world over a 100-year period.
- 19) At present in 2023 (https://www.triptrivia.com/7-cities-that-are-below-sea-level/XphLiNfEsAAGy_GO), the following six cities function efficiently under sea level. Therefore, there is no need

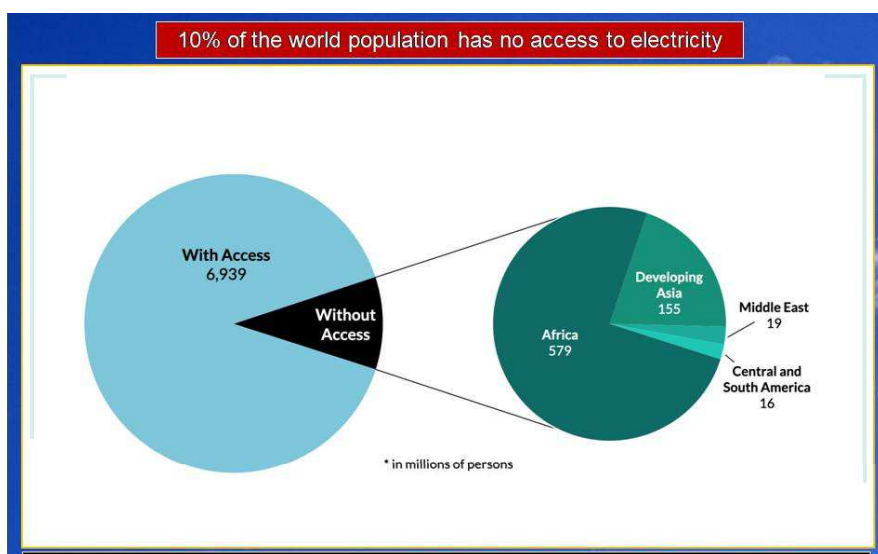


Fig. 20. Diagram showing 800 million (10%) of the world population has no access to electricity. Diagram from Epstein (2022). Portfolio/Penguin. Additional labels by G. Shanmugam.

to fear the future management of additional cities, should more cities go under sea level.

- a) **Salton City, California, USA:** 125 feet below sea level,
 - b) **Baku, Azerbaijan:** 92 feet below sea level,
 - c) **Amsterdam, The Netherlands:** 12 feet below sea level,
 - d) **New Orleans, Louisiana, USA:** 1-2 feet below sea level,
 - e) **Copenhagen, Denmark:** 0-3 feet below sea level,
 - f) **Singapore (City and Country):** 0 feet below sea level.
- 20) Patrick Moore (2021) Co-Founder and Ex-president of the Greenpeace, asserted that CO₂ is the lifeline for People and Plants.
- 21) Freeman Dyson (2007), a World-renowned Professor of Physics at the Institute for Advanced Study (IAS) near Princeton University, cautioned that Climate Models are bogus and that they cannot predict the future. The reason is that Climate Models consider CO₂ only in the atmosphere, but ignore CO₂ in the soil, vegetation, and ocean (Dyson, 2015).
- 22) Simon Michaux (2023), an Associate Professor, Geological Survey of Finland, alerted that there is simply not enough minerals and materials in the Earth's crust and under the sea needed to replace fossil fuels with renewable energy (Michaux, 2023). For example, there is a global shortage of lithium and cobalt minerals needed to manufacture batteries used in electric vehicles.
- 23) According to the Economist (2023), high energy prices claimed 68,000 European lives during the winter of 2022.
- 24) Finally, our economic freedom, welfare, and comfort that we enjoy today can only be attributed to Fossil Fuels since the 1900s. Fossil Fuels will continue to be abundant during the next 100 years because of new discoveries:
- a) South China Sea (CNOOC, 2002);
 - b) Arctic Pechora Sea (Nilsen, 2022);
 - c) Offshore Norway (RIGZONE, 2023);
 - d) Offshore Cyprus (RIGZONE, 2023);
 - e) Offshore Malaysia (RIGZONE, 2023);
 - f) Offshore Gambia (RIGZONE, 2023);
 - g) Colombian Caribbean Coast (RIGZONE, 2023);
 - h) Near the Johan Castberg field in the Barents Sea (RIGZONE, 2023);
 - i) Turkey (RIGZONE, 2023);
 - j) Saudi Arabia (RIGZONE, 2023); among others.

In addition, fracking of shale gas will continue to provide unlimited Fossil Fuels. These new petroleum reserves will compliment the proven world reserves of oil totaling 236.29 billion tonnes (Fig. 21) or 1,732 billion barrels in 2020. By combining BP data with Oil & Gas Journal's annual assessment (Xu and Bell, 2022), it is clear that there has been a steady increase in proven oil reserves during the past three years:

2020: 1,732 billion barrels
 2021: 1,735 billion barrels
 2022: 1,757 billion barrels.

In summary, the proven oil reserves in the world have increased from 682 billion barrels in 1980 (Fig. 21) to 1,757 billion barrels in 2022. In other words, the reserves have more than doubled in 42 years. This trend is likely to continue beyond 2100.

Global Greening by CO₂ Emissions (Fig. 22)

In a seminal paper by Zhu et al. (2016), promoted by NASA (2023b), the following key points are worth noting:

- 1) An international team of 32 authors from 24 institutions in eight countries led the effort, which involved using satellite data from NASA's Moderate Resolution Imaging Spectrometer and the National Oceanic and Atmospheric Administration's Advanced Very High Resolution Radiometer instruments to help determine the leaf area index, or amount of leaf cover, over the planet's vegetated regions. The greening represents an increase in leaves on plants and trees equivalent in area to two times the continental United States (Fig. 22).
- 2) Zhu et al. (2016) have used three long-term satellite leaf area index (LAI) records and ten global ecosystem models to investigate four key drivers of LAI trends during 1982–2009. They showed a persistent and widespread increase of growing season integrated LAI (greening) over 25% to 50% of the global vegetated area, whereas less than 4% of the globe shows decreasing LAI (browning).
- 3) Green leaves use energy from sunlight through photosynthesis to chemically combine carbon dioxide drawn in from air with water and nutrients tapped from the ground to produce sugars, which are the main source of food, fiber and fuel for life on Earth. Studies have shown that increased concentrations of

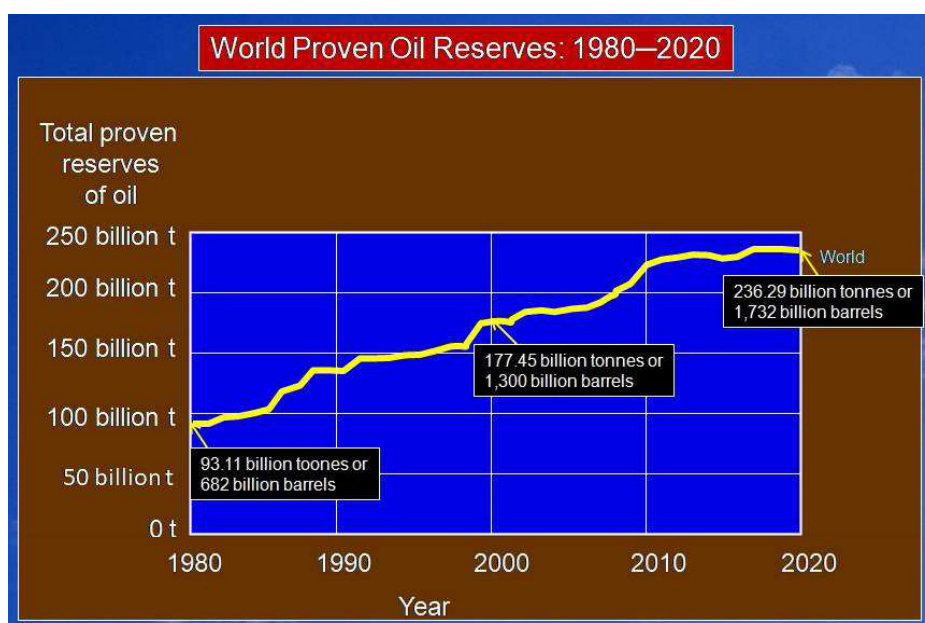


Fig. 21. World proven oil resources for the period 1980-2020. Source: Statistical Review of world energy-BP (2022). Diagram source: Our World in Data (2023). Conversion: 1 tonne - 7.33 barrels. Additional lables by G. Shanmugam.

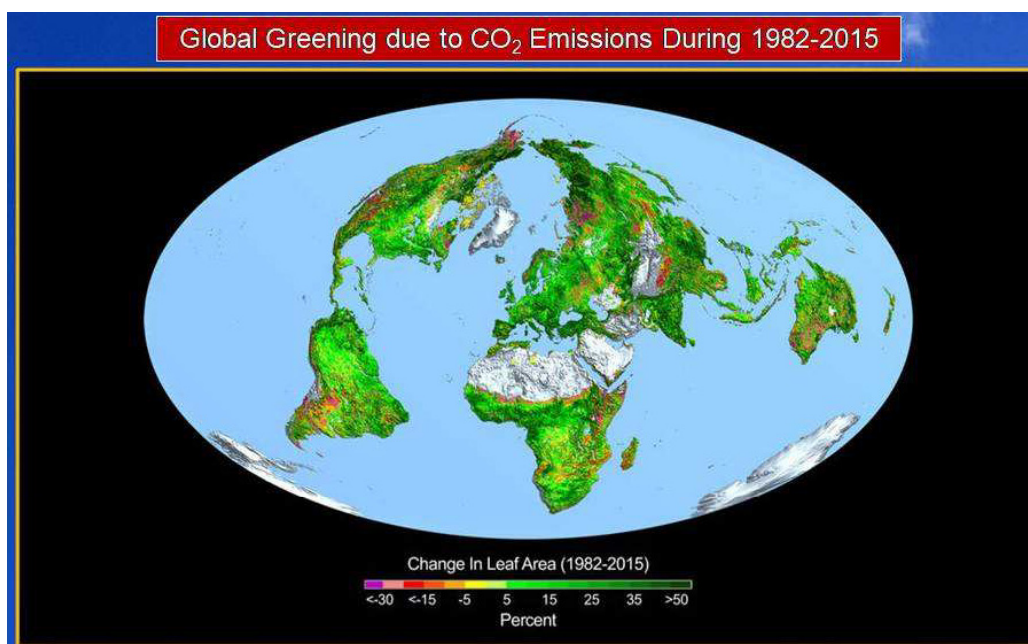


Fig. 22. Global Greening due to CO₂ emissions during 1982-2015. Credits: Boston University/R. Myneni; Zhu et al. (2016); NASA (2023b)

- carbon dioxide increase photosynthesis, spurring plant growth.
- 4) Natural plants and related photosynthesis have been influencing Atmospheric Greenhouse Gases for billions of years.
 - 5) The present-day atmosphere reflects the cumulative effects of the Sun's radiation and the photosynthetic activities of plants for the past 3 billion years. Kiang (2008) studied the History of Photosynthesis:
 - 4.6 billion years ago — Formation of Earth
 - 3.4 billion years ago — First photosynthetic bacteria
 - 2.7 billion years ago — Cyanobacteria
 - 2.4–2.3 billion years ago — First rock evidence of atmospheric oxygen
 - 1.2 billion years ago — Red and brown algae
 - 0.75 billion years ago — Green algae
 - 0.475 billion years ago — First land plants
 - 0.423 billion years ago — Vascular plants

Amid this billion-year natural Climate Change, to think that humans can overturn this natural phenomenon of Climate Change by emission of CO₂ for a mere 263 years, since the Industrial Revolution that commenced in 1760, is ludicrous!

Roadmap to PEACE

- Preserve the Arts & Heritage.
- Enrich life with Fossil Fuels.
- Appreciate the Greening by CO₂.
- Cancel the Climate Crusade.
- Eliminate poverty with Fossil Fuels.

The proposed roadmap for the future is to continue to use the Fossil Fuels as usual. The Planet Earth is doing well in terms of Global Greening (Fig. 22). Therefore, we should shift our resources and attention from Global Warming to Global Poverty (Fig. 20).

Acknowledgements: I thank Prof. G. M. Bhat, Editor-in-Chief of the Journal of the Geological Society of India (*JGSI*), for inviting me to write this Review, which is partly based on my book review (Shanmugam, 2022) of Alex Epstein's (2022) book "Fossil Future". I thank Alex Epstein for providing color images from his book. My

employment with Mobil Oil Company (1978-2000) is the basis for my knowledge on petroleum. I thank J.E. Damuth, my former colleague at Mobil, for valuable discussion over the years and for his review of this article. I am grateful to William Happer (Cyrus Fogg Bracket Professor of Physics, Emeritus, Princeton University, and a Co-Founder of CO₂ Coalition) for his input on Nitrogen in the atmosphere. I am indebted to the late George Devries Klein for his motivation since 1988 on the topic of Climate Change (Shanmugam, 2018). As always, I am grateful to my wife, Jean Shanmugam, for her general comments. By invitation, I have become a member of the CO₂ Coalition in April 2023.

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Appendix

Basic Terminology

- Weather: State of the atmosphere at a local level over a short-time period (e.g., a few hours or a day).
- Climate: Average of the weather pattern in regional or global level over a longer time period (e.g. 30 years or more). Even this definition is not adequate because there is no single climate that can represent the entire Earth. There are many climate regimes that represent various parts of the Earth (e.g., Equator, Middle Latitude, and Pole) (Lindzen, 2023).
- AGW: Anthropogenic Global Warming
- AOML: Atlantic Oceanographic and Meteorological Laboratory
- CFTC: Commodity Futures Trading Commission
- CO₂ Coalition: It is the nation’s leading non-profit organization providing facts, resources and information about the vital role carbon dioxide plays in our environment. Arlington, VA.
- COP26: The UN 2021 Climate Change Conference in Glasgow, Scotland
- CMIP5: Phase 5 of the World Climate Research Program
- EPA: Environmental Protection Agency
- ESG: Environmental, Social, and Governance
- GWPF: Global Warming Policy Foundation
- IEA: International Energy Agency
- IMF: International Monetary Fund
- IPCC: Intergovernmental Panel on Climate Change (1988)
- JPL: Jet Propulsion Laboratory
- The Keeling Curve

MLO: Mauna Loa Observatory. Hawaii
MIT: Massachusetts Institute of Technology
NASA: National Aeronautics and Space Administration
NHC: National Hurricane Center
NOAA: National Oceanic and Atmospheric Administration
The Paris Climate Agreement (2015)
The Planck's Curve
The Rayleigh-Jeans Curve
USGCRP: U.S. Global Climate Research Program
USGS: U. S. Geological Survey
WEF: World Economic Forum
WMO: World Meteorological Organization.

Data Source

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- 3) arxiv.org. Cornell University,
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- 5) The *British Broadcasting Corporation (BBC)*,
- 6) The *British Petroleum Company plc (BP)*,
- 7) *Cable News Network (CNN)*,
- 8) CO₂ Coalition,
- 9) The 2021 United Nations 26th Climate Conference in Glasgow, Scotland(COP26),
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- 12) Earth.org,
- 13) Elsevier,
- 14) Energy Digital,
- 15) Environmental Science and Ecotechnology,
- 16) Future Timeline,
- 17) Global Warming Policy Foundation {GWPF},
- 18) Heartland Institute (Singer and Idso, 2009; Watts, 2009; Moser, 2023; Plimer, 2023),
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- 36) Reuters,
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- 38) Scripps CO₂ Program,
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- 44) The World Meteorological Organization (WMO), and
- 45) WorldoMeter.