# Fossil fuels, climate change, and the vital role of $CO_2$ to people and plants on planet Earth

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***ABSTRACT***

A rigorous examination of empirical data confirms the fact that there is no threat from $CO_2$ to People. Fossil Fuels (i.e., Oil, Natural Gas, and Coal) are the underpinning of modern living in the 21st century and that $CO_2$ is essential for the thriving of both People and Plants. The geologic record shows that the Earth's climate has always been changing naturally during the past 600 million years in terms $CO_2$ and temperature, without $CO_2$ emissions from Fossil Fuels by humans. Aplot of $CO_2$vs. Temperature for the last 600 million years shows basically no correlation for most of this time (Berner, 2004; Scotese et al., 2021). If the Net-Zero $CO_2$ policy were to be implemented in 2050, 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. A climate-change model for 200 years (1900─2100) is proposed based on four basic parameters, namely, $CO_2$, Temperature, Population, and GDP (gross domestic product) per capita. In this model, calculations based on the Max Planck's Curve by Van Wijngaarden and Happer (2020), an increase in Temperature by 2100 would be trivial even if $CO_2$ is nearly doubled in value to 800 ppm. The $CO_2$ in the atmosphere helps not only to modulate the Earth's Temperature suitable for human survival, but also to enhance Global Greening.

*Keywords: $CO_2$ (Carbon Dioxide), Fossil Fuels, Climate Change, Anthropogenic Global Warming (AGW), The Net-Zero $CO_2$ Policy*

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## 1. Introduction

In the most recent IPCC (Intergovernmental Panel on Climate Change) Sixth Assessment Report (AR6), Lee et al. (2023) have made it clear that Global Warming caused by emission of $CO_2$ (Carbon Dioxide) from Fossil Fuels is a threat to humanity. They also offer various solutions. However, available empirical data suggests that there is no threat from $CO_2$ to People. More importantly, the data confirm that $CO_2$ is the underpinning element for the thriving of People and Plants on this Planet Earth. In the following review with copious number of 41 images and 4 tables of datasets, I attempt to provide conceptual clarity to the muddled issues surrounding Climate Change. In particular, I have explained this complex issue in simple terms with students in mind. And I cover a range of domains that include atmospheric sciences, geological sciences, petroleum sciences, oceanography, meteorology, economics, politics, scientific bias, and governance with 26 diverse topics, which have resulted in this tome.

## 2. Acronyms and Terms

Weather: State of the atmosphere at a local level over a short time period
(e.g., a few hours to 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).

AGW: Anthropogenic Global Warming
AOML: Atlantic Oceanographic and Meteorological Laboratory
CFTC: Commodity Futures Trading Commission
$CO_2$ Coalition: It is the nation's leading nonprofit organization (Established, 2015) 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.

**3. GDP per capita for the last 2,000 years**

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, 2023*a*). 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 (Figure 1). In recent years, there have been attempts to villainize Fossil Fuels by various groups under the banner "Climate Change" (Gore, 2007; Allen et al., 2018; Koonin, 2021; Christy, 2022; Epstein, 2022; Happer, 2022; Happer and Lindzen, 2022; Lomborg, 2022; Lee et al., 2023). Such a critique is not only unfounded but dangerous, and it deserves a rigorous scrutiny. Therefore, the purpose of this article is to provide clarity to the ongoing debate on Climate Change.

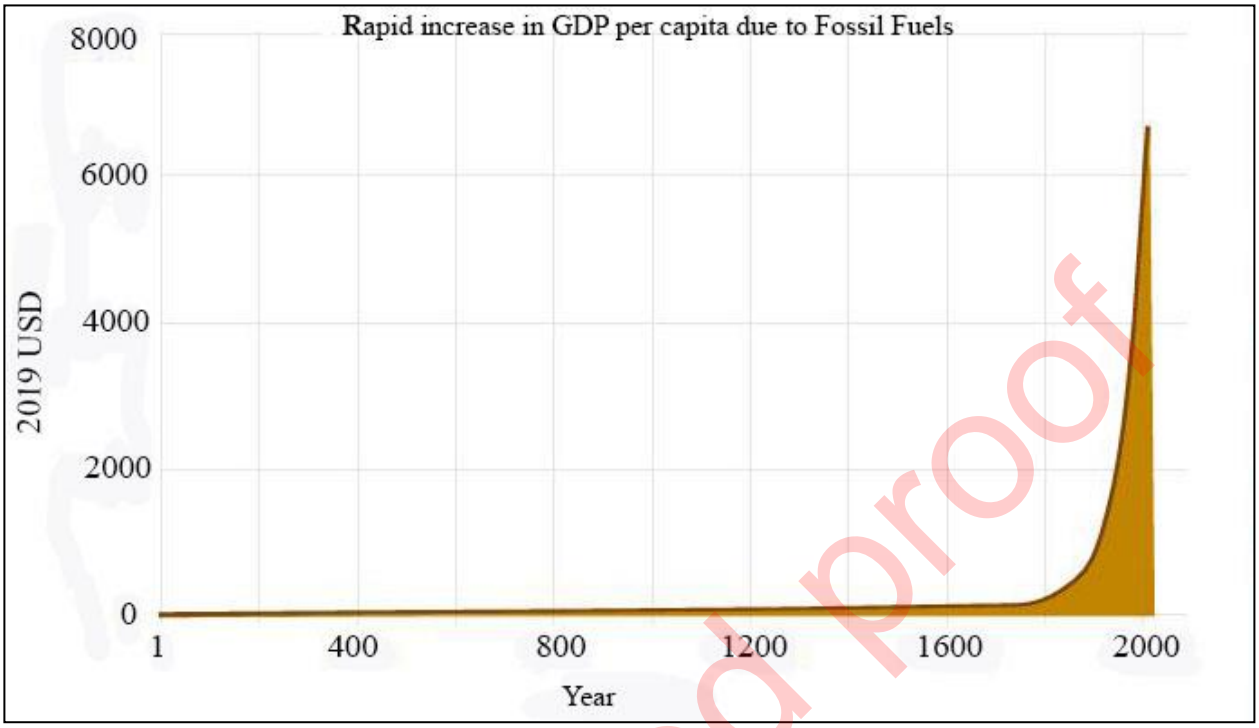


Figure 1. Chart of the GDP per capita for the last 2,000 years. Note that GDP has dramatically Increased since the Industrial Revolution that began around 1760. Fossil Fuels have been the key factor for this increase in GDP. Diagram from Darwall (2020).



**4. 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 (Figure 2). There is no modern living in the 21$^{st}$ century without oil.

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

| Serial Number | Property | Fossil Fuels | Renewable Energy |
|---|---|---|---|
| 1 | Types | Oil<br>Natural gas<br>Coal | Solar<br>Wind<br>Hydro*<br>Geothermal*<br>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<br>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.<br>Sun and the wind are intermittent, uncontrollable, unreliable, sources of energy<br>(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).<br>Minimum Emission of $CO_2$<br>(Lindzen, 2012; Happer, 2022) | Only five percent of the EV lithium–ion batteries are recycled (Eberling, 2022).<br>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.<br><br>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.<br><br>Methods of extraction of Fossil fuels do not employ renewable energy | Hypocritical.<br><br>Methods of extraction of renewable energy do utilize Fossil Fuels.<br><br>1. Wind turbines and Solar panels ─the means of collecting renewable energy─ are made with petrochemical products (Hockstad, 2016)<br><br>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 article

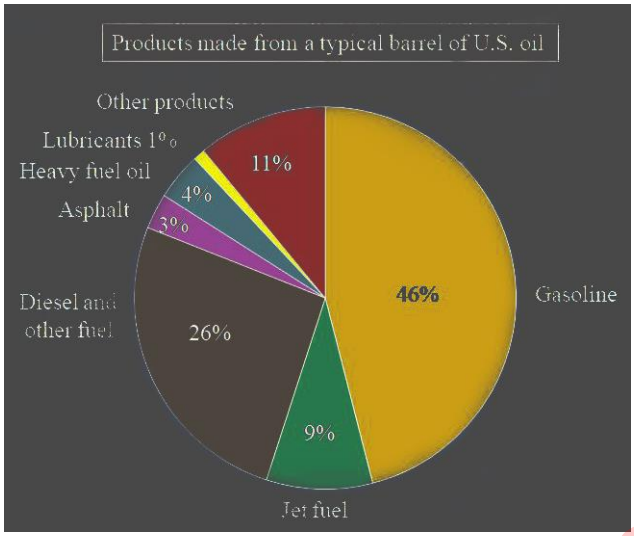


Figure 2. Products made from a typical barrel of U.S. oil. Credit: U. S. Energy Information Administration. Public Domain.

**5. Meteorological Phenomena of 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 page 277 by noting that "Long before significant $CO_2$ emissions, storms were taking tens and even hundreds of thousands of human lives in the 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 (Figure 3) (Epstein, 2022, his Figure 7.5).

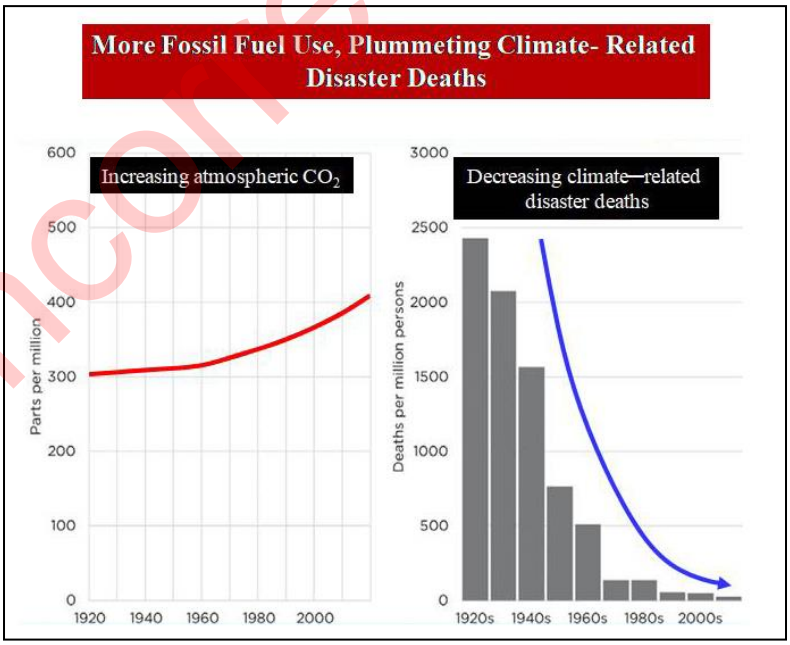


Figure 3. Increasing atmospheric CO2 from 1920 to 2020 and decreasing climate-related disaster deaths for the same period. Credit: Epstein (2022), Portfolio/Penguin.

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, 2007*a*, *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, 2007*a*, 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, 2007*b*).

Structurally, tropical cyclones are large, rotating systems of clouds, winds, and thunderstorms. In the Northern Hemisphere (Figure 4), the rotation is counterclockwise, but in the Southern Hemisphere, the rotation is clockwise because of the Coriolis force. They are such powerful agents that they can stir up the entire U.S. Atlantic Shelf (Figure 5) and destroy huge oil platforms (Figure 6) in minutes. Necessary conditions for the development of tropical cyclones are (Gray, 1979; AOML, 2007*c*; Shanmugam, 2008) (1) a minimum distance of at least 500 km (311 mi) from the equator (Figure 7) , (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 exist. Thus, our understanding of the formation of tropical cyclones is far from complete (Gray, 1979; Shanmugam, 2008).

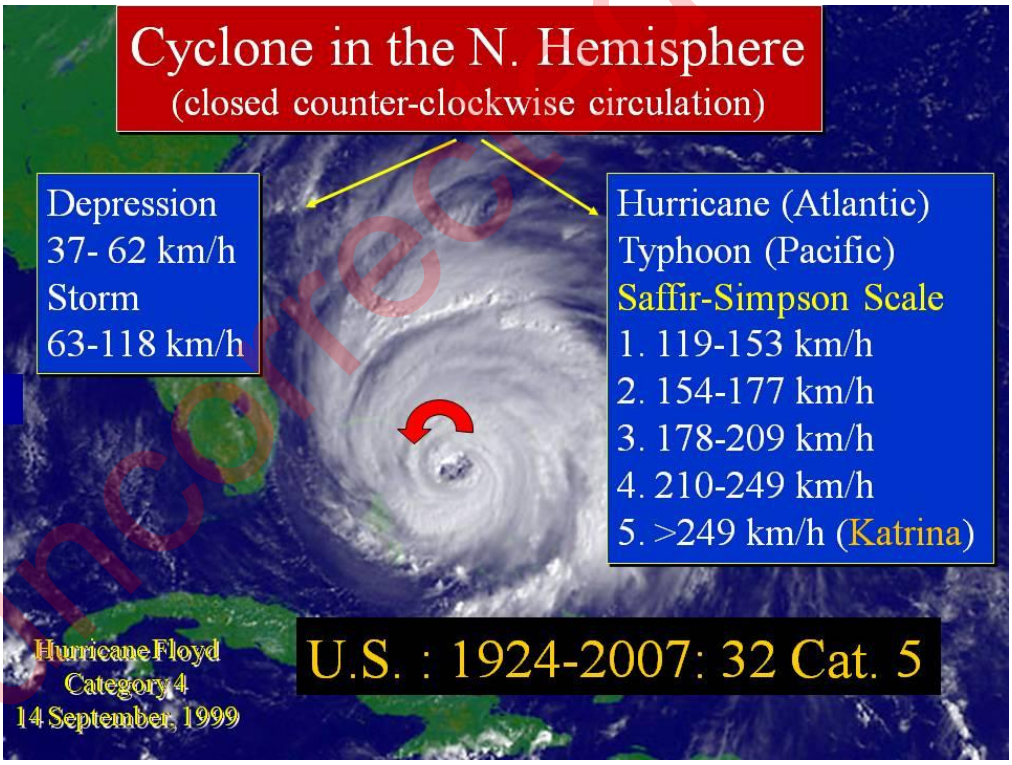


Figure 4. Cyclone terminology based on wind velocity. Credit: NASA and NOAA.

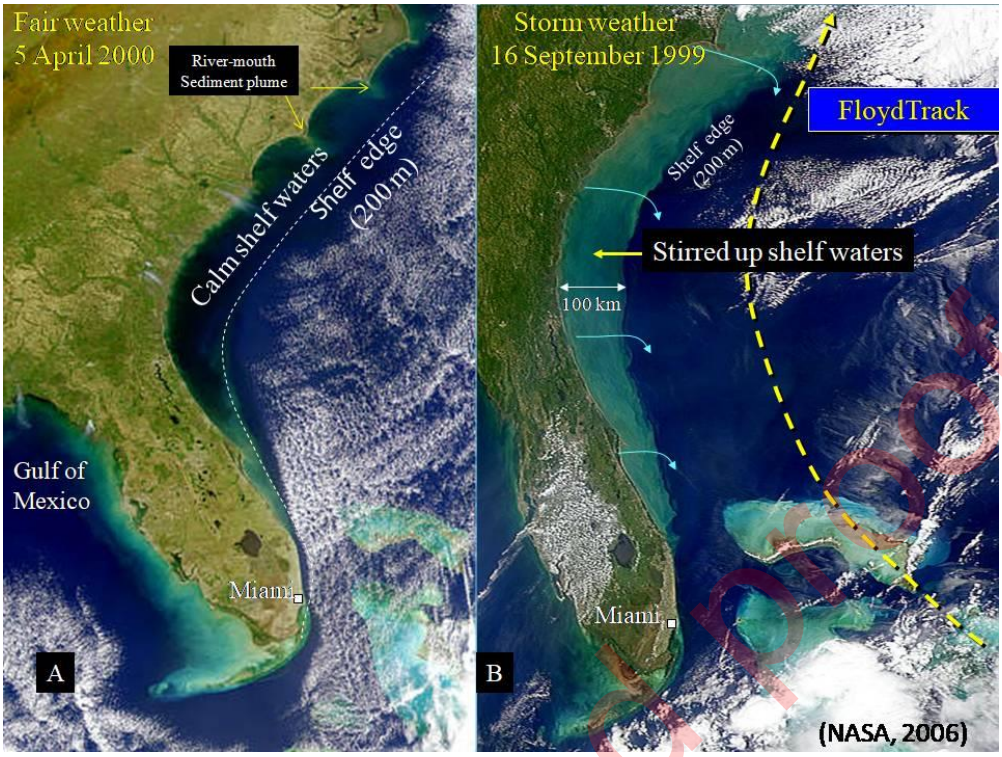


Figure 5. Comparison of shelf sedimentation before and during Hurricane Floyd. From Shanmugam (2008). credit: NASA.

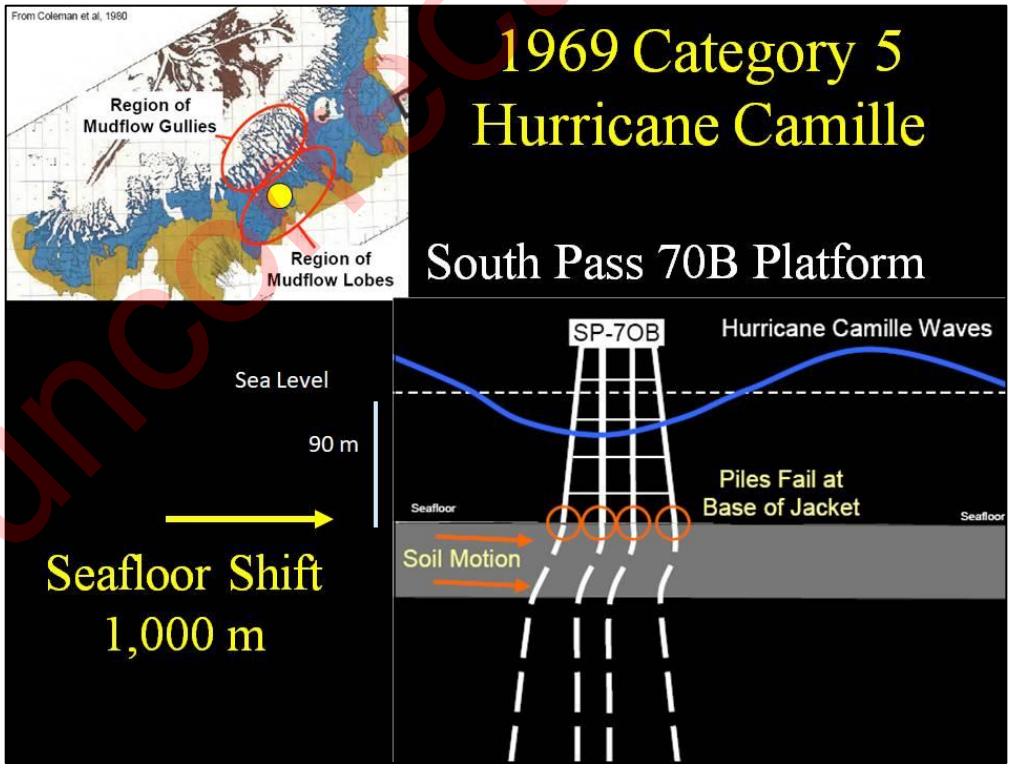


Figure 6. Sketch showing destruction of South Pass 70B Platform. Credit: Hooper and Suhayda (2005).

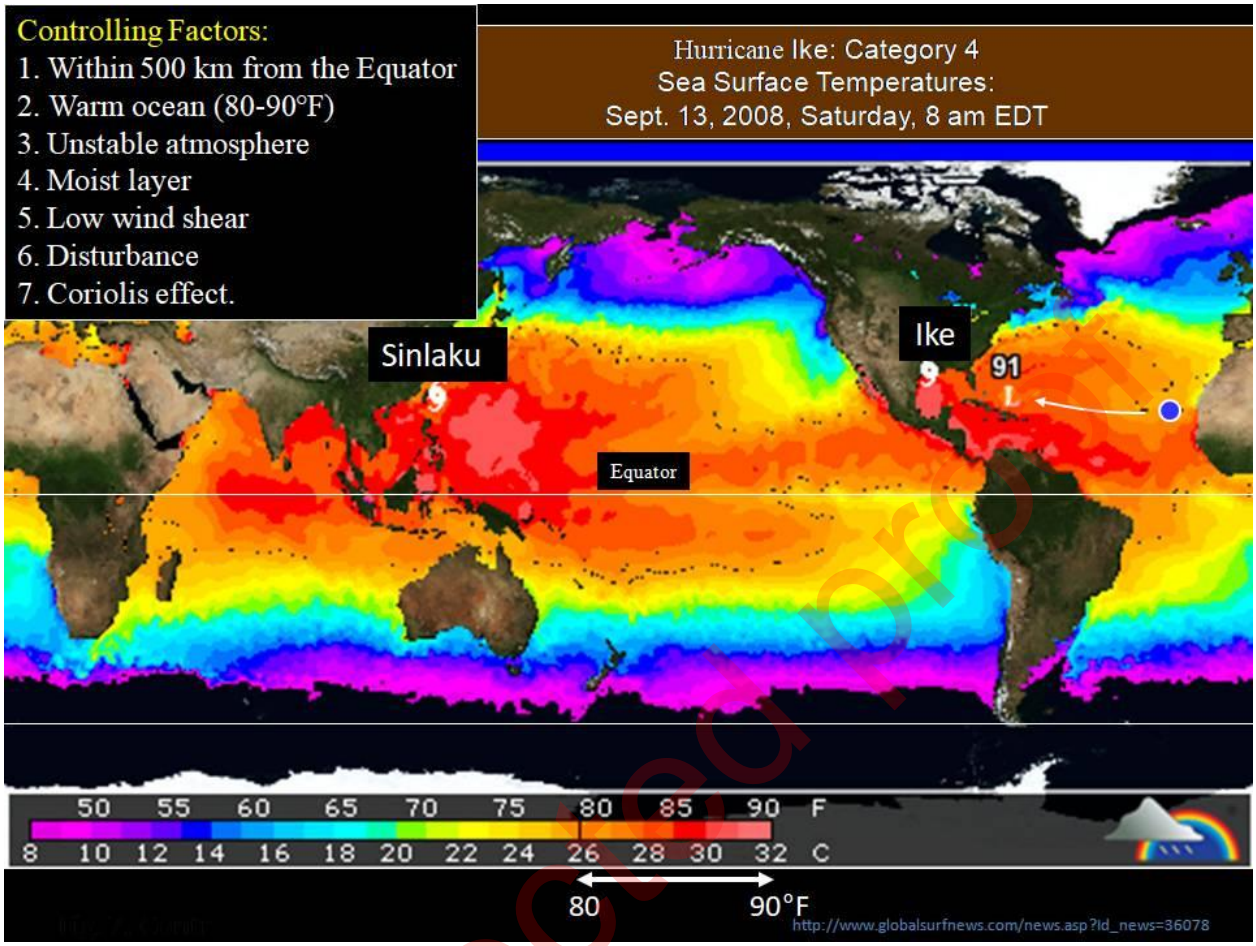


Figure 7. Necessary conditions for the development of tropical cyclones. Tropical cyclones are products of meteorological factors, and they cannot be generated by humans. See Shanmugam (2008).



Empirical Data

- Cape Verde Islands (Figure 8), 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 177$^{th}$ in terms of $CO_2$ emissions with 600,000 tones in comparison to the Rank # 1 China with 10,432,751,400 tons of $CO_2$ emissions (WorldoMeter, 2023*b*). Such empirical data undermine the notion that tropical cyclones are the manifestation of Anthropogenic Global Warming.
- 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 (Figure 9). These two examples show that there is no correlation between population density and cyclone generation.
- The detection of cyclones on Saturn (Figure 10) proves that cyclones can be triggered without humans.
- Empirical data for the U.S. Atlantic Hurricanes show that there is a decline in number of hurricanes from 1941 to 2004 (Figure11) (Table 2) (NHC, 2023*a*).
- 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 (Figure12).

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 are impotent; they can neither create nor stop cyclones.

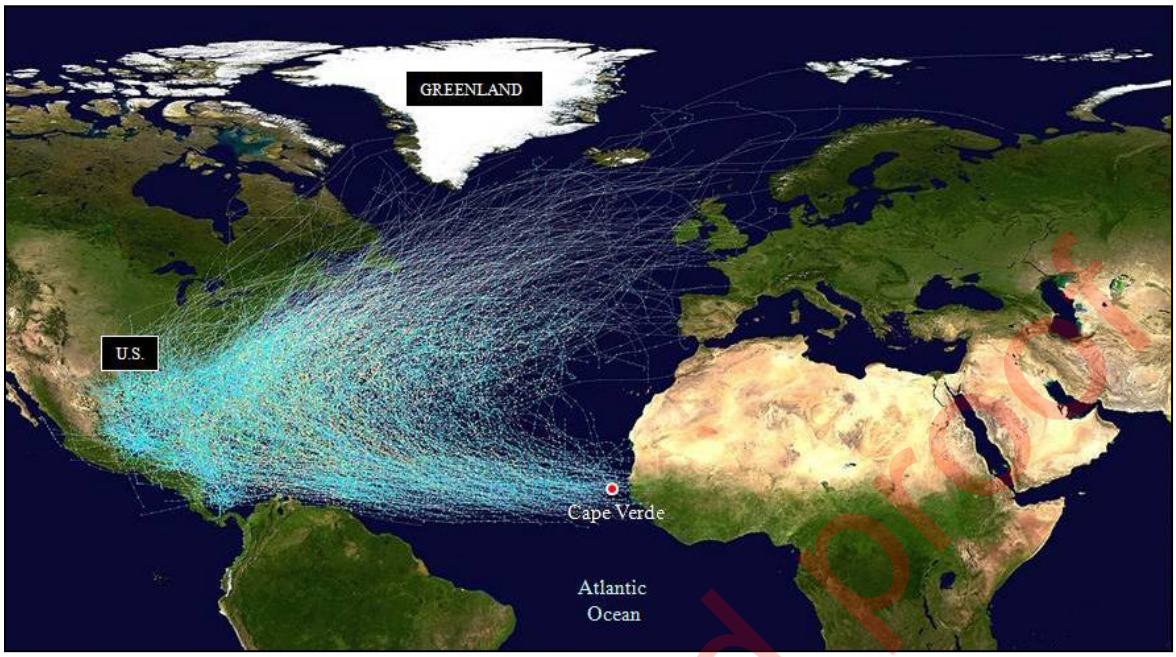


Figure 8. Tracks of all tropical cyclones in the North Atlantic Ocean from 1851 to 2019. Cape Verde Population: 540,000. It is ranked 177th in CO2 emissions. It is ironic that a small island nation with a meager population and trivial CO2 emissions could generate large number of cyclones! Image credit: Nilfanion. NHC. NASA. Wikipedia. Public Domain. Additional labels by G. Shanmugam.


Figure 9. Comparison of number of cyclones in the Bay of Bengal with the Arabian Sea for the period 1945-2000. Data from Shanmugam (2008, his Table 2). Image credit: Hurricane Alley.

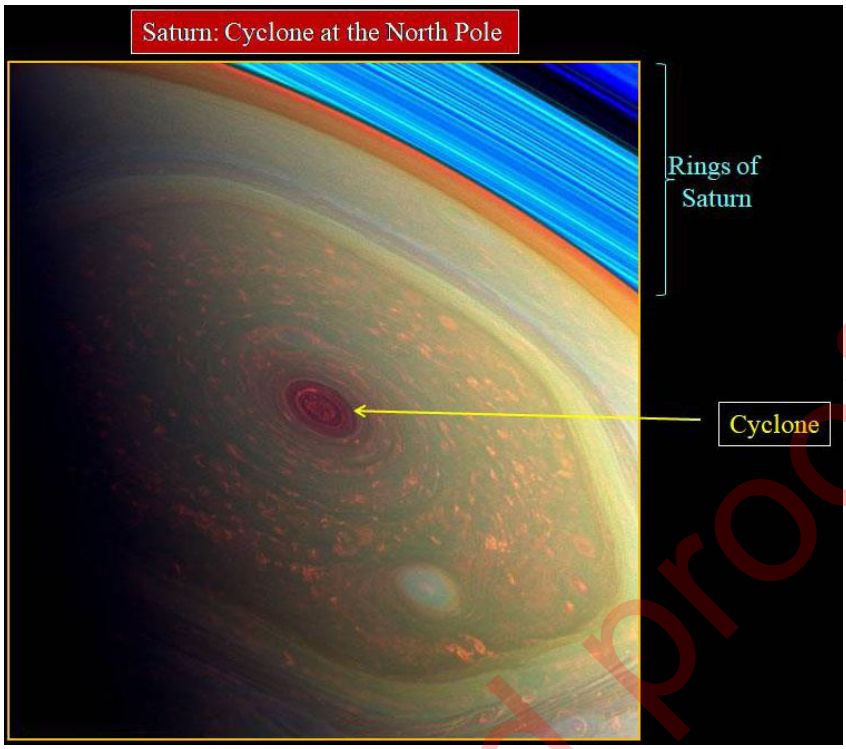


Figure 10. Cyclone detected at the North Pole of Saturn. Image credit: NASA, Casini Mission, http://www.nasa.gov/mission_pages/cassini/multimedia/pia14946.htm

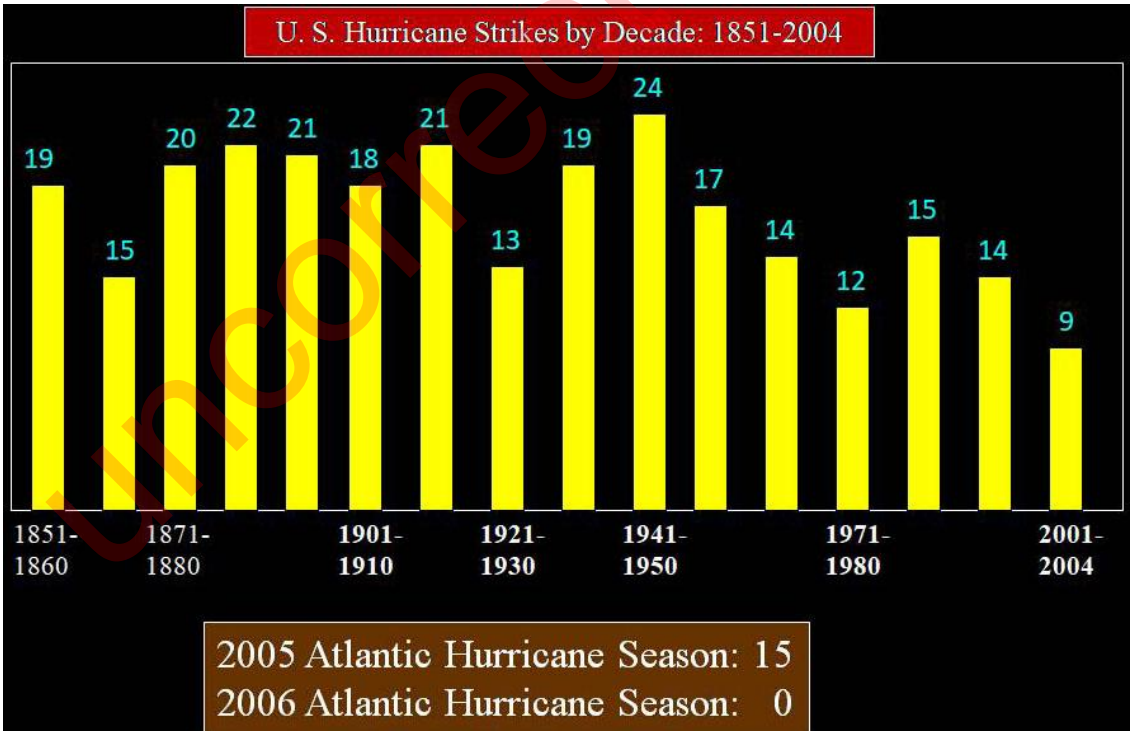


Figure 11. Empirical data showing complex trends in cyclone strikes. Note a general decline in strikes from1941 to 2004. Also note the drastic difference between 2005 and 2006. Data Credit: NHC (2023a).

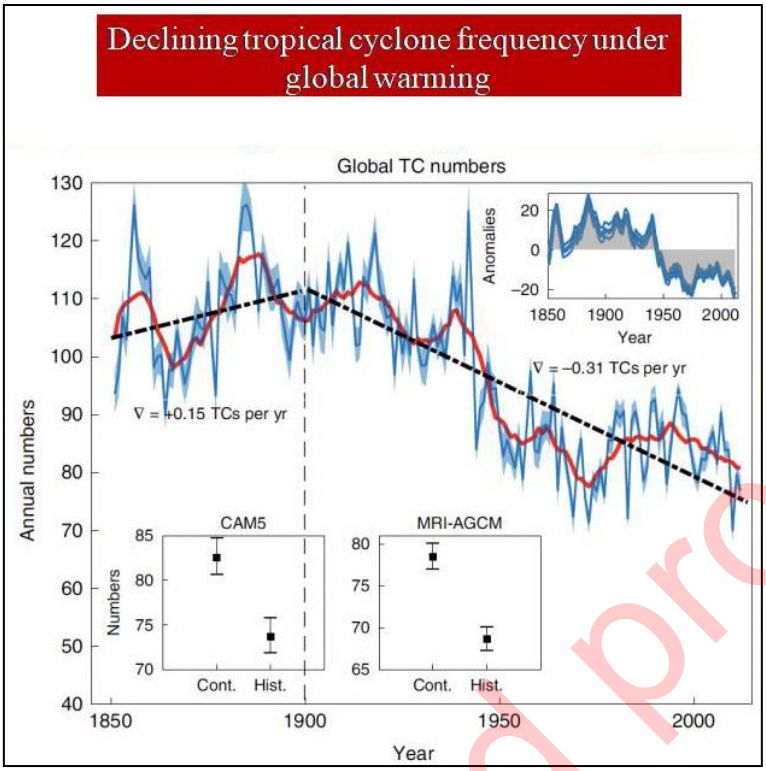


Figure 12. Decline in frequency of tropical cyclones from 1900 to 2020 (dashed line). Diagram Credit: Chand et al. (2022).

Table 2- Complex distribution of hurricanes over the decades. Category 1 to 5 represents Saffir-Simpson Scale (NHC, 2023*a*)

| **Decade** | **1** | **2** | **3** | **4** | **5** | **All 1,2,3,4,5** | **Major 3,4,5** |
|---|---|---|---|---|---|---|---|
| 1851–1860 | 8 | 5 | 5 | 1 | 0 | 19 | 6 |
| 1861–1870 | 8 | 6 | 1 | 0 | 0 | 15 | 1 |
| 1871–1880 | 7 | 6 | 7 | 0 | 0 | 20 | 7 |
| 1881–1890 | 8 | 9 | 4 | 1 | 0 | 22 | 5 |
| 1891–1900 | 8 | 5 | 5 | 3 | 0 | 21 | 8 |
| 1901–1910 | 10 | 4 | 4 | 0 | 0 | 18 | 4 |
| 1911–1920 | 10 | 4 | 4 | 3 | 0 | 21 | 7 |
| 1921–1930 | 5 | 3 | 3 | 2 | 0 | 13 | 5 |
| 1931–1940 | 4 | 7 | 6 | 1 | 1 | 19 | 8 |
| 1941–1950 | 8 | 6 | 9 | 1 | 0 | 24 | 10 |
| 1951–1960 | 8 | 1 | 5 | 3 | 0 | 17 | 8 |
| 1961–1970 | 3 | 5 | 4 | 1 | 1 | 14 | 6 |
| 1971–1980 | 6 | 2 | 4 | 0 | 0 | 12 | 4 |
| 1981–1990 | 9 | 1 | 4 | 1 | 0 | 15 | 5 |
| 1991–2000 | 3 | 6 | 4 | 0 | 1 | 14 | 5 |
| 2001–2004 | 4 | 2 | 2 | 1 | 0 | 9 | 3 |
| **1851–2004** | 109 | 72 | 71 | 18 | 3 | 273 | 92 |
| **Average Per Decade** | 7.1 | 4.7 | 4.6 | 1.2 | 0.2 | 17.7 | 6.0 |

## 6. Storm Surges vs. Climate Change

A storm surge is a coastal flood or tsunami-like phenomenon of rising water commonly associated with low pressure weather systems, such as hurricanes and similar cyclones. It is measured as the rise in water level above the normal tidal level, and does not include waves (Figure 13*a*). An aerial photograph shows the total destruction of the Bolivar Peninsula (Texas) (Figure13*b*). 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).

The point is that humans should be more concerned about controlling the real damage that a storm surge can cause in a few hours (e.g. 20 feet or 6.09 m in 6 hours) than the imaginary damage that will probably never happen due to rising sea level of 0.3-1 m in 100 years due to AGW Change (Nicholls et al., 2021).


Figure 13. A. Storm Surge Model. B. Aerial photograph showing total destruction of the Bolivar Peninsula (Texas) by Category 4 Hurricane Ike's storm surge of 20 feet (6.1 m) in September2008. Source: Wikipedia (2023) and NHC (2023b).



## 7. Climate Hypocrisy by the Western Countries

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 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 (Figure14). 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 favor (Eckert and Sims, 2022).


Figure 14. Map showing Nord Stream Pipelines 1 and 2 from Russia to Germanyvia the Baltic Sea. Map credit: Gasprom, BBC.

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 26$^{th}$ Climate Conference (COP26) in Glasgow, Scotland and most of the same western countries were admonishing India and China for not agreeing to "phase out" coal altogether in reducing $CO_2$ 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!

**8. Media Hypocrisy**

In all, there were four underwater pipelines because each Nord Stream pipeline contains two. Sabotage of Nord Stream 1 and 2 pipelines (Figure 14) 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 tones of methane in six days (i.e., 36,000 tones/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) (Figure 15).

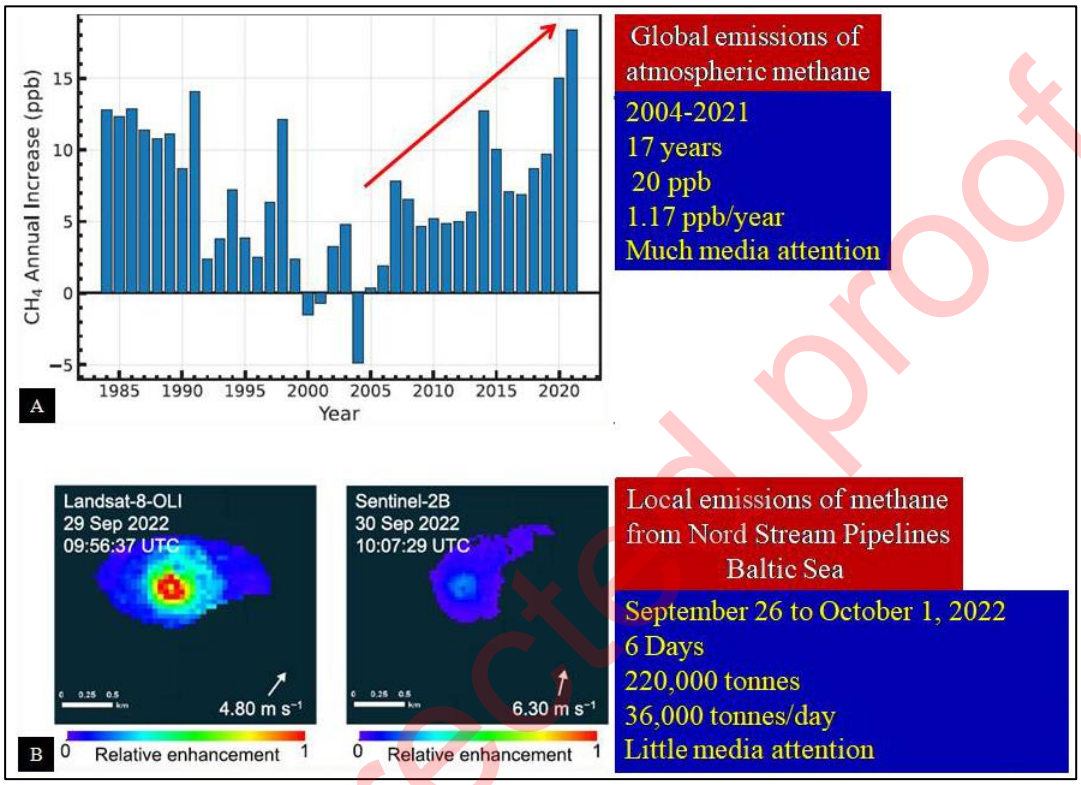


Figure 15. Comparison of global A) and local B) methane emissions. A. Increase in emissions from 2004 to 2021 (arrow). Image credit: WMO (2022). Arrow by G. Shanmugam. B. Enhanced images of methane leaks during two days in the Baltic Sea. Image credit: Jia et al. (2022).

**9. Paris Climate Agreement**

The objective of the Paris Climate Agreement of 2015 (UNFCC, 2021; Schleussner, 2022) is to make all countries are 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 (Figure 16*a*). 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 (Figure 16*b*). In short, the Paris Climate Agreement is of no practical value in reducing Carbon emissions until all countries participate in the Agreement. Chances are that Universal Agreement on Climate Change will never happen so long as there is poverty.

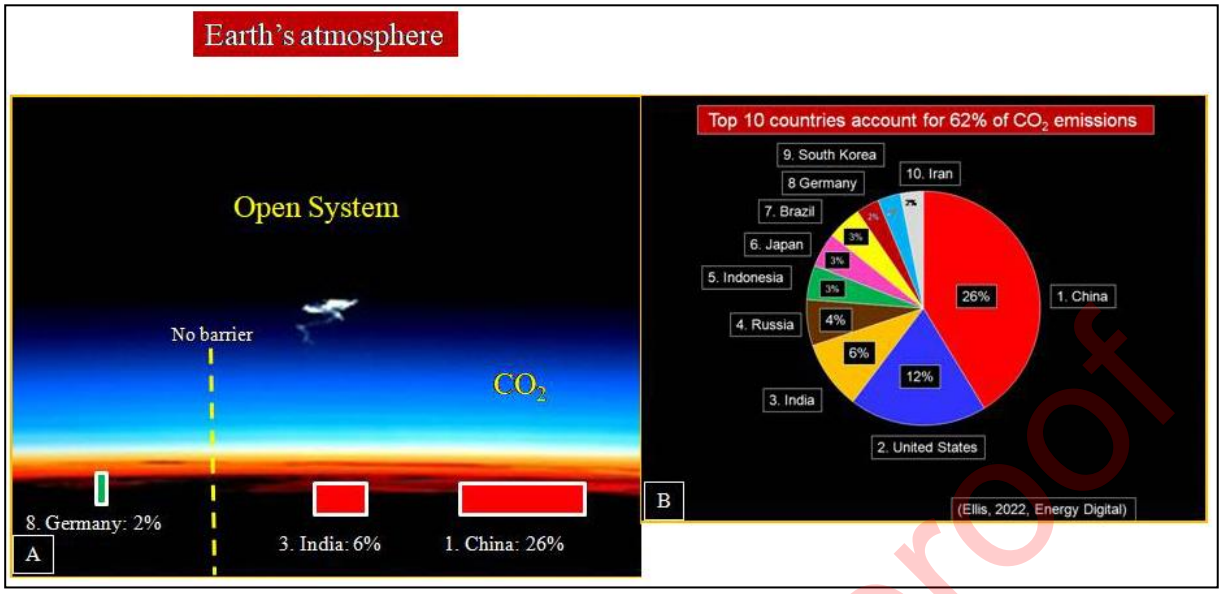


Figure 16. A. Image showing that Earth's atmosphere is an open system. There is no barrier between countries that emit low amounts of CO2 like Rank # 8 Germany and countries that emit high amounts like Rank # 1 China. The object in the middle of the image is remnants of Soyuz capsule. Image credit: NASA. https://www.nasa.gov/image-feature/the-remnants-of-soyuzs-fiery-plunge Retrieved June 8, 2023. Additional labels by G. Shanmugam. B. Top 10 countries that emit high amounts of CO2. Data source: Ellis (2022).

**10. The World Economic Forum**

Every year, the Global Elites arrive at Davos in Switzerland to attend the World Economic Forum in Private Jets (Figure 17), emitting enormous amounts of $CO_2$, to devise policies on reducing $CO_2$ emissions by the world's population.

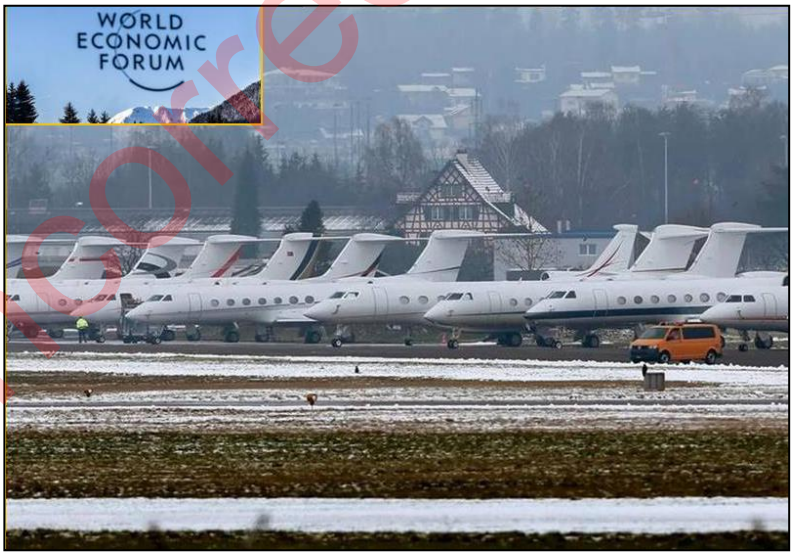


Figure 17. Masterclass In Hypocrisy: Global Elites arrived at Davos in Switzerland to attend the World Economic Forum In Private Jets, by emitting enormous amounts of CO2 from burning Jet fuels, to discuss Climate Change. Credit: Isha Sharma post on Jan 18, 2023, 23:09 IST. India Times.https://www.indiatimes.com/trending/environment/global-elites-slammed-for-arriving-at-davos-summit-in-private-jets-590644.html. Retrieved February 29, 2023.

## 11. The Net-Zero Ultimatum

Epstein (2022) notes that "…President Joe Biden has made it a goal for the U.S. to have "Net-Zero" $CO_2$ emissions from electricity by 2035 and from all forms of energy by 2050with 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 (Figure18). This policy can realistically be achieved only by eliminating the entire use of Fossil Fuels that emit $CO_2$. Renewable energy sources (Wind and Solar) cannot produce petroleum products (Figure 18) because wind and solar energy sources do not contain hydrogen and carbon molecules. If the Net-Zero $CO_2$ 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 (Figure 19).

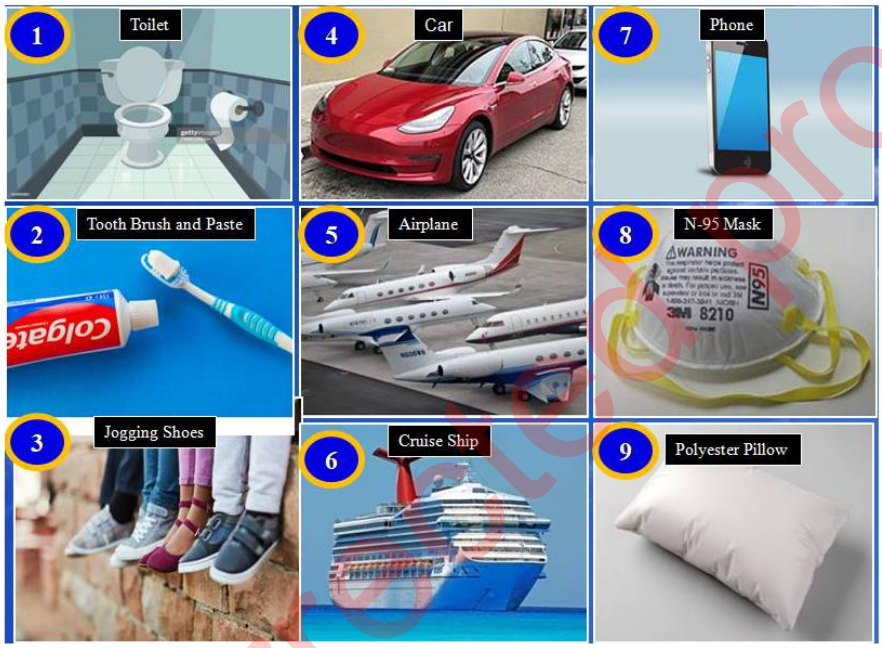


Figure 18. Nine examples of petroleum products that will be banned under the Net-Zero policy in 2050, These products cannot be manufactured or can function without Fossil Fuels. Image sources: Public domain.

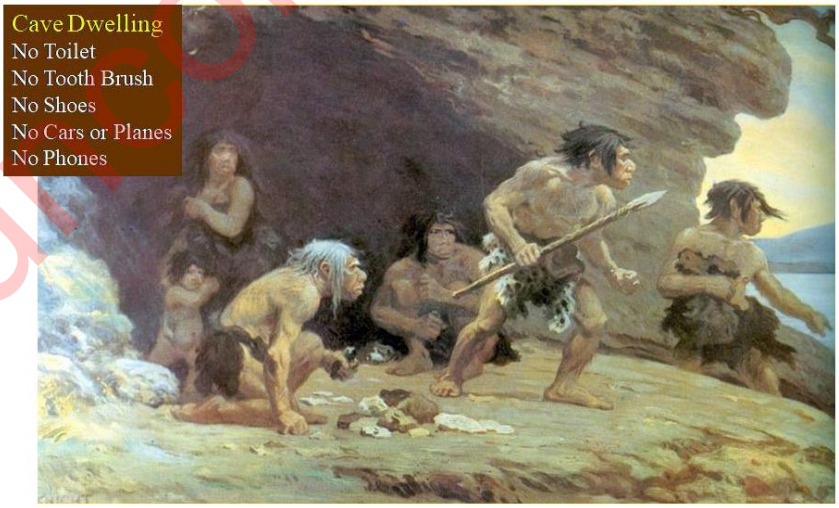


Figure 19. A perceived scenario of living under Net-Zero policy. Image credit: Charles R. Knight, 1920, (Wikipedia).

**12. Oil Saves whales, whereas wind Farms kill whales**

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 Figure20. This is the high cost of going Green!


Figure 20. A. 1860s: Petroleum replaced Whale Oil used for illumination and machine lubrication. Stopped the whaling industry. Photo credit: Michaël CATANZARITI, Wikipedia B. Whales are killed by Wind Farm development. Photo credit: Jeffrey-Wilensky and Radde (2023). C. Birds are killed by Wind Turbines.

**13. Threat to Arts and Heritage**

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 Figure 21). In an 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 Figure 22) (Reuters, 2022). These protests would not reduce $CO_2$ emissions, and the whole renewable-energy (Wind and Solar) movement is not only hollow but hypocritical.


Figure 21. Activists glued themselves to copy of Leonardo da Vinci's 'The Last Supper' at the Royal Academy of Arts in London, UK. Students protest against the use of oil. Ironically, the synthetic glue is made from petroleum-based plastic Polymers. Photo Source: CNN 10th July, 2022.

Figure 22. The "Mona Lisa" painting by Leonardo da Vinci was smeared with cream in aclimate-protest stunt art the Louvre Museum in Paris, France. Photo Credit: Reuters, May 30, 2022.

## 14. Governance in Sri Lanka

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.

## 15. The Netherlands and Nitrogen Emission

In an 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 Boerburger 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 follows:

1. Nitrogen means the diatomic molecules $N_2$ that makes up some 78% of our atmosphere. There is not much anyone can do to lower the most abundant atmospheric $N_2$.
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, $N_2O$, to the atmosphere. When the fixed nitrogen of the soil is finally broken down and returned to the atmosphere most returns as $N_2$, but around 1% returns as the greenhouse gas $N_2O$.
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 $(NH_2)_2$.
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.

## 16. The Concrete-Cement-$CO_2$Conundrum

In the Industrial World, Concrete has been considered to be the God' Gift to Humanity. Cities like New York were the envy of the world when the Empire State Building was completed in 1931. A total of 58,000 cubic yards (44,344 cubic meters) of Concrete was used to construct this landmark building. However, like Fossil Fuels, Concrete is being blamed for emitting $CO_2$in huge quantities. According to Nature (2021), at least 8% of global emissions caused by humans come from the cement industry alone. The reasons are as follows:

1. Concrete is made by mixing sand, gravel, cement, and water.
2. Cement is made by heating a mixture of limestone and clay to more than 1400 °C in a kiln using Fossil Fuels.
3. About 600 kilograms of $CO_2$is emitted for every tone of cement produced.

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!

## 17. The rise and fall of $CO_2$

The geologic record shows that the Earth's climate has always been changing naturally during the past 600 million years in terms $CO_2$ and temperature, without $CO_2$ emissions from Fossil Fuels by humans. 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 (2023*a*) has claimed that there is a cause for concern due to rapid rise in $CO_2$ from 1958 to 2023 (Figure 23). This claim is based on the measurements of $CO_2$ emitted by Fossil Fuels at Mauna Loa Laboratory in Hawaii for constructing the Keeling Curve. Let's examine the merits of the Keeling Curve (Figure 24).

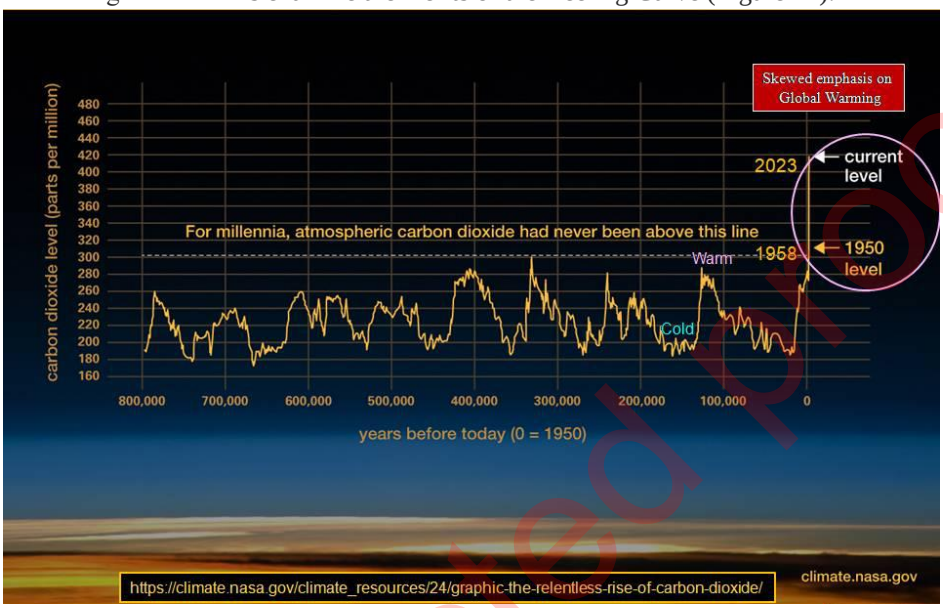


Figure 23. Long-term curve showing lower levels of $CO_2$ during Cold periods and higher levels of $CO_2$ during Warm periods. During ice ages, $CO_2$ levels were around 200 parts per million (ppm), and during the warmer interglacial periods, they were around 280 ppm. Note rapid rise in $CO_2$ from 1958 to 2023 represented by the Keeling Curve. Source: NASA (2023a).

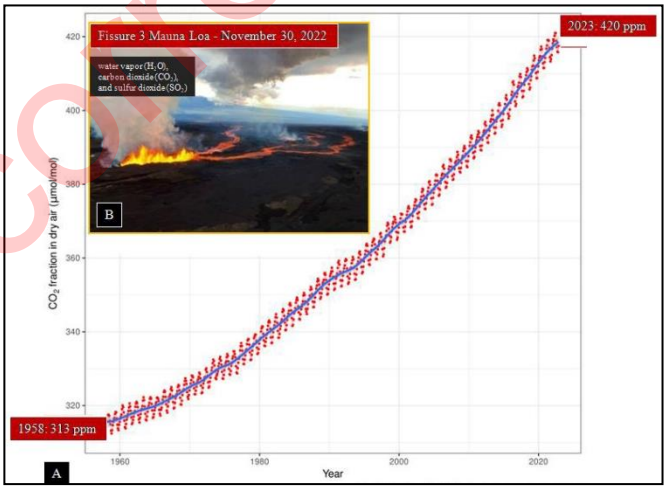


Figure 24. The Keeling Curve: Mauna Loa Observatory. Hawaii. Source: Scripps CO2 Program, 2023). Additional labels by G. Shanmugam. B. Eruption at Fissure 3 Mauna Loa on November 30, 2022. USGS.GOV. Data: Dr. Pieter Tans, NOAA/ESRL (https://gml.noaa.gov/cogg/trends) and Dr. Ralph Keeling, Scripps Institution of Oceanography (https://scrippsco2.ucsd.edu). Accessed 2022-12-19.

**18. The Keeling Curve**

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 $CO_2$ 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 (Figure 25). Their measurements of $CO_2$ are consistent with those at Mauna Loa (Scripps $CO_2$ Program, 2023). The use of the Keeling Curve as the gold standard for anthropogenic $CO_2$ emissions, however, could be problematic (Figure 24*a*). This is because $CO_2$ measurements have been made next to an active Mauna Loa volcano since 1958 (Figure 24*b*). Although measurements are temporarily halted during eruptions, the instruments do not discriminate between $CO_2$ from volcanic eruptions and $CO_2$ from Fossil Fuels. Volcanoes invariably emit greenhouse gases (e.g., $CO_2$ and $SO_2$) not only during periods of eruptions but also during non-eruptive periods through fumaroles and fissures on the ground.

The Keeling Curve (Figure 24) shows that in 65 years (1958─2023), the $CO_2$ has increased 107 ppm. At this rate, $CO_2$ 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 $CO_2$ in the next 130 years, based on empirical evidence, to a cataclysmic level.

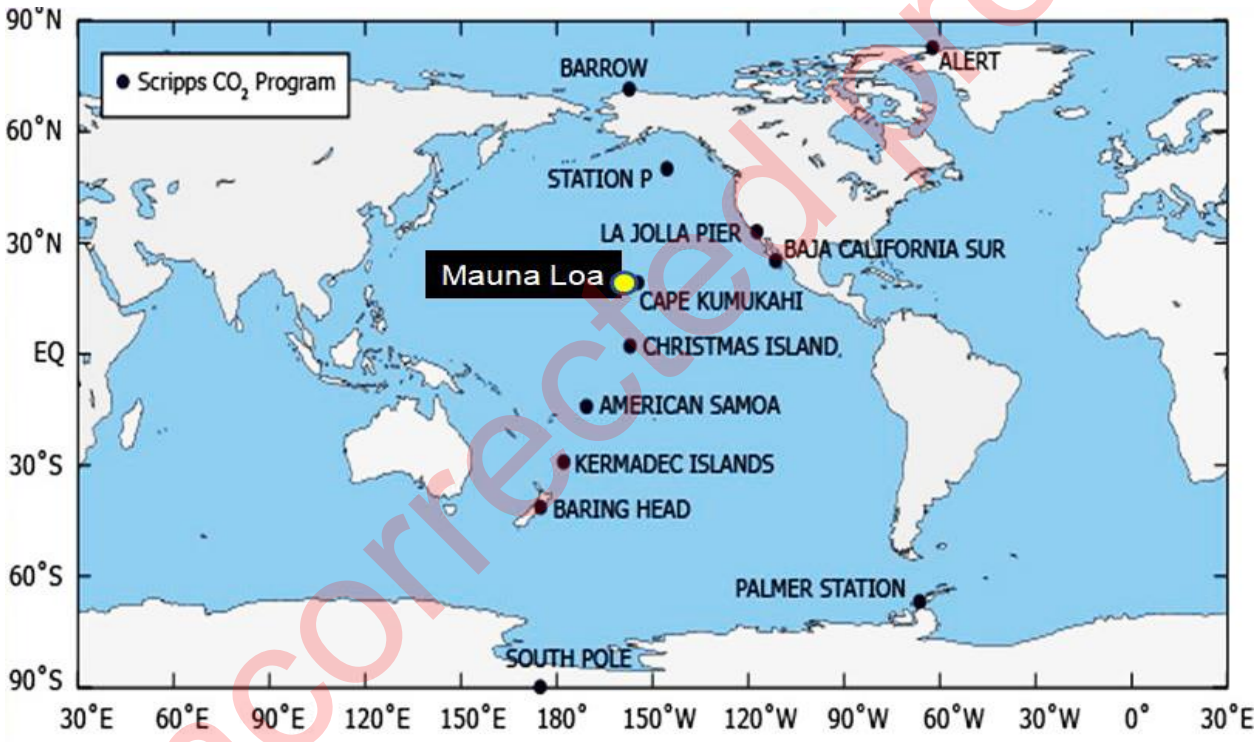


Figure 25. Global map showing locations of measurements of $CO_2$ for the Keeling Curve, such as the Mauna Loa Observatory in Hawaii and others. Additional labels by G. Shanmugam. Source: Scripps CO2 Program, 2023).



**19. Scientific Bias**

1. Christy (2022) illustrated that there is a definite exaggeration of Temperature increase in Climate models than the actual observations (Figure 26).

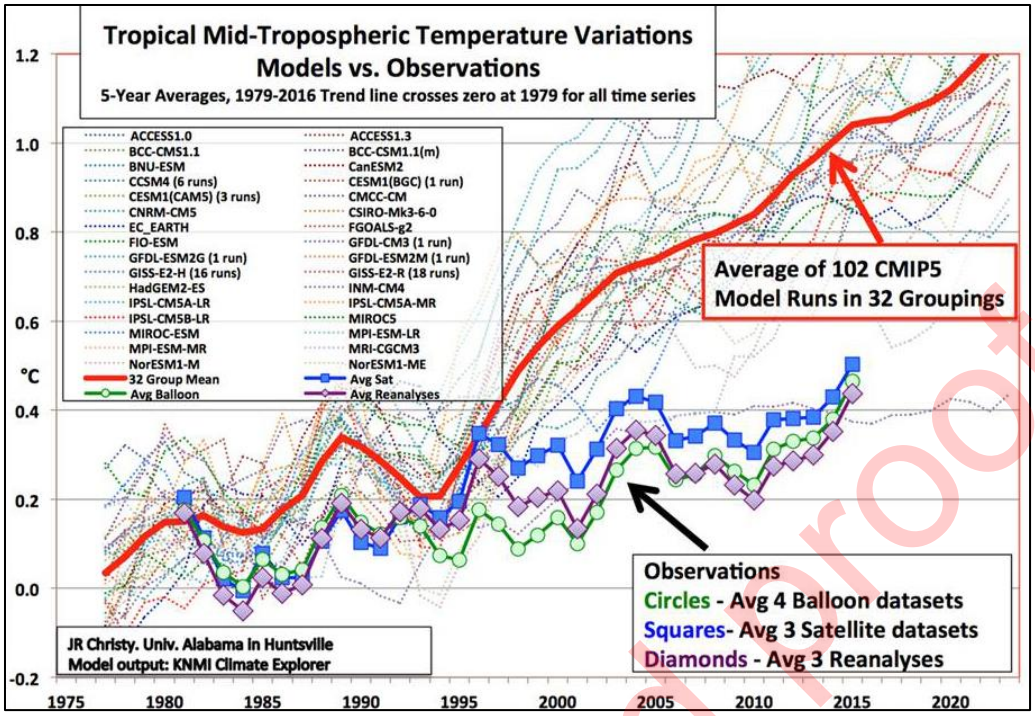


Figure 26. Exaggerated Temperature Predictions (Red Line) vs. Actual Data Observations. Diagram Source: Christy (2022).

2. Wrightstone (2017) demonstrated less global warming for each additional 50 ppm by volume of $CO_2$, which disputes the claim by IPCC (Figure 27).

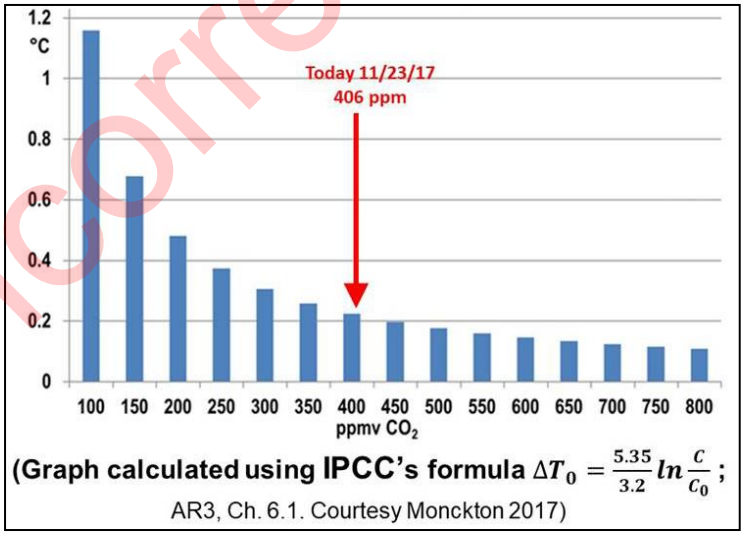


Figure 27. Calculations show that less global warming for each additional 50 ppm by volume of CO2, which disputes the claim by IPCC. Diagram source: Wrightstone (2017). Silver Crown Productions, LLC.

3. 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 $CO_2$ measurements near an active volcano from Hawaii by the Scripps $CO_2$ 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 $CO_2$ emissions.

4. 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"

5. Christy et al. (2010) noted out that IPCC models predict much greater Global Warming than the actual measured Temperature data show.

6. Curry (2023) pointed out that there are many uncertainties with Climate models that have never been addressed. For example, the role of ocean circulation, volcanic activity, and the impact of the Sun.
7. 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; McKitrick and Christy, 2020; Koonin, 2021).

**20. 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.

1. 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 (Figure 28) (Rossen and Egger, 2016). However, the role of Sun in climate models is downplayed.

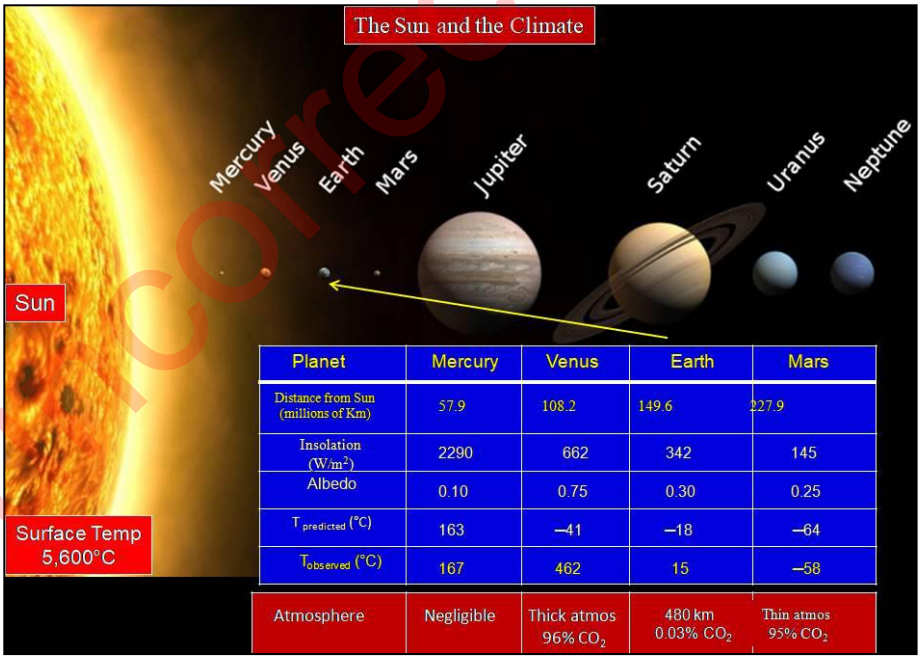


Figure 28. The Sun is the supreme driver of climate. Blue Table: Rossen and Egger (2016); Red Table: NASA, https://www.space.com/18527-venus-atmosphere.html Retrieved June 9, 2023; Image credit: NASA. https://www.universetoday.com/15451/the-solar-system/Retrieved June 9, 2023

2. The Earth's atmosphere is a critical factor in providing humans a comfortable climate for survival under 15°C (288°K (273+15) or 59°F) (Figure 29), but humans cannot alter atmosphere to control climate.
3. Earth's Temp withoutAtmospheric Cover and its $CO_2$would be −18°C or 255°K or 0°F Figure 29). At this Temperature, humans will be frozen to death. Therefore, $CO_2$ is divine in keeping humans alive.

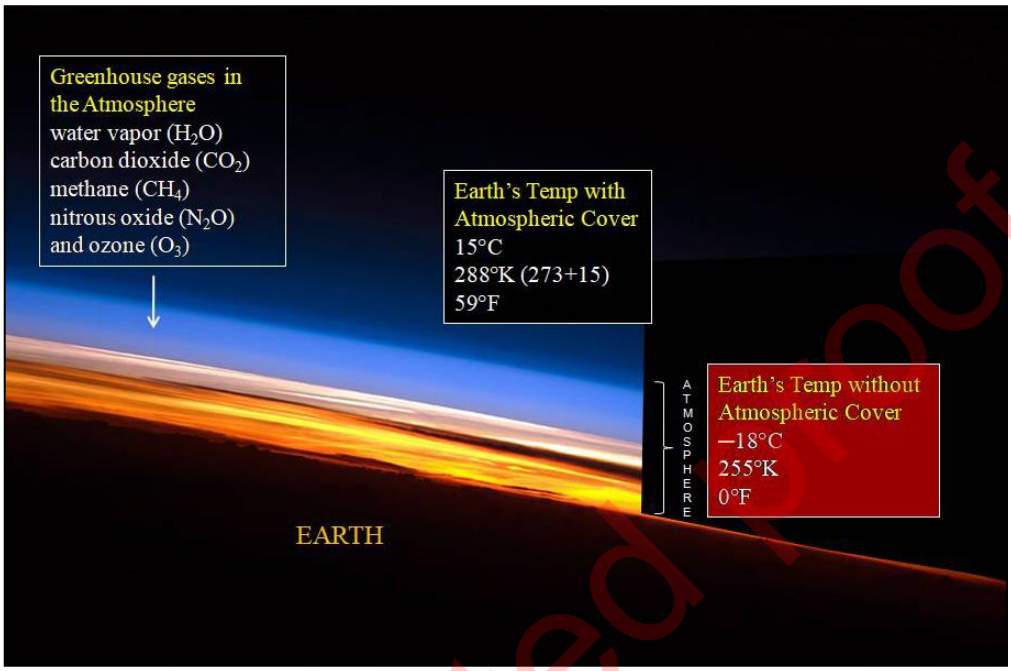


Figure 29. The importance of atmosphere in modulating temperature on Earth. Image Credit: NASA. https://climate.nasa.gov/news/2914/the-atmosphere-earths-security-blanket/Retrieved June 9, 2023. See Buis (2019). See also Hossenfelder (2023) and NASA (2023a). Additional labels by G. Shanmugam.

4. Although water vapor is a more important greenhouse gas than $CO_2$, the current emphasis is not on water vapor.
5. No one knows what the effects of water vapor and cloud on temperature is.
6. Fossils Fuels are the least important factor in controlling climate, but most attention is given to Fossil Fuels for evil political reasons.
7. 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
8. The climate models cannot predict extreme weather events.
9. The current Climate models tend to exaggerate future Temperature increase (Van Wijngaarden and Happer, 2020; Happer and Lindzen, 2022).

**21. $CO_2$ Coalition**

According to the "$CO_2$ Coalition", a nonprofit organization (Happer and Lindzen, 2022), there are fundamental issues surrounding the Climate Change paradigm:
1. There is no climate-related financial risk caused by Fossil Fuels and $CO_2$, but there will be disastrous consequences if fossil fuel use and $CO_2$ emissions are reduced to "Net Zero."
2. Temperature Models tend to overhype the increase of temperature values with time.
3. Geologic models have neglected to point out that $CO_2$ has been declining for 145 million years from about 2,800 ppm to today's low 420 ppm.
4. Finally, there is no need for alarm due to increase in $CO_2$ in the future because even if the $CO_2$ 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 (Figure30) is in order here because Van Wijngaarden and Happer (2020) used this curve as the basis of their calculation of temperature for $CO_2$ value of 800 ppm.

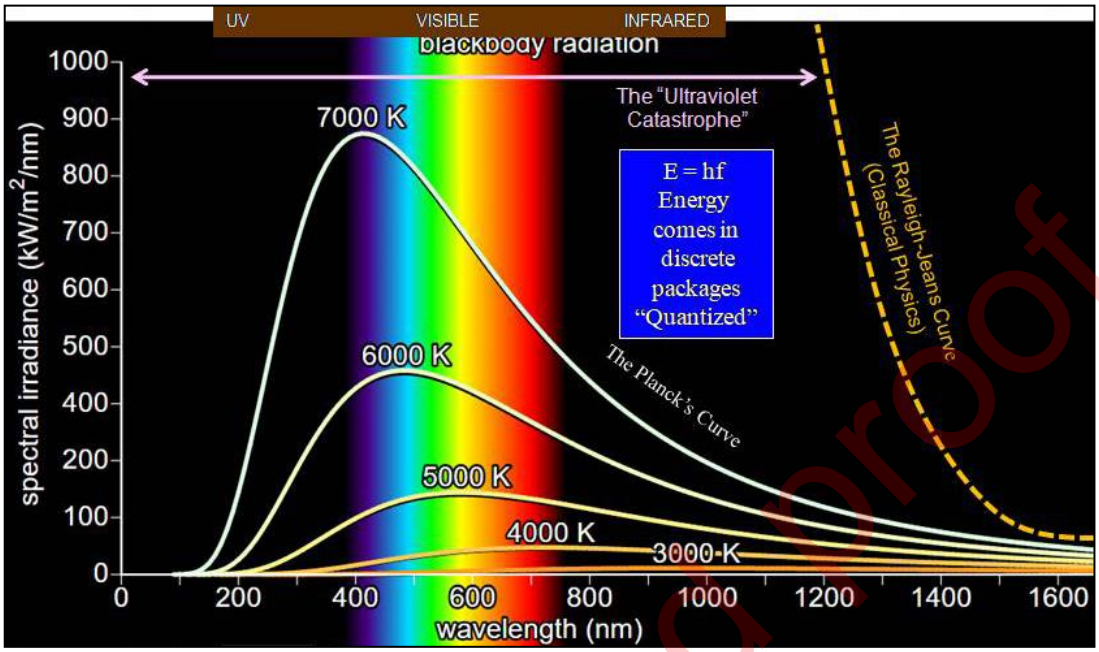


Figure 30. Black body curves of Planck for various temperatures and comparison with classical theory of Rayleigh-Jeans. The Planck-Einstein relation (E=hf), a formula integral to quantum mechanics, says that a quantum of energy (E), commonly thought of as a photon, is equal to the Planck constant (h) times a frequency of oscillation of an atomic oscillator. Diagram source: Elert (1988-2022). 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.

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 ($B_\lambda$)*:*
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 = $6.62 \times 10^{-34} Js$, k = Boltzmann's Constant = $1.381 \times 10^{-23}$ J/°K, $\lambda$ = Wavelength, c = Speed of Light

The Planck's Curve (Figure30) 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 = hν Quantum energy of photon

The Planck–Einstein relation (**E=hν**), 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= $6.62 \times 10^{-34}$, Joule.Sec = $4.136 \times 10^{-15}$ eV.s, f or v = Frequency

**22. Van Wijngaarden and Happer (2020) Calculation**

Van Wijngaarden and Happer (2020) emphasized that with respect to their calculation of future temperature increase caused by increasing $CO_2$ emissions using the Planck's Curve (Figure30) (see also Happer and Lindzen, 2022):

1. The area under the blue Planck's curve Calculation (Figure 31) is about 394 W/m$^2$. This is the total flux if the Earth would radiate to space if the surface were at a temperature of 60$^0$F and there were no greenhouse gases to retard the escape of radiation.
2. Without greenhouse gases, the total heat loss of 394 W/m$^2$ 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.
3. Van Wijngaarden and Happer (2020) demonstrated that doubling $CO_2$ would result in a temperature increase of less than 1° C (Figure 30) because the atmosphere is saturated with $CO_2$. In other words, there is no climate-related financial risk caused by Fossil Fuels and $CO_2$.

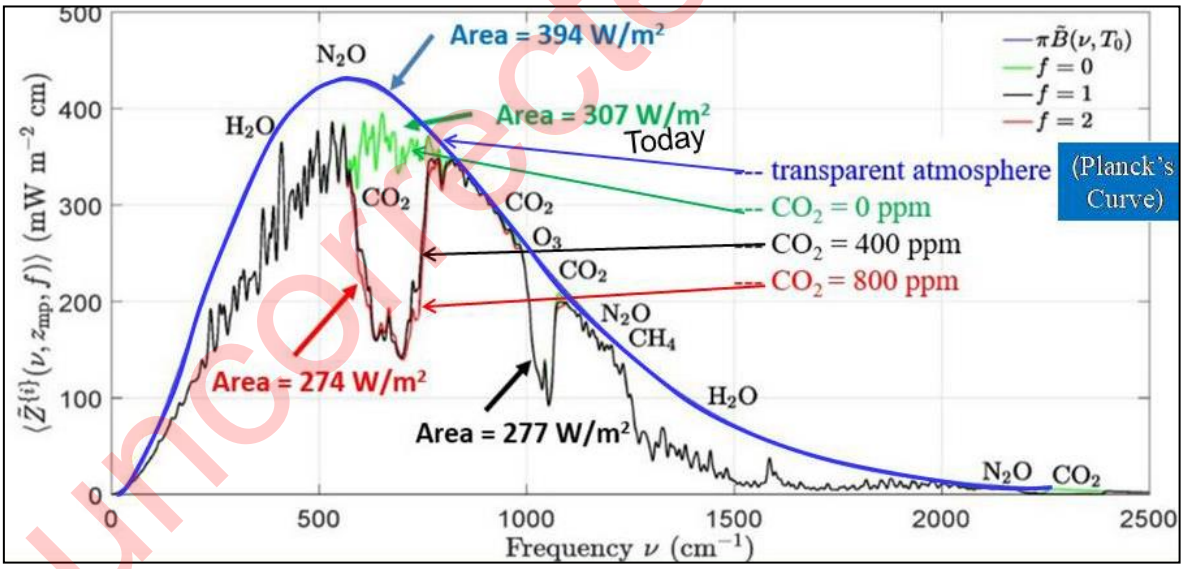


Figure 31. Calculations, based on the Planck's Curve, reveal that Temperature increase would be <1°C even with doubling of $CO_2$. Diagram from "van Wijngaarden and Happer (2020)). Additional labels by G. Shanmugam.

**23. Climate-Change: A Model for 200 Years (1900-2100)**

Although the proposed model is for Climate Change, 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, John. D. Rockefeller's 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 airplane. 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 and lived in Dayton, Ohio. This 1900-time frame allows a full integration of $CO_2$ emissions from Fossil Fuels into the climate model. Incidentally, the $CO_2$─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, using robust datasets (Tables 3 and 4; Figure32), for 200 years (Figure33), I have examined the four basic parameters, namely

1. $CO_2$ (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),
3. Population (United Nations, 2023; WorldoMater, 2023*a*)
4. World GDP per capita (Long, 1998; Darwall, 2020; Future Timeline, 2023).

Table 3-History of Changes in the Earth's Temperature. Modified after Current Results (Osborn, 2023). 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 = 16.0ºC. 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

Table 4- World population (WorldoMeter, 2023*a*)

| **Year** | **Population** |
|---|---|
| 2020 | 7,794,798,739 |
| 2010 | 6,956,823,603 |
| 2000 | 6,143,493,823 |
| 1990 | 5,327,231,061 |
| 1980 | 4,458,003,514 |
| 1970 | 3,700,437,046 |
| 1960 | 3,034,949,748 |
| 1951 | 2,584,034,261 |
| 1927 | 2,000,000,000 |
| 1900 | 1,600,000,000 |
| 1850 | 1,200,000,000 |
| 1804 | 1,000,000,000 |
| 1760 | 770,000,000 |
| 1700 | 610,000,000 |
| 1600 | 500,000,000 |
| 1500 | 450,000,000 |
| 1400 | 350,000,000 |
| 1200 | 360,000,000 |
| 1100 | 320,000,000 |
| 1000 | 275,000,000 |
| 900 | 240,000,000 |
| 800 | 220,000,000 |
| 700 | 210,000,000 |
| 600 | 200,000,000 |
| 200 | 190,000,000 |
| –500 | 100,000,000 |
| –1000 | 50,000,000 |
| –2000 | 27,000,000 |
| –3000 | 14,000,000 |
| –4000 | 7,000,000 |
| –5000 | 5,000,000 |

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

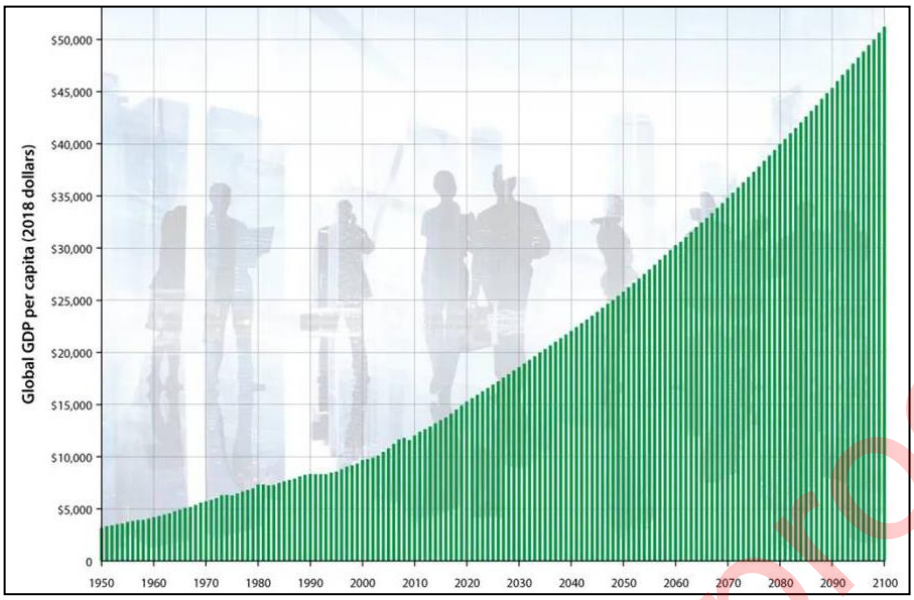


Figure 32. Global GDP per capita. Source: Future Timeline (2023).

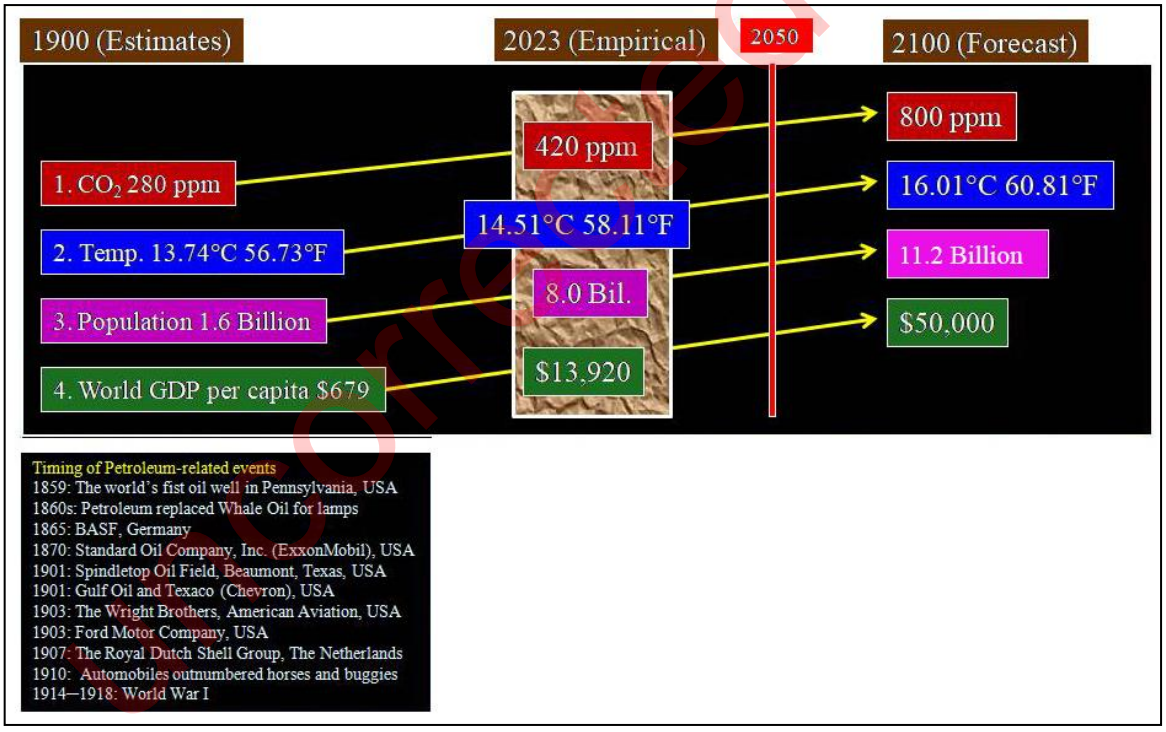


Figure 33. Climate change model for 200 Years (1900-2100) showing increase in all four parameters with time. In other words, an increase in CO2 will not hinder population growth or GDP growth in 2100. The Net-Zero 2050 marker is shown for reference. References: 1. $CO_2$: Lindsey (2022); Happer and Lindzen (2022); Scripps $CO_2$ Program (2023). 2. Temperature: Allen et al. (2018); Happer and Lindzen (2022); Lee et al. (2023); Osborn (2023); Table 4. 3. World Population in Billion: Roser et al. (2013); United Nations (2023); WorldoMeter (2023a): Table 5. 4. World GDP per capita: Long (1998); Darwall (2020); Future Timeline (2023); IMF (2023). Diagram from Shanmugam (2023*b*)

**24. AWI (2019) New climate model for the IPCC**

The AWI (Alfred Wegener Institute) (2019) proposed a New climate model for the IPCC (Figure 34). In this model, the Temperature and $CO_2$ values would be 19ºC and 1142 ppm in 2100; respectively. Even these higher values are not harmful to either humans or plants. For example, I have been living in Dallas, Texas (USA) since 1978. During these 45 years (1978-2023), Dallas Summer Temperature in averages as follows (High/Low):

June: 92/73.5ºF or 33.33/23.05 ºC
July: 96/77.4 ºF or 35.55/25.22 ºC
August: 96/77.5 ºF or 35.55/25.27 ºC

In other words, I and 6 million other residents in the Dallas-Fort Worth-Arlington Meytoplex have been living comfortably for the past 45 years in an area where the Temperature is 20 ºC higher than the 2100 Temperature predicted by the AWI (Alfred Wegener Institute) (2019). This verifiable weather data is the testament to prove that the "Climate Crisis" is a fallacy. Furthermore, plants will thrive on this higher predicted value of $CO_2$ at 1142 ppm!

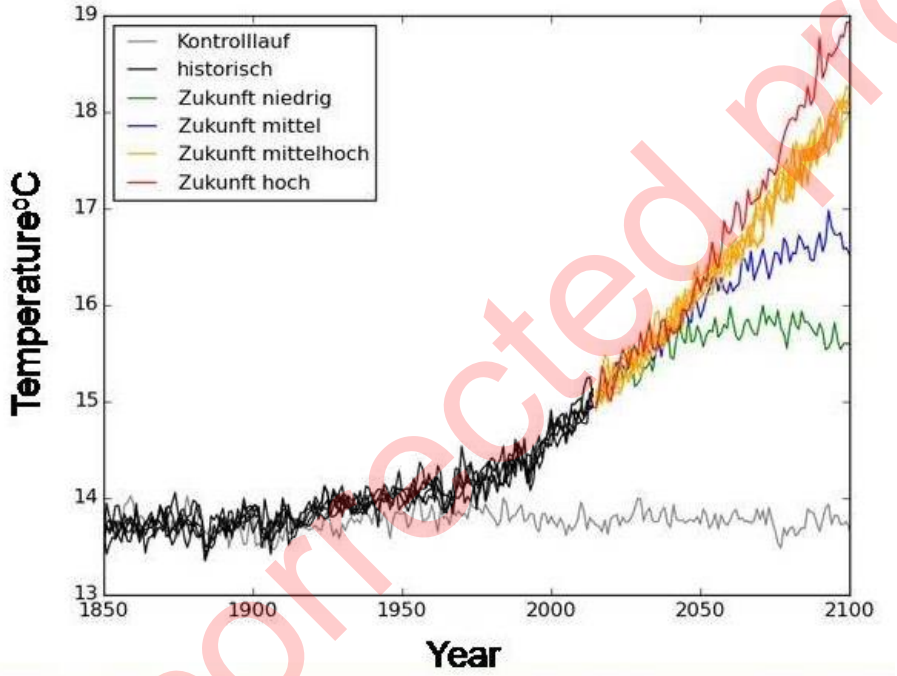


Figure 34. The AWI (Alfred Wegener Institute (2019) proposed a New climate model for the IPCC. In this model, the Temperature and CO2 values would be 19oC and 1142 ppm, in 2100, respectively.

**25. Global Poverty**

At present, 800 million (10%) of the world population still has no access to electricity (Figure 35). Rescuing humanity from poverty using Fossil Fuels is our moral virtue, not vice (Epstein, 2014; 2022; Lomborg, 2007; 2022).

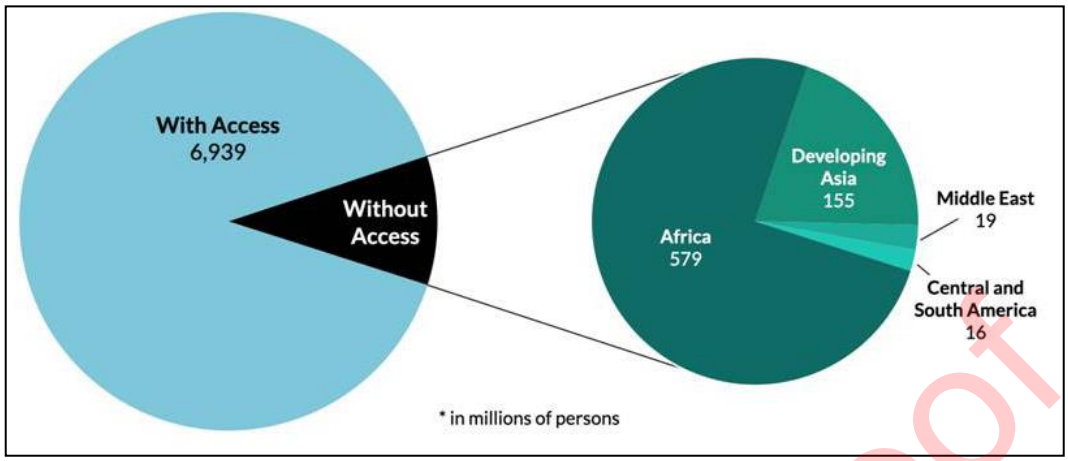


Figure 35. Diagram showing 800 million (10%) of the world population has no access to electricity. Diagram from Epstein (2022). Portfolio/Penguin additional labels by G. Shanmugam.

**26. Lessons Learned**

1. Climate Change is a Natural Phenomenon. There is no emergency, crisis or catastrophe.
2. By 2100, the temperature increase would be trivial as to it would not affect the population and GDP growth (Figure33). The increase in $CO_2$ 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. During the geologic past, $CO_2$ levels were much higher than the present level of 420 ppm (Figure 36).For example, around the Ordovician period, 500 million years ago, atmospheric $CO_2$ concentration was around 5000 and 6000 ppm! Mulhern (2020), reported $CO_2$ levels between 3000 and 9000 ppm during the Ordovician. However, pre-industrial $CO_2$ levels were around 280 ppm (Figure 23).

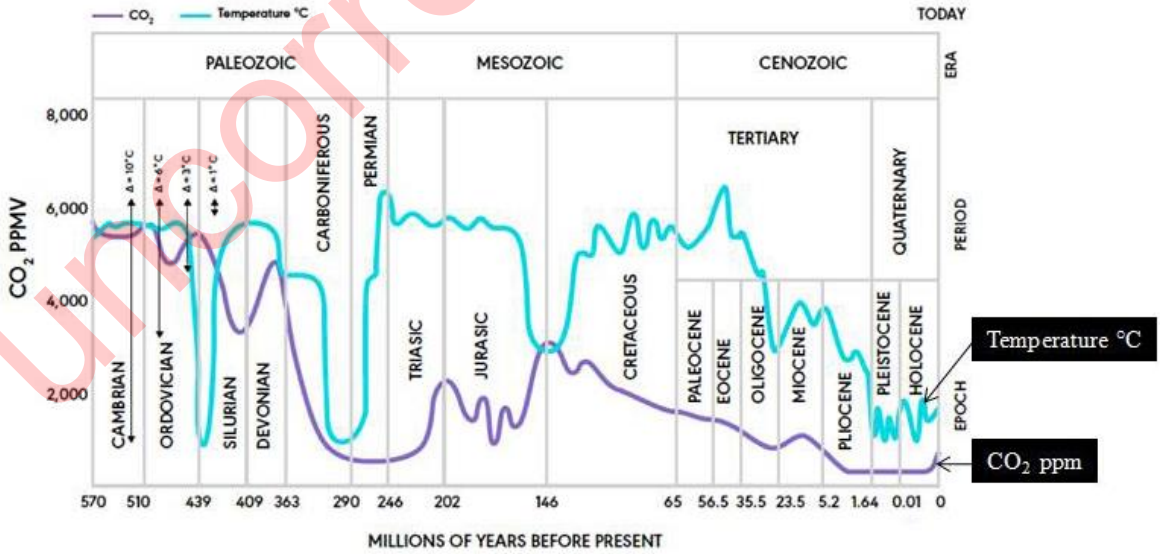


Figure 36. Diagram showing that during the geologic past $CO_2$ level was much higher than the present level of 420 ppm. Note that there is no correlation between Temperature and $CO_2$ trends. Diagram from Epstein (2022). Portfolio/Penguin. See also Berner (1991, 2004) and Scotese et al. (2021). Additional labels by G. Shanmugam.

4. Throughout geologic history, there has not been any correlation between $CO_2$ and Temperature trends (Figure36). Importantly, current $CO_2$ and Temperature values are the lowest when compared to the geologic past Figure 36).
5. Wind and Solar are unreliable alternative sources because they do not meet the demand (Figure 37). 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.).

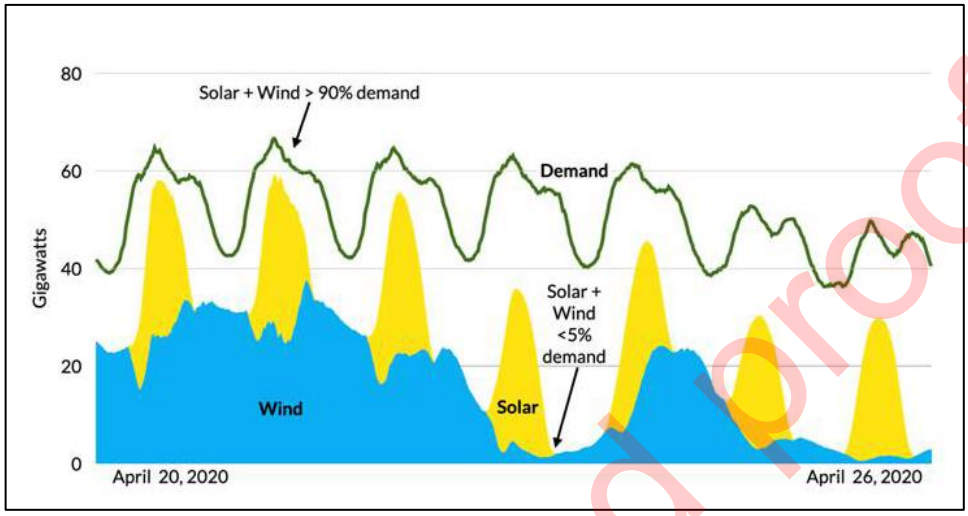


Figure 37. Diagram showing unreliable nature of wind and solar energy sources that do not meet the demand. Note intermittent wind and solar can go to near zero for extended period of time. Diagram source: Epstein (2022). Portfolio/Penguin.

6. Political crisis in Sri Lanka is an affirmation that ESG is futile. Also, the Green Energy movement can trigger riots by the most passive religious people of Buddhism in Sri Lanka with 70% Buddhists.
7. In the Democratic Republic of Congo, Climate Change policies have resulted in slave-like conditions for child labors. 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 laboring in slave-like conditions in the Democratic Republic of Congo."
8. In 1910, automobiles finally outnumbered 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.
9. According to Chandrasekharam (2021), "For extracting, one ton of Li 6 tons of $CO_2$ is emitted. Li is used in the manufacture of Battery Electric Vehicles (BEV), Hybrid Electric Vehicles (HEV), plug-in hybrid electric vehicles (PHEV)."
10. 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.
11. 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 a few scattered locations around the world. At this rate, sea-level rise will be of no consequence to the world over a 100─year period. In addition, sea level fluctuates 1 to 5 meters twice a day at most locations around the world due to tides. The global warming alarmists never seem to mention this!
12. 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 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.

13. 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 complement the proven world reserves of oil totaling 236.29 billion tones (Figure 38) 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 (Figure 38) 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, unless the global warming alarmists are able to keep preventing use of fossil fuels.

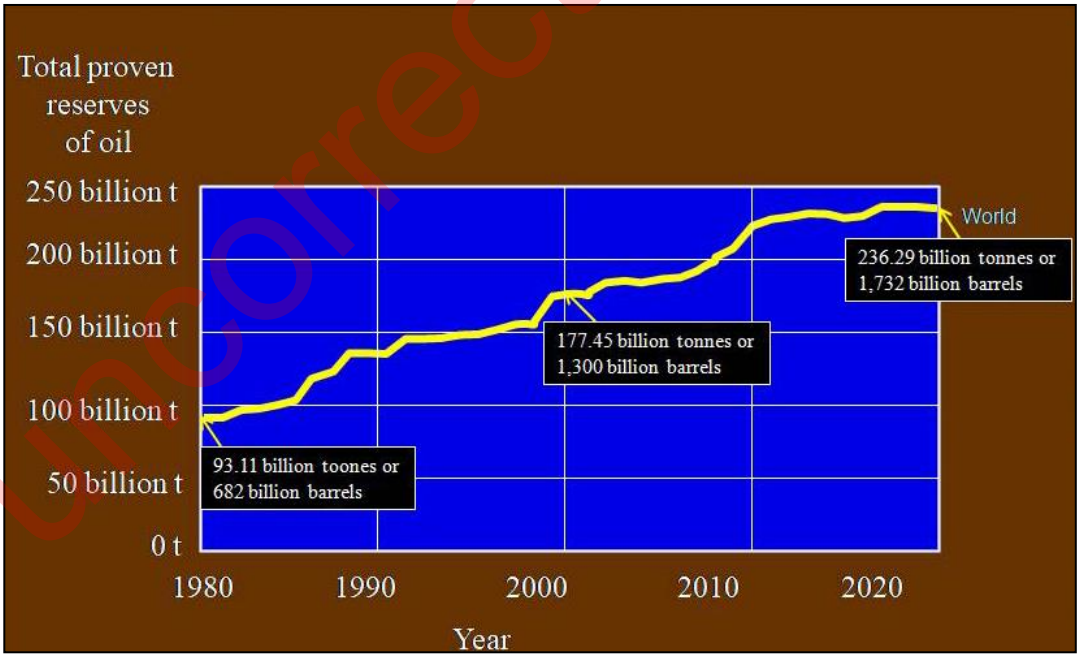


Figure 38. World proven oil reserves for the period 1980-2020. Source: Statistical Review of world energy-BP (2022). Diagram source: Our World in Data (2023). Conversion: 1 tone = 7.33 barrels. Additional labels by G. Shanmugam.

**27. Global Greening by $CO_2$emissions**

In a seminal paper by Zhu et al. (2016), promoted by NASA (2023*b*), 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 (Figure39).
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 the 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 carbon dioxide increase photosynthesis, spurring plant growth.
4. Natural plants and related photosynthesis have been influencing Atmospheric Greenhouse Gases for billions of years (Figure40).
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. To think that humans can overturn this natural phenomenon of climate change by emission of $CO_2$ for a mere 263 years, since the Industrial Revolution that commenced in 1760, is ludicrous!

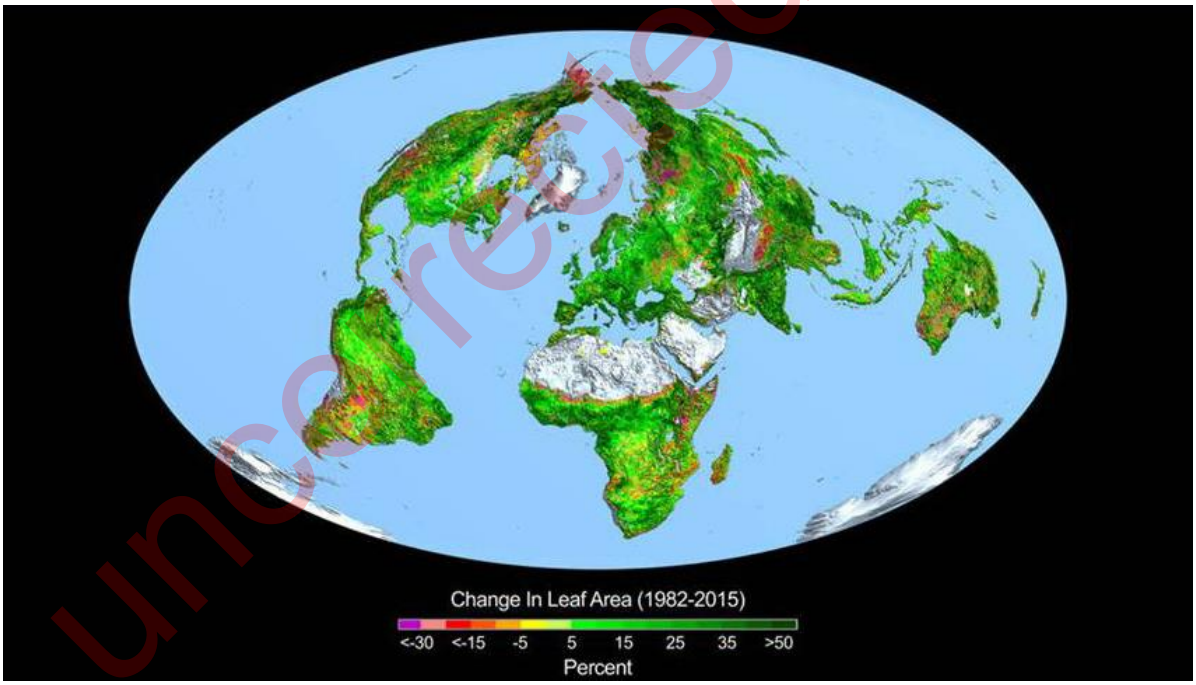


Figure 39. Global Greening due to $CO_2$ emissions during 1982-2015. Credits: Boston University/R. Myneni; Zhu et al. (2016); NASA (2023b).

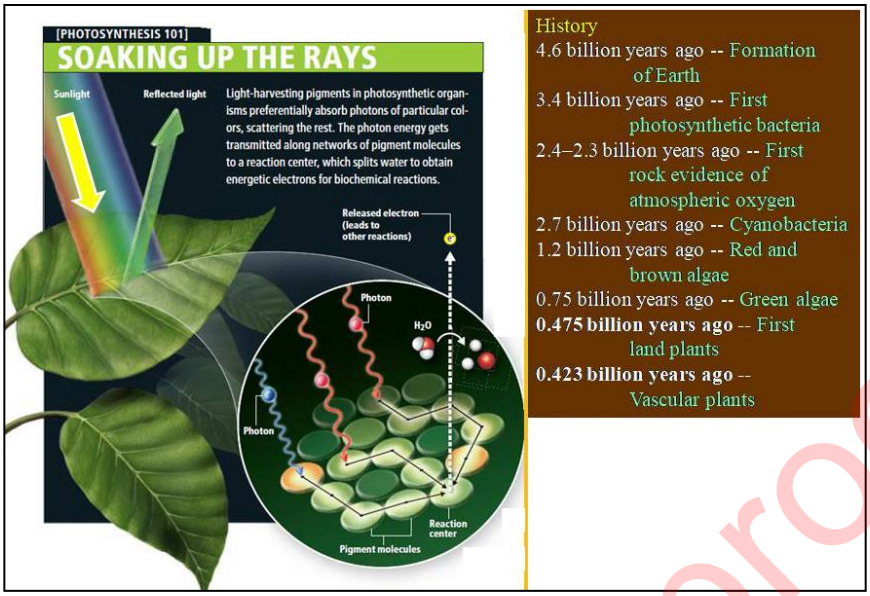


Figure 40. Natural plants and related photosynthesis have been influencing Atmospheric Greenhouse Gases for billions of years. However, fossil fuels came into the picture only recently during the Industrial Age in 1760, just 263 years ago. Diagram Source: Kiang (2008). Scientific American.

**28. Conclusions**

1. There is no Climate Crisis.
2. There is no Climate Emergency.
3. There is no Climate Catostrophe.
4. There is no Existential Threat.
5. Leavethe Planet, People, and $CO_2$alone! (Figure 41).

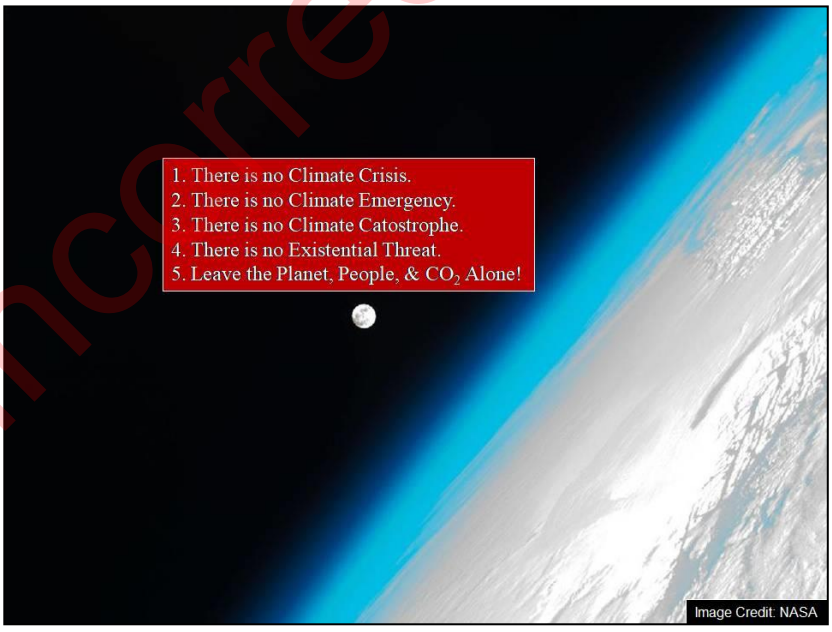


Figure 41. Conclusions. Image Credit: NASA. Title: The Moon and Earth's atmosphere. ISS030-E-031275 (8 Jan. 2020). https://www.nasa.gov/mission_pages/station/multimedia/gallery/iss030e031275.html, Retrieved June 8, 2023.

Our global strategy for the future should be to:

1. Shift resources and attention away from Climate Change.
2. Embrace Fossil Fuels in all sectors (agriculture, transportation, etc.).
3. Avoid unreliable wind and solar energy sources.
4. Learn from policy mistakes made by Germany, Sri Lanka, and the Netherlands.
5. Treat the phrase "Scientific Consensus" as an oxymoron.
6. Reject hypocritical climate policies that deprive developing countries of Fossil Fuels.
7. Reject Climate Models that do not agree with real-world empirical data.
8. Evaluate Climate Change based on Atmospheric Sciences.
9. Educate youngsters on the vital role of $CO_2$ to People and Plants.
10. Eliminate Global Poverty.

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## References


Allen, M.R., Dube, O. P., Solecki, W., Aragón─Durand, F., Cramer, W., Humphreys, S., Kainuma, M.,Kala., J., Mahowald, N., Mulugetta, Y., Perez, R. M., Wairiu, M., Zickfeld, K. 2018. Framing and Context. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre─industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of Climate Change, sustainable development, and efforts to eradicate poverty [Masson─Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, 49-92.

AOML (Atlantic Oceanographic and Meteorological Laboratory), 2007*a*. What is a hurricane, typhoon, or a tropical cyclone: http://www.aoml.noaa.gov/hrd/tcfaq/A1.html Retrieved February 15, 2023.

AOML (Atlantic Oceanographic and Meteorological Laboratory), 2007*b*. What is an extra-tropical cyclone: http://www.aoml.noaa.gov/hrd/tcfaq/A7.html Retrieved February 15, 2023.

AOML (Atlantic Oceanographic and Meteorological Laboratory), 2007*c*. How do tropical cyclones form: http://www.aoml.noaa.gov/hrd/tcfaq/A15.html Retrieved February 15, 2023.

Berner, R. A. 1991. A model for atmospheric CO2 over Phanerozoic time: American Journal of Science, 291, 339–376.

AWI (Alfred Wegener Institute), 2019. New climate model for the IPCC. https://phys.org/news/2019-09-climate-ipcc.html Retrieved May 4, 2023.

Berner, R.A. 2004. The Phanerozoic carbon cycle: $CO_2$ and $O_2$: Oxford University Press, 158 p.ISBN-13: 978-0195173338.

Bostock, W. 2022. Sri Lanka says it is 'bankrupt' as financial crisis ravaging the country https://www.businessinsider.com/sri-lanka-says-bankrupt-financial-crisis-ravages-country-debts-default-2022-7Retrieved November 28, 2022.

Buis, A. 2019. The Atmosphere: Earth's Security Blanket. *Sizing Up Humanity's Impacts on Earth's Changing Atmosphere: A Five-Part Series.Part 1. NASA Global Climate Change. Vital Signs of the Planet. Feature. October 2, 2019.*

Chand, S.S., Walsh, K.J.E., Camargo, S.J., Kossin, J. P., Tory, K. J., Wehner, M. F., Chan, J. C. L., Klotzbach, P. J., Dowdy, S. J., Bell, S. S., Ramsay, H. A. and Murakami, H. 2022. Declining tropical cyclone frequency under global warming. Nature Climate Change12, 655–661.

Chandrasekharam, D. 2021. The NZE tamasha and the CoP 26.https://timesofindia.indiatimes.com/blogs/dornadula-c/the-nze-tamasha-and-the-cop-26/Retrieved May 10, 2023.

Christy, J. R. 2022. Data shows there's no climate catastrophe looming – climatologist Dr J Christy debunks the narrative. BizNewsTv. https://www.youtube.com/watch?v=qJv1IPNZQao Retrieved May 2, 2023.

Christy, J. R., Herman, B., Pielke Sr. R., Philip K., McNider R. T., Hnilo, J. J.,Spencer, R. W., Chase T., Douglass., D. 2010. "What Do Observational Datasets Say About Modeled Tropospheric Temperature Trends since 1979?" *Remote Sensing* 2, 9, 2148-2169.

CNN. 2022. Activists glue themselves to copy of Leonardo's 'The Last Supper,' adding to string of similar protests. https://www.cnn.com/style/article/just-stop-oil-protest-leonardo-da-vinci/index.htmlRetrieved May 6, 2023.

CNOOC. 2022. CNOOC discovers large deep-water gas field, containing 50 billion cubic meters of fuel.Global Times, https://www.globaltimes.cn/page/202210/1277590.shtml Retrieved November 22, 2022.

Curry, J. 2023. Jordan Peterson - The Predictions Are Wrong!! Judith Curry. https://www.youtube.com/watch?v=Jl_6vtiTOPo Retrieved February 9, 2023.

Daily Caller News Foundation, 2022. 'Complete Collapse': Here's How ESG Destroyed One Nation's Economy. https://dailycaller.com/2022/07/06/complete-collapse-esg-destroyed-nations conomy/https://dailycaller.com/2022/07/06/complete-collapse-esg-destroyed-nations-economy/ Retrieved November 26, 2022.

Darwall, R. 2020. Climate Noose: Business, Net Zero and the IPCC's Anticapitalism Global Warming Policy Foundation, 21.

De Lange, C. A., Ferguson, J. D., Happer, W., van Wijngaarden, W. A. 2022. Nitrous Oxide and Climate. https://arxiv.org/abs/2211.15780 Retrieved April 28, 2023.

Eberling, M. 2022. The environmental downside of electric vehicles. https://www.themainewire.com/2022/04/the-environmental-downside-of-electric-vehicles/ Retrieved 31, 202.

Eckert, X., and Sims, T. 2022. Energy crisis fuels coal comeback in Germany. https://www.reuters.com/markets/commodities/energy-crisis-fuels-coal-comeback-germany-2022-12-16/ Retrieved March 4, 2023.

Elert, G. 1988-2022. Blackbody Radiation. In The Physics Hypertextbook. https://physics.info/planck/ Retrieved March 2, 2023.

Ellis, D. 2022. Top 10 countries for carbon dioxide emissions. https://energydigital.com/top10/top-10-countries-for-carbon-dioxide-emissions Retrieved March 4, 2023.

Ellis-Peterson, H. 2021. India criticised over coal at Cop26 – but real villain was climate injustice. https://www.theguardian.com/environment/2021/nov/14/india-criticised-over-coal-at-cop26-but-real-villain-was-climate-injustice Retrieved March 8, 2023.

Epstein, A. 2014. The Moral Case for Fossil Fuels. Portfolio/Penguin, 256.

Epstein, A. 2022. Fossil Future: Why Global Human Flourishing Requires More Oil, Coal, and Natural Gas--Not Less. Portfolio/Penguin,480.

Follett, C., Cochran, M. 2022. Sri Lanka Is a Wake-Up Call for Eco-Utopians. https://www.humanprogress.org/sri-lanka-is-a-wake-up-call-for-eco-utopians/Retrieved November 26, 2022.

Fouche, G. and Klesty, V. 2023. Greta Thunberg detained by Norway police during pro-Sami protest. https://www.reuters.com/world/europe/greta-thunberg-detained-by-norway-police-during-demonstration-2023-03-01/ Retrieved March 1, 2023.

Future Timeline, 2023. World GDP per capita, 1950-2100. https://futuretimeline.net/data-trends/8.htm Retrieved February 5, 2023.

Gore, A. 2007. An Inconvenient Truth: The Crisis of Global Warming. Viking Books. ISBN-13: 978-0670062720. 192.

Gray, W. M. 1979. Hurricanes: Their formation, structure and likely role in the tropical circulation, in D. B. Shaw, ed.,Meteorologyover tropical oceans: Royal Meteorological Society, 155–218.

Gross, T. 2023. How 'modern-day slavery' in the Congo powers the rechargeable battery economy. https://www.npr.org/sections/goatsandsoda/2023/02/01/1152893248/red-cobalt-congo-drc-mining-siddharth-kara Retrieved March 3, 2023.

Haigh, J. D., Cargill, P. 2015. The Sun's influence on climate. Princeton University Press, Princeton, New Jersey, 216.

Happer, W. 2021. CLINTEL lecture William Happer in Amsterdam. https://co2coalition.org/media/clintel-lecture-william-happer-in-amsterdam/ Retrieved February 15, 2023.

Happer, W. 2022. 138. Climate Physics w/Professor William Happer. October 29, 2022. https://www.google.com/search?q=harper+climate+physics+youtube&oq=harper+climate+physics+youtube&aqs=chrome..69i57j33i160l2.19747j0j7&sourceid=chrome&ie=UTF8#fpstate=ive&vld=cid:e59ba35f,vid:5Uf_AbyG6ho Retrieved November 23, 2022.

Happer, W., Lindzen, R. 2022. Responses and Declaration on the "CFTC Climate-Related Financial Risk RFI" 87 Fed. Reg. 34856 (June 8,2022).

Hersh, S. 2023. How America Took Out The Nord Stream Pipeline https://seymourhersh.substack.com/p/how-america-took-out-the-nord-stream Retrieved February 8, 2023.

Hockstad, M. 2016. Petrochemicals: The Building Blocks for Wind and Solar Energy. AFPM (American Fuel & Petrochemica Manufacturers)https://www.afpm.org/newsroom/blog/petrochemicals-building-blocks-wind-and-solar-energyRetrieved November 26, 2022.

Holland, G. J., ed., 2007. Global guide to tropical cyclone forecasting, Bureau of Meteorology Research Center, Melbourne, Victoria, Australia: http://www.bom.gov.au/bmrc/pubs/tcguide/globa_guide_intro.htm (accessed November 10, 2007).

Holligan, A. and Kirby, P. 2023. Farmers' protest party win shock Dutch vote victory. BBC NEWS. https://www.bbc.com/news/world-europe-64967513 Retrieved March 16, 2023.

Hooper, J. R., Suhayda, J. N. 2005, Hurricane induced seafloor failures in theMississippi delta: 2005 Offshore Hurricane Readiness and Recovery Conference, American Petroleum Institute, Houston, Texas, July 26–27, 2005: http://www.mms.gov/tarprojects/559/AC2_Soils-Geotechnical_Issues-Hooper.pdf Retrieved November 10, 2007.

Hossenfelder, S. 2023. I Misunderstood the Greenhouse Effect. Here's How It Works. https://www.youtube.com/watch?v=oqu5DjzOBF8 Retrieved February 21, 2023.

IEA (International Energy Agency) 2021. Net Zero by 205A Roadmap for the Global Energy Sector. https://iea.blob.core.windows.net/assets/deebef5d-0c34-4539-9d0c-10b13d840027/NetZeroby2050-ARoadmapfortheGlobalEnergySector_CORR.pdfRetrieved April 4, 2023.

IMF (International Monetary Fund), 2023. GDP per capita for October 2022. https://www.imf.org/external/datamapper/profile/WEOWORLD Retrieved February 8, 2023.

Jeffrey-Wilensky, J.,Radde, K. 2023. Dead whales on the east coast fuel misinformation about offshore wind development.Npr.https://www.npr.org/2023/02/25/1159025632/dead-whales-east-coast-misinformation-offshore-wind Retrieved May 3, 2023.

Jia, M., Li, F., Zhang, Y., Wu, M., Li, Y., Feng, S., Wang, H., Chen, H., Ju, W., Lin, J., Cai, J., Zhang, Y., Jiang, F. 2022. The Nord Stream pipeline gas leaks released approximately 220,000 tonnes of methane into the atmosphere. Environmental Science and Ecotechnology 12, 100210.

Kiang, N. 2008. The Color of Plants on Other Worlds. Scientific America, April 48-55.

Koonin, S. E. 2021. Unsettled: What Climate Science Tells Us, What It Doesn't, and Why It Matters. BenBella Books. 316.

Koonin, S. E. 2023.Unsettled: Climate and Science | Dr. Steven Koonin | EP 323. Jordan B Peterson and Dr. Steven Koonin discuss the IPCChttps://www.youtube.com/watch?v=reaABJ5HpLk Retrieved February 5, 2023.

Lawson, A. 2022. Nord Stream 1: Gazprom announces indefinite shutdown of pipeline. The Guardian. https://www.theguardian.com/business/2022/sep/02/nord-stream-1-gazprom-announces-indefinite-shutdown-of-pipelineRetrieved November 27, 2022.

Lee, H., Calvin, K., Dasgupt, D., Krinner, G., Mukherji, A., Thorne, P., Trisos, C., Romero, J., Aldunce, P., Barrett, K., Blanco, G., Cheung, W. W. L., Connors, S. L., Denton, F., Diongue-Niang, A., Dodman, D., Garschagen, M., Geden, O., Hayward,

B., Jones, C., Jotzo, F., Krug, T., Lasco, R., Lee, J. Y., Masson-Delmotte, V., Meinshausen, M., Mintenbeck, K., Mokssit, A., Otto, F. E. L., Pathak, M., Pirani, A., Poloczanska, E., Pörtner, H. O., Revi, A., Roberts, D. C., Roy, J., Ruane, A. C., Skea, J., Shukla, P. R., Slade, R., Slangen, A., Sokona, Y., Sörensson, A. A., Tignor, M., Vuuren, D., Wei, Y. M., Winkler, H., Zhai, P., Zommers Z. 2023. *Synthesis Report of the IPCC Sixth Assessment Report (AR6): Summary for Policymakers*. Intergovernmental Panel on Climate Change. 36 p. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://report.ipcc.ch/ar6syr/pdf/IPCC_AR6_SYR_SPM.pdf Retrieved April 28, 2023.

Lindsey, R. 2022. Climate Change: Atmospheric Carbon Dioxide. Climate. Gov. https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide Rretrieved February 5, 2023.

Lindzen, R. 2012. Reconsidering the Climate Change Act: Global Warming: How to approach th science (Climate Models and the Evidence?). Seminar at the House of Commons Committee Rooms. Westminster, London. 22nd February 2012.

Lomborg, B. 2007. Cool It: The Skeptical Environmentalist's Guide to Global Warming. Knopf Publishing Group. 272.

Lomborg, B. 2022. 2022.12.19 Peterson and Lomborg - the world is not ending - EP 315. https://www.youtube.com/watch?v=QYg6U6arl_ Retrieved February 9, 2023.

Long, B. D. 1998. Estimates of World GDP, One Million B.C. –Present. Department of Economics, U.C. Berkeley, California. delong@econ.berkeley.eduhttp://econ161.berkeley.edu/ Retrieved February 5, 2023.

McKitrick, R., Christy, J. 2020. Pervasive Warming Bias in CMIP6 Tropospheric Layers. Earth and Space Science, 7 (9), First published: 15 July 2020.

Meza, E. 2022. German funding for energy research reaches 1.31 billion Euros. https://www.cleanenergywire.org/news/german-funding-energy-research-reaches-131-billion-euros Retrieved November 26, 2022.

Mulhern, O. 2020. A Graphical History of Atmospheric CO2 Levels Over Time.https://earth.org/data_visualization/a-brief-history-of-co2/ earth.org. Retrieved January 26, 2023.

NASA (*National Aeronautics and Space Administration)*2023*a*. Graphic: The relentless rise of carbon dioxide. https://climate.nasa.gov/climate_resources/24/graphic-the-relentless-rise-of-carbon-dioxide/Retrieved February 10, 2023.

NASA (*National Aeronautics and Space Administration)*2023*b*. Carbon Dioxide Fertilization Greening Earth, Study Finds. https://www.nasa.gov/feature/goddard/2016/carbon-dioxide-fertilization-greening-earth Retrieved February 15, 2023.

NASA 2023*c*. Graphic: The relentless rise of carbon dioxide, https://climate.nasa.gov/climate_resources/24/graphic-the-relentless-rise-of-carbon-dioxide/, Retrieved May 3, 2023.

Nature. 2021. EDITORIAL. Concrete needs to lose its colossal carbon footprint. Nature, Vol 597, pp. 593-594, 30 September 2021. https://www.nature.com/articles/d41586-021-02612-5 Retrieved May 1, 2023.

NHC (National Hurricane Center) 2023*a*. U. S. Hurricane Strikes by Decade. https://www.nhc.noaa.gov/pastdec.shtml Retrieved February 9, 2023.

NHC (National Hurricane Center)2023*b*. Introduction to Storm Surge. chromeextension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.nhc.noaa.gov/surge/surge_intro.pdf Retrieved May 3, 2023.

Nicholls, R.J., Lincke, D., Hinkel, J., Brown, S., Vafeidis, A. T., Meyssignac, B., Hanson, S. E., Merkens, J., Fang, J.2021. A global analysis of subsidence, relative sea-level change and coastal flood exposure. Nat. Climate Change 11, 338–342.

Nilsen, T. 2022. Rosneft announces a big oil discovery in the Pechora Sea. Arctic Today. The Independent Barents Observer. https://www.arctictoday.com/rosneft-announces-a-big-oil-discovery-in-the-pechora-sea/ Retrieved March 9, 2023.

Osborn, L. 2023. History of Changes in the Earth's Temperature. Current Results. https://www.currentresults.com/Environment-Facts/changes-in-earth-temperature.php#:~:text=The%20average%20global%20annual%20temperature,%C2%B0F)%20until%20the%201980s.Retrieved February 5, 2023.

Our World in Data 2023. https://ourworldindata.org/grapher/oil-proved-reserves?country=~OWID_WRL Retrieved March 12, 2023.

Palumbo, J. 2022. Activists glued themselves to copy of Leonardo da Vinci's 'The Last Supper' at the Royal Academy of Arts in London. CNN, https://www.cnn.com/style/article/just-stop-oil-protest-leonardo-da-vinci/index.html Retrieved March 19, 2023.

Planck, M. *1900*. "Über eine Verbesserung der Wien'schen Spectralgleichung". Verhandlungen der Deutschen Physikalischen Gesellschaft. *V. 2: pp. 202–204*. Translated in *ter Haar, D. (1967)*. "On an Improvement of Wien's Equation for the Spectrum" (PDF). *The Old Quantum Theory*. Pergamon Press. *pp. 79–81*. LCCN 66029628.

Planck, M. *1901*. "Über das Gesetz der Energieverteilung im Normalspektrum". Annalen der Physik. *V. 4 (3), pp. 553─563*. Bibcode:1901AnP...309..553P. doi:10.1002/andp.19013090310. Translated in *Ando, K*. "On the Law of Distribution of Energy in the Normal Spectrum" (PDF).

Planck, M. 1914. The Theory of Heat Radiation. Translated by Masius, M. (2nd ed.). P. Blakiston's Son & Co. OL 7154661M.

Ranken Energy Corporation 2022. Products made from petroleum. https://www.ranken-energy.com/index.php/products-made-from-petroleum/ Retrieved November22, 2022.

Renowden, G. 2015. Confusing Greenland warming vs global warming. https://skepticalscience.com/10000-years-warmer.htm Retrieved January 30, 2023.

Reuters (May 30, 2022). Mona Lisa left unharmed but smeared in cream in climate protest stunt. https://www.reuters.com/world/europe/mona-lisa-left-unharmed-smeared-cream-climate-protest-stunt-2022-05-30/ Retrieved April 3, 2023.

RIGZONE 2023. Discoveries News. https://www.rigzone.com/news/topic/discoveries/ Retrieved March 12, 2023

Rosen, J. Egger, A. E. 2016. Factors that Control Earth's Temperature. Visionlearning Vol. EAS-3 (4), 2016.

Roser, M. Ritchie, H. Ortiz-Ospina, E., Rodés-Guirao, L. 2013. World Population Growth. Published online atWorldInData.org. 'https://ourworldindata.org/world-population-growth' Retrieved February 29, 2023.

Schleussner, C. 2022. "The Paris Agreement – the 1.5 °C Temperature Goal". Climate Analytics.https://climateanalytics.org/briefings/15c/Retrieved March 4, 2023.

Schreiber, R. 2022. Deutsche Bank Says Germans May Need to Switch from Gas-to-Wood for Heating this Winter, is Wood-to-Gas for Cars Next?https://www.thetruthaboutcars.com/2022/07/deutsche-bank-says-germans-may-need-to-switch-from-gas-to-wood-for-heating-this-winter-is-wood-to-gas-for-cars-next/November 26, 2022.

Scotese, C. R., Song, H., Mills, B. J. W., van der Meer, D. G. 2021. Phanerozoic paleo-temperatures: The earth's changing climate during the last 540 million years. Earth-Science Reviews215, April 2021, 103503.

Scripps $CO_2$ Program 2023. $CO_2$ Concentration at Mauna Loa Observatory, Hawaii. Scripps Institution of Oceanography. UC San Diego, California. https://scrippsco2.ucsd.edu/ Retrieved February 8, 2023.

Shanmugam, G. 2008. The constructive functions of tropical cyclones and tsunamis on deepwater sand deposition during sea level highstand: implications for petroleum exploration. AAPG Bulletin, 92, 443-471.

Shanmugam, G. 2018. Preface to the Special Issue dedicated to George Devries Klein by the Journal of the Indian Association of Sedimentologists (JIAS). Journal Indian Association of Sedimentologists, 35(2), 1-5.

Shanmugam, G. 2022. “Fossil Future: Why Global Human Flourishing Requires More Oil, Coal, and Natural Gas--Not Less” by Alex Epstein. Book Review: Journal of the Indian Association of Sedimentologists, 39 (2), 58─68.

Shanmugam, G. 2023*a*. Climate Change: Fossil Fuels, Renewable Energy, Cyclones, Hypocrisy, Governance, $CO_2$ Coalition, Model, Lessons Learned, and Roadmap. OHIO University Geological Sciences Alumni Symposium, Virtual Lecture, 10:10 - 10:40 AM, EST, Saturday, April 15, 2023, OHIO University, Athens, Ohio, USA.

Shanmugam, G. 2023b. 200 Years of Fossil Fuels and Climate Change (1900-2100). The Journal of the Geological Society of India, v. 99 1043-1062.

Shanmugam, G., Moiola, R. J. 1988. Submarine fans: characteristics, models, classification, and reservoir potential. Earth-Science Reviews, 24, 383–428.

Shao, Gaofeng; et al. 2019. Improved oxidation resistance of high emissivity coatings on fibrous ceramic for reusable space systems. Corrosion Science, 146: 233–246. arXiv:1902.03943.

Sharma, I. 2023. Masterclass In Hypocrisy': Global Elites Arrived At Davos Summit In Private Jet To Discuss Climate Change. https://www.indiatimes.com/trending/environment/global-elites-slammed-for-arriving-at-davos-summit-in-private-jets-590644.html By Isha Sharma on Jan 18, 2023, 23:09 IST. Retrieved January 30, 2023.

Sharma, P. 2023. Climate Hypocrisy: How Developed World Exports Climate Crisis | Vantage with Palki Sharma. February 28, 2023. https://www.youtube.com/watch?v=-7vyk_jlqtoRetrieved March 7, 2023.

Soon, W, Connolly, R., Connolly, M. 2015. Reevaluating the role of solar variability on Northern Hemisphere temperature trends since the 19th century. Earth-Science Reviews, 150, 409-452.

Soon, W., Baliunas, S. 2017. A Brief Review of the Sun–Climate Connection, with a New Insight Concerning Water Vapour. https://lweb.cfa.harvard.edu/~wsoon/myownPapers-d/SoonBaliunas17-June8-FINAL-CCTF2017_Ch11_2pp.pdf Retrieved December 5, 2022.

Tarbell, I. M. 2013. The History of the Standard Oil Company (Vol. 1, Illustrated). Create Space Independent Publishing Platform. ISBN-10: 1494812789, 208.

UNFCC, 2021. The Paris Agreement. United Nations Climate Change. https://unfccc.int/process-and-meetings/the-paris-agreement Retrieved March 4, 2023.

United Nations, 2023. World population projected to reach 9.8 billion in 2050, and 11.2 billion in 2100. https://www.un.org/en/desa/world-population-projected-reach-98-billion-2050-and-112-billion-2100Retrieved February 5, 2023.

Van der Lingen, G. J. 2018. Post-modernism andclimate change. Special Issue dedicated to George Devries Klein in celebrating his life and achievements. Jour. Indian Association of Sedimentologists, 35, 2, 6-12.

van Wijngaarden, W. A., Happer, W. 2020. Dependence of Earth’s Thermal Radiation on Five Most Abundant Greenhouse Gases (June 8, 2020), https://arxiv.org/pdf/2006.03098 Retrieved April 30, 2023.

Wikipedia, 2022. 2022 Sri Lankan political crisis. https://en.wikipedia.org/wiki/2022_Sri_Lankan_political_crisis Retrieved May 4, 2023.

Wikipedia, 2023. Storm Surge. https://en.wikipedia.org/wiki/Storm_surge#:~:text=Unexpected%20flooding%20in%20estuaries%20and,was%20the%201970%20Bhola%20cyclone. Retrieved May 2, 2023.

WMO (World Meteorological Organization), 2022. The State of Greenhouse Gases in the Atmosphere Based on Global Observations through 2021. WMO Greenhouse Gas Bulletin No. 18l October 2022.

WorldoMeter,2023*a*. World Population by Year. https://www.worldometers.info/world-population/world-population-by-year/ Retrievefd February 5, 2023.

WorldoMeter, 2023*b*. CO2 Emissions by Country https://www.worldometers.info/co2-emissions/co2-emissions-by-country/Retrievefd February 14, 2023.

Wrightstone, G. 2017. Inconvenient Facts: The science that Al Gore doesn't want you to know. Silver Crown Productions, LLC. 158 p. ISBN-13 : 978-1545614105.

Xu, C., Bell, L. 2022. https://www.ogj.com/exploration-development/reserves/article/14286688/global-oil-and-gas-reserves-increase-in-2022 O&G Journal, Retrieved March 13, 2023.

Zhu Z, Shilong Piao, Ranga B.Myneni, Mengtian Huang, Zhenzhong Zeng, Josep G. Canadell, Philippe Ciais, Stephen Sitch, Pierre Friedlingstein, Almut Arneth, Chunxiang Cao, Lei Cheng, Etsushi Kato, Charles Koven, Yue Li, Xu Lian, Yongwen Liu, Ronggao Liu, Jiafu Mao, Yaozhong Pan, Shushi Peng, Josep Peñuelas, Benjamin Poulter, Thomas A. M. Pugh, Benjamin D. Stocker, Nicolas Viovy, Xuhui Wang, Yingping Wang, Zhiqiang Xiao, Hui Yang, Sönke Zaehle, Ning Zen, 2016. Greening of the Earth and its drivers. Nature Climate Change, 6, 791–795.