What is Next? Our Planet, Our Climate, Our Energy

By Ivan Sandrea Silva

There are several scientific theories and religious beliefs that explain how our planet formed and when life began, but no one really knows. Our best evidence indicates that our planet is at least 4.5 billion years old, and life started at least 3.6 billion years ago. What is a fact is that the geological and fossil records and paleotemperature proxies, show that over millions of years many events and changes have taken place such as volcanic activity, the earth orbit, the oceans, the intensity of the sun, plate tectonics, chemical weathering, the rise of the forests, the rise of life, ice, meteorite impacts, just to name a few.

The planet's climate has been influenced by all the above (and much more), but how these events interacted is very complex because of the feedback effect, the fact that there is no abundance of data, and our limited knowledge of very long-term carbon cycles, among others. To simplify all, the meta factors that have contributed to climate changes since the planet formed may be fewer than a dozen but likely involve hundreds of thousands. As an example, changes in temperature and CO_2 levels, the two most watched variables today, according to many studies have been affected by chemical weathering and volcanic activity, which are regional, and random events. In another example, Ice Ages occurred despite relatively high concentrations of CO_2.

The best estimations and evidence show that since the beginning, the planet's climate was highly unstable, and broadly speaking, the instability lasted for hundreds of millions of years until around 60 - 55 million years ago. Since then, the planet has been experiencing both declining temperatures and CO_2 levels. On a more granular level, several analyses conducted using the Vostok Ice core of Antarctica, proves that for the past few hundred thousand years, both temperature and CO_2 levels have been moving up and down in cycles of approximately 100,000 years, as the planet reached some of the lowest levels on the geological record. From the start life flourished and experienced 5 mass extinctions under many different geological and climatic conditions and all forms of life that have existed consumed energy in the form of food, sunlight, or other.

The first human-like species appeared at least 2 million years ago, and agriculture started around 15,000 years ago. Over time, the human population developed and by 1800 A.C. reached 1 billion people. Energy consumption began to increase at faster rates, and it was mainly renewable until the use of whale oil was introduced. Since the 1800's, it is undeniable that humans have had an impact and not just on CO_2 levels, because a new species, that consumes energy, has populated the planet – we are 7.7 billion people today but over 100 billion people have lived and died.

Why all the above matters? The record (very recent when compared to full history) shows that both temperatures and CO_2 levels have been rising (again) since the industrial revolution. And there is common belief that CO_2 levels drive temperature increases, and the entire climate system is in peril and will deteriorate for the foreseeable future, but this ignores the human perspective, planetary complexities, and long-term carbon cycles.

For the average person with access to news and social media, the message is that human activity will irreversibly destabilize the planet in a few years. However, in the context of geological time scale, our measurements fail to capture the pace of changes in very long-time scales, which also means that great caution must be observed when referring to current climate changes as "unprecedented" or irreversible. Furthermore, using recent data, scientists and institutions have demonstrated that there is a loose relationship between rising temperatures and rising CO_2, but not between falling temperatures and falling CO_2.

Energy related CO_2 emissions is now the global focus, but not methane which is 25x more powerful greenhouse gas than CO_2 (there are 6x more google results for CO_2 than for methane!). There are over 1,690,000,000 climate change results in google with images of destruction compared to just 200 authoritative papers covering oceanic and continental temperature changes spanning the Ordovician period to the present, which provides a picture of the magnitude and rate of both warming and cooling episodes, but none of the authors or their work is instagramable. The knowledge system appears to be broken, as mentioned by several independent thinkers, and the media is exploiting the scientific vacuum.

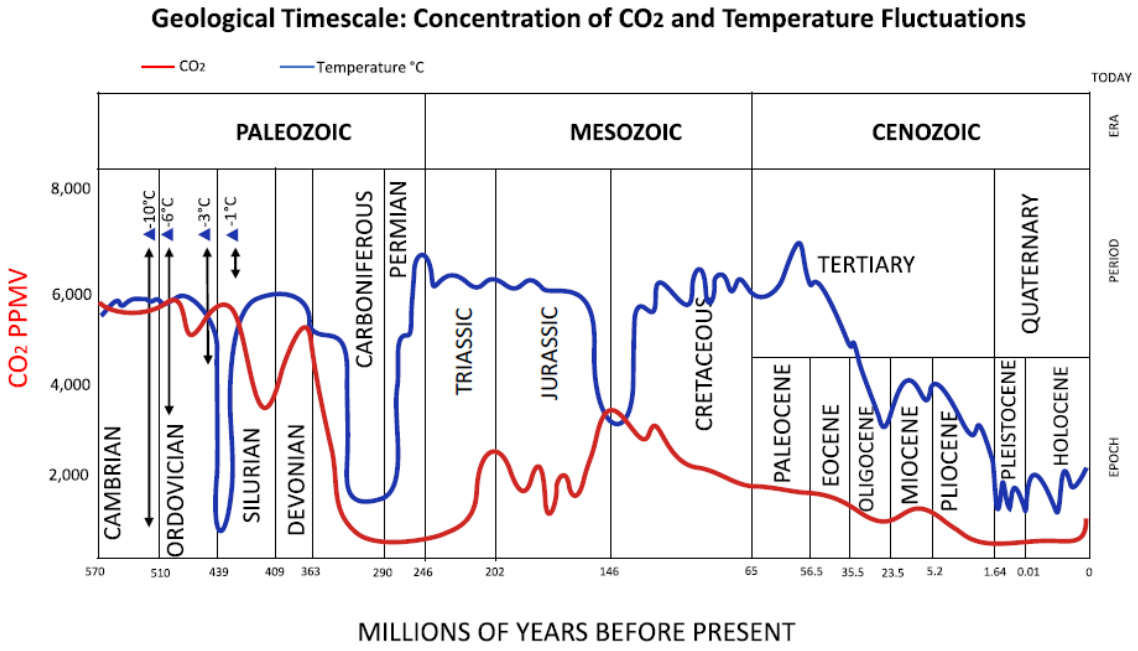
Humans are an energy hungry species, and, in that sense, we are similar to other species. We require energy in the form of food, water to keep us alive, and to generate heat/cooling as well as shelter and care to survive. Everything else we have created is a luxury to improve our living standard in this planet, and all requires energy to make it happen. Energy consumption per capita (in terms of KWh) has increased 4x since 1800's. Energy is central to our existence, as it is love. So the big question is: can humans continue to experience a high quality of life and reach zero energy related CO_2 emissions?

Long ago I participated in a talk at Ettore Majorana Centre, on the Kardashev method (developed in 1964) which measures a civilization's level of technological advancement based on the amount of energy it is able to use or access. I always found this fascinating as it puts energy at the center of human development and gives a number. According to Kardashev, there are three types of civilizations: Type I civilization is able to access all the energy available on its planet and store it for consumption, Type II civilization can directly consume the energy of a star, Type III civilization can capture all the energy emitted by its galaxy.

In energy terms, to reach a Type I civilization energy consumption must be 10^{16} watts (far from current levels), and Type II (10^{26} watts) and Type III (10^{46} watts) could be achieved in thousands of years or more. Given how complex his work is, very few have dared to use it or improve it, but leading physicists and futurologists Sagan and Kaku have made revisions. Their conclusion is that we have not yet reached Type I civilization status, but we are getting closer. According to work conducted by Kaku, if we maintain a 3% energy consumption growth per year, we may attain Type I status in about 100 – 200 years; Type II status in a few thousand years, and Type III status in 100,000 to a million years. Therefore, broadly speaking, it seems that from a geological perspective and level of technological development, for human beings, the journey in this planet has just started, and to continue to make progress we will need to produce much more energy than what we do today.

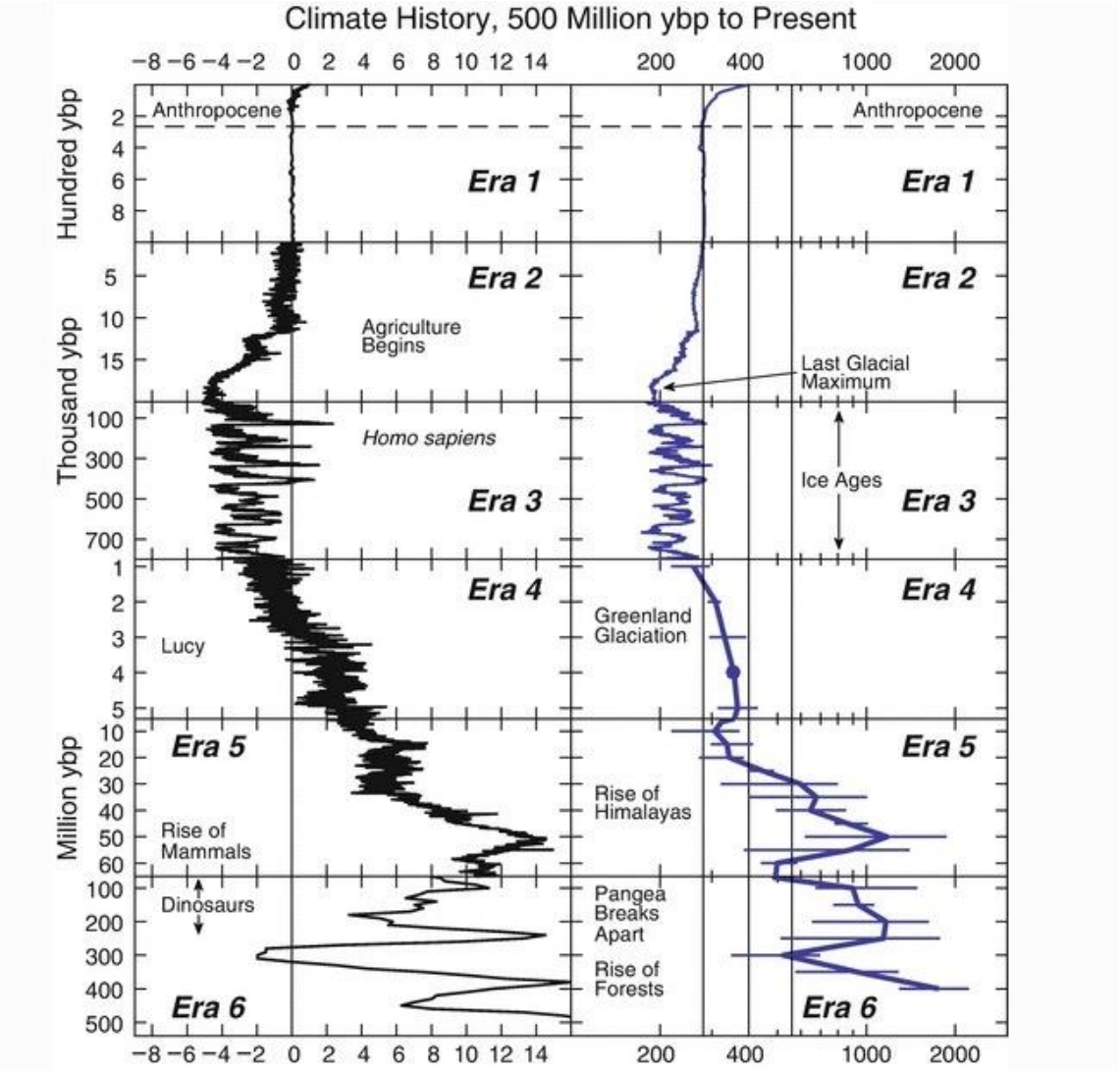
Figures A, B, C, D, E, shows data, trends, and analysis and are from publications by leading authors/institutions that have been used in this article.

Figure A



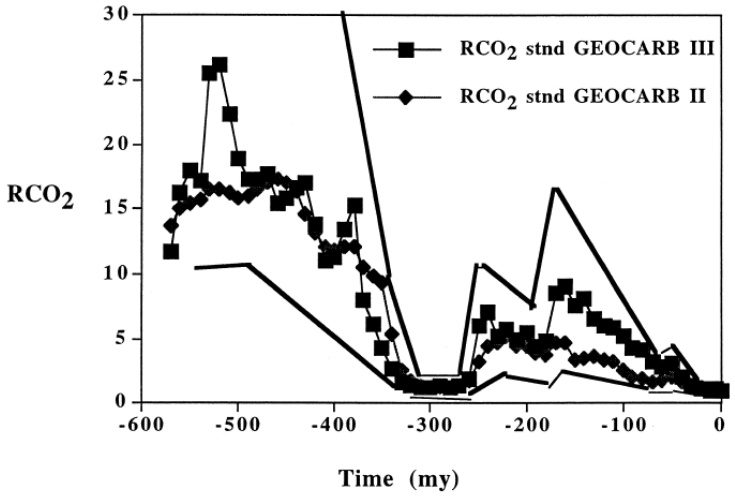
Source: Fossil Future, A. Epstein (2022). Research from Nassif Nahle (2009), C.R. Scotese (2002), W.F. Ruddiman (2011), Pagani et al. (2005).

Figure B



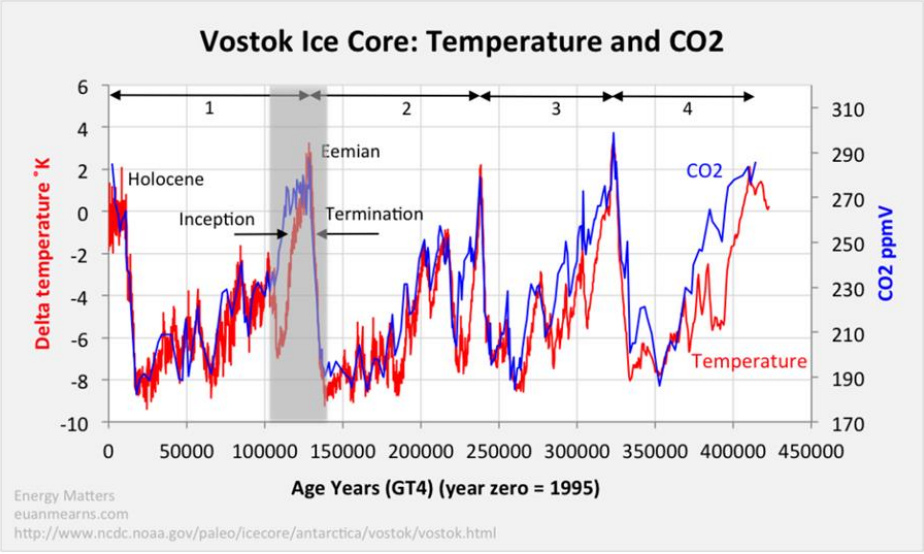
Source: Earth's Climate System, by Ross J. Salawitch, et al Brian F. Bennett. Earth's climate history, past 500 million years. Historical evolution of global mean surface temperature anomaly (ΔT) relative to a pre-industrial baseline (i.e., mean value of global temperate over 1850–1900) (left) and the atmospheric mixing ratio of CO2 (right).
https://link.springer.com/chapter/10.1007/978-3-319-46939-3_1

Figure C



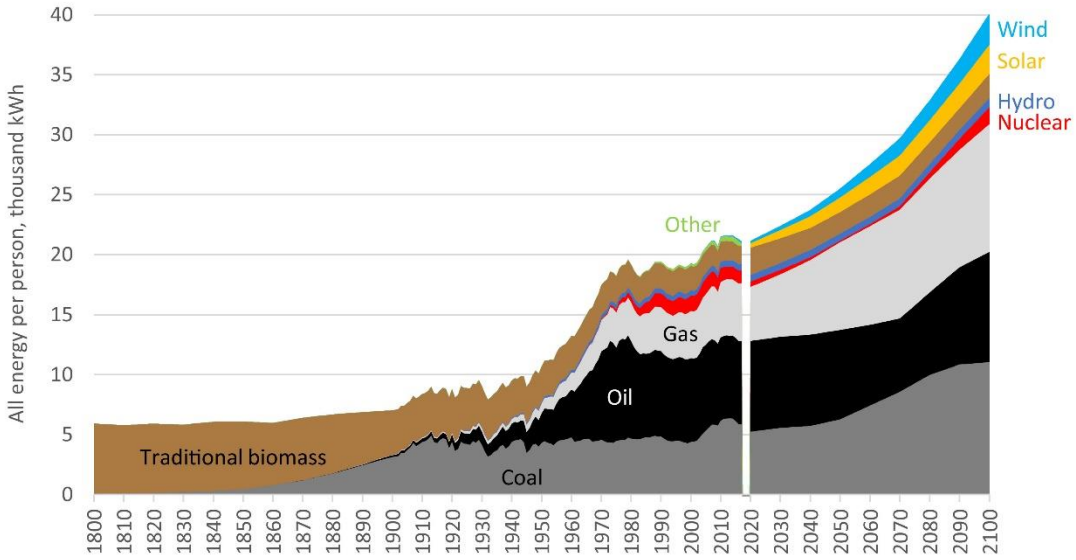
Source: GEOCARB III: A REVISED MODEL OF ATMOSPHERIC CO2 OVERPHANEROZOIC TIME, ROBERT A. BERNER and ZAVARETH KOTHAVALA.
https://earth.geology.yale.edu/~ajs/2001/Feb/qn020100182.pdf

Figure D



Source: Shown in a variety of studies, including Cornwall Alliance Senior Fellow David Legates's review article "Carbon Dioxide and Air Temperature: Who Leads and Who Follows?" Two-and-a-half years ago geologist Euan Mearns contributed "The Vostok Ice Core: Temperature, CO2, and CH4." https://cornwallalliance.org/2017/06/global-temperature-and-co2-which-drives-which/

Figure E



Source: Welfare in the 21st century: Increasing development, reducing inequality, the impact of climate change, and the cost of climate policies. Bjorn Lomborg. https://www.sciencedirect.com/science/article/pii/S0040162520304157