

Carbon Dioxide and Carrying Capacity

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Abstract

Carbon atoms are an essential component of life. The levels of carbon dioxide in the atmosphere are very low due to strong demand for carbon from living organisms. The increase of carbon dioxide increases the carrying capacity of the earth. Carbon dioxide is a greenhouse gas. Its increase makes the earth a greener place.

I thank Jamie Galbraith for stimulating discussion.

The increase of carbon dioxide in the atmosphere has many consequences. From different perspectives, from different people, we may get very different assessments. Carrying capacity is probably the most relevant, most universal measure for the biosphere and the human societies. We will discuss how the increase of carbon dioxide in the atmosphere affects the carrying capacity.

Carbon sits at the very middle in the second row of the periodic table. It is the smallest atom that has four chemical bonds. It can connect with many other atoms to form large molecules. All life are constructed from molecules with long carbon chains. Carbon is the backbone of life.

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|----|----|----|----|---|---|----|
| Li | Be | B | C | N | O | F |
| Na | Mg | Al | Si | P | S | Cl |

The source of carbon for life comes from carbon dioxide. All plants breathe in carbon dioxide for carbon. Animals eat plants or other animals to get carbon and other nutrients. Carbon dioxide was very abundant in atmosphere before life emerged on the earth. Since carbon dioxide is in great demand for life, its concentration in atmosphere gradually decline most of the time.

Currently, its concentration is very low, around 0.04%. Because carbon dioxide is in such a short supply, some plants evolve a new mode of absorbing it called C4. C4 plants are more efficient at retaining carbon dioxide with extra energy cost. Some familiar crops, such as corn, sugarcane, sorghum and millet, are C4 plants. C4 plants have become very numerous since about six million years ago. The very evolution of C4 plants indicates that plants are starving for carbon dioxides.

Carbon dioxide, temperature and carrying capacity

Over geological time, the decline of carbon dioxide in the atmosphere often causes tremendous crisis for the existence of life. Carbon dioxide absorbs and retains heat more effectively than oxygen and nitrogen, the main components of atmosphere. The abundance of carbon dioxide in the atmosphere helps keep the surface of the earth warm. About seven hundred million years ago, due to the scarcity of carbon dioxide in the atmosphere, the surface temperature of the earth dropped so low that the whole earth was covered with snow. Most life died out due to the low temperature. Over time, the eruptions of volcanos replenish the atmosphere with abundant carbon dioxide. The earth temperature increased. Snowball melt away. Life flourishes again.

Over long term, the atomic energy that heats the earth gradually declines. This reduces the amount of volcanic activities and the amount of carbon dioxide released to the atmosphere. Therefore, there is a long term downward pressure for the level of carbon dioxide.

About twenty thousand years ago, the level of carbon dioxide in the atmosphere was only 0.018%. It was a glacier period. Subsequently, carbon dioxide concentration increased to about 0.027%. With the increase of carbon dioxide and other factors, temperature increased, and many

glaciers receded about ten thousand years ago. The high temperature and high carbon dioxide made the environment more fertile. That made the agriculture possible. Thus, began the human civilization. Our human civilization owes its existence to the increase of carbon dioxide and increase of temperature.

When living organisms die, some of them are buried underground. Over time, some dead bodies of life turn into fossil fuels, which have retained much energy and material of living systems. They have been laying underground quietly for millions of years. In the past several hundred years, the technology advance enables us to use coal and other fossil fuels on a large scale. The energy and material from the ancient life embodied in fossil fuels have been driving most of our activities since. Large quantities of carbon dioxide, the final output from the working of fossil fuels, are released and returned into the atmosphere. This increases the concentration of carbon dioxide in the atmosphere.

The increase of carbon dioxide warms up the earth. After industrial revolution, some people began to wonder if the increase of carbon dioxide will warm up the earth. Around 1895, Svante Arrhenius, a scientist from Sweden, dreamed that his frigid country will one day be warmer and more hospitable due to the increase of carbon dioxide. This warming effect is especially significant in colder areas, where part of the year is covered with white snow. Snow and ice reflect much of the sun light back into the space. The melting of snow exposes soil, which absorbs more solar energy than white snow.

Higher temperature shortens the time period of snow covering. Soil and vegetation reflect less solar light than snow and ice. This further increases the surface temperature. The positive feedback may cause significant temperature increase in cold areas and cold season. The increase of carbon dioxide makes winter season a little bit shorter. The increase of carbon dioxide makes the bitter North a little bit milder.

The increase of carbon dioxide makes the plants breathe easier. This makes plants grow better and grow more. Deserts turn into grasslands, contrasting to claims made by many experts. Forests expand and become lush. Carbon dioxide is called a greenhouse gas. Higher concentration of carbon dioxide makes the earth a greener place. Plants absorb more solar energy than rocks and sands. Plants evaporate large amount of water into the atmosphere. This moderates the temperature increase. Plants also transform large amount of solar energy into chemical energy and store it as potential energy. With greater coverage of plants on the earth, plants absorb more solar energy. Surface temperature declines and air becomes more moist. This will increase rainfall, which lowers temperature further. With the increase of vegetation and the increase of rainfall, temperature changes in most places are modest.

All animals, directly or indirectly, depends on plants to survive. The increase of carbon dioxide increases the amount of plants, which in turn increases the amount of animals. The increase of carbon dioxide increases vegetation density and increases the amount of arable land. This increases the global agricultural output. In 1930, human population was at 2 billion. Today, human population is around 8 billion. The increase of the carrying capacity is due to the increase of crop output, which is due to the increase of use of fossil fuels and the increase of

concentration of carbon dioxide, a final output from fossil fuels. The increase of carbon dioxide increases the carrying capacity of life on the earth.

On the rise of sea level

The study of past data and our recent experience show that the increase of carbon dioxide in the atmosphere is highly beneficial to living organisms in general and to human civilizations in particular. However, no change will benefit everyone. Global warming will not benefit everyone. The end of ice age about ten thousand years ago was a global warming. It generated great floods in many places.

Bible recorded the story of Noah, a story of global warming and great flood. Noah lived in a time of global warming. Warming generates huge melting of ice. Warming generates huge amount of rain. Warming generates huge floods.

Some people then thought that was the end of the world. Flood did devour some low-lying area. But the warming ends the ice age. The warming energizes the globe and greatly increased the carrying capacity on the earth. Human civilizations flourished with the global warming.

Today's warming is no different. Fossil fuels, the fossilized life locked underground, are released to the surface to power the world. Carbon dioxide, the final product of fossil fuel, is recycled back into the atmosphere to feed the growth of plants. Warming energizes the globe. Carbon dioxide, the green house gas, greens the earth.

Some people today think this is going to be the end of the world. Rising water level could devour some low-lying area. But carrying capacity of the earth has been increasing tremendously with the increase of the carbon dioxide, the foundation of all life.

There could be a maximum of ten meter rise of sea level if all ice in Antarctica melts. This is far less than over one hundred meter sea level rise at the end of the last ice age. However, the rise of temperature and level of carbon dioxide made the environment more fertile. Overall, global carrying capacity increased greatly when the last ice age ended. This time, the increase of carbon dioxide is tremendous. Yet the increase of sea level so far is very small and the upper limit is far less than the sea level increase at the end of last ice age. This means the overall increase of carrying capacity has been and will be tremendous.

We will discuss in greater detail about sea level rise and overall carrying capacity. Most of the land ice is at Antarctica. Warmer temperature erodes part of ice sheet around ocean water. This increases the sea level. At the same time, warmer temperature increases water vaporization and moisture in the air. This generates more rain fall and snow fall. More ice will be formed due to increased precipitation. As a result, the ice sheet in Antarctica becomes higher in many places. The increase of ice formation could lower the sea level.

The increase of vegetation turns more rocks and sands into soil, which absorb more water than sand and rock. The increase of vegetation retains more water on land. This will partly offset the

melting of ice in cold areas. Overall, the sea level change has been mild since 1990s, when the ideas of global warming and its catastrophic impacts have become popular. Land prices in New York City, which is supposed to be submerged under water by now, has increased substantially since 1990. The feared predictions of huge sea level rise have to be put into further and further distant future.

When we strive to predict the future, we want to look for the patterns in the recent past. In the past one hundred years, the amount of carbon dioxide in the air has been increasing steadily, due to the increase of fossil fuel consumption. During the same period of time, the carrying capacity of the earth has been increasing tremendously and the sea level has risen mildly. The overall impact of fossil fuel consumption and increase of carbon dioxide in the atmosphere has been beneficial to human beings. After all, carbon is the foundation of all life. At 0.04% in atmosphere, carbon dioxide is a very scarce and precious resource for plants.

Why most mainstream opinions are against carbon?

Carbon is essential to life. Why are many of us so oblivious to this obvious fact? Long ago, George Orwell asked a similar question in his 1937 book, *The Road to Wigan Pier*. He concluded,

Practically everything we do, from eating an ice to crossing the Atlantic, and from baking a loaf to writing a novel, involves the use of coal, directly or indirectly. ... But most of the time, of course, we should prefer to forget that they were doing it. It is so with all types of manual work; it keeps us alive, and we are oblivious of its existence.

it is only because miners sweat their guts out that superior persons can remain superior. ... all of us really owe the comparative decency of our lives to poor drudges underground, blackened to the eyes, with their throats full of coal dust, driving their shovels forward with arms and belly muscles of steel. (P 31)

If we acknowledge the essential role of coal and carbon in our life, we can no longer ignore the harsh life of essential workers, the coal miners and other frontline workers. If we improve the working conditions and pay for the essential workers, many of us will no more afford the luxury of modern life. This is why superior persons ignore the essential role of coal in the past.

With the development of technology, the chains from the raw materials and the final products become longer over time. In early days, people keep their house warm by burning coal directly. Later, they burn coal to generate electricity, then using electricity to warm their houses. Still later, some burn coal to generate electricity, then using electricity and other raw materials to produce solar panels. Others would use solar panels to generate electricity to warm their houses. The chains from production to consumption become longer and longer. It becomes profitable for those at the higher end of the production chain and food chain to charge carbon tax toward the lower end of the production chain and the food chain.

Take electric cars as an example. The production of battery is very dirty. The driving of electric car is very clean. The actual production of battery is by the inferior. The driving of electric cars is by the superior. By charging carbon taxes to the inferior and distributing carbon credits mostly to the superior, the superior get more superior and the inferior get more inferior, all in the name of saving the world. At the time of writing, Elon Musk, whose electric car company Tesla makes profit solely from carbon credit, is the richest person in the world.

This is why superior persons demonize carbon today. Superior persons are only a small portion of human population. But they dominate most mainstream opinions. This is why most mainstream opinions demonize carbon today.

At any time, in any society, the ruling class is a small minority of the population. The ruling theory of the day is to justify the control and consumption of large amount of resources by the ruling minority. The key is to package the exploitation of the working class by the ruling minority as a common good for all. Since there is no intrinsic rationale why the ruling minority should control and consume large amount of resources, any ruling theory of the day is a false narrative. Today's ruling theory is no exception, whether it is coated in religion or science.