

Our Faustian Bargain

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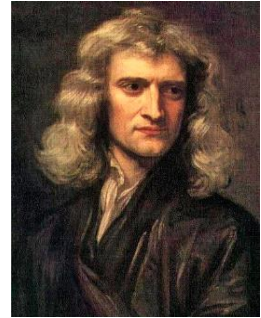
Have We Unwittingly made a Faustian Bargain?

This is an account of events that have led to our ever-growing climate crisis. Young people wonder if they have a future. How is it that climate scientists discuss such an outcome of advancements in technology and the comforts associated with them? This is about the consequences of the use of coal, oil and gas for fuel as well as about the science that has enlightened us. These fuels drive heat engines that provide motive power and electricity to run our civilization, all of which have thus far been to the benefit of humankind. Is there a cost looming ahead of us? If so, how might we avoid that cost?

I start with Sir Isaac Newton (1642-1727).² In the **1660's** he discovered three laws of motion plus the law of gravitation, which required the concept of action at a distance, a concept that scientists of his day reacted to with horror. Yet without that strange action at a distance we would have no way to explain the motion of planets. The main law is

$$\text{Force} = \text{Mass} \times \text{Acceleration}$$

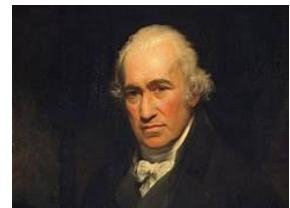
This is a differential equation that must be integrated twice to obtain position. Newton was an English mathematician, physicist, astronomer, theologian and author. Before him, no method of integration existed, so he had to develop a method. Newton's method was complex and difficult to use, but almost simultaneously German polymath, logician, mathematician and natural philosopher Gottfried Wilhelm Leibniz (1646-1716) developed the method of integration we use today. British mathematicians were slow to adopt Leibniz's method and thus set back the development of science in Britain by a century. With the laws introduced by Newton and the mathematical tool developed by Leibniz, during the 18th century many mathematicians, scientists and engineers contributed to the development of the engineering sciences taught in engineering schools today. They form the scientific backbone of the steadily expanding



INDUSTRIAL REVOLUTION.

Thomas Newcomen (1664-1729), an English inventor, invented the steam engine in **1712**, with steam generated by burning coal. Joseph Black (1728-1799), a Scottish physicist and chemist in **1754** discovered **carbon dioxide**, CO₂, a product of burning coal.

James Watt (1736-1819), a Scottish inventor, mechanical engineer, and chemist in **1776** added a separate condenser to the steam engine, which enabled it to be mounted on a moving vehicle.



² Pictures thanks to Wikipedia.

Robert Fulton (1765-1815), an American inventor and engineer, invented and in **1807** operated the first commercially successful steamboat, which was powered by coal, which releases CO₂.



John Blenkinsop (1783-1831), an English mining engineer, in **1811** invented the first steam locomotive with its coal cars trailing behind.



Michael Faraday (1791-1867) a British physicist and chemist is best known for his discoveries in the **1820's** of the principles of electromagnetic induction and electrolysis. His biggest breakthrough was his invention of principles of the electric motor and, running it backwards, the electric generator, which is the tool needed for commercial generation of electricity, without which our lives would be quite different. The generator was a rotary machine driven by a steam turbine with high-pressure steam produced by burning coal. Faraday is considered one of the greatest discoverers of all time. The SI unit of capacitance, the farad, is named after him.



Up to a few years ago the 1000-megawatt electrical-power generator in Becker, Minnesota, required four one-mile-long train loads of coal from Montana every day. Around the world there are today the equivalent of about 700 of such facilities, all releasing CO₂. Natural gas is now used in the Becker plant, which is equivalent in CO₂ release to about 60% as much coal, but it leaks methane, CH₄.

Joseph Fourier (1768-1830), a famous French mathematician, in **1824** found that certain gases allow sunlight to pass unimpeded but absorb heat radiation.



Eunice Newton Foote (1819-1888)³, an American physicist and inventor, was the first to do experiments that led to the conclusion that increases in the proportion of CO₂ in the atmosphere will increase its temperature. Her results were presented in an AAAS paper in **1856**.



1859 Petroleum: In Alberta, Azerbaijan, Pennsylvania and Romania oil production was started close to this date. Petroleum and coal had been known and burned for thousands of years, but it took the steam engine, the electric-power generator and the internal-combustion engine, discussed below, to vastly increase the use of these fuels, which has vastly increased the release of CO₂ into the atmosphere.

Adolfo Bartoli (1851-1896), an Italian physicist, discovered radiation pressure. James Clerk Maxwell (1831-1879), a Scottish mathematical physicist in the **1860's** formulated the equations of the electromagnetic field and found that radiation pressure followed from his equations, thus it is called Maxwell-Bartoli pressure. Understanding of radiation pressure is necessary to understand the energy balance that determines the earth's temperature.



Maxwell

³ See her biography in Wikipedia.

Josef Stefan (1835-1893) and his student Ludwig Boltzmann (1844-1906), both Austrian physicists, discovered in **1884** the law of nature $E = 5.67037T^4$ in which E is the energy radiated from a Black Body in watts per square meter and T is the absolute temperature of the body's surface in degrees Kelvin. The Stefan-Boltzmann law is essential in calculating the temperature of the Earth's surface needed to release enough energy to balance the energy input from the Sun.



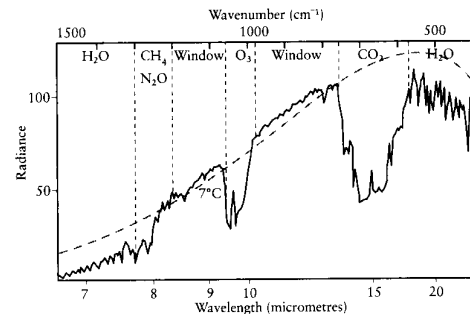
The Internal-Combustion Engine enormously expanded the use of refined oil. In the 19th Century many engineers contributed to its development. In **1886** German engineer Karl Benz (1844-1929) began the first commercial production of vehicles using the ICE. The ICE replaced the horse and led to freedom of the road. It became so popular that there are now more than 1.2 billion ICE-driven vehicles worldwide, a number growing quickly. 99.8% of them release CO₂ into the air. The rest are run by electricity.



Wilhelm Wien (1864-1928), German physicist, in **1893** discovered the Law of Black-Body radiation, which states that $\lambda_{max}T = 0.288cm \times K$ where λ_{max} is the maximum wavelength in a statistical distribution and T is absolute temperature. This law shows that the maximum wavelength of radiation pressure from the surface of the earth lies in the range of wave lengths absorbed by CO₂, water vapor, methane, nitrous oxide, and ozone.



This chart, taken from Peter Wadham's book,⁴ shows Radiance vs. Wavelength as measured by a satellite travelling over the Mediterranean Sea. The distribution is close to Wien's statistical distribution for 7°C. The absorption band for CO₂ is seen to be by far the largest and is near the maximum wavelength, which is why CO₂ is the most important greenhouse gas.



Svante Arrhenius (1859-1927), was a Swedish scientist and student of Boltzmann. In developing a theory to explain the ice ages, Arrhenius, in **1896** used the properties of CO₂, the Stefan-Boltzmann Law and the Wien Law to calculate the extent to which increases in atmospheric CO₂ will increase the earth's surface temperature through the greenhouse effect. Now it was known quantitatively why increasing CO₂ will increase the temperature of the earth's atmosphere and why the lack of trace gases in the earth's atmosphere will result in a temperature of -18°C – too low to support life.



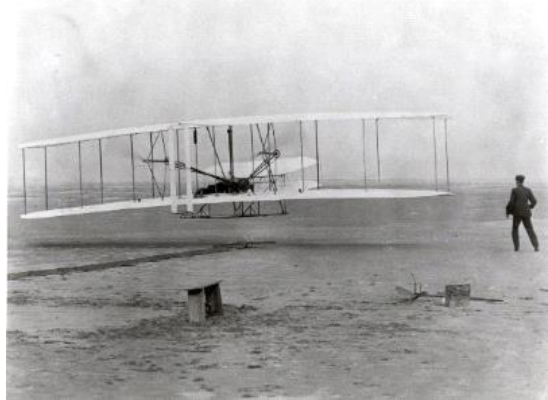
⁴ A Farewell to Ice: A Report from the Arctic, Oxford, Fig 5.1, 2017.

Currently (early 2020) there is an average of about 416 molecules of CO₂ per million molecules of air in our atmosphere. This is only 0.042%. Climate deniers have argued that such a small percentage cannot possibly have any effect, but without it the earth's surface temperature would be too low to support life.

Nitrogen, N₂, and Oxygen, O₂, are 2-atom molecules. They have no vibration modes in the infrared region of the spectrum. These molecules make up more than 99.9% of the atmosphere and do not absorb radiance from the earth.

Carbon Dioxide, CO₂, Water, H₂O, Nitrous Oxide, N₂O, and Ozone, O₃, are 3-atom molecules. From experiments they have vibration modes in the infrared region of the spectrum. They absorb and reradiate in all directions energy radiated from the earth. For thousands of years the amount of these gases in our atmosphere has been neither too great nor too small to permit a healthy temperature for humankind. Now, without thought of consequences, they have been allowed to increase! Methane is a 5-atom molecule. It is a much more powerful greenhouse gas.

Flight: The Wright Brothers are shown here experiencing in December **1903** the first sustained flight of a heavier-than-air aircraft. Because it was soon believed that aircraft would be useful in war, in 1915 the United States Congress established the National Advisory Committee for Aeronautics (NACA) to study problems of flight. In the late 1950s NACA was recommissioned as NASA. In World War I and then World War II the art of flight advanced rapidly. Today there are about 39,000 aircraft carrying about 4.1 billion passengers per year. These aircraft are all fueled by a CO₂-releasing fuel. Stopping flight now to reduce CO₂ is unthinkable. It would stop civilization in its tracks!⁵



Stopping flight now to reduce CO₂ is unthinkable. It would stop civilization in its tracks!⁵

From page 36 of *The Global 2000 Report to the President*, published in **1982**:

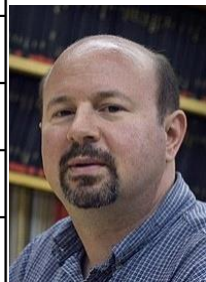
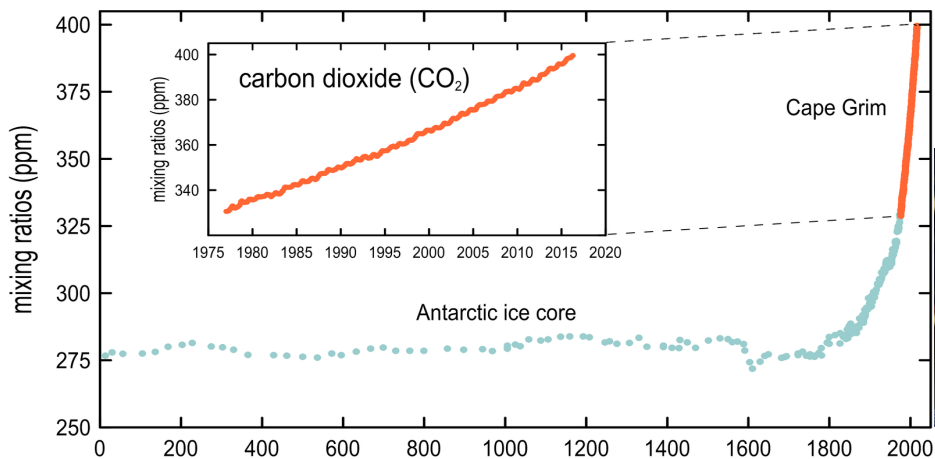
“Another environmental problem related to the combustion of fossil fuel is the increasing concentration of carbon dioxide in the earth’s atmosphere. Rising CO₂ concentrations are of concern because of their potential for causing a warming of the earth... The CO₂ content of the world’s atmosphere has increased about 15 percent in the last century and by 2000 is expected to be nearly a third higher than preindustrial levels. If the projected rates of increase in fossil fuel combustion (about 2 percent per year) were to continue, a doubling of CO₂ content of the atmosphere could be expected by the middle of the next century; and if deforestation substantially reduces tropical forests (as projected), a doubling of atmospheric CO₂ could occur sooner. The result could be significant alterations of precipitation patterns around the world, and a 2°-3° C rise in temperatures in the middle latitudes of the earth... Even a 1°C increase in average global temperature would make the earth’s climate warmer than it has been any time in the last 1,000 years.”

⁵ With the Coronavirus, it is close to happening.

In **1988** physicist and climate scientist Dr. James E. Hansen, from 1981 to 2013 Director of the NASA Goddard Institute for Space Studies, testified before Congress on the urgent necessity to stop the increasing level of CO₂ in the atmosphere. He headed a group that had the scientific talent and tools needed to study the problem in the necessary detail. He has been and continues to lecture widely on the climate crisis and its critical importance for humankind.⁶ What will happen if CO₂ continues to increase?



In **2006**, former Vice President Al Gore published his book *An Inconvenient Truth: The Planetary Emergency of Global Warming and What we can do about It*. He said, “I vowed to make the climate crisis the top priority of my professional life.” While not a scientist himself, he spent a great deal of time talking with climate scientists, which becomes evident from reading his book. If we had taken him seriously in 2006, the earth would be much better off and perhaps we could have averted the most serious consequences of the climate crisis. Al Gore trains young people to lecture on the climate crisis through www.climaterealityproject.org.



This chart shows CO₂ in parts per million (ppm) vs. time in years. It shows the “hockey stick” behavior first reported by climate scientist Michael E. Mann.⁷ It was strongly criticized by climate deniers but has been confirmed by many scientists. It shows how much the growing Industrial Revolution, beginning with the steam engine and the electricity generator, has contributed through burning of coal, oil, and natural gas to the increase of CO₂ in the atmosphere. Since 1957 the level of CO₂ has been measured daily at 11,000 ft at the Mauna Loa Observatory on the Island of Hawaii and more recently at Cape Grim in Tasmania, as well as in many other places.

The current average level of CO₂ is about 416 ppm and it is rising at a rate of about 2.4 ppm per year.

⁶ Please watch Dr. Hansen’s TED talk to learn more about the need to reduce CO₂.

⁷ Michael E. Mann, *The Hockey Stick and the Climate Wars: Dispatches from the Front Lines*, Columbia, **2012**. www.realclimate.org.

Dr. Peter Wadhams, Emeritus Professor of Ocean Physics in the Department of Applied Mathematics and Theoretical Physics at Cambridge University, released in **2017** his book *A Farewell to Ice*. In Chapter 14: “A Call to Arms” he says “*The discovery in 2015⁸ of very high long-term climate sensitivity⁹ of the planet to greenhouse gases is of utmost importance in clarifying what should be **our priority as human beings** in the crisis that faces us. It shows that the existing level of carbon dioxide in the atmosphere is enough to cause unacceptable amounts of warming in the future. We no longer have a ‘carbon budget’ that we can burn through before feeling worried that we have caused massive climate change. We have burned through the budget and are causing the change now.*



*We have destroyed our planet’s life support system by mindless development and misuse of technology. A mindful development of technology, first for geoengineering,¹⁰ then for **carbon removal**, is now necessary to save us. **This is the most serious and important activity in which the human race can now be involved, and it must begin immediately.**” (He said this in 2017.)*

Dr. David Wasdell, Director of the ten-year London-based Apollo-Gaia study mentioned in footnote 8, concluded: “*Detailed analysis of historical planetary response to change in concentration of carbon dioxide reveals an eight-fold amplification of CO₂ forcing in contrast to the three-fold amplification predicted by the IPCC climate modeling computer ensemble. Applying the corrected value of Climate Sensitivity multiplies the previously predicted temperature rise by more than 2½ times in response to any given change in CO₂ concentration.*”



The IPCC’s prediction that the earth’s mean temperature must be held to a rise of no more than 1½°C means that an IPCC predicted rise of 1½°C would really be 1.5x2.5 = 3.75°C, whereas the IPCC estimated that a rise of only 2°C will be catastrophic.

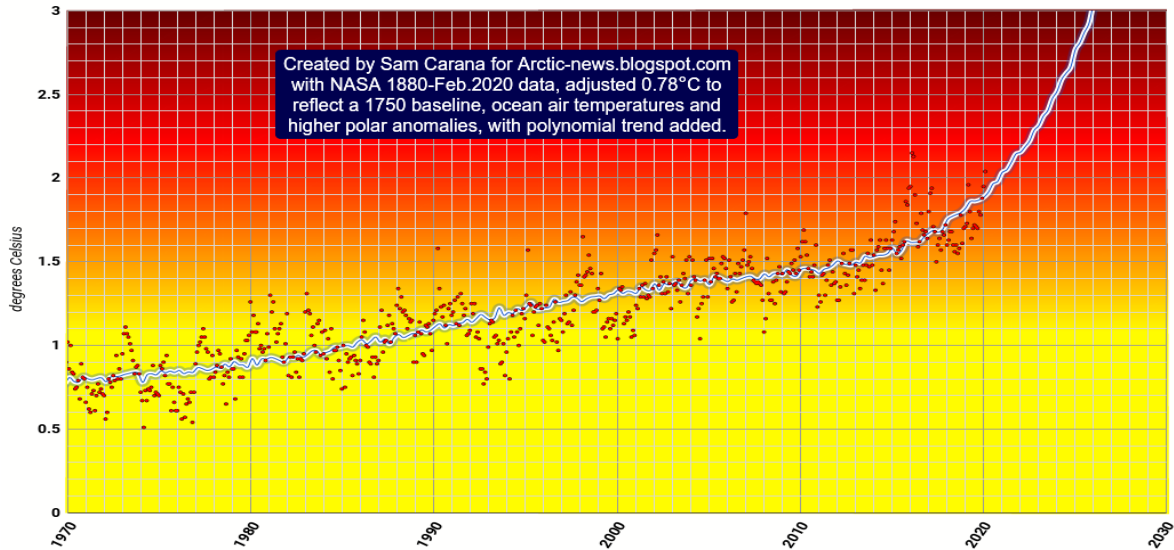
As shown in the chart on the next page the Earth’s mean temperature is now rising at an increasing rate. I can point to three events that in 2019 are much different than in 2018:

- A nephew of mine runs a farm near Pocahontas, Iowa. He told me that 2019 was close to catastrophic because there was so much rain.
- I have a friend whose family owns a farm 35 miles north of Detroit. He told me that his tenants and other farmers were unable to plant their corn and soybeans in 2019 because fields were too wet during the entire planting season.
- Meteorologists say that the rain in the USA in 2019 set a record high.

⁸ Dr. David Wasdell, *The Harsh Reality of Now*, 2015, www.apollo-gaia.org.

⁹ Climate sensitivity is the temperature increase with doubling of CO₂.

¹⁰ Professor Wadhams was concerned about geoengineering but said that we have no choice.



Compared with the summer of 2018, these events stand out. Warmer air holds more water. Because the temperature in the Northern Hemisphere is rising at an increasing rate, we can expect the changes and effects from 2019 to 2020 will be greater than they were from 2018 to 2019. The rise now is about 1.6°C per decade and the changes are very noticeable. If CO₂ is not removed from the air, the temperature will continue to increase with eventually catastrophic consequences for humankind!

Concern about the climate is increasing rapidly. Thanks to Swedish student Greta Thunberg hundreds of thousands of young people have staged demonstrations, the biggest on March 15, 2019 and more in the fall of 2019, but CO₂ keeps rising. Methane does too. There is much less of it, but it is a much more powerful greenhouse gas.



Extinction Rebellion started in London in the fall of 2018. There are now chapters in many countries and teams of them often lay down in busy streets to call attention to the need for serious action. www.TheClimateMobilization.org has formed, declaring that the **Climate Emergency** requires a World War II level of commitment starting immediately. James Hansen recommends <https://citizensclimatelobby.org>. There are many more. We cannot turn on the radio without hearing the latest about the climate, and CO₂ keeps rising.

Where is our public? Ford Motor Company has decided to manufacture almost only F-150 pickup trucks because so few people want their much lighter-weight sedan. General Motors has decided to close a plant that has made their smallest sedan because the public they see only want larger and hence heavier vehicles, which release more CO₂. No one is telling them to save energy, so they do not!

For the earth's mean temperature to remain steady, the energy absorbed from the sun must match the energy radiated away into space. Eight hundred thousand years of ice-core data have shown how the earth's mean temperature has risen and fallen in step with

the amount of carbon dioxide (CO₂) in the air.¹¹ Beginning over 200 years ago due to burning of coal, then oil, and now natural gas the amount of CO₂ in our atmosphere has risen, slowly at first and then more and more rapidly each year. It is now 50% higher than the maximum during the previous 800,000 years and rising at a rate of about half of one percent a year.

StarTribune



Most dire climate warning

The U.N. report describes worsening food shortages, Arctic melting without action.

By CHRIS MOONEY and BRADY DENNIS • Washington Post

The world stands on the brink of failure when it comes to holding global warming to moderate levels, and nations will need to take “unprecedented” actions to cut their carbon emissions over the next decade, according to a landmark report by the world’s top scientific body studying climate change.

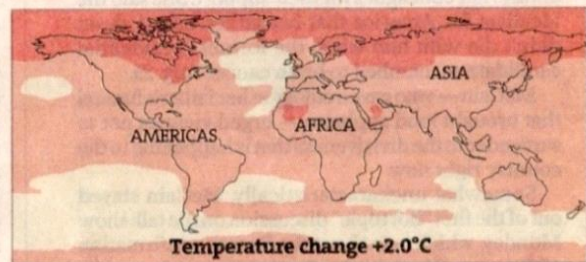
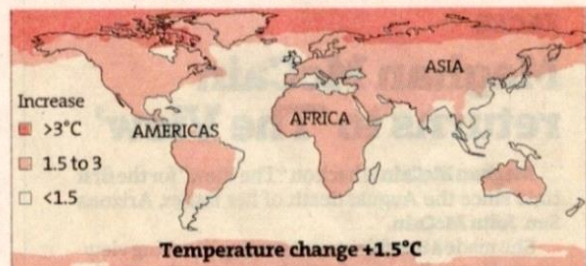
With global emissions showing few signs of slowing and the United States — the world’s second-largest emitter of carbon dioxide — rolling back a suite of Obama-era climate measures, the prospects for meeting

the most ambitious goals of the 2015 Paris Accord look increasingly slim. To avoid racing past warming of 1.5 degrees Celsius (2.7 degrees Fahrenheit) over preindustrial levels would require a “rapid and far reaching” transformation of human civilization at a magnitude that has simply never happened before, the group found.

“There is no documented historic precedent” for the sweeping change to energy, transportation and other systems required to reach 1.5 degrees Celsius, the U.N. Intergovernmental Panel on Climate Change, or IPCC, wrote in a

See **CLIMATE** on A10 ►

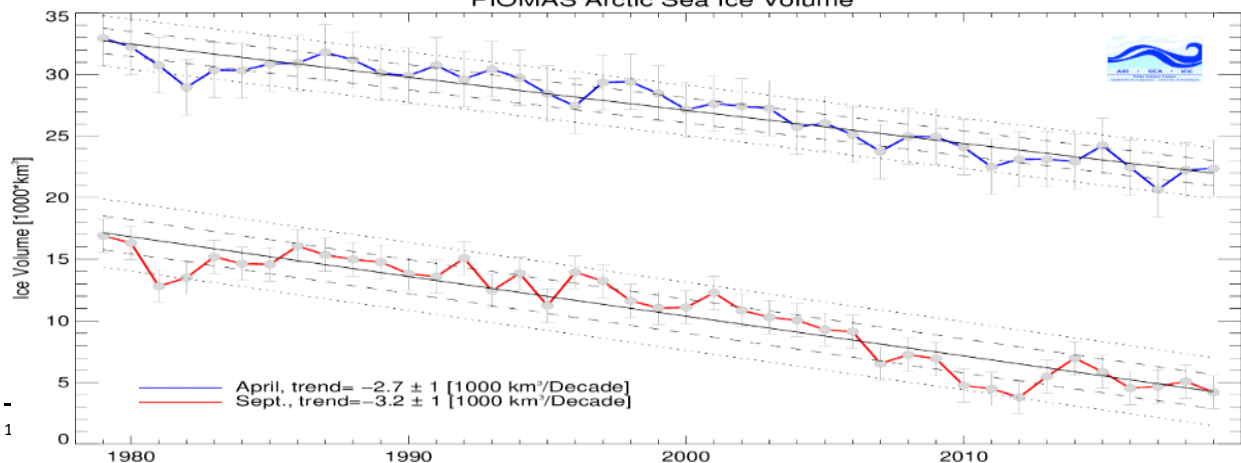
WHAT A HOTTER WORLD WOULD LOOK LIKE



Source: Intergovernmental Panel on Climate Change

Associated Press

PIOMAS Arctic Sea Ice Volume



CO₂ is the main absorber of energy radiated away from the earth's surface. As CO₂ in the atmosphere increases, more of the energy radiated away from the earth's surface is captured by that CO₂ and less is radiated into space from the top of the atmosphere. To restore balance between energy coming in and going out the surface temperature of the earth increases, but it takes time for that to occur – at least a decade.

The solar energy absorbed by the earth is increasing even more because, as shown in the chart on the previous page, ice cover in the Arctic Ocean is decreasing, which means that every year an increased amount of solar energy reaching the arctic is absorbed rather than reflected into space. This additional energy heats the atmosphere even more.

An enormous amount of methane is locked in the Arctic Ocean floor and is bubbling to the surface.¹² Scientists who study the problem are concerned that when the temperature in the shallow portions of the Arctic Ocean reaches a tipping point, likely not far away because the amount of arctic ice is now so low, the rate of release of methane will increase enough to raise the earth's temperature rapidly. But when will there be enough concern to cause serious action? On www.arctic-news.blogspot.com stroll down to Gary Hauser in the list of names on the right, click on his name and watch the movie "Sleeping Giant in the Arctic."

As the CO₂ content of our atmosphere continues to rise, our atmospheric temperature continues to rise, with a lag of about ten years. Because of the time it takes for these changes to take place, today's temperature is lower than the level it will reach, which continues to rise as the CO₂ content continues to rise. At some point human intervention will no longer be able to control further temperature increases, if it can now, and life on earth will in time become impossible. Since the amount of ice in the Arctic Ocean is now so low, this point may be close. Arctic scientists are terrified. Most folks are not because they have not viscerally absorbed the problem.

Most people are not educated in the sciences, and when faced with a totally new situation are not likely to believe anything that is not directly in front of them. Many will not act on what climate scientists have warned will happen until it happens, and by then it may be too late for life on earth to continue. Many people are too busy with current activities to think about an unprecedented problem. Moreover, many people depend on the fossil-fuel industry for their livelihood and will fight and have fought every thought of reducing CO₂. Abandoning fossil fuels, the largest industry in the World, will be enormously difficult and the climate deniers they fund tell us daily what we want to hear: "No problem. Just keep doing what you're doing."

BUT CO₂ KEEPS RISING!¹³

¹² The Arctic Atmospheric 'Methane Global Warming Veil'. Its Origin in the Arctic Subsea and Mantle and the Timing of the Global Terminal Extinction Events by 2040 to 2050 - A Review by Malcolm P.R. Light, Harold Hensel and Sam Carana, www.arctic-news.blogspot.com. June 8th, 2014

¹³ The coronavirus has substantially slowed the rate of CO₂ rise, but that is temporary.

Are we trapped? Is there a way out? Do we have enough time to save ourselves? What will it take? Wind and solar power are unreliable and intermittent. We need a non-polluting 24/7 steady source of power¹⁴ and we must remove CO₂ from the air.

CLIMATE CHANGE

(a Letter to the Minneapolis Star Tribune, 2018)

It's here, and more is coming

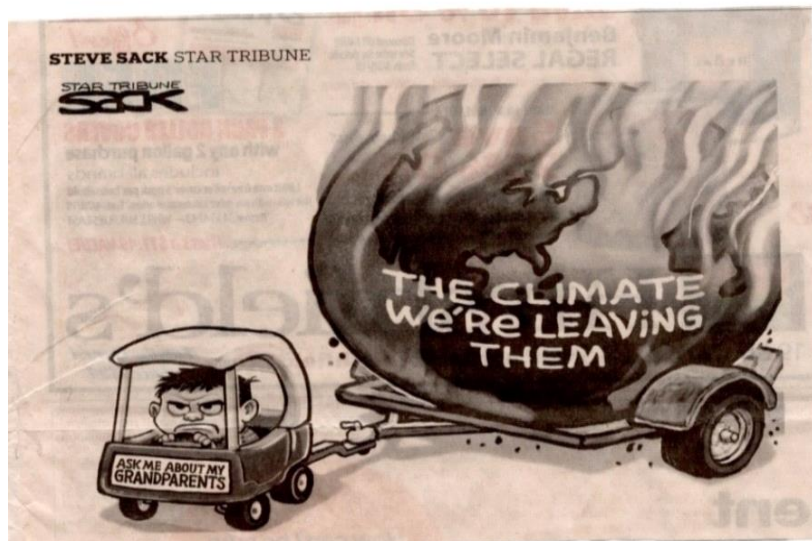
Something needs to be done about global warming because it's causing more natural disasters like droughts, floods and wildfires to happen. In fact, in 2015, there were 10 natural disasters in the U.S. that totaled \$1 billion in damages. This affects us because it's damaging homes, communities and buildings and it needs to change.

Global warming is making the earth dangerously hot. Earth's temperature has likely risen more in the years between 2000 and 2009 than it did in the previous 1,300 years. This means that the world will eventually become so hot we won't be able to live on the earth if we don't change.

LUKE FRELIX, Minneapolis

The writer is a seventh grader at Hiawatha College Prep-Kingfield.

Kids seem to know more than adults! Why?



Professor Peter Wadhams: **This is the most serious and important activity in which the human race can now be involved, and it must begin immediately.**

[NASA/Climate](#)

¹⁴ George Erickson, *Unintended Consequences: The Lie that Killed Millions and Accelerated Climate Change*. Because of Erickson's concern, you can order his book free from <http://nuclearclimatefix.com/node/94>. He shows why nuclear power is essential and why today's nuclear power (much different than the 1950's) is safe.

CLIMATE CHANGE

The future is terrifying; we have to act — now

We're young people worried about dire climate-change impacts. The feds aren't doing what's needed, so state and local governments must.

By SOPHIA MANOLIS, LIA HAREL,
GABRIEL KAPLAN, MARCO
HUNT, SHAZA HUSSEIN, KATIE
CHRISTIANSEN, and SOFIA VALDES

We, Minnesota youth, are terrified for our future. By our middle-aged years, extreme weather events will be commonplace, intense drought and heat waves could occur regularly, major coastline areas could be submerged, millions will live with the threat of frequent storm surges and the incidence of certain illnesses may be substantially higher — all because of climate change.

Societal inequities will be exacerbated as climate impacts fall disproportionately on some. Costs of repairing climate-related infrastructure damage will be unworkable.

We ask Minnesota leaders and policymakers: Can you envision such a future through our eyes?

A new report released this week by the United Nations' Intergovernmental Panel on Climate Change (IPCC) says that countries will need to dramatically and urgently decarbonize their economies and lower human-caused greenhouse gas emissions to net zero by 2050 in order to keep global warming under 1.5 degrees Celsius — the target set by the 2015 Paris Climate Accords and the likely tipping point for the worst possible scenarios. This requires major changes during the next 10 years.

The science is unequivocal; the costs of delay will far outweigh the investment and sacrifices needed to make this transition.

Scientists and political leaders have understood for decades that the climate is changing unnaturally and that human activities are the cause. This was well described in the recent New York Times article "Losing Earth: the decade we almost stopped climate change," detailing the climate change knowledge of scientists and policymakers starting in the 1970s. Yet our current federal government continues to make decisions that exacerbate climate change and have dire implications for our futures.

In the absence of federal leadership, we need our state and local governments to take bold actions to decarbonize our economies and our way of living. Minnesota's leaders should focus not only on achieving the bipartisan Next Generation Energy Act of 2007 that calls for an 80 percent reduction in greenhouse gas emissions by 2050, but also act even more aggressively toward decarbonization. We cannot simply do what most deem politically possible; we have to do what is necessary — and young people are already leading in many ways.

We are presenting a "Youth Climate Inheritance Resolution" to the state Legislature to aim for net zero greenhouse gas emissions within a decade because Minnesota can't wait. Already we have presented this resolution to numerous legislators and

gubernatorial candidates Tim Walz and Jeff Johnson to ask for bipartisan support because climate change doesn't discriminate based on political affiliation.

Several of us are part of a group of 11 youths from across our state asking Minnesota to join 10 other states and several Canadian provinces in creating an enforceable greenhouse gas emission limit to support transition to a prosperous clean economy. We are calling on the next governor to take executive action directing the Minnesota Pollution Control Agency to create stronger rules to limit greenhouse gas pollution.

**We must increase
pressure on our
leaders because
their decisions
now will shape
our futures.**

Finally, we are demanding that the Line 3 tar sands pipeline project be stopped. Line 3 exemplifies backward-looking fossil fuel infrastructure that ensures continued fossil fuel extraction for decades and forestalls the essential transition to a fossil-fuel-free economy. We represent the Youth Climate Intervenors who are sharing leadership in opposing this shortsighted and dangerous proposal.

In addition to urgently demanding those actions, we declare our solidarity with the 21 young people who have initiated a lawsuit — Juliana vs. United States — which begins on Oct. 29 in Oregon. These youths are suing the federal government on the basis that — despite its ever-increasing body of knowledge about the causes and likely trajectory of climate change — federal leaders have not done enough to limit and reduce carbon emissions, thereby failing to protect the constitutional right of today's youth to life, liberty and happiness.

We need everyone's support in telling our leaders that they are not holding up their responsibility of representing us and protecting our future. We are rallying in front of the U.S. Court of Appeals on the afternoon of Oct. 28, and we need loud public support. We must increase pressure on our leaders because their decisions now will shape our futures. We must act now; we must make change. For if we don't, it will be too late.

Learn more about youth action and join us at www.mncantwait.com.

Sophia Manolis (Minneapolis South), Lia Harel (Hopkins), Marco Hunt (Breck), Shaza Hussein (Rosemount), Katie Christiansen (St. Louis Park) and Sofia Valdes (St. Anthony) are seniors at Twin Cities high schools. Gabriel Kaplan is a sophomore at St. Louis Park High School.

Some Final Thoughts



Here is a famous picture of our earth taken from one of our spaceships. This ball is almost 8000 miles in diameter and our activities take place within a spherical shell at the surface about 10 miles thick. Our earth circles around a massive sun 93,000,000 miles away. We are one of 9 planets that, with our sun, circle within a galaxy so large that it takes light travelling at 186,000 miles a second 26,000 years to move from the center of our galaxy to our position. Astronomers tell us that there are at least one to two trillion of such galaxies within the universe. *We live on a **tiny blue dot**¹⁵ in an unbelievably vast universe.*

Our earth likely is not unique, but it has some remarkable properties. We have an atmosphere containing gases that for many thousands of years have kept us at a tolerable temperature, neither too hot nor too cold, and that shields us from deadly ultra-violet rays from our sun. The latter is the result of a layer of less than 10 ozone molecules per million air molecules in the upper atmosphere. The former is the result of several trace gases, the most important of which is carbon dioxide. Before the Industrial Revolution, our atmosphere contained about 280 carbon dioxide molecules per million air molecules. That is 0.028%. If these gases were not present, our temperature would be about minus 18°C or 0°F – too cold to support life. If there were twice as much CO₂ in our atmosphere, according to Dr. Wasdell the average temperature would be too high to support life.

Over 240 years ago James Watt's steam engine began the Industrial Revolution. It has eased our lives while burning fossil fuels. The products of combustion include carbon dioxide. For several decades, no thought was given to the consequences of adding carbon dioxide to the atmosphere. Then, just before our Civil War, Eunice Newton Foote found from her experiments that increases in carbon dioxide in our atmosphere increase its temperature. The increase has been extremely gradual, but 126 years later, in 1982, serious warnings began and now the increase in temperature is beginning to cause great concern.¹⁶ We have benefited from burning fossil fuels, without which we would be riding in horse-drawn carriages and would not enjoy the benefits of electricity. Will a power source that does not release carbon dioxide save us,¹⁷ or will the fossil-fuel industry, the largest industry in the world, carry its fight for its existence to the point of no return? Since the steam engine went into practical use, the carbon dioxide in our air has increased by 50% and is increasing by 0.5% per year. Like Faust, we have bargained that burning of fossil fuels will forever be to our benefit.

¹⁵ Carl Sagan first used this term when he asked NASA to take a picture of the Earth as far away as they could.

¹⁶ In *Mechanical Engineering*, May 2020, Professor Steven Chu in the lower left corner of page 18 mentions this.

¹⁷ Safe, modern nuclear power is both safe and essential. Read *Power to Save the World: The Truth about Nuclear Energy* by Gwyneth Cravens, Vintage Books, 2007.

A Climate Emergency

*“Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to ‘tell it like it is.’ On the basis of this obligation and the geographic indicators presented below, we declare, with more than 11,000 scientists’ signatories from around the world, clearly and unequivocally that planet Earth is facing a **climate emergency**.”*

In a five-page document on www.ScientistsWarning.org entitled “World Scientists’ warning of a **climate emergency**,” from which the above paragraph was taken, **scientists declare an emergency**. They say: “An immense increase of scale in endeavors to conserve our biosphere is needed to avoid untold suffering due to the climate crisis.”

It seems obvious that the consequence of no action will be the eventual destruction of life on Earth. The remedy must include marked reduction in use of fossil fuels. A problem that scientists understand but that is not often discussed is that burning of fossil fuels leaves sulfur compounds in the air that reflect sunlight. Stopping burning fossil fuels will cause these compounds to fall out of the air in weeks, and that will result in much more sunlight heating the air, which will cause the temperature to rise quickly.¹⁸ By some form of geoengineering, we must avoid that outcome. If we fail, we will have to pay, like Faust, the price of our bargain with the Devil. In our case the price, the ultimate price, will be loss of a livable Earth! We must not let that happen!

Eunice Newton Foote warned us, Svante Arrhenius warned us, *The Global 2000 Report* warned us, Dr. Jim Hansen warned us, former Vice President Al Gore warned us, Climate Scientist Michael Mann warned us, Prof. Emeritus Guy McPherson¹⁹ warned us, Arctic Researcher Dr. Peter Wadhams warned us, Dr. David Wasdell warned us, Dr. George Erickson warned us, Gary Hauser warned us, Greta Thunberg warned us, and many others warned us. Yet, most of us carry on our lives as if all is well! In many cities including ours there are Climate Action groups that you can join. They call attention to the problem and what to do.

This fall we absolutely must elect a President, Senators and Representatives who will be devoted to solving the **Climate Emergency**. They must turn our National Labs and Military on to the **Climate Emergency** full bore as if their lives depend on it, which they do. They must bring all the Nations on Earth together to solve the **Climate Emergency**, recognizing that it is our common problem. There already are many groups working on it including the IPCC and the United Nations. We really do need **Planetary Cooperation**. The consequences of failure are beyond anything we have had to think about. This year’s harvest, as mentioned on page 7, will be reduced, next year’s reduced even more, the year after that still more until eventually food will be no longer available. As the temperature continues to rise there will be more forest fires. With higher temperatures, there will be more riots. As the temperature continues to rise, lower latitudes become uninhabitable and people, now climate refugees, move north. With further increasing temperature there are fewer places to go, and more living creatures perish. Finally, not a soul is left on this

¹⁸ With the Coronavirus upon us and with it a great reduction in activity the concern is now.

¹⁹ Caroline Baker & Guy McPherson, *Extinction Dialogs: How to Live with Death in Mind*, Next Revelation Press, 2015.

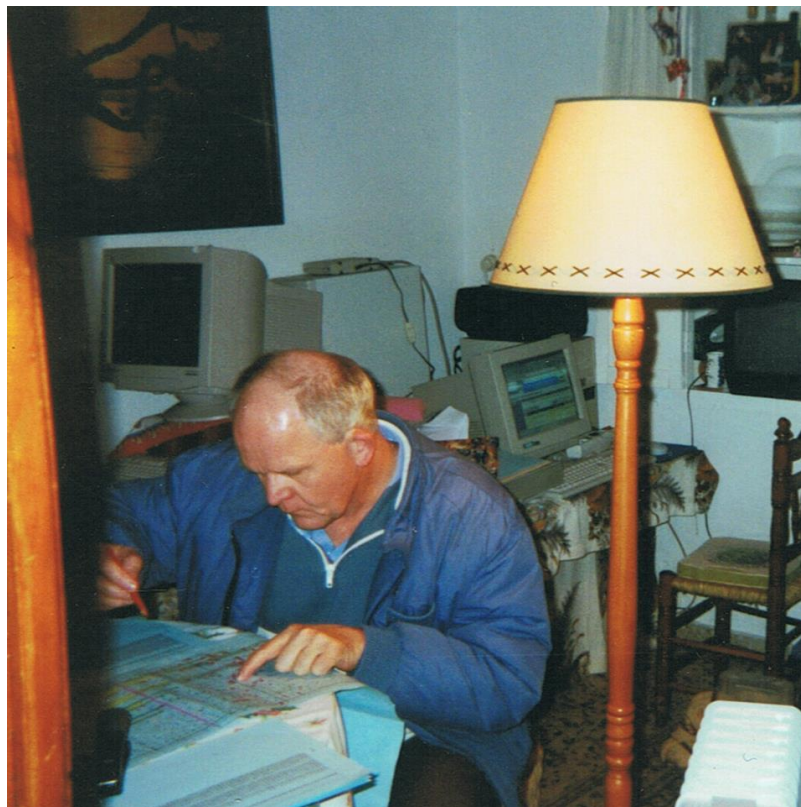
beautiful tiny blue dot and it will spin on quietly around our Sun. We must not let that happen, but without serious help it will!

We are now facing a devastating final show down with Mother Nature, which is being massively accelerated by the filthy extraction of fossil fuels by US and Canada by gas fracking, coal and tar-sand mining and continent-wide bitumen transport. The United States and other developed nations made a fatal mistake by refusing to sign the original Kyoto protocols. The United States and Canada must now cease all their fossil fuel extraction and go entirely onto renewable energy in the next 10 to 15 years, reducing their carbon dioxide emissions by 80% to 90% otherwise they will be guilty of planetary ecocide - genocide by the 2040 - 2050's. There must also be a world-wide effort to capture methane in the Arctic seabed and oceans and eradicate the quantities accumulating in the atmosphere.

Dr. Malcolm Light, Center for Polar Observation and Monitoring, London, 2014

Humanity is facing the final, western corporate capitalist, fossil fuel initiated, catastrophic Arctic methane hydrate destabilization and Permian style methane blowout – firestorm that will culminate in 1 to 4 years (2020 to 2023). We will all be boiled alive like lobsters in a massively humid atmosphere and converted into stardust.

Dr. Malcolm Light, 2019²⁰



Malcolm Light

²⁰ See Malcolm Light on www.arctic-news.blogspot.com.

Dr. Malcolm Light states clearly his conclusion that in a few years there will be no life on earth. Who is Malcolm Light? His biography can be found on the Internet. His parents were both meteorologists. He has a PhD in geology from the University of London and while with the Center for Polar Observation and Monitoring in London spent 12 years studying the Arctic. He has seen the huge threat that Gulf Stream heat poses in destabilizing Arctic methane hydrates and was first to warn about the consequences. While at CPOM among other papers he co-authored with Harold Hensel and Sam Carana the paper listed in footnote 11 on page 10. He spent years studying how to remove methane from the atmosphere. His credentials are solid. His work on the most important problem facing humankind is solid. He is one of the leading scientists of the 32 associated with www.arctic-news.blogspot.com. Why isn't there more news about his finding? It is shocking! Maybe that is why. The fraction of people aware of his finding must be exceedingly small. What warning signs may there be that he is correct? What affect may the coronavirus have on his finding?

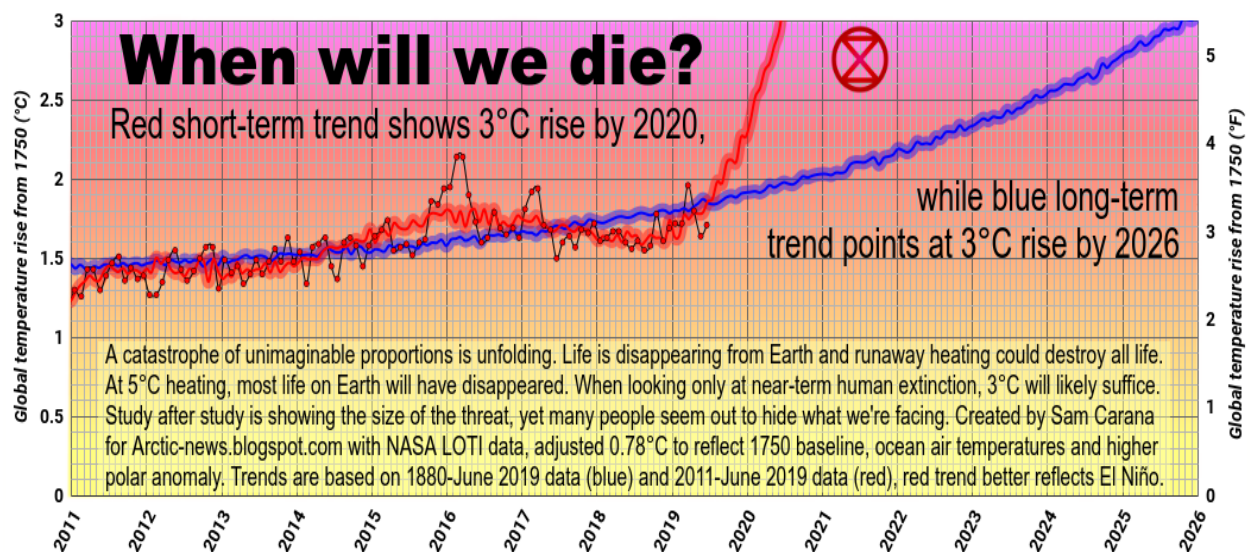
More than 11,000 scientists are associated with www.ScientistsWarning.org. In their five-page summary paper I looked for statements about consequences. The most meaningful I found was in a paper that appears in the *Proceedings of the National Academy of Sciences*, August 14, 2018, 115 (33) 8252-8259 authored by Will Steffen (a Professor at the Australian National University) and 15 colleagues. Especially worrying, they say, are *potentially irreversible climate tipping points and nature's reinforcing feedbacks (atmospheric, marine, and terrestrial) that could lead to a catastrophic hothouse Earth beyond control by humans*. To avoid such a catastrophe, they say that collective human action is required *"to steer the Earth System away from such a threshold and stabilize it in a habitable interglacial-like state. Such action entails stewardship of the entire Earth System – the biosphere, climate, and societies – and includes decarbonization of the global economy, behavioral changes, technological innovations, new governance arrangements, and transformed social values."*

Now, more than three years after those words were written, we have seen little sign that leaders have taken heed, and we are amid a coronavirus crisis with little being said about the climate. The marked reduction in traffic due to stay-at-home orders is expected to reduce carbon dioxide emissions. We have not seen those results yet, nor have we witnessed the expected increase in insolation because of less sunlight reflected into space. We must be patient. The Earth reacts slowly. Due to human inertia, the consequence is that we seem most likely to follow the path projected by Dr. Light in his 2019 statement. How might this play out? The temperature will have to rise more rapidly than shown in the chart on page 8. In the many areas that have air conditioning the demand for electricity will increase until it cannot increase anymore, and because of unbearable heat people will stop leaving their homes for any purpose. As the outside temperature continues to increase air conditioners will fail and people will die. People without air conditioning will have expired earlier. By then everyone will urge government to "do something," but it will be too late if it is not too late now.

I reread Jonathan Schell's 1982 book *The Fate of the Earth*. Those of us who remember that time recall that President Reagan, based on advice from the Pentagon, proposed that the United States plan to fight and prevail in a six-month-long nuclear war with the Soviet Union. It was a tense period. I wrote a paper then with the title "Nuclear War Fighting means First Strike." I showed that if you do not strike first, you will have no chance to strike second. Jonathan Schell goes on for 231 pages describing in exhaustive detail what terrible things such a war would mean for us. Such a possibility then was the result of a few decades of high-tech development, and the fear subsided when the Soviet Union collapsed.

Now the consequence is much worse and involves every country on this Earth, this time all on the same side. It too is the result of technological development, in this case over a period of more than 240 years and has seemed until recently to be to the benefit of humankind. In the past few decades, the consequences of temperature rise have become enough to worry many people, but not yet enough to make the necessary changes. Have we become locked in? We seem to be about to fall off a proverbial cliff. If Malcolm Light is right, what must we look for? While in the cool of April, I would guess that this coming summer will be the hottest on record. We have no choice but to wait and see! Most folks, it seems, are either unaware of possible consequences or inhibited from talking about a dire situation. But, even knowing, what can one do in face of the possibility of near-term death of all? If Jonathan Schell were to write a book now, it would be short. We may be about to pay the price of our **Faustian Bargain**.

Arctic News Blogspot has recently begun with discussions of 10 tipping points saying that this summer will be extremely hot. Just today I found that the tipping point discussion has been preceded by an article by Andrew Glikson, an Earth and Paleo-climate scientist at the Australian National University. He refers to the current situation as a **Climate Catastrophe**.



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