

WHAT ARE WE DOING TO OUR CLIMATE? WHAT IS IT DOING TO US? WHAT CAN WE DO?

Paul H. Carr, IRAS Climate Conference Champion, www.MirrorOfNature.org

OVERVIEW

I will be introducing you to **ECONOMIC, ECOLOGICAL, and TECHNOLOGICAL ISSUES.**

- Climate change is an unintended consequence of carbon dioxide emissions from burning fossil fuels.
- By pricing in the social and environmental cost of these emissions, we can expedite their reduction. Let's harness profit greed towards green technology development.
- The environmental challenge is to balance the beauty and sacredness of nature with its utility.

ABSTRACT

What are we doing to our climate? The scientific consensus. Tides and temperatures are rising. Since the beginning of the industrial age, emissions from fossil fuel burning have raised carbon dioxide concentrations to 410 ppm. This is 33% higher than in the last million years. This increase is warming our planet via the Greenhouse Effect. At the present rate of carbon dioxide increase, we could reach 800 ppm by 2100. When our earth was at this concentration 40 million years ago, it was so warm that there was no ice. Sea levels were about 300 feet higher than today.

What is climate change doing to us? "The earth and its poor cry out, and we must listen" Pope Francis. Dry regions are drier and wet ones wetter. Wildfires have increased threefold since 1970, storms more violent, floods setting record heights, and glaciers melting. Natural catastrophes are occurring more than twice as frequently as in 1980. Sea levels could rise as high as 18 feet by 2060. Parts of Earth are increasingly uninhabitable, resulting in millions of climate change refugees, CLIMmigration.

What can we do? Religion and science matter. Ethics trumping economics. Let's yoke our knowledge of climate science with the motivational power of spiritual values. We need to reduce our carbon footprints. We now have the option to purchase green electric cars getting the equivalent of 100 miles per gallon and solar PV panels to lower our electric bills. We can waste less food and eat more vegetarian. We can support the Citizen's Climate Lobby which advocates a revenue neutral carbon production fee resulting in a dividend returned to all. This would stimulate our economy creating millions of jobs and expedite green solar, wind, and nuclear energy sources. Thorium, in addition to uranium, is a green energy source for the future. Republicans are less afraid of nuclear energy than Democrats. Solar energy comes from nuclear fission in our sun.

1. WHAT ARE WE DOING TO OUR CLIMATE?

The scientific consensus.

Our present age of human flourishing and increasing domination of the whole earth is known as the Holocene Era. For the last 11,000 years, the temperatures and carbon dioxide concentrations in the atmosphere have been so stable that our population increased from 3 million to 7 billion.

However, since the beginning of the Industrial Era about 250 years ago, temperatures, tides, and carbon dioxide levels have been rising, mostly from the increased burning of fossil fuels, first coal and then oil and natural gas. This burning releases carbon dioxide. Its increase is an unintended consequence of the standard of living increase brought about by fossil fuel burning.

The protective blanketing of the greenhouse effect in our earth's atmosphere is warming our planet from the increasing carbon dioxide. The greenhouse effect in the earth's atmosphere is apparent when we compare our climate to that of the moon, which has no atmosphere with heat-trapping gases. Temperatures on the moon are above boiling, 123 C (396 Kelvin) during the day and extremely cold, -233 C (40 Kelvin) at night. On earth, even on cloudless nights, non-condensing, persistent, and increasing carbon dioxide, trap the heat radiation to keep us warmer than on the moon.

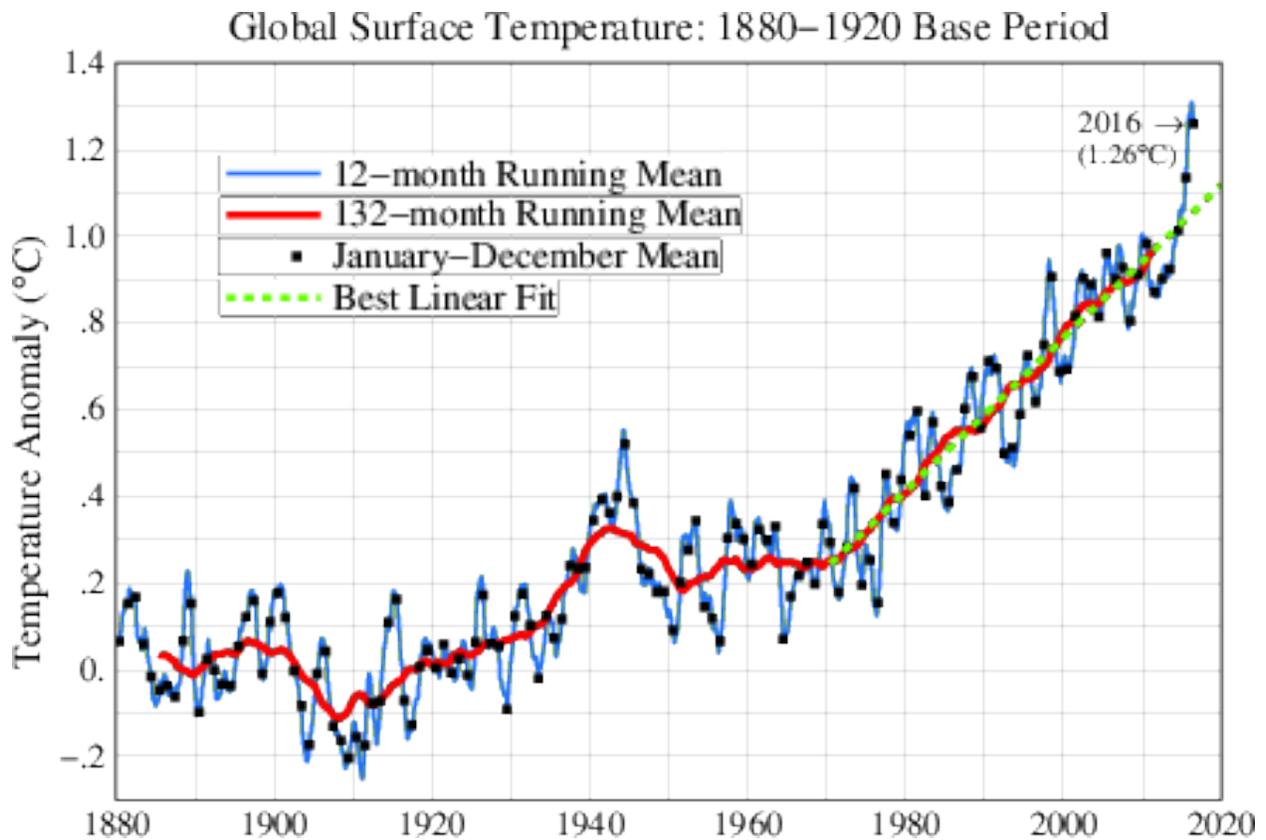


Fig. 1. Plot of Temperature Anomaly versus Time. Since 1981 “CO₂ warming has emerged from the noise of natural variability (Hansen 1981).” The year 2016 was the warmest on record.

Climate scientist James Hansen’s paper “Climatic Impact of Increased Carbon Dioxide,” published in *Science Magazine* (1981) observed that carbon dioxide levels had increased to 355 parts per million in 1980 from 280 ppm in 1880 (a 0.27%/year increase.) There was a corresponding increase of 0.4 C in the average temperatures. In 1981, Hansen predicted “CO₂ warming should emerge from the noise of natural variability.” His predictions have come true. In the 36 years since then, carbon dioxide levels have increased to 410 ppm (0.43%/year increase) while temperature have grown an additional 0.9 C. The years 2017 and 2016 have been the warmest on record.

Are these temperature increases due to the increased greenhouse effect alone or might there be other causes? Another possibility might be that the energy from the sun may have increased. Many satellites have been measuring this solar energy (Duffy). These measurements show the eleven-year sun spot cycle, but have not detected an increase in the solar energy since 1980. There are smaller increases from other greenhouse gases like methane and from deforestation, but the carbon dioxide increase continues to have the greatest influence on our warming.

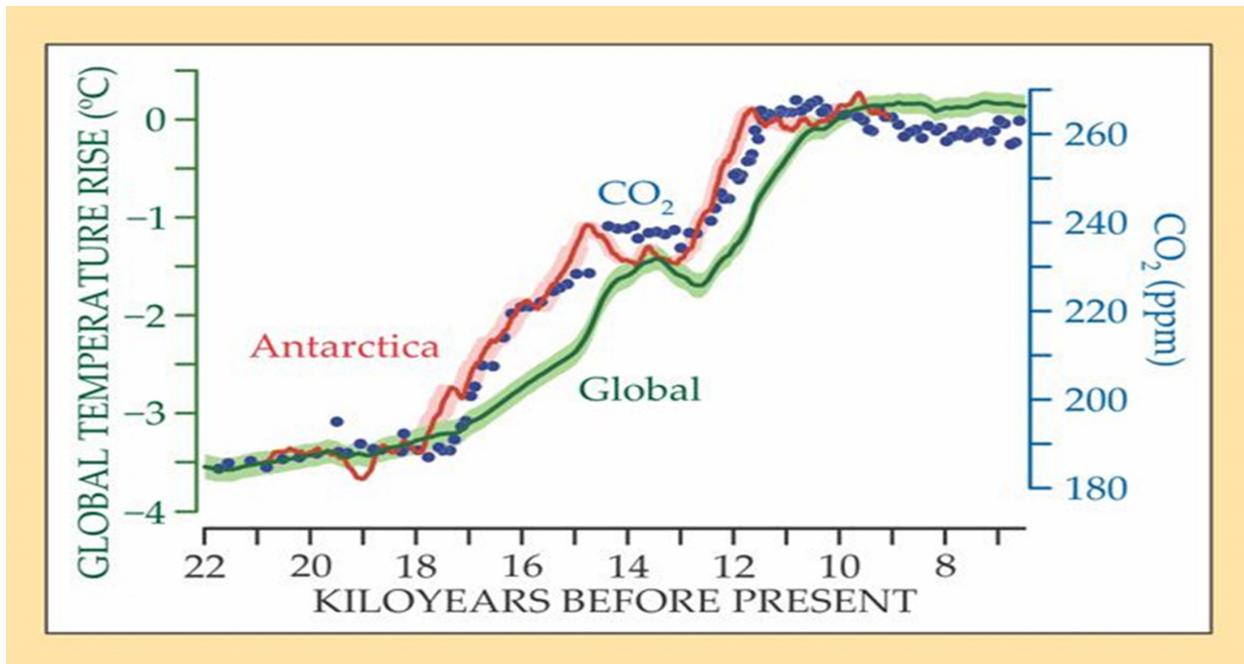
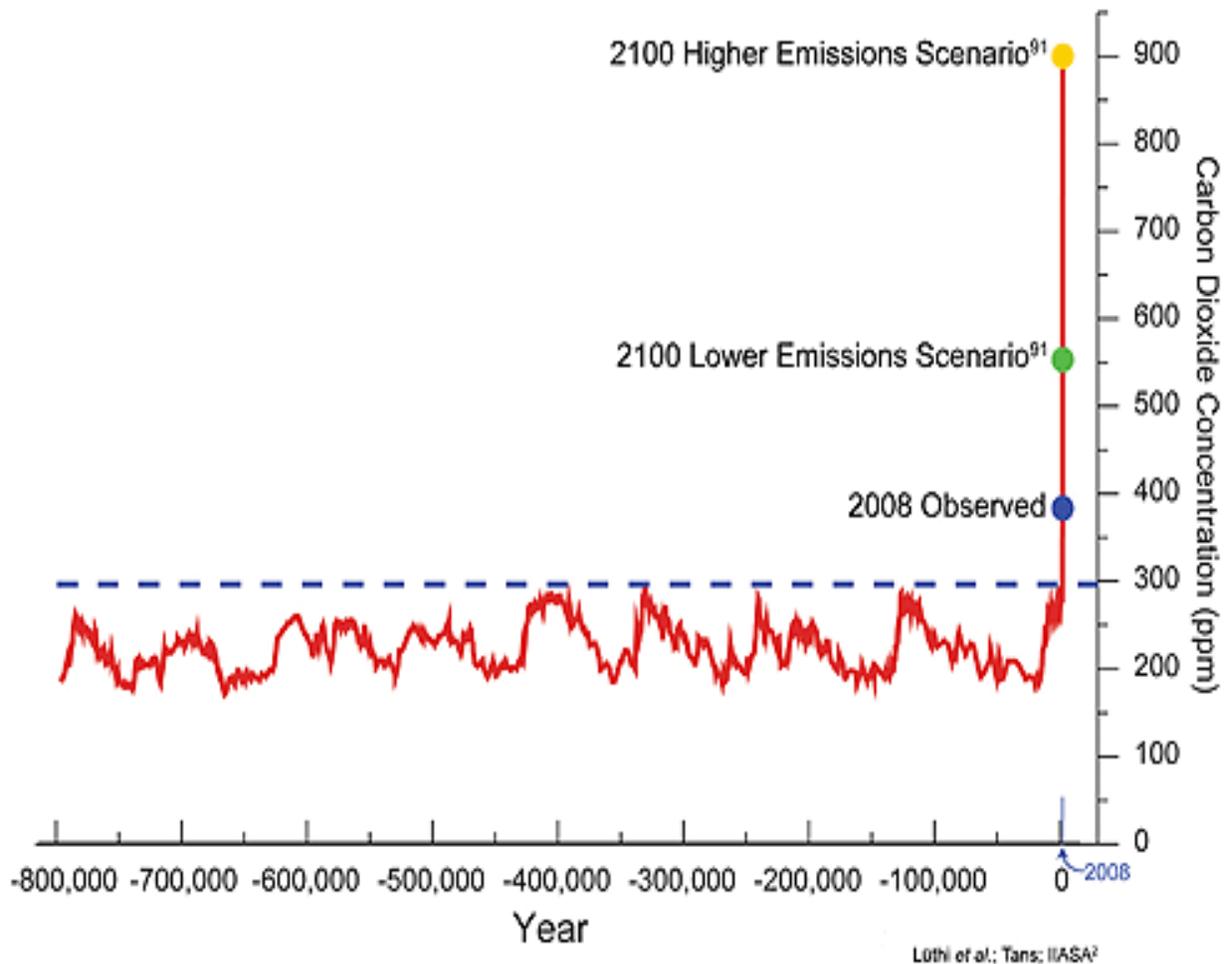


Fig. 2. The carbon dioxide increase at the end of the Ice Age, 18,000 years ago, increased the greenhouse effect that raised the global temperature.

What happened to our climate before our Holocene Era that started 11,000 years ago? About 18,000 years ago the Ice Age, that had started 90,000 years ago, began to warm (See Fig 2.) Changes in the earth's tilt and orbit triggered a temperature rise and a carbon dioxide release from the ocean. The solubility of carbon dioxide decreases with increasing temperature, as is evident from the fact that carbonated drinks like beer are served cold. Thus, as the temperature warms, more carbon dioxide is released from the oceans to the atmosphere. Atmospheric CO₂ rose dramatically. It increased the greenhouse effect centuries ahead of the temperature rise during the great deglaciation (Shakun). The rising temperature melted the polar ice caps, raising sea levels about 100 meters or 324 feet. This is a naturalistic explanation for flood stories like Noah's ark in the Bible. There are ancient cities submerged under the Black Sea which were flooded as the rising Mediterranean Sea broke over the Bosphorus land bridge. Since 11,000 years ago, average temperatures have been relatively stable until the beginning of the Industrial Era in 1750.



Analysis of air bubbles trapped in an Antarctic ice core extending back 800,000 years documents the Earth's changing carbon dioxide concentration. Over this long period, natural factors have caused the atmospheric carbon dioxide concentration to vary within a range of about 170 to 300 parts per million (ppm). Temperature-related data make clear that these variations have played a central role in determining the global climate. As a result of human activities, the present carbon dioxide concentration of about 385 ppm is about 30 percent above its highest level over at least the last 800,000 years. In the absence of strong control measures, emissions projected for this century would result in the carbon dioxide concentration increasing to a level that is roughly 2 to 3 times the highest level occurring over the glacial-interglacial era that spans the last 800,000 or more years.

Fig. 3. Present increase in carbon dioxide emissions since the end of the last ice age -90, 000 to -18,000 years ago. The last warm period was about -100,000 years, when carbon dioxide levels were below 300 parts per million, which was also true for earlier warm periods.

Our present rate of carbon dioxide increase of 2.5 ppm per year is 300 times faster than that observed when the earth recovered from the last Ice Age in Fig 3. During this age, the polar ice caps covered the northern half of the United States. The present concentration of carbon dioxide of 410 ppm is 33% higher than the highest carbon dioxide level in the 800,000 years shown in Fig. 3. Carbon dating of our carbon dioxide increase in the atmosphere confirms that the present increase is from the burning of fossil fuels at are hundreds of millions of years old.

During the 18,000 to 11,000 year ago period the increase in the average global temperature was 3.5 C. Since the beginning of the industrial era, our average temperatures have risen 1.3 C.

In summary, the UN Intergovernmental Panel on Climate Change (IPCC), consisting of hundreds of scientists, concluded in 2013 “It is *extremely likely (>95% likely)* that human influence has been the dominant cause of the observed warming since the mid-20th century.” (www.ipcc.ch)

Prof. Richard Muller’s independent non-government funded research team, www.BerkeleyEarth.org, showed how all warming since 1900 is due to human greenhouse gas emissions.

“We’re staring down a climate bubble that poses enormous risks to both our environment and economy..” HENRY M. PAULSON Jr. Secretary of the Treasury under Pres. George W. Bush.

“Science is true whether you believe it or not.” Neil DeGrassie Tyson

2. WHAT IS OUR CLIMATE CHANGE DOING TO US?

“The earth and its poor cry out, and we must listen” Pope Francis

- Rising sea levels from thermal expansion and melting mountain glaciers, Greenland, & Antarctica.
- Oceans becoming more acidic from CO₂ absorption, threatening the bottom of the food chain.
- Weather extremes are increasing:
 - *Wet areas are becoming wetter:* floods & snow.
Atmosphere holds more water vapor at higher temperatures.
 - *Dry areas, drier:* droughts & wildfires.
- Climate Refugees “CLIMmigration” from droughts.
- More diseases in the North
 - Tick-born Lyme Disease doubled since 1990 as winters warm.
 - West-Nile and Zika Viruses could increase.
 - Germs released as the frozen Arctic melts; Anthrax cases reported.

Rising Sea Levels

Miami Beach and other coastal areas are now flood zones during the king high tides. Miami is spending almost a billion dollars to raise roads and install pumps. Rising salt water levels are encroaching on fresh water supplies.

If our present rate of carbon dioxide increase continues, carbon dioxide concentrations could double, reaching 800 ppm by the end of the century. About 8 million years ago, when carbon dioxide levels were at present level of 410 ppm the Arctic had completely melted. About 40 million years ago, when carbon dioxide levels were 800 ppm, our earth, including the Antarctic, was ice free and sea levels were 100 meters or 328 feet higher than today.

At present our Arctic is half melted and sea levels are presently melting at the rate of one foot per century, which is four times faster than in 1900. The sea level rise is from the melting of Greenland, Antarctica, mountain glaciers, and thermal expansion of the oceans. The rate of sea level rise is increasing as reflecting snow is replaced by sunlight absorbing water and land.

In their 2016 paper "Ice melt, sea level rise and superstorms..." James Hansen et. al. predict that sea levels could rise as much as 1 meter (3.28 feet) by 2050. That would be high enough hopefully for the world to drastically reduce its carbon dioxide emissions. Hansen et. al. also predict that sea levels could rise by 5 meters (16.4 feet) by 2058, causing significant flooding around the world. Given that fact that the lifetime of carbon dioxide in the atmosphere is hundreds of years, would 8 years be enough time to prevent a rise from 1 meter to 5 meters?

Richard Alley, a glaciologist at Penn State University, an author of the last IPCC report is concerned about the Thwaites Glacier in Western Antarctica, which is the size of Mexico. If it should break free from its rocky berth, it would raise sea levels 10 ft. We need to act now or swim later.

Oceans are more acidic.

Atmospheric carbon dioxide is absorbed by our oceans. It becomes carbonic acid which is dissolving the carbonate shells of sea creatures. Oyster and clam shells are becoming thinner from the fact that the ocean is now 30% more acidic than in before the beginning of the industrial era. Baby oysters cannot form their carbonate shells at present acid levels. Oyster farmers must use chemicals to reduce the acidity.

Its present rate of acid increase is 100 times faster than in the last 20 million years. The acidification will more than double in the next 40 years. At this rate of increase, it is unlikely sea life will be able to adapt. The phytoplankton at the bottom of the food chain have carbonate shells which are becoming thinner. If the plankton population dies off, the whole ocean food chain could collapse.

Weather extremes are increasing (Carr 2013).

Since 1980, weather extremes have more than doubled. Normally dry areas are becoming drier, with more droughts and wildfires. California is now recovering from its longest drought on record. Wet areas are becoming wetter from the fact that the atmosphere holds more moisture at higher temperatures. When it does rain, there is more of it. "Hundred year floods" are happening more frequently.

There has been a threefold increase in wildfires since 1970. In addition to the contribution of dryness, warmer winters no longer kill off the Western pine beetles, which are killing more trees and making more timber to feed wildfires. In May 2016, an out-of-control wildfire forced the evacuation of 80,000 people from Fort McMurray, Alberta, Canada. This is the center of the tar sands oil region, which requires heat from fossil fuel burning to melt the oil tar so it can flow for processing and refining. This is the most carbon-dioxide emitting type of oil. Could the forest fire be “environmental justice” in the sense that the tar sands emissions are increasing global warming? Could Nature be “crying out” to destroy the Canadian oil sands mining?

The Russian drought in the summer of 2010 was so severe that it could no longer export wheat. The price of wheat thereafter reached record highs, contributing to the Arab Spring. Population explosions also contributed. For example, the population of Egypt in 1950 was about 20 million, which has increased to 80 million. In addition, most of family income is spent on food, so when its price increases, many could not afford to eat.

CLIMmigration.

Population increases and droughts also preceded the Syrian Revolution. Because of the drought from 2006 to 2009, over 1.5 million farmers were forced to leave their land and migrate to urban areas. The government did little for them before the revolution which started in 2011. CLIMmigration from Syria is a continuing challenge.

Hurricane Katrina in New Orleans forced millions to migrate all over the United States. There are 150 million people in Bangladesh living only one to four feet above sea level. Recently one million people were evacuated from coastal areas as a tropical storm approached.

By 2040 the deserts in the American Southwest are predicted to expand into now productive farmland. The Ogallala Aquifer of the central [United States](#) is one of the world's great aquifers, but in places it is being rapidly [depleted](#) by growing municipal use, and continuing agricultural use. This huge aquifer, which underlies portions of eight states, contains primarily [fossil water](#) from the time of the last [glaciation](#). Farming will move north to underpopulated Canada, whose northern lands will become more suitable for agriculture.

Similarly, Southern China will become too hot and dry for agriculture, while underpopulated Siberia will become more suitable. The potential CLIMmigration of China's over billion people to a different country to the north will have international repercussions.

More diseases in the North. Tick-borne Lyme Disease has doubled since 1990 as winters warm. Cases of West-Nile and Zika Viruses, which have been mostly in the South, could move North. Anthrax cases have been reported as the frozen Arctic melts and releases its germs. Air pollutants from coal combustion act on the respiratory system, contributing to serious health effects including asthma, lung disease and lung cancer.

3. WHAT WE CAN DO? Harness greed (profit) towards green technology.

There are three options:

- A. Adaptation to what we cannot change due to the hundred-year lifetime of carbon dioxide.
- B. Mitigation to reduce our carbon emissions by conservation and non-carbon emitting technology, such as solar, wind, storage, and next generation nuclear reactors. A carbon fee which accounts for the true cost of burning fossil fuels will expedite reduced emissions.
- C. Do nothing different, then complain, blame, and suffer.

"The poor will suffer the most." Pope Francis, 2015, On Care for our Common Home.

New options for individuals

Conservation and improved energy efficiency are continuing options. For example, many of us grew up hanging up our washed clothes on lines, where solar energy made them dry. Many lived in towns with no buses because everyone walked to school, work, and grocery stores. The book "Drawdown" (Hawkin) ranks 100 possible solutions to reverse global warming. The third and fourth ranked solutions were "reduce food waste" and "plant-rich diet." A vegetarian diet requires the least energy and carbon emissions. The energy required to produce chicken is much less than that for red meat.

To motivate individuals to drive energy efficient automobiles, a conservative religious group raised the question, "If Jesus were to return to earth, what car would he drive?" My wife believes he would drive a Prius "to prius from our sins." A biblical answer is, "Jesus would drive a Honda Accord, because in Acts 2:1 it states, "...all the disciples were in one accord."

On June 21, 2008, *The Economist* had a cover article envisioning non-carbon emitting electric cars charged by electricity from windmills, solar photovoltaic arrays, and next generation nuclear reactors. This vision has been fulfilled. Electricity from wind and solar PV is now equal to or less than that generated by fossil fuels. Solar PV panels are now being installed on the rooftops of individual homes saving homeowners many dollars over the twenty-year lifetime of the array.

For several years, Tesla motors has marketed an electric car with a range of over 200 miles per charge, but costing over \$70,000. The electricity cost is equivalent to a conventional car getting 100 miles per gallon. Electric motors have high torque at low speeds and require a simple one speed transmission. The Tesla Model S will accelerate from 0 to 60 miles per second in three seconds. In 2017, Chevrolet is marketing its Bolt, which has the same 200 miles per charge range. It accelerates from 0 to 60 miles per hour in 6 seconds, but cost only \$35,000 after the Federal tax rebate. The Bolt has a fuel savings of \$ 4,250 over 5 years as compared to the average new vehicle. Although the Bolt is assembled in Michigan, its motor, single-speed transmission, and batteries are manufactured in South Korea.

Technology advances promise to make longer range electric cars likely. John Goodenough, 94, co-inventor in 1980 of the lithium-ion battery, has discovered a lithium- or sodium-glass battery that has three times the energy storage capacity of a comparable lithium-ion battery. "The next

step is to verify that the cathode problem is solved,” Goodenough says. “And when we do [that] we can scale up to large-scale cells.” (Cornell). These are examples of new green energy sources available to motivated individuals.

Global Community Options

How are we doing as a world community? Since 2006, China became the world’s greatest carbon dioxide emitter. However, since 1960 the United States has been and continues to be the world’s largest carbon per capita emitter, about twice that of the European Union (Fig 4). In 2011, China’s per capita emission recently rose to be equal to that of Europe. India’s per capita emissions are significantly less than those of China. However, India has an over billion population comparable to that of China. India could therefore be a “wild card” whose emission could equal those of China in the future (Savaram). Ten of the world’s twenty most polluted cities are in India.

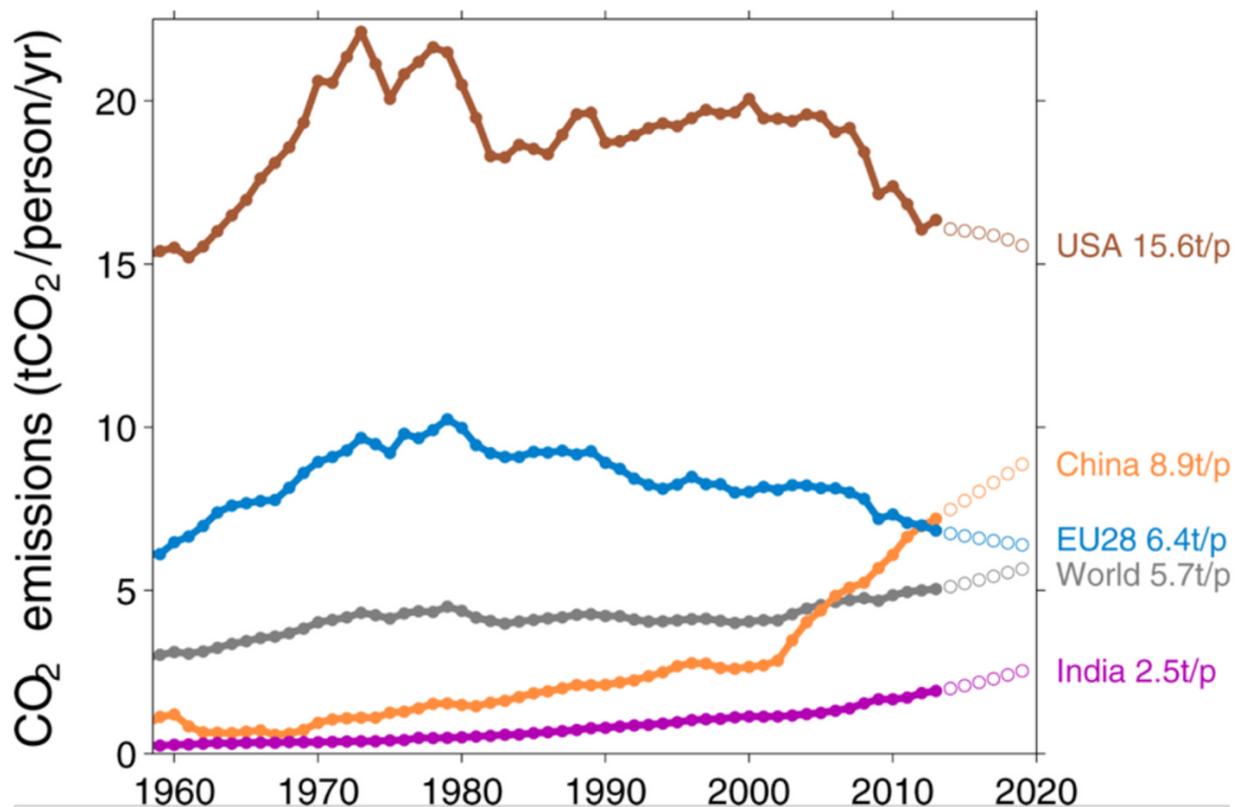


Fig. 4. Per capita carbon dioxide emissions.

Why is the per capita carbon emissions of the US about twice that of the European Union (EU), which is equally developed (Fig 4)? Adam Smith’s “invisible hand” of economics is evident in the cost of gasoline, which is about two times higher in the EU than the US. Oil is an internationally traded commodity; whose cost is the same worldwide. The Europeans tax gasoline and use it to subsidize public transportation whose per capita cost per mile is much lower than driving an individual automobile.

Adam Smith's "invisible hand" of economics is also evident in two time periods when the per capita carbon emissions in the US decreased. One was in 1960 to 1980, when the cost of gasoline increased from \$.30 to \$1.00 per gallon. Recently, the US per carbon emissions have been declining as coal generated electricity has been replaced by less expensive natural gas. Natural gas is less polluting than coal and its carbon dioxide emissions are one half that of coal for the same amount of energy.

Overall, the carbon emissions of the US and the EU have been slowly decreasing, while at the same time their Gross Domestic Products have been increasing. This disproves the skeptic's and President Trump's claim that decreasing carbon dioxide emissions would destroy economic growth (Carr 2017).

"We have to figure out how to live without fossil fuels someday. Why not now, before we have destroyed the creation?" said Dr. James Hansen (2009), Director of the NASA Goddard Space Science Institute. "Coal burning is the biggest contributor to increases in carbon dioxide levels. Each year several hundred thousand people in the world die of air pollution from coal. If that many people died from a nuclear plant malfunction, we would shut them all down. A moratorium on building new coal plants without carbon sequestration and a phasing out of present ones within 20 years could enable our earth to recover a sustainable CO₂ level."

Economic Policy

Economic policy has the power to reduce carbon dioxide emissions. Sweden introduced a CO₂ tax in 1991. Since then its GDP has grown 60 percent, and at the same time, its emissions have been reduced by 25 percent.

In 2009 the US House of Representatives passed the Waxman-Markey bill, which placed a price on carbon, but the Senate did not. This cap-and-trade bill would have placed a limit or cap on the amount of carbon that a coal fired generating plant can emit. To exceed this limit, the coal plant would have to buy tradeable permits. Nevertheless Sweden, California, Quebec, and the Northeast Regional Greenhouse Gas Initiative are using cap-and-trade to decrease coal-burning and give an economic advantage to non-carbon emitting geothermal, hydro, nuclear, wind, and solar energy sources. This energy is free, after capital and maintenance costs are paid, and will last until the sun burns out, billions of years from now.

China has recently taken its first steps to build what is destined to be the world's second-biggest carbon emissions market. Guangdong province has the largest of seven pilot programs for a proposed national market within a year. Exchanges will trade permits to emit an estimated 1 billion metric tons of greenhouse gases a year by 2018, close to half the volume in the European Union system.

Former Treasury Secretary under President Reagan, George Shultz has proposed a revenue neutral carbon fee with the dividend returned to everyone. A typical family of four would get

about \$2000 per year, which would stimulate our economy and create an estimated 2 million new jobs. This would spur green energy innovation, giving it an economic advantage over fossil fuels. The carbon fee would make the economic system work as carbon emitters would be paying the true social and environmental cost of their use. (<https://citizensclimatelobby.org>)

Nuclear Energy

In “How fear of nuclear power is hurting the environment, “ Michael Shellenberger (2016) observed that the world is presently decommissioning nuclear reactors faster than the increase in wind and solar power. Solar energy is only available 26% of the time and wind 33%. Nuclear is 24/7. To make up for the net nuclear decrease, the world is increasing its burning of fossil fuels. They are raising carbon dioxide emissions that are warming our planet. This is particularly true in Germany, where the cost of electricity is twice that in the US. Neighboring France gets most of its electricity from its nuclear reactors. Its carbon dioxide emissions and its electricity costs are lower than in Germany.

Solar energy is nuclear. The energy that enables life on earth comes from the nuclear fusion of hydrogen into helium in our sun. The temperatures are so high that no materials can contain these fusion reactions here on earth. For this reason, present nuclear reactors get energy from the fission of Uranium into lower elements in the periodic table.

As Marie Curie put it, “Nothing in life is to be feared, it is only to be understood. Now is the time to understand more, so that we may fear less.” Curie was the first woman to receive a Nobel Prize. It was for her pioneering research on radioactivity, a term which she coined.

NASA’s Dr. James Hansen, MIT’s Prof. Kerry Emanuel, (2015) and two other top climate scientists wrote an open letter, “Nuclear power paves the only viable path forward on climate change.” They stated, “*Modern nuclear technology can reduce proliferation risks and solve the waste disposal problem by burning current waste and using fuel more efficiently. Innovation and economies of scale can make new power plants even cheaper than existing plants.*”

Engineers at MIT are designing a nuclear plant that could be moored at sea, like an oil rig. It would cost about one-third less than a conventional nuclear reactor and take about half the time to build. Floating reactors would not be in anyone’s backyard (NIMBY). According to MIT Prof of Nuclear Science & Engineering, Ian Hutchison, “The Republicans are less scared of nuclear energy than the Democrats.”

Bill Gates is presently funding next generation nuclear power. TerraPower's nuclear pilot plant is being built in China, whose National Nuclear Corporation has a contract with Bill Gates. This traveling wave reactor converts depleted uranium, a byproduct of the nuclear-fission process, into usable fuel. This is solving our nuclear storage problem. China is leading the world in the construction of 23 new nuclear reactors, with 33 planned.

Thorium molten salt nuclear reactors (MSR), demonstrated at Oak Ridge National Laboratory 1965-1970, consume nearly 100% of their fuel, compared with 3% for older reactors with solid uranium fuel (Cornell). MSRs eliminate the need for Yucca Mountain storage by consuming nuclear waste. Thorium fluoride molten fuel for MSRs is of *no weapons value*. Thorium fuel is more abundant and cheaper than uranium. MSRs require no expensive containment since they operate close to atmospheric pressure. Thorium reactors are designed to shut down automatically without operator intervention in the event that they overheat. They have a zero chance of a meltdown. China is investing \$350 million over five years to develop molten-salt thorium reactors. It plans to build a two-megawatt test reactor by 2020. Thorium is the green energy source for the future (Martin).

Since Thorium nuclear reactors are better for peacetime, why are there so many uranium reactors? Alvin Weinberg demonstrated a **Thorium** nuclear fission reactor at Oak Ridge in 1970. Its fission byproducts had no weapons value during the Cold War's nuclear arms race. Thorium reactors lost to Navy Admiral Rickover's **Uranium** ones for nuclear submarines and aircraft carriers. Present uranium civilian reactors, which generate 20% of our electricity without carbon emissions, are a spinoff from Rickover's navy technology.

India has large Thorium reserves and little Uranium. It plans to get 30% of its electrical energy from Thorium by 2050. This plus solar microgrids in rural areas will hopefully keep India from becoming like China in being a country with the largest carbon dioxide emissions. China now leads the world in the construction of its 23 nuclear reactors, with 33 planned. India is 3rd, with 4 reactors under construction and 20 planned. China also has the largest market share of solar PV panels. With its solar, wind, and nuclear advances it is well on its way of getting 20% of its electricity from non-carbon emitting sources by 2020.

According to Michael Bloomberg, US states, cities, and businesses will still meet Paris targets for carbon dioxide reductions. The former New York mayor, now UN cities and climate ambassador, says Trump may have withdrawn from Paris accord but American people haven't.

CONCLUSIONS

Since fossil fuels are a limited resource, by 2100 fossil fuel burning will be declining due to the depletion of the finite world resource. The world's primary sources of electricity will be renewable intermittent wind and solar, and nuclear power plants which generate 24/7. By then electricity stored in batteries will power most of our transportation.

The Golden Rule of ethics must re-balance our economy. At present, those with the gold make the rules. Pope Francis' "Laudato Si: On Care for our Common Home" states that we have the moral imperative to stop plundering our planet for profit, the poor suffering the most.

Does Adam Smith's "invisible hand" guide the pursuit of individual gain towards creating the *Wealth of Nations*? Let's update this 1776 economics and re-balance it with Garrett Hardin's

1968 “Tragedy of the Commons,” in which the pursuit of individual gain leads to negation of the common good. If carbon emitters and users would pay the true cost of their emissions, our world economy will keep the world’s remaining carbon in the ground. Let’s harness the greed for profit towards developing green technology.

The environmental challenge is to balance the beauty of nature with its utility (Carr 2006). Is beauty “in the eye of the beholder” or/and an encounter with the Divine? Without divinely created beauty, nature becomes an object that may be ravaged. For example, a coal mine can be beautiful in the eye of its owner because it is a source of black gold. Hopefully we will re- envision beauty to transform our relationship with nature in time to lessen the impact of weather extremes and rising tides and temperatures.

Margaret Mead, who was a plenary speaker at our 1969 IRAS conference once said, “*Never doubt that a small group of thoughtful committed citizens can change the world; indeed, it is the only thing that ever has.*”

Rachael Carlson’s best- selling “Silent Spring (1962)” led to environmental movement that banned DDT.

My goal and that of our co-chairs, Karl Peters and Emily Austin, is that you will be scientifically informed and spiritually inspired to change the world.

Ask not what our country can do for you.
Ask what you can do now to save our planet.

It ain't what you don't know that gets you into trouble. It's what you know for sure that just ain't so.
Mark Twain

REFERENCES:

Andersson, Magdalena 2016. “When It Comes to Emissions, Sweden Has Its Cake and Eats It Too” May 16, 2016. <http://www.worldbank.org/en/news/feature/2016/05/16/when-it-comes-to-emissions-sweden-has-its-cake-and-eats-it-too>

Anderson, Mark. 2017 “Will a New Glass Battery Accelerate the End of Oil?” *IEEE Spectrum*, March 3, 2017 <http://spectrum.ieee.org/energywise/energy/renewables/does-new-glass-battery-accelerate-the-end-of-oil>

Carr, Paul H. (2006). The beauty of nature versus its utility: the environmental challenge. Chapter 9 of *Beauty in Science and Spirit*. Beech River Books, Center Ossipee, NH.

Carr, Paul H. 2013. ["Weather Extremes from Anthropogenic Global Warming."](#) *Natural Science* Vol 5, No. 1A, 130-132, January 2013.

Carr, Paul H. 2017. Climate Change Debates and Papers.
<http://mirrorofnature.org/ClimateIEEEDebatePaper.html>

Carr, Paul H. 2017. "What are we doing to our climate? What is it doing to us? What can we do?" <https://www.slideshare.net/paulhcarr/what-are-we-doing-to-our-climate-what-is-it-doing-to-us-what-can-we-do>

Cornell, David A. 2017. Fracking and the Future of Fuel." *Physics Today*, pgs 10 -11. February 2016

Duffy, Phillip B. et al. (2009) Solar variability does not explain late 20th-century warming. *Physics Today*. (January 2009) pg 48

Fountain, Henry. 2015 "Researchers Link Syrian Conflict to a Drought Made Worse by Climate Change." <https://www.nytimes.com/2015/03/03/science/earth/study-links-syria-conflict-to-drought-caused-by-climate-change.html>

Hansen, James, et. al. 1981, "Climate Impact of Increasing Atmospheric Carbon Dioxide." *Science* vol. 218, no. 4511, (28 August 1981). <http://www.c02.gr/pdf/6.pdf>

Hansen, James E. (2009) 'The Climate Challenge: Urgency of Actions on Coal Emission.' PowerPoint presentation, New Hampshire State House, Concord, NH. 2 April 2009.
<http://www.columbia.edu/~jeh1/>

Hansen, James, Emanuel, Kerry, Caldeira, Ken, and Wigley, Tom, 2015 "Nuclear power paves the only viable path forward on climate change,"
<https://www.theguardian.com/environment/2015/dec/03/nuclear-power-paves-the-only-viable-path-forward-on-climate-change>

Hansen, James et. al.2016. [Ice melt, sea level rise and superstorms: evidence from paleoclimate ... www.atmos-chem-phys.net/16/3761/2016/acp-16-3761-2016.pdf](http://www.atmos-chem-phys.net/16/3761/2016/acp-16-3761-2016.pdf) March 2016

Hawkin, Paul. 2017 "Drawdown: The Most Comprehensive Plan Ever Proposed to Reverse Global Warming." Penguin.

Martin, Richard 2013. "SuperFuel: Thorium, the Green Energy Source for the Future" St. Martin's Griffin.

Paulson, H, Bloomberg, M, Steyer, T. 2014. "The Economic Risks of Climate Change in the United States." <http://riskybusiness.org/reports/>

Pope Francis 2015. "Laudato Si: On Care for our Common Home." <https://laudatosi.com/watch>

Shakun, J. D. et al. 2012. "Global warming preceded by increasing carbon dioxide concentrations during the last deglaciation." *Nature* 484, 49-54 (April 2012).

Sivaram, Varun 2017. "The Global Warming Wild Card." *Scientific American*, May 2017
<https://www.scientificamerican.com/article/can-india-save-the-warming-planet/>

Shellenberger, Michael, 2016. YouTubeTED Talk.
https://www.ted.com/talks/michael_shellenberger_how_fear_of_nuclear_power_is_hurting_the_environment

Shultz, George P. 2015 A Reagan approach to climate change –
<https://www.washingtonpost.com/.../4f4182e2-c6a8-11e4-b2a1-bed1aae...>
March 13, 2015
