

# **Republicans and Climate Change: It's Time for A Reality Check!**

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Global warming and climate change appear to be anathema to conservative Republicans. The topic is simply being ignored or dismissed as “junk science” or a hoax perpetuated by left wing alarmists and academics. There was not a single question or mention about climate change during the first Republican candidate presidential debate in Cleveland on August 6th. Climate change skeptics assert that the science of climate change is “not settled” and that there is considerable difference of opinion among scientists as to the extent of human influences on climate. Measures to cut fossil fuel greenhouse gas (GHG) emissions are denounced as job killing and bad for the economy, and that a cost-benefit analysis does not justify the expense of reducing the use of fossil fuels and building green energy infrastructure. Opponents to climate change legislation say that we must not make policy based on unreliable computer models.

As a petroleum geologist who in 2010-2011 served as the elected president of the American Geosciences Institute (AGI), a federation that represents over 250,000 of the nation's professional earth scientists of every geologic discipline, and as a life-long Republican who is a fiscal conservative, I would like to weigh in on the debate.

Fellow Republicans, global warming is happening; human activity has overwhelmed natural processes; and the evidence of the past 100 years is not based on computer models. The economic, social and security impacts on our way of life will be devastating unless we immediately begin to deal with the human factors that are driving climate change. Climate scientists are in general agreement that global warming is a serious problem, and that humans are the culprits.

Republicans and the public at large who do not believe in climate change must look at the overwhelming scientific evidence that documents climate change and the impact of humans, and re-assess their position. The earth's atmosphere and oceans are warming, but at rates that vary significantly on a regional basis. Profound environmental changes are in progress. Shifts in weather patterns, sea level rise, agricultural crop distribution, regional drought and increasing desertification, an increase in forest fires, and changes in plant, animal and insect distribution, are all well documented. Asthma and allergy attacks are becoming more common. Sea level is rising, posing an increasing threat to coastal cities. Melting of the Arctic Ocean in the summer months, and its rapid warming, is impacting northern hemisphere atmospheric and oceanic circulatory patterns. Regional differences in oceanic warming, and perturbations in the atmospheric and oceanic circulatory patterns are increasing the frequency and ferocity of major storms. Oceans are becoming acidified from absorption of carbon dioxide. This “other carbon

problem” which most people have no idea is occurring, will have a profound impact on the marine food chain and the supply of fish to feed a growing global population.

These climate change developments are real - they are not the figment of some professor’s computer model. The Republican Party must face reality and develop a climate policy position. All candidates in the approaching congressional and presidential elections must be prepared to answer how they will deal with climate change. Balancing the budget, job creation, health care and immigration are important and manageable political issues for the next election. However, because the potential impact of climate change on our way of life could be so severe, dealing with climate change and measures to mitigate its impact, simply must also be part of the political debate.

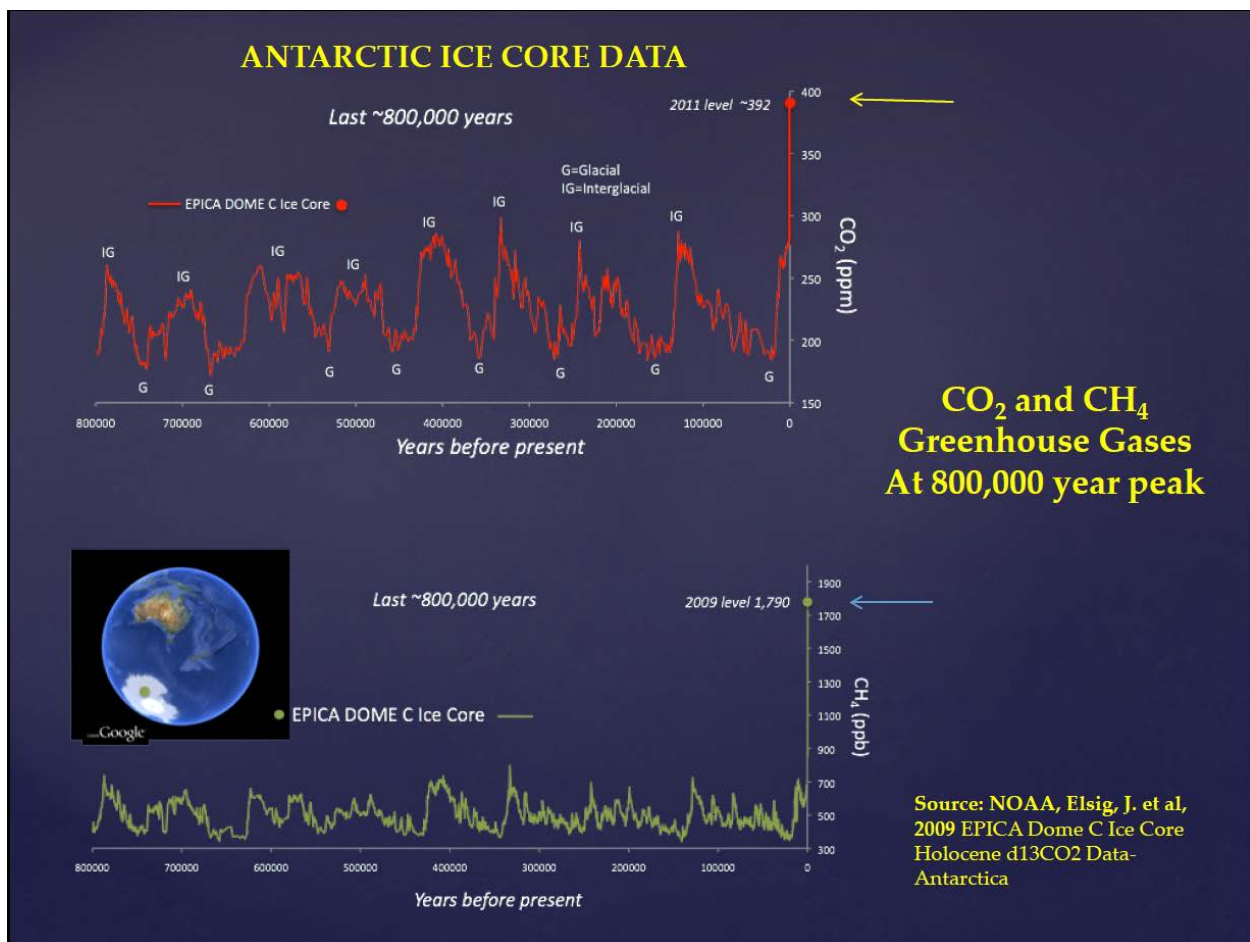
## **Discussion and the Data**

I used to doubt the human impact on climate change, and as a petroleum geologist, thought that excess carbon dioxide could easily be absorbed in the oceans and result in the harmless deposition of another layer of carbonate rich sediment. However, as a result of my 10 years on the board of the American Geosciences Institute, and former service as the co-chair of the Energy and Environment Committee of the Council of Scientific Presidents, I learned about the scientific basis for climate change and the human (anthropogenic) factor. I read the scientific papers on climate change and go to meetings organized by such scientific organizations as the Geological Society of America, the American Geophysical Union, and the Yale Climate and Energy Institute, where I have been able to talk personally with leading climate scientists. It has been my experience over the past five years in interacting with the earth scientists who are doing the research, that there is nearly universal agreement that human greenhouse gas emissions have overwhelmed the factors that cause natural climate change; global warming is occurring; and that the future impact on the biosphere will be profound unless action is taken to limit GHG emissions now.

Climate has changed through geological time due to natural variation in the shape of the earth’s orbit around the sun, the tilt of the earth’s axis relative to the sun, changes in solar intensity, continental drift, massive episodes of volcanism, and changes in the composition of the atmosphere. These changes normally occur over thousands, if not millions of years. Sea level dropped by almost 400 feet during the last ice age. However, when the last glaciers melted and sea level rose to its current level by about 6,000 BC, no one was harmed as there were no cities on the former coastlines, and there was ample space for human and animal climate migrants to relocate. As sea level rises in the future to the point where coastal cities are in serious danger of catastrophic flooding, where and how do we move the billions of people living on or near global coastlines today, and at what cost? Where will humanity’s food be grown as temperature increases and drought impact areas that are currently important agricultural centers?

Human activity, in particular the production and burning of fossil fuels which releases the warming greenhouse gases carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and nitrogen dioxide (NO<sub>2</sub>) into the atmosphere, is causing changes that are now occurring at a rate and scale that is unprecedented in recent geological history. Human emissions of CO<sub>2</sub> since 1850 are estimated to

total about 1,500 billion tons, and are now at an annual level of 37 billion tons. This is overwhelming the natural carbon cycle balance between vegetation, land and oceans and the atmosphere, resulting in the excess buildup of CO<sub>2</sub> in the atmosphere. Evidence from ice cores recovered in Antarctica and Greenland document that over the past 800,000 years, the difference between multiple periods of glaciation and inter-glacial warm periods is a matter of just a few degrees of temperature, and there is a relatively small variation in the concentration of carbon dioxide and methane. The ice core data demonstrate that CO<sub>2</sub> has fluctuated between about 170 parts per million (ppm) during periods of glaciation, and a maximum of 300 ppm during warm periods. Methane which is about twenty-five times more potent than CO<sub>2</sub> as a greenhouse gas, has fluctuated between about 300 and 700 parts per billion (ppb). Over the past century atmospheric CO<sub>2</sub> levels have now risen to 400 ppm and CH<sub>4</sub> has shot up to over 1,800 ppb, primarily as a result of the burning of fossil fuels. The figure below shows this dramatic change.



**Figure 1.** 800,000 years of Antarctic ice core data on atmospheric greenhouse gases.

The increase in atmospheric GHG over the past century has led to warming of both the atmosphere and oceans. The average temperature in the United States during the past decade was 0.8° Celsius (1.5° Fahrenheit) warmer than the 1901-1960 average, and the last decade was the warmest on record both in the United States and globally. According to the National Oceans

and Atmosphere Administration (NOAA), 2014 was the warmest year across global land and ocean surfaces since records began in 1880. Including 2014, nine of the ten warmest years in the 135-year period of record keeping have occurred in the 21st century. The 2014 global average ocean temperature was also a record high.

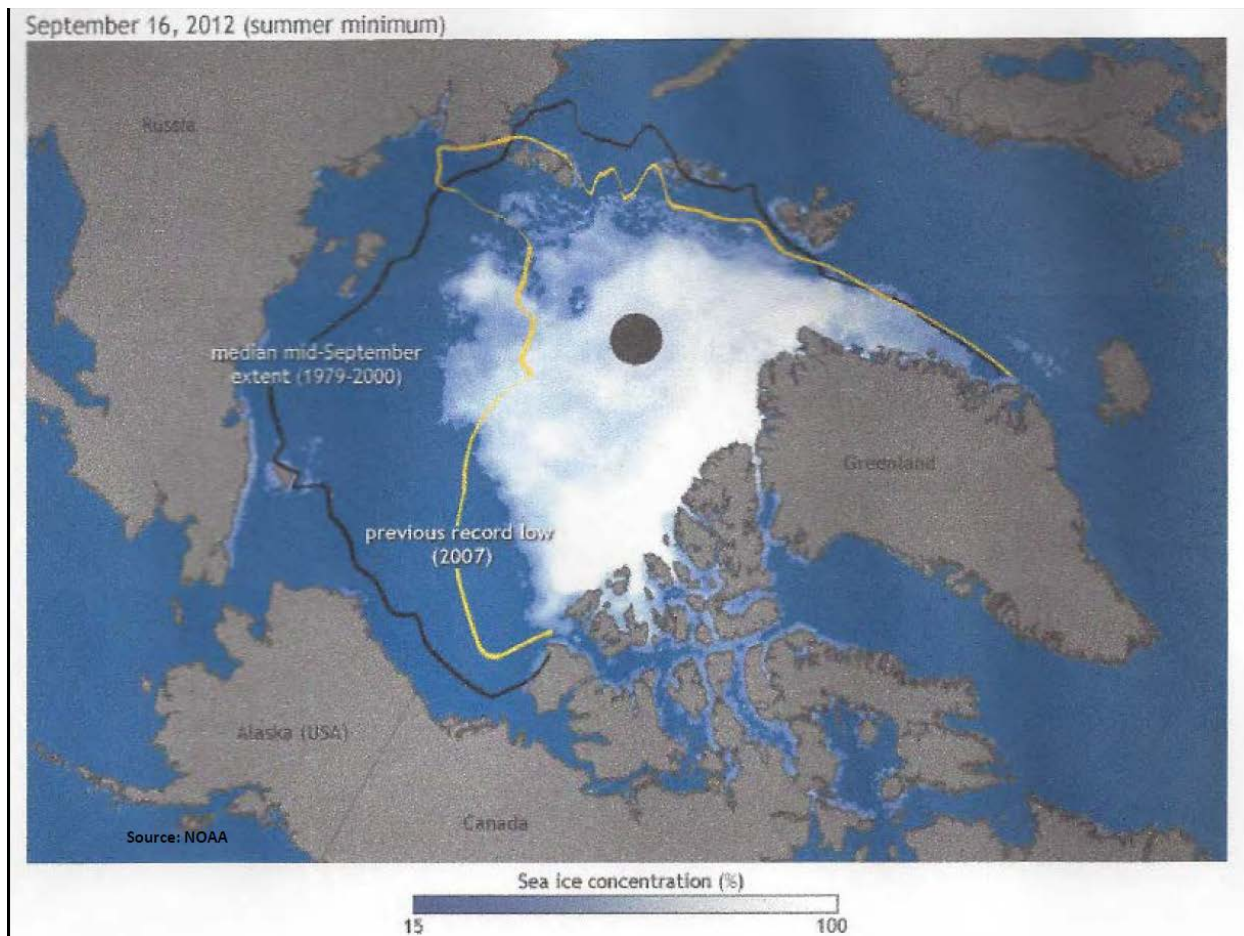
Global temperature changes vary significantly depending on location, with the greatest changes occurring in the Arctic. An “average” global temperature change of a degree or less does not tell the whole story. Alaska, for example is warming at twice the rate of the rest of the United States. Over the past 50 years, the average annual air temperature has risen 3.4° F, while Alaskan winters have warmed by 6.3° F (ref: EPA). Summer melting of permafrost is wreaking havoc to coastlines and infrastructure in Northern Alaska. The route of the famous Iditarod dog sled race had to be changed in 2015 due to a lack of snow.

Over the past decade water temperatures in the Gulf of Maine have been rising at the phenomenal rate of 1°F every two years (ref: *New York Times* 12/14/14) with significant ecological impact on fishery resources. Rapidly warming waters are, for example, allowing the invasive green crab to proliferate, resulting in the decimation of Maine’s softshell clam population, and seagrass – an important marine habitat. Cod fishing has been banned. The Maine shrimp harvest is threatened and now at a record low. Will lobsters be next?

Global warming skeptics cite an apparent hiatus since 2000 in the rise of average global atmospheric temperatures as evidence that there is no global warming. There has been no hiatus in global warming as concluded in a comprehensive study released in June by the National Ocean and Atmospheric Administration. “Adding in the last two years of global surface temperature data and other improvements in the quality of the observed record provide evidence that contradict the notion of a hiatus in recent global warming trends,” said Thomas R. Karl, Director of NOAA’s National Centers for Environmental Information. “Our new analysis suggests that the apparent hiatus may have been largely the result of limitations in past datasets, and that the rate of warming over the first 15 years of this century has, in fact, been as fast or faster than that seen over the last half of the 20th century.” There has also been a redistribution of excess heat. The oceans are the principal sink for atmospheric heat, and they release this heat periodically during events like the El Nino in the Southern Pacific. Naysayers ignore the fact that beginning in 2000, the oceans have experienced the most sustained warming trend on record, and at rates below 700m that appear to be unprecedented (ref: Balmaseda et al, 2013)<sup>1</sup>.

The accumulation of atmospheric aerosols resulting from the industrialization of Asia and other parts of the developing world may be masking global temperature increases. Once the Chinese and Indians control their SO<sub>x</sub>, NO<sub>x</sub> and soot emissions, as we have done in North America, temperatures will likely continue their upward journey more rapidly.

Recent Arctic warming has led to a significant reduction to summer sea ice cover in the Arctic Ocean as shown in the NOAA illustration below.



**Figure 2.** Summer 2012 Arctic Ocean Ice Cover (ref: NOAA)

Ocean-going commercial ships can now navigate through Arctic waters in the summer, resulting in significant cost savings in fuel and days on the sea between North Atlantic ports and Asia. Russia recently laid claim to an additional 1.2 million square kilometer swath of the Arctic Ocean where there are significant fishery resources and potential oil and mineral deposits. At a conference of the American Geophysical Union in 2011, I found myself sitting next to a uniformed naval officer, and asked him why he was in attendance at a climate change conference. His reply was “that the Navy now has a new ocean to protect”. The officer’s business card read “Chief Oceanographer and Navigator of the United States Navy”. He was a Rear Admiral and had a Ph.D. from the Scripps Institution of Oceanography; and he was definitely not some left wing climate nut.

The year 2012 marked a record low in Arctic ice cover. During the summer of 2012, over 90% of the surface area of the Greenland ice cap experienced melting. This compares with a 1981-2010 average ice melt in Greenland of about 25% (ref: National Snow & Ice Data Center).

Without a summer ice cover which reflects solar energy, the dark open Arctic Ocean is warming rapidly, creating a temperature and air pressure anomaly that is impacting atmospheric and oceanic circulatory flow patterns. Shifts in the Arctic Oscillation atmospheric circulatory pattern are believed to have allowed the Jet Stream to plunge south in Canada and in Siberia and to push bitter cold and snowy weather over much of the Central and Eastern United States and

Europe the past two winters. At the same time, a northward meandering Jet Stream over the Central Pacific has resulted in severe drought in the western U.S. and record warming in Alaska.

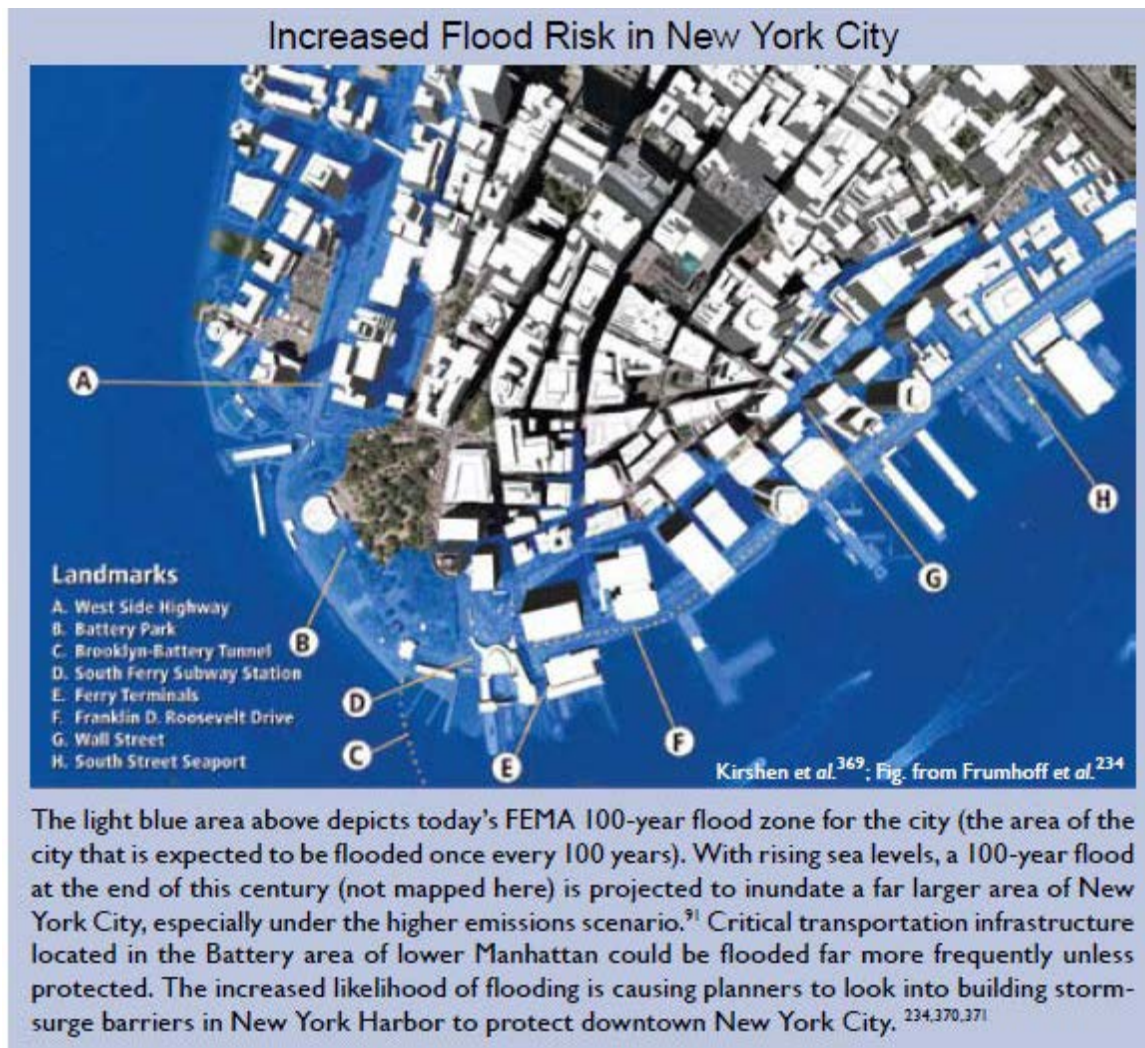
Melting of the Arctic Ocean ice cover and of the Greenland ice cap, and a coincident increase of fresh water influx into the North Atlantic, is also causing significant salinity changes in the North Atlantic. Changes in water temperature, salinity, and Arctic atmospheric and oceanic circulatory patterns, may ultimately cause a migration of the Gulf Stream to the south.

Global warming is a reality in the Arctic – not a computer model artifact. But how fast can changes impact the quality of our daily lives? Is this a problem for us or our great grandchildren? High resolution isotopic research on ice cores from Greenland by Dr. Paul Mayewski, Director of the University of Maine Climate Change Institute, and other researchers, has indicated that there have been abrupt changes in temperature during the last several hundred thousand years by as much as plus or minus 25°F, over periods of less than a decade – sometimes as little as two years, and that these new climate conditions can persist for decades to millennia (ref: Mayewski P.A. and Morrison, M.C., 2011, *Journey Into Climate*). These sharp climate changes are attributed to abrupt shifts in the position and strength of polar atmospheric circulation patterns, and have also been associated with changes in the strength and position of the Gulf Stream. Dr. Mayewski's research suggests that Arctic warming can have dramatic impacts upon weather patterns across the heavily populated northern mid-latitudes, and that such impacts could increase as ice cover continues to retreat and the Arctic continues to warm.

It is the Gulf Stream which brings large volumes of warm waters northward, such that Europe enjoys its present climate and not that of Siberia. Will a soon-to-be summer ice-free Arctic be the tipping point for a very rapid climate change and a southerly shift of the Gulf Stream?

Sea level rise is a consequence of the thermal expansion of the oceans and melting of ice caps in Greenland and Antarctica, and mountain glaciers. Global sea level has risen about 8 inches since reliable record keeping began in 1880. However, sea level rise is variable regionally. At Philadelphia, PA, for example, data indicate a rise of 1.2 feet since 1901. Cities like Miami are already threatened with inundation. Current research indicates that global sea level is rising about 1.4 inches per decade, and at a rate that is increasing. Projections to the year 2100 indicate a most likely increase of an additional 15 to 55 inches of sea level change, with a “business as usual” scenario projection of as much as six feet (ref: GlobalChange.gov).

FEMA has created the map included below which shows what New York City will look like during a projected 100-year storm, as sea levels rise over the next 50 years. Hurricane Sandy in 2012 cost an estimated \$71.4 billion in damages and business interruption, and damaged or destroyed 651,000 housing units in New Jersey and New York (ref. FEMA and Wikipedia). Restoration costs in New York alone were \$19 billion. As sea levels rise, the damage will become even more costly.



**Figure 3.** Projected 100-year flood in New York City, not including potential sea-level rise of up to three feet or more by 2100.

Global warming is also causing severe regional drought and desertification. Water shortages are already impacting agriculture in the USA. California, for example, the “vegetable garden” for the USA, is experiencing a major water crisis. Where will cities like Phoenix obtain potable water? Shortages of water for agricultural and potable use in the Middle East and in Central and North Africa are already exacerbating the social unrest that exists in these regions. Can Europe continue to absorb the ever growing exodus of political and climate migrants? Can America? Mass migrations of climate refugees will be a major security issue in the future.

Significant ecological changes are resulting from global warming. A northward march of insect pests such as the pine bark beetle has destroyed pine forests in the Rocky Mountains and Pacific Northwest, and now in New Jersey. New England’s stately hemlocks are succumbing to the woolly adelgid pest as it moves north with warmer winters. Birds are migrating north earlier, but unfortunately many of their food sources are evolving more slowly, and the birds are starving

when they reach their traditional nesting sites. The Inuit native people of Northern Canada do not have a word for the red breasted bird that is now summering in the Canadian Arctic - Americans call the bird a robin!

In addition to raising atmospheric temperatures, increasing levels of CO<sub>2</sub> is also resulting in increasing ocean acidification (carbonic acid forms when CO<sub>2</sub> and water react). The uptake of anthropogenic CO<sub>2</sub> by the global oceans induces fundamental changes in seawater chemistry that could have dramatic impacts on biological ecosystems in the upper ocean” (Feely et al, 2009)<sup>2</sup>. NOAA has documented how ocean acidification in the Pacific Northwest is now measurably impacting the formation of the calcareous shells of oyster larva and free swimming pteropods or “sea butterflies” which are an important food source for juvenile Pacific salmon. Coral reefs are globally endangered. The pre-industrial pH of the oceans was about 8.2; the pH dropped to 8.1 by 2000; and it is projected to decrease to about 7.8 by 2100 (Feely et al, 2009)<sup>2</sup> if there are no reductions in carbon emissions. This represents a 150% increase in ocean acidity, which will have very significant consequences for the marine food chain that has evolved over millions of years at a pre-industrial oceanic pH.

Some climate change skeptics will say that high levels of carbon dioxide are good for plants, and that CO<sub>2</sub> concentrations in the atmosphere have been much higher in the geological past. That is indeed correct. However, they fail to mention the impact on global temperature and sea level rise, and profound ecological changes, and what this would do to humans today. According to the comprehensive climate change statement of the Geological Society of London, the last time CO<sub>2</sub> levels were between 330 and 400 ppm was during the Pliocene Age some 2.6-5.2 million years ago. Isotopic evidence indicates global temperatures were 2-3°C (3.6-5.4°F) higher than now, and that sea level was likely 10-25 m (33- 82 feet) higher (say goodbye to Houston, New Orleans, Miami, Washington, New York, Boston, Los Angeles, and every other major coastal city around the globe). There were large fluctuations in ice cover on Greenland and West Antarctica during the Pliocene. Those areas were probably largely free of ice, and some ice may also have been lost from parts of East Antarctica during the warm intervals. Coniferous forests replaced tundra in the high latitudes of the Northern Hemisphere, and the Arctic Ocean may have been seasonally free of sea-ice. Going back further in geological time to the Paleocene-Eocene Thermal Maximum (PETM) 55 million years ago, temperatures rose 5-9°C (9-16°F) over 10,000 years and CO<sub>2</sub> concentration in the atmosphere was possibly as high as 2,000 ppm. There were semi-tropical conditions in the Arctic, and no global ice cover. This extreme warming might have been caused by major kimberlite eruptions (source of diamonds) and/or melting of methane hydrates when the permafrost melted. Major ecological changes resulted.

### **The Experts vs. Naysayers**

The National Academies of Science, the nation’s most prestigious body of scientists, and the climate position papers of such distinguished scientific organizations as the American Association for the Advancement of Science, the Geological Society of America, the American Geophysical Union, the American Chemical Society, and the Geological Society of London, all confirm the climate trends that are occurring as described herein, and what is likely to occur as



GHG levels continue to rise; and they all cite the anthropogenic factor in climate change. Policy makers must not ignore or discredit the learned opinions of the professional societies whose members are the experts on climate. There is still much work to be done, and there is considerable debate among climate scientists. Nevertheless, the science is settled insofar as to the reality of global warming and the effect of fossil fuels and other human activity.

Trade groups and their lobbyists in Washington work hard to discredit the science of global warming, and oppose environmental legislation which they believe will negatively impact corporate earnings and employment within their industries. Their dollars speak, but do they communicate the truth or the positions of vested-interests? Politicians such as Sen. James Inhofe (R, OK), Sen Mitch McConnell (R, KY), Sen. Ted Cruz (R, TX), and former Texas Gov. Rick Perry, together with political activists like the Koch brothers and conservative public advocacy groups like the Heartland Institute, are doing a major disservice to the American people by claiming that global warming is overblown or simply not happening, and that humans are not the problem. They fight attempts to reduce the nation's carbon footprint by saying that measures to do so will hurt jobs and the economy. The Koch brothers are very astute and successful businessmen, but they are not climate scientists, and are apparently getting bad advice in this regard. *The Wall Street Journal*, as one of the most widely read newspapers in America, is also doing a disservice to investors and the public when it publishes articles that criticize climate science, suggest that the scientific community is deeply divided on global warming, and oppose price support mechanisms for green energy. The *WSJ* editors are stuck in the past, are ignoring the science, and appear to delight in publishing articles by writers who are simply out of the mainstream of climate science.

People who are intellectually unable to adapt to new information which might undermine their own entrenched theories, or who feel economically threatened by new realities, have historically opposed new scientific hypotheses since humans believed the earth was flat. Some of the most controversial scientific theories have included: the startling observation by Galileo that the sun, in fact, did not revolve around the earth (Galileo was almost burned at the stake for this heresy); Darwin's theory of evolution and that man is descended from the apes; continental drift; and now the anthropogenic factor in global warming. When I was a geology student in the 1960's, there were distinguished academics who opposed the concept of plate tectonics and continental drift. They had too much at stake to accept the new evidence and admit that they were wrong. The scientific method demands that a researcher regularly evaluate new data concerning his or her hypothesis, and adjust prior conclusions, if warranted by the new information.

One can make the analogy that today's anti-climate change activists are like those special interests who fought legislation to limit tobacco, claiming that there was no conclusive scientific evidence that smoking was bad for one's health, thereby causing unnecessary health problems and even death for millions of Americans as a result of their delaying tactics. Special interests fought auto emission and federally mandated fuel efficiency (CAFÉ) standards for years, until it reached a point that Detroit was producing autos that no one wanted to purchase when oil prices

began to surge in 2002-2008. Detroit auto makers went bankrupt in 2008 while Toyota sales soared because the Japanese made fuel efficient cars.

The scientific community has confirmed that rising temperatures, melting sea ice and glaciers, sea level rise, ocean acidification, drought, changes in agriculture, and increasing storm intensity and frequency, are all very real. Earth's biosphere simply cannot naturally adapt to the rate of climate change today.

When current climate trends are loaded into computer models, the projections do not auger well for the quality of life on earth by 2100, under a "business as usual" option for current energy use. Mitigating the impact of climate change on humans on every continent will be the greatest social and economic challenge of the 21st Century. Doing nothing is simply not an option if we value the quality of life of our children and grandchildren, and hope to avoid the future cost of what will likely be trillions of dollars to mitigate the impact of climate change. What will it cost to build high walls around New Orleans, Miami, London or Hong Kong, or abandon the cities and relocate everyone and their jobs inland? The White House Council of Economic Advisors (CEA) released a report in 2014 that estimated the global cost of climate change will reach \$150 billion per year, and continue rising as reversing temperature increases becomes more difficult. The financial and social impact of global warming will be devastating if steps are not taken now to reduce GHG emissions.

### **So What Must We Do?**

Global energy demand is expected to continue growing over the next two decades as the developing world enters what I call the Consumer Age. People want and should have a modern life-style. Fossil fuels now provide 82% of primary energy needs, and this is expected to drop to a still robust 76% by 2035 (ref: IEA). However, the transition to green energy sources and reduction in greenhouse gas emissions must be accelerated if we hope to be able to successfully mitigate the impacts of global warming. The Europeans have accepted the realities of climate change and have passed legislation to reduce greenhouse gas emissions by 40% by 2030 through a "cap and trade" mechanism and a targeted 20% renewable energy in the EEU by 2020. The goal is to limit global warming to 2°C (3.6°F) by 2050. Atmospheric levels of CO<sub>2</sub> must be limited to no more than 450 ppm if this goal is to be achieved.

So what do we do? I for one am prepared to set aside my conservative Republican economic principles and work to reduce our carbon footprint. Dealing with climate change requires a fundamental reappraisal of our nation's energy policy, and how we as individuals think about energy use and conservation in all forms. Abundant and cheap fossil fuels energized the economies of North America and Europe, and have been a major building block for economic growth. However, the business model is no longer sustainable, and we, and every other nation, must now change our ways for the good of humanity and planet earth. There are now simply too many people emitting far too many greenhouses gases.

A transition from fossil fuels to renewable energy is a major step in the process, as fossil fuels account for more than 50% of annual global CO<sub>2</sub> emissions. Renewable energy sources

cannot compete with cheap coal and petroleum without subsidies until a certain scale is reached. Fortunately, this is happening already in certain regional wind and solar markets. Americans have to adjust to higher fossil fuel and electricity costs. This must be accepted as the tradeoff for mitigation of the potentially devastating impact of global warming. The cost of not facilitating the transition to green energy now will be a missed opportunity compared with the cost of mitigating the impact of climate change in the future.

Reductions in CO<sub>2</sub> emissions can be achieved through: improved fuel and energy efficiencies; fuel switching (i.e. - converting vehicles to natural gas and electric power); biofuels made from non-edible agricultural products and wastes; generating electricity with natural gas instead of coal; significantly limiting the emissions of coal-fired and natural gas electric power plants; building efficient public mass transit; and installation of “smart” electric grids and smart electric control technologies in workplaces, institutions, and homes. Conservation measures such as: significantly improved thermal insulation in homes, offices, schools, and manufacturing facilities; heating and cooling efficiencies; and retrofitting old buildings, and making new buildings Leadership in Energy and Environmental Design (LEED) certified, are all important ways to reduce energy consumption. People should get used to less air conditioning in the summer and wearing a sweater in the winter. Recycling of metals, plastics, glass and paper, which are energy intensive to produce from primary raw materials, should be federally mandated.

No greenhouse gases are emitted by nuclear power plants. A new US energy policy should promote a re-birth of nuclear power. Nuclear plants are safe if properly engineered and monitored. The safety factor would be significantly improved if they are constructed where there are no active faults or threats of major flooding, or tsunamis. It is also critical that the Yucca Mountain nuclear waste disposal site finally be completed and commissioned. A major nuclear waste reprocessing facility should be constructed to reduce the volume of spent fuel rods and other radioactive matter such as medical isotopes and industrial x-ray sources.

Fossil fuels are significantly less expensive than green energy substitutes, and there are additional out-of-pocket costs for consumers which create financial barriers to implementing energy efficiencies. As such, normal “market forces” will not work in the near term, as end-users will continue to use cheaper fossil fuels to maximize profits, and the public will try to avoid the cost of being green. The market for fossil fuels vs subsidized green energy is not a level playing field, which, as a fiscal conservative, I do not like, but am prepared to accept. Legislative “sticks and carrots” are required to stimulate the transition to green energy and reductions in GHG’s. These must include increased fossil fuel energy production and consumption taxes, tax credits, and subsidies for improving energy efficiencies, and developing new technologies. Carbon cap and trade legislation should be implemented.

A ten percent federal excise tax on oil and gas production at the wellhead and coal production at the mine mouth would generate about \$30 billion in annual tax revenue. An excise tax on gasoline, distillate and jet fuel in the amount of \$0.25 per gallon, rising to \$1.00 per gallon over five years would initially generate about \$55 billion per year in tax revenue, and would rise

to about \$220 billion over five years. These tax revenues would be offsets to the green tax credits and help pay for energy R&D and energy efficient infrastructure.

### **Economic Impact of Green Legislation**

Clean energy legislation opponents will naturally attack mandates to reduce greenhouse gas emissions as a draconian hit on the US economy. The era of cheap energy is over, and must be so, if the public wishes to do something about climate change. Near term, the energy excise taxes will definitely increase the cost of gasoline and diesel. However, the retail cost at the pump will still be significantly less than in Europe, where the equivalent price per gallon of gasoline currently ranges from about US\$5.00 - \$7.00/gallon. Taxes are the primary reason for the cost differential. Higher fuel costs have not destroyed the European economy. The long-term result of implementing the energy efficiencies and emission reductions is that people will likely pay more for less energy - so perhaps the ultimate out-of-pocket cost will be neutral. A reduction in health costs from reduced exposure to emissions will also be a very positive public benefit.

Opponents to cap and trade, carbon taxes, and increased energy efficiencies who cite the potential loss of jobs and damage to our economy should read *New York Times* columnist Tom Friedman's excellent book "*Hot, Flat and Crowded*". Friedman writes that America must use its incredible reservoir of innovative skill sets to "out green" the competition, and by doing so, lead the world in the green revolution, create jobs, grow the economy, and significantly reduce our dependence on foreign oil. By dithering and delaying meaningful change, we are allowing the Chinese to ride the green wave into the future, and the USA will be buying its green technologies from Asia.

Those who oppose climate legislation cite, for example, the potential for destroying jobs in the coal industry. The coal mining, transportation and power industries currently employ only 174,000 in the USA, and the numbers are shrinking rapidly (ref: Sourcewatch.org). Data easily accessible from a Google search indicate that the solar and wind industries now employ over 258,000 persons in the US and are growing rapidly (ref: American Wind Energy Association and the Solar Foundation). A generation ago, there were no wind and solar industries. In 2014 global investment in renewable energy increased 17% to US\$ 270.2 billion (ref. Frankfurt School-UNEP Centre/BNEFF.2015).

The Clean Air Act of 1970 and Clean Water Act of 1972 did not harm the economy, despite the whining of industry and lobbyists who opposed the legislation; and a cleaner and healthier America has resulted.

High-paying new jobs will be created to: build, install and operate renewable energy power plants, and the equipment needed to reduce emissions; to tear down and recycle to the extent possible, obsolete plants; and to build new, efficient, and low impact coal-fired plants, gas-fired plants, and more nuclear power plants. Further jobs will be created by the manufacturers who build energy efficient automobiles (this is happening!), trucks, and public transportation systems; and energy efficient electric appliances. The construction of better intra

and inter-city public transportation and smart electric grids will positively impact employment. Even more jobs will be created by the increased manufacture and installation of improved thermal insulation in homes, factories and work places, and implementing LEED certification.

The coal industry will continue declining over the next couple decades as a result of environmental legislation. However, America is truly the “Saudi Arabia” of coal with a 250 year supply of coal reserves. This resource should not be ignored or thrown away. I would like to see more R&D funding directed towards clean coal technologies, converting coal to liquid synfuels to displace imported oil, and for carbon sequestration. Successful implementation of these technologies would keep the coal mines and power plants operating.

The petroleum industry will fight green legislation as a threat to its very existence. My colleagues in the oil and gas exploration and production business must appreciate that the transition to green energy will take decades. New technologies will be developed to reduce emissions from fuel combustion, which will support continued demand for petroleum transportation fuels. If a hydrogen economy becomes a reality, petroleum is an excellent source for hydrogen. The market for domestic petroleum will remain strong as there is simply no near-term alternative to petroleum as a major transportation fuel for trucks, trains, airplanes, ships, heavy equipment, or for petrochemical feed stocks. Every drop of oil and natural gas produced by American companies will have a market for the next generation, and hopefully back out imported oil as fuel efficiencies reduce demand (the USA imported 9 million barrels/day of crude and petroleum products in 2014 according to the EIA). The reserve life of most known oil and gas fields is considerably less than the decades it will take to make the transition.

### **The Political Process**

Limiting greenhouse gas emissions is not a new concept for Congress. In June 2009, the 111<sup>th</sup> Congress passed the American Clean Energy and Security Act of 2009 (HR 2454) in the House by a vote of 219 to 212. This was the first time that Congress has passed meaningful climate legislation. The bill contained significant tax “sticks and carrots” and subsidies to reduce greenhouse gas emissions, including a “cap and trade” mechanism, and a very broad range of energy efficiency mandates. By mid-century, the bill would have reduced GHG emissions by 83% below 2005 levels. Opponents called the bill a “job killer”, an “energy tax on consumers that will raise the cost of electricity and gasoline”; and as described by Rep. Joe Barton of Texas, it was “an economic disaster bill”. The legislation never made it through the Senate.

A benefit of our democracy is that when properly informed, the public and Congress will support environmental legislation that makes a difference. DDT, for example, was banned once the public understood that our national symbol – the bald eagle, was imperiled. Increased ultraviolet radiation resulting from depletion of the ozone strata over Antarctica by chlorofluorocarbons (CFCs) was an abstract issue, until the public began to see photos of blinded sheep in Patagonia. Oops - this is real, and perhaps it could affect me! The Montreal Protocol of 1987, ratified by the United States and 195 other nations, banned the manufacture of CFCs

which were used primarily as refrigerants and solvents. As a result, we appear to have avoided a major environmental catastrophe. Can we do the same with greenhouse gases?

The United States refused to approve the 1997 United Nations Kyoto Climate Change Protocol because of its many perceived flaws, and the fact that mega-GHG emitters China and India were not parties to the agreement. The Kyoto Accord expired in 2012. On November 30<sup>th</sup>, the 2015 United Nations Conference on Climate Change convenes in Paris. Hopefully, a new international climate treaty can be negotiated that will have the approval of all nations, and truly make a difference in reducing GHG's.

The challenge today is to inform and educate all stakeholders about climate change - to communicate that objective, peer-reviewed research indicates that anthropogenic CO<sub>2</sub> and other GHG's are causing unprecedented rates of climate change; damage will occur; and that there is a very significant adverse economic impact of a "do nothing" scenario. When the public realizes that their personal well-being will likely be negatively impacted, and that there will be an out-of-pocket cost, they will respond appropriately. President Kennedy inspired the nation to reach for the moon. Can we convince the electorate and policy makers to roll up their sleeves and make a concerted commitment to a green energy revolution?

Voters have a choice concerning the quality of life they want for their children and grandchildren. I believe they will overwhelmingly support comprehensive energy and climate legislation when presented with all the facts. Perhaps Republicans can surprise the nation by leading the campaign for a green economy.

### ***Footnotes***

1. Balmaseda, M.A. *et al*, *Distinctive climate signals in reanalysis of global ocean heat content*, Geophysical Research Letters, Vol. 40, 1754-1759, May 2013.
2. Feely, R.A. *et al*, *Ocean Acidification*, special publication of the Oceanography Society, Oceanography, Vol. 22, No. 4, December 2009.

### ***About the Author***

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250,000 members in every earth science discipline. He was AGI President in 2010-2011. Hobbs was a member of the Council of Scientific Society Presidents in Washington, D.C., from 2009-2012, where he served as Co-Chair of the Committee on Energy and the Environment. From 2000-2014 Skip was a Trustee of the New Canaan Nature Center and was president of the Nature Center from 2012-2014. He writes and lectures frequently on energy economics and energy policy, and on environmental issues. In his spare time Hobbs manages a family farm in Massachusetts. He can be reached at [skiphobbs@ammoniteresources.com](mailto:skiphobbs@ammoniteresources.com).

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