# EDITORIAL

## Climate Change – The Scientific and Technical Issue

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The most pressing scientific issue facing us today is not the composition of matter or the structure of the universe. Certainly not the nuances of sound and vibration technology in our small field. It is of course climate change – argued vehemently in the scientific, technical and political communities. Why can't all sides accept one basic premise and then go on from there to an optimum solution for all?

There can be no doubt climate change is real – and why can't politicians say so. One only has to look at glaciers – most are receding and have been doing so for many years prior to the relatively recent increase in $CO_2$. At the Athabasca Glacier in Alberta, there are markers on the walkway from the parking lot showing the location of the receding face for about the last 80 years.

Climate is clearly a cyclical phenomenon. Some 12,000 or so years ago, Chicago was under approximately 1,000 feet of ice from the glacier that carved the great lakes. Cleveland, Buffalo and New York City, likewise. Boulders in Central Park were an early gift from Canada, shoved there by the advancing glacier. If you know what you are looking for, the glacial moraine is visible in the drive to JFK Airport. (A moraine is an accumulation of glacial debris.)

Vikings colonized North America in the 10th century in a place they called Greenland. They lived and survived on locally grown crops for about 500 years, the so-called Medieval Warm Period. Paintings in European museums clearly show colder conditions in the 16th and 17th centuries than exist today. Colder conditions that forced the Vikings from Greenland – the little ice age.

As in so many issues of the day, there is also a big *but*! For that you will have to read this whole editorial. No peeking allowed.

Many assert a scientific consensus exists for human-caused global warming. But science is not a consensus. It is an unending search for truth.

Science changes and evolves as theories are tested, new discoveries made, new technologies developed and refined. Theories once thought to be inviolate are discarded and replaced by new discoveries. Air, earth, fire and water were the earliest classification of nature's fundamental building blocks. As recently as the 1950s, science taught in high school and college proclaimed that matter was made up of three components: protons, neutrons and electrons. Discoveries since have proven the true nature is vastly more complex.

Science in the '50s likewise taught that the universe was a continuous process without beginning or end. Creation and the Big Bang were discounted as religious superstition. Today that hypothesis has been reversed. Science has determined the age of the universe to a few percent and can estimate what occurred during the first fractions of a second following the Big Bang. The earth was considered flat until sometime before Columbus in the 15th century. Science asserted that the sun, planets and stars rotated around the earth until disproven by Copernicus and later Galileo in the 16th century.

Ridiculous in today's world, a prediction of the demand for computers issued in the 1950s was something less than two dozen worldwide! Take a look in the Smithsonian and you'll see why this didn't seem farfetched.

Scientists recently announced that information from NASA's Juno satellite require a total revision of theories regarding the makeup and atmospheric processes of the planet Jupiter.

The carbon capture and release cycle cited as a cause for climate change is likewise a natural cycle. Carbon released by many sources is essential for plant and sea life and rock formation, where it is absorbed to be recycled. In fact, increasing levels of $CO_2$ and warmer temperatures accelerate plant growth. While humans are certainly altering the rates of both release and absorption, we are not creating or destroying carbon. The carbon inventory originated within an earlier star.

In our domain, we know from signal processing that the duration of observation determines the resolution (and lowest frequency) that can be determined. It is virtually impossible to separate a trend (linear or otherwise) from a low-frequency periodic event if the observation period is too short (say a human lifetime). Our planet and its characteristics have been with us and changing for a very long time. About 55 million lifetimes if I can do the math.

Can we realistically expect to recognize a climate trend within a few human lifetimes? Maybe there's another definition of the Nyquist frequency hiding in all of this.

With this background, there are three essential questions pertaining to climate change: the percentage of human-caused climate change within a natural cycle? Is this a danger? And if so, are there realistic and feasible objectives to reduce man-made contribution short of returning to rather brutal living conditions prior to the industrial revolution?

The population of North America at the turn of the 16th century is estimated to be between 5 and 20 million, certainly living without any appreciable use of fossil fuels. Today, the population of the same approximate area is something over 400 million, largely relying on fossil fuels for energy and economic success. The energy to sustain civilization and allow poorer parts of the world to elevate living standards is likely to remain based on fossil fuels for the foreseeable future.

Answers and solutions are not aided by pejoratives such as denier and conspiracy. People who are willing to listen are forced into extreme camps – you are either a true believer and advocate or not. As in so many instances, the real answer likely resides somewhere in the middle. Improving energy efficiency is good; attempting to dramatically alter the energy production mix by statute before the technology is proven, requirements, effects and results clear is likely not so good.

The dream of a civilization independent of fossil fuels with current or anticipated technology would require a significant reduction in some combination of population and/or living standards. Even assuming that 50% of current energy needs could be replaced by sustainable sources (probably unrealistic in the foreseeable future for a variety of technical and practical issues), dramatic changes would be required to attain the objective.

The question is whether today's population is willing to significantly reduce the aspirations, benefits and living standards of modern life to address a potential condition in the distant future based on computer projections:

- Computer projections based on averages presumed to be considerably more accurate and with less variation than the measurements themselves.
- Computer projections from models that cannot account for all components in a chaotic atmosphere within a complex solar radiation system where there appear to be regular cyclic components.

- Models that do not predict current conditions from past data without adjustment.
- And finally, computer results that are some uncertain percentage of the natural variation between past ice ages and a historical climate somewhat warmer than now.

As I said earlier, there is no doubt that climate change is real. Furthermore, climate change existed long before the industrial revolution. And here is the big *but*: when critically examined, the heavily promoted scientific consensus stating that global warming caused by man-made greenhouse gas is a major danger does not exist and is not supported by evidence.

While moving from a carbon based economy is good, the dangers of moving faster than technology can be developed and proven in all its dimensions driven by political considerations is even more dangerous.

Our lovely spinning ball provides a number of energy sources, some renewable some not. Before casting our lot on any source, including renewables that do not yet have a proven capacity to replace current supplies, we must make certain the new mix, including replacement(s), is technically viable and fully capable of meeting a broad range of needs from manufacturing, transportation, including aviation fuel, lighting and HVAC under all conditions. (There are days when the sun doesn't shine, the wind doesn't blow and thus far there are no storage options capable of safely replacing even a minuscule amount of current energy demand.)

With decades, perhaps longer to increase efficiency, develop and refine improved energy technology let's not get ahead of ourselves and rush headlong into solutions that may sound great to the public but require huge subsidies and carry great risk to the very elements of existence deemed essential by that same public. A well thought out and engineered sequence from improved efficiency to alternative sources is essential while there is time and sufficient proven supplies to assure an optimum solution and orderly transition with minimal disruption of the energy requirements that are essential for a modern civilization. SV

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