April 8, 2015

CUTTING THROUGH CLIMATE CHANGE BULLSH!T

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There is a great deal of BS in the popular press these days about climate change. It comes from both the followers of Saint Al Gore, and from the climate change deniers. Virtually none of it is worth reading. In my opinion, we are inundated with this BS because the voting public is woefully ignorant of science. Moreover, our leaders are all too often people who did not study calculus and physics in college, which compounds the problem. In other words, there are simply too many people who have no idea how the physical world really works having a say about what should be done about climate change.

The purpose of this paper is to present a simple explanation of climate change without unnecessary detail, discuss carbon dioxide as an insulator, and present what I think is the real problem. At the end is an epilogue.

A Simple Explanation of Climate Change

Our cars and the earth are thermodynamic systems. We put energy into our cars in the form of gasoline – chemical energy. We then transform that chemical energy into kinetic energy with the engine. Some of that kinetic energy is stored in the flywheel, and some is transformed into electrical energy and stored in the battery. The remainder of that kinetic energy is transformed into work – driving around – or exhausted from the system as waste heat.

The law that cars, the earth, and thermodynamic systems in general are subject to is the "first law of thermodynamics"[1].

[1] A statement of the first law of thermodynamics can be found in physics and engineering books. A reference I use is David Halliday and Robert Resnick, Physics for Students of Science and Engineering, John Wiley & Sons, 1960, my college physics textbook.

This law can be expressed as an equation; energy into the system equals energy stored in the system plus work plus energy out of the system:

$$E_{in} = E_{stored} + Work + E_{out}.$$

Rearranging terms:

$$E_{in} - E_{out} = E_{stored} + Work.$$

In the case of the earth, ($E_{in} - E_{out}$) is the difference in the solar radiation coming to the earth and the energy radiated by the earth. If it is positive, energy is being stored (E_{stored}) in the air, water, and ice (by melting) and expended in the creation of weather (work) – which in this context is not only the weather we see from our porches, but the movement of ocean water masses. If ($E_{in} - E_{out}$) is zero or negative, energy is being extracted from (E_{stored}) and used to create weather and/or radiated out into space.

Figure one[2], shown below, shows the net radiation ($E_{in} - E_{out}$) for the earth. In this graph, it has been positive since at least 1990. According to the graph, all of the net radiation until 2005 has gone into storage. Since 2005, some of the net radiation has not been found. My guess is that, if the measurements are valid, the energy has gone into areas that we do not monitor well or into creating weather.

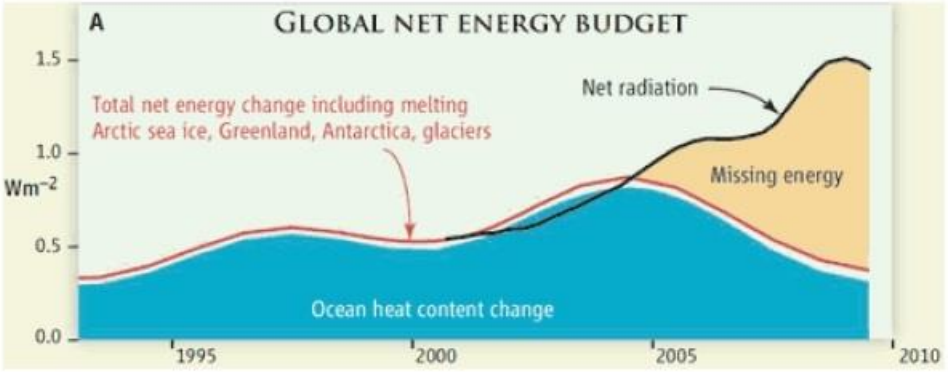

Figure One

[2] Figure one, the global net energy budget, comes from K.E. Trenberth, J.T. Fasullo, Tracking Earth's Energy, Science 16 April 2010, DOI: 10.1126/science.1187272.

Carbon Dioxide

Carbon dioxide acts as an insulator, not unlike the insulation in our attics, reducing the radiation of energy back to space (E_{out}). Figure two[3], shown below, is a graph of CO_2 concentration over time. As shown in the graph, the insulation in our attics has been increasing over time.

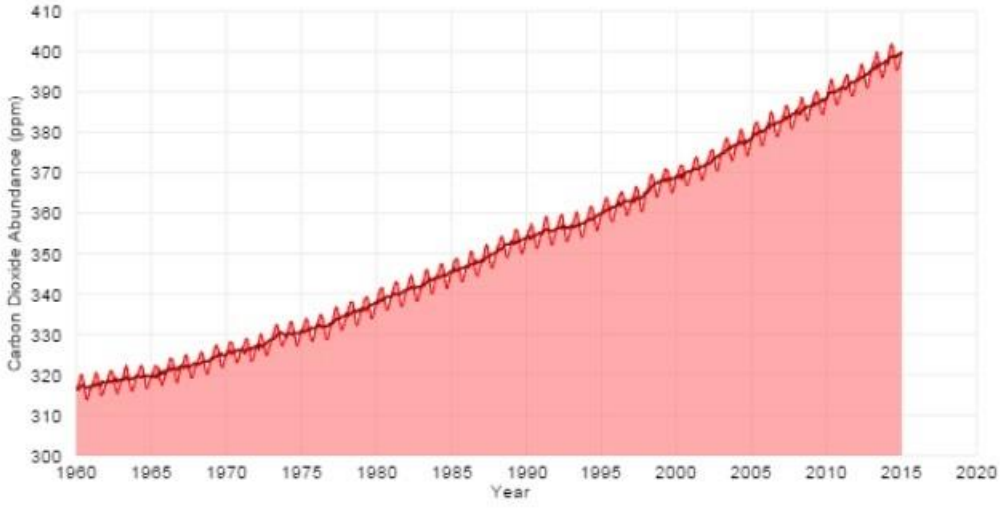

Figure two

The disciples of Saint Al want to shut down, or mostly shut down, the world's use of fossil fuels to reduce the amount of insulation in our attic. In my opinion, this is not going to happen because developing countries want cheap and reliable energy to achieve a standard of living equal to that of the developed world. Their expanding use of fossil fuels for that purpose renders hopeless the current efforts in Oregon to reduce global CO_2 emissions. Even more hopeless is the efforts of the Corvallis City Council to reduce global CO_2 through setting council goals.

As more and more people acquire cheap reliable energy – which, at this point, comes from fossil fuels – I expect that the amount of CO_2 in the atmosphere will increase.

[3] This graph comes from the NOAA website, Climate.gov. Quoting from the website, "During the Industrial Revolution, humans began burning coal, natural gas, and oil to power machines for manufacturing and transportation. Since then, we have burned more fossil fuels each decade, releasing vast amounts of carbon dioxide that were previously stored in the ground into the atmosphere. Before the Industrial Revolution, the atmospheric concentration of carbon dioxide was about 280 ppm. When continuous observations began at Mauna Loa in 1958, carbon dioxide concentration was roughly 315 ppm. On May 9, 2013, the daily average concentration of carbon dioxide measured at Mauna Loa surpassed 400 parts per million for the first time on record.

Figure three[4], shown below, shows what would happen if the use of fossil fuels were terminated at various levels of CO_2. Notice that the CO_2 drops relatively quickly and stays relatively high for at least one thousand years.

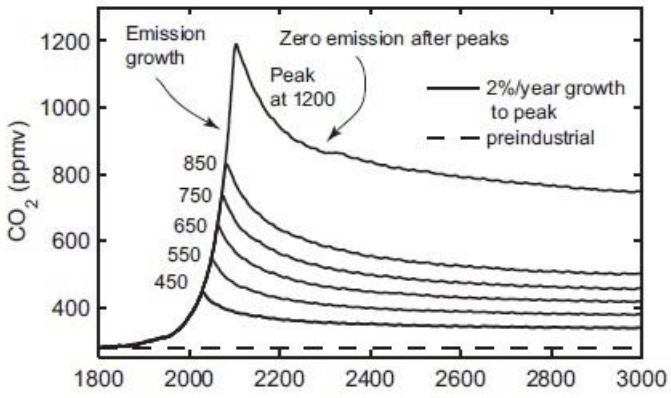

Figure three

In other words, cutting CO_2 emissions is not going to do much good. Moreover, there is not much we can do except to try geoengineering schemes to reduce solar radiation coming to the earth (E_{in}) which may have unintended consequences. Like it or not, we will have to adapt to the anticipated changes.

[4] This graph comes from an article by S. Solomon, GK PLattner, and et.al. Irreversible climate change due to carbon dioxide emissions, dated December 16, 2008, published www.pnas.org_cgi_doi_10.1073_pnas.0812721106.

The Real Problem

The real problem is the increasing world population. Figure four[5], shown below, shows how the population is increasing.

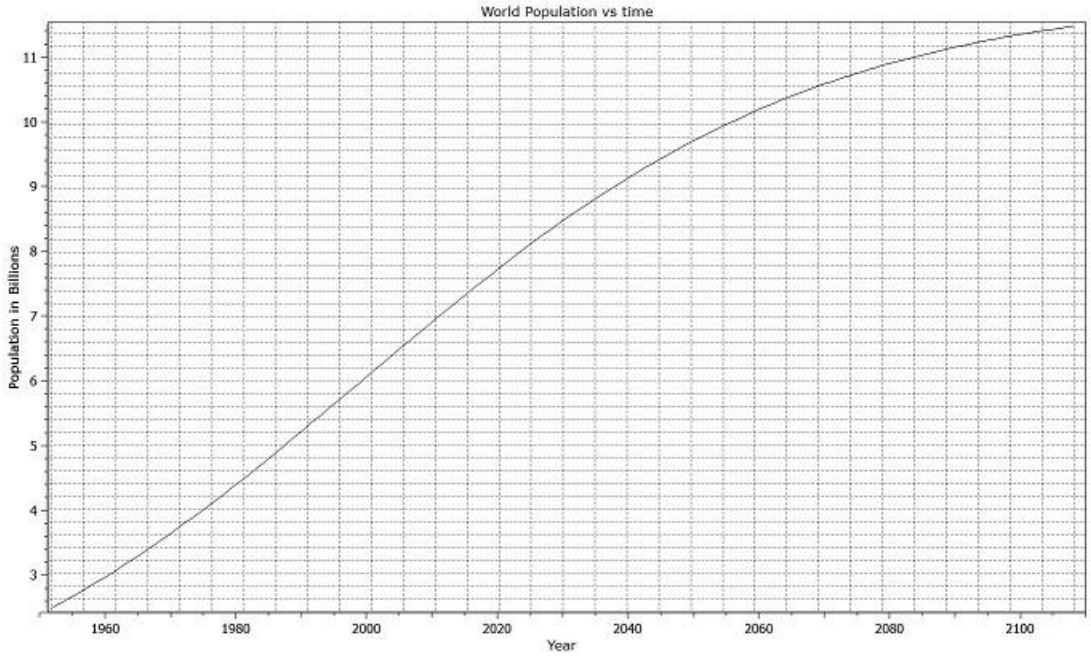

Figure Four

This curve is the classic S shaped curve asymptotically approaching a maximum of twelve billion people. Early in the next century, the population will be at 95% of the asymptote. The shape of the curve is driven by the data, which does appear to reflect changing fertility rates. If the reader thinks the fertility rates are not correct, he/she can go to the website of the UN department of Economic and Social Affairs and look at their models with different fertility rates. I chose to use the Verhulst curve because it has been around for a while and did not require any assumptions about fertility on my part.

The point of this exercise is that the world population is going to increase and want cheap reliable energy and a standard of living equal to that of the developed world. Therefore, the efforts of Oregon and Corvallis, Oregon, to reduce their carbon footprints are nothing more than noise in the earth's thermodynamic system.

[5] Figure four was created from United Nations, Department of Economic and Social Affairs, Population Division (2013). World Population Prospects: The 2012 Revision, CD-ROM Edition estimates of world population from 1950 to 2010. The curve was developed by fitting the following equation: $N = C_1 * C_2 *\exp(r*t)/(C_2 + C_1 *(\exp(r*t)-1))$ where N is population, C_i are constants and r is the growth rate. Verhulst first proposed the equation in 1836 (J.D. Murray. Mathematical Biology. Springer-Verlag. 1989).

If we in Corvallis really care about taking a stand on the world's carbon footprint, we must: 1) focus our money and policies on creating and/or developing other energy sources that are just as cheap and reliable as fossil fuels, in order to be a model and give our global neighbors a realistic alternative, and 2) in the meantime, ensure that our Corvallis neighbors do not freeze in the dark because of well-meaning but ineffectual "statement" goals and policies.

Epilogue

I circulated an earlier version of this paper and received some feedback on my not seeing a world powered by anything but fossil fuels. According to the feedback, a prosperous energy intensive world powered by various clean electricity for most things is possible. Solar, wind, geothermal, hydro and atomic all contribute nothing to greenhouse gases. Moreover, varieties of storage technologies are coming to the market, which will make this not just a possibility, but also a compelling economical choice.

My response is that we will see if and when these new technologies pencil out. However, I do not see these new technologies penciling out for India, China, or Africa soon enough to avoid their extensive use of fossil fuels; but again, we will see.

The feedback went on to ask, that assuming that humans do not choose to go with clean energy, what are my plans for Florida and the coasts of the world? Who pays for the sea walls, who gets them and how long do we defend the coasts? According to the feedback, these are the problems that are appropriately addressed by responsible politicians.

I cannot really answer these questions. However, in my opinion, responsible politicians should minimize any defense of the coasts because defending the coasts is futile. The seaward edge of the continental shelf was the shoreline at one time. Moreover, I expect that much of what is now land on all coasts will become part of the continental shelf. My suggestion is not to buy ocean front property or any land at all in Florida.