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The Energy-Climate Crisis is Your Business

Part II: Climate Change & Global Sustainability[1]

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Over the last two centuries, our civilization has inadvertently initiated a level of climate change more intense than any time in the last 740,000 years – well before the birth of modern humanity. Is global sustainability, as we envision it, possible?

The Energy-Climate Crisis Is Your Business

It is a disconcerting revelation to take a quantitative look at the core issue behind climate change – the emission of carbon dioxide (CO_2) into our atmosphere – its impact on global sustainability, and the options we have to address the formidable challenges before us. Is global sustainability – *meeting today's economic and environmental needs, while preserving the options of future generations to meet theirs* – even a remote possibility, as a consequence of the "progress" of civilization?

Our Climate Future in a Word

Grim – that's basically how the future looks if we continue with the status quo. Last year, the United Nations' Intergovernmental Panel on Climate Change (IPCC) concluded in its *Fourth Assessment Report*[2] that the temperature of the Earth's surface rose 0.74 °C over the past 100 years, and it will increase between 1.1 °C and 6.4 °C by the end of this century, depending upon what we do before then. That small increase of just 0.74 °C was enough to melt more than half of the glaciers on Earth since the end of the 19th century, and to take a significant bite out of our Arctic ice sheet (See Figure 1), leading to a modest rise in sea level. But sea levels are now predicted to increase rapidly with a significant negative impact. Recent reports show that should the average global temperature reach 3°–4 °C, we can expect at least 200 million people to be permanently displaced, and more than 15 % of all species to become extinct, with numerous related issues, such as an increase in insect-borne disease, flooding, desertification, and storm intensity (See Figure 2).[3,4]

Our Problem in a Nutshell

Most of the world's population has become a capitalist society. Growth and expansion are an intimate part of our culture and our psyche. It doesn't matter whether you live in the U.S., the European Union, India or Communist China, we yearn to create and grow market after market, essentially with no end in sight. By 2050, our global GDP in 2006 dollars is projected to increase six-fold, from $48 trillion to nearly $300 trillion, and the energy required to get us there, by four-fold, from 15 trillion watts to 60 trillion watts of installed capacity.[5]

In 2007, the amount of CO_2, the most worrisome of the greenhouse gases,[6] pumped into our atmosphere by all humankind was 36 billion tons, of which 29 billion tons were caused by burning fossil fuels, and the remaining 7 billion tons by destruction of tropical forests, which are an excellent sponge for atmospheric CO_2.[7] Of the total global CO_2 emissions in 2007, the U.S. was responsible for 8 billion tons (~22 %), and the European Union, 6 billion tons (~17 %).

Regardless of what climate-change naysayers maintain, it is well established that CO_2 is increasing in our atmosphere and is a primary factor in climate change. Several thousand highly-skilled scientists, worldwide, using millions of pieces of critically analyzed data, support this conclusion. We can distill their message down to a few key charts that make the essential points. The data in Figure 3 are based on Antarctic deep ice-core analysis and atmospheric measurements on Mt. Mauna Loa in Hawaii. They show that over the last 150 years the CO_2 concentration in our atmosphere has continuously increased, and in fact the rate of increase is growing rapidly.[8] Figure 4 shows that during that same period, our average global temperature has also increased.[9] And finally, Figure 5 demonstrates that going back nearly 500,000 years, there is essentially a direct correlation between global temperature (blue line) and the CO_2 concentration in our atmosphere (red line).[10] The fact is that geologic history teaches us that *when the CO_2 concentration in our atmosphere increases, we can expect our global temperature to rise as well, with all of the attendant consequences of global warming*.

It is clearly established that the ongoing Industrial Revolution, initiated in the late 18th century, fueled by coal combustion, and subsequently by oil and natural gas, is the major contributor to increasing the concentration of CO_2 in our atmosphere from 280 parts per million (ppm) in 1800 to slightly more than 380 ppm in 2007 (see Figure 6). In fact, power generation accounts for 25 % of our global CO_2 emissions. A level of 380 ppm means that 1 million cubic meters of air contains 380 cubic meters of CO_2. This may not seem like much, but it does not require much CO_2 to reflect back to the Earth's surface enough energy from the sun to heat our atmosphere to a point where critical climate change is induced with catastrophic outcomes. This is known as the Greenhouse Effect, and a delicate balance of it is necessary for human life to exist. Thus, Mars has no Greenhouse Effect and the temperature there is an unbearably cold -63 °C. Venus, whose surface is completely obscured by thick clouds of CO_2, has a surface temperature of more than 500 °C, high enough to melt lead.

Every 15 billion tons of CO_2 raises its concentration in our atmosphere by 1 ppm. Based on decades of research, the vast majority of climate scientists, including most world au-

Figure 2

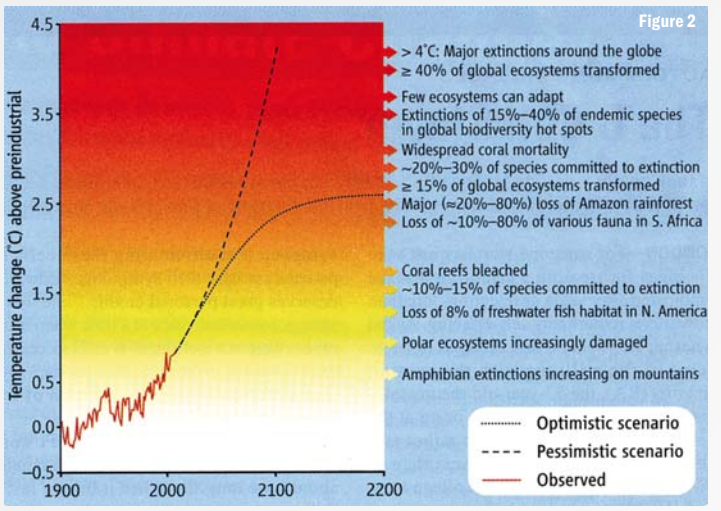
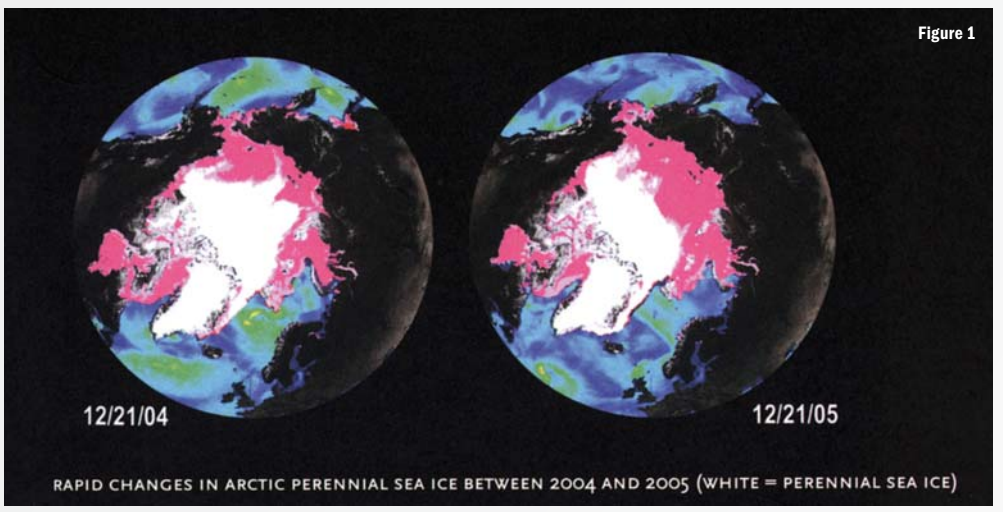


Figure 1



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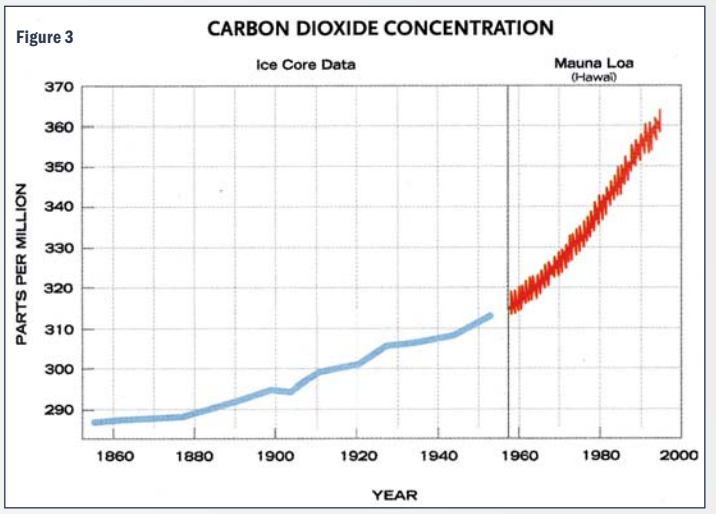
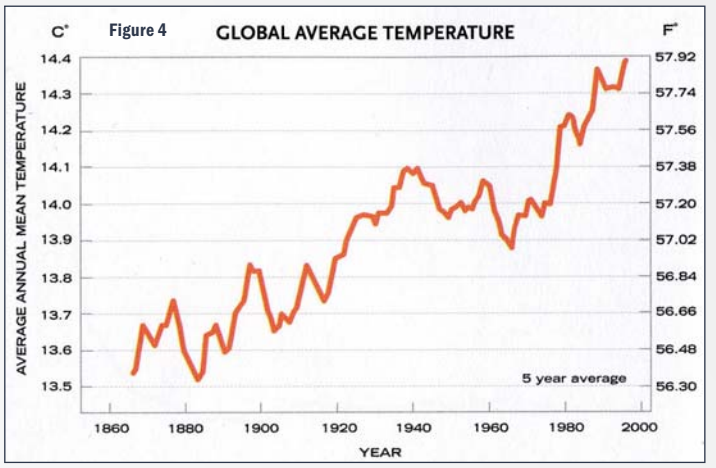
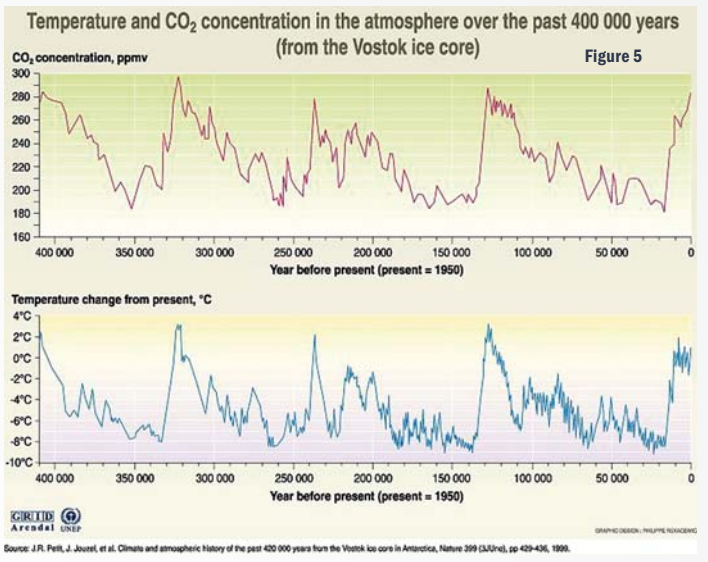




thorities such as Dr. James E. Hansen, longtime Director of NASA's Goddard Institute for Space Studies, agree that to minimize the calamitous results of climate change, *the atmospheric concentration of CO_2 must not exceed 440 ppm by 2050*. In government testimony, Hansen points out that, "...Scientific data and analysis reveal that the Earth is close to dangerous climate change, to tipping points of the system with the potential for irreversible deleterious effects... The dangerous level of CO_2 is at most 450 ppm, and it is probably less.[11]" Unfortunately, this is only about 60 ppm more than today's level of CO_2. This means that 900 billion additional tons of CO_2 is the maximum amount that can be emitted to our atmosphere[12], which on average is about 21 billion tons per year[13], or 15 billion tons less per year than the 36 billion tons we discharged into the atmosphere in 2007. Can we possibly meet the maximum target of 440 ppm, and if so, how?[14, 15]



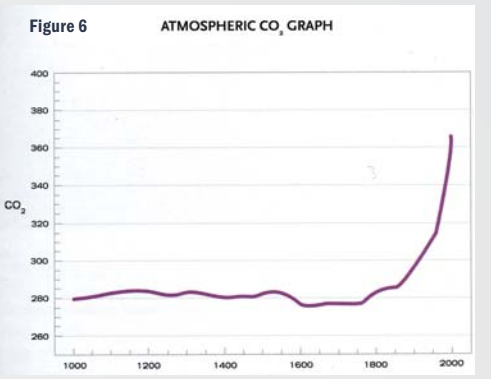
The answer is probably yes, but to do so, nearly all electricity generation and transportation fuels must be made essentially emission-free well before 2050. There is no other reasonable choice to achieve a sustainable society, especially if we are to avoid pushing climate change momentum beyond the "tipping point" of no return.[16] Short of everyone going back to the farm and closing up all metropolitan areas, we really have only two primary options. The first, espoused by many politicians and some corporate executives is massive expansion of nuclear power and "clean" coal.[17] Neither of these, in my opinion, could be achieved safely, economically, and in time to make a formidable difference, when compared to a strategic combination of alternate energy sources. Petroleum is not a long-term option, as global oil production has either peaked or is about to peak and decrease forevermore. We are not running out of oil, just out of cheap oil. As discussed later in this series, triple-digit oil prices more than justify commercial use of clean, sustainable, alternative energy sources, such as biofuels, wind, solar, and fuel cells.

"Clean coal," – which many consider an oxymoron – invokes unproven technologies, all requiring safe burial of byproduct CO_2 for "eternity," so that it never returns to the surface of the Earth. History teaches us that there is reason for deep concern. Climatologists know from geologic records that 55 million years ago the Earth was completely covered by ice, right up to the Equator. However, over a period of just decades, there was a rapid transition from this ice age to a global tropical planet, caused by an explosive release of CO_2 from the ocean floor, triggered by a massive subterranean volcanic eruption. Clean coal technology envisions "sequestering" byproduct CO_2 into deep wells, underground aquifers, and on the ocean floor. Even neglecting the significant additional cost for CO_2 sequestration, the dire risk to future generations is obvious.

As for nuclear power, we could not build a sufficient number of large-scale plants quickly enough to have a meaningful impact. More importantly, as we shall see in a subsequent issue of this series, nuclear power is unsafe and uneconomic compared to other more effective, lower-cost, renewable, energy sources. Furthermore, it significantly increases the probability of proliferation of long-lived toxic radioactive waste – some components for more than 10,000 years – as well as terrorist nuclear attacks on any of a large number of vulnerable Western targets.[18]

The Solution

The second approach to achieve the goal of emissions-free transportation and power generation before 2050 requires strong political leadership, courage spawned by deep conviction, and project implementation in an Apollo or Manhattan Project mode of action, starting immediately. It is based on existing technologies and/or their immediate extension, i.e. no major scientific or technological discoveries are necessary.[19, 20] The basic elements and strategy of this approach are discussed in Part III of this series.



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[1] *Part I of this series outlines the Global Energy Security issue and how the price of oil will increase in triple-digit figures, forevermore. See Prague Leaders Magazine, No. 2, 2008.*
[2] *U.N. IPCC – Summary Report: http://www.ipcc.ch/ (2007)*
[3] *Nicholas Stern, "The Economics of Climate Change – The Stern Review," Cambridge University Press, 2007.*
[4] *Richard Kerr, SCIENCE 318, November 23, 2007, p. 1231.*
[5] *Jeffery D. Sachs, "Climate Change after Bali," Scientific American March 2008, p. 22.*
[6] *Methane, the major constituent of natural gas, could eventually be at least an equally devastating contributor, if global warming occurs to a point that triggers the release of the huge inventories of this gas currently locked up in millions of square miles of frozen tundra throughout the globe and in the ocean depths.*
[7] *Jeffrey D. Sachs, op. cit., p. 22.*
[8] *Geoffrey B. Holland and James J. Provenzano, "The Hydrogen Age – Empowering A Clean-Energy Future," Gibbs Smith, Publisher, Santa Barbara, CA, 2007, pp. 61-62.*
[9] *Ibid.*
[10] *U.N. IPCC, op.cit.*
[11] *James E. Hansen, Testimony before the Select Committee on Energy Independence and Global Warming: United States House of Representatives, April 26, 2007.*
[12] *(440 – 380 = 60 ppm) x 15 billion tons/ppm = 900 billion tons*
[13] *900 billion tons / (2050–2007) years = 21 billion tons/year*
[14] *To be precise, the problem is more challenging. If other greenhouse gases such as methane, nitrous oxide, and chlorofluorocarbons are included and adjusted for their concentration in the atmosphere plus their heat-trapping potency relative to CO_2, the current total greenhouse gas level is about 425 ppm of CO_2 equivalent.*
[15] *Jim Giles, NewScientist, March 2008, p. 13. A recent study by Bryan Mignone of Princeton University concludes that 440 ppm by 2050 is nearly impossible, and 550 ppm will be difficult.*
[16] *Malcolm Gladwell, "The Tipping Point – How Little Things Can make a Big Difference," Little, Brown & Co., 2002.*
[17] *Jerry B. Brown, Rinaldo S. Brutoco and James A. Cusumano, "Freedom from Mid-East Oil," World Business Academy Press, 2007, Chapters 5&6.*
[18] *Jerry B. Brown, Rinaldo S. Brutoco and James A. Cusumano, op. cit, Chapter 5.*
[19] *Ibid, See the Prometheus Plan and its extensions, Chapter 8.*
[20] *The technology innovation process – discovery through successful commercialization – can be envisioned as consisting of 3D's – Discovery, Development, and Deployment. The second option requires no discovery, some development and a major focus on deployment of commercial facilities.*

About the Author: James A. Cusumano is Chairman and co-owner of Chateau Mcely (www.ChateauMcely.Com), chosen in 2007 by the European Union as the only "Green" 5-star luxury hotel in Central and Eastern Europe. He is a former Research Director for Exxon, and subsequently founded two public companies in California's Silicon Valley, one in clean energy generation, the other in pharmaceuticals manufacture via environmentally – benign, low-cost, catalytic technologies. While he was Chairman and CEO, the latter – Catalytica Pharmaceuticals, Inc. – grew in less than 5 years, to a $ 1 billion enterprise with 2,000 employees. He is co-author of "Freedom from Mid-East Oil," recently released by World Business Academy Press (www.World Business.Org) and can be reached at Jim@ChateauMcely.Com.

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