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Phantom Land and Ghost Slaves: Humankind's Addiction to Fossil Energy

Abstract : Humankind uses vast amounts of fossil energy accumulated millions of years ago. The rate of use is many orders of magnitude greater than the replacement rate. Peak oil is the most immediate problem, and replacing this rate of energy use with biofuels is problematic. Coal is an alternative but produces more severe environment problems than petroleum and is less suitable for some forms of transportation such as airplanes. Nuclear energy does not reduce greenhouse gases, but does generate troublesome waste disposal problems (e.g., one-million year storage for some components). Solar and wind power are proven alternatives, but are not likely to generate sufficient energy to replace the petroleum no longer available. The prudent course of action, then, is reduced energy consumption per capita. As the Marks et al. (2006) report illustrates, high energy and material goods consumption is not highly correlated with happiness (i.e., satisfaction). Even if high consumption were related to happiness, continued extremely high energy consumption would probably not be justified. The approximately 100-200 years of the petroleum era are a brief, aberrant period of human history, and breaking this addiction will be painful, but not fatal.

Key words : Peak oil, Petroleum era, Reduced energy consumption, Carrying capacity, Environmental refugees, Energy return on investment.

Conquer thyself, till thou hast done this, thou art but a slave. **Sir Richard Francis Burton**

It is evident that the fortunes of the world's human population, for better or for worse, are inextricably interrelated with the use that is made of energy resources. **M. King Hubbert**

There is no substitute for energy. The whole edifice of modern society is built upon it … It is not "just another commodity" but the precondition of all commodities, a basic factor equal with air, water, and earth.
E. F. Schumacher

Power tends to corrupt and absolute power corrupts absolutely.
(Lord Acton was referring to political power,
but might equally well apply to energy use since
the latter has led humans to believe they are
immune to natural law.) **Lord Acton**

An attempt by any outside force to gain control of the Persian Gulf region will beregarded as an assault on the vital interests of the United States of America. **US President Jimmy Carter in a 1980 address to US Congress**

Thus there may be no solution to the problem of oil depletion, if by "solution" we mean a strategy that will enable us to continue living as we are. **Richard Heinberg**

As Catton (1982) notes, humans increase Earth's carrying capacity for themselves by "diverting some fraction of the earth's life-supporting capacity from supporting other kinds of life to supporting one kind." For example, during the Agricultural Revolution about 10,000 years ago, humans began taking over land occupied by other species to produce food for human consumption. In many areas, this acquisition resulted in extinction of other life forms. In some cases (e.g., Australian Aboriginals), humans learned the necessity of stabilizing their own population levels through extended lactation, use of contraceptive herbs, or infanticide in order to co-exist successfully with other species. Regrettably, at present, sharing resources, including energy and other natural resources, with other life forms is not the norm.

Fossil Fuels

Approximately three decades ago, I heard a jest (possibly from H. T. Odum) that humans had a purpose on Earth - to get rid of all fossil fuels. When the easily obtained fossil fuels were gone, humans could depart. At present, this prophecy is no longer a jest - Earth's fossil fuels, oil and coal, which accumulated for hundreds of millions of years, are now being burnt in a few centuries. Moreover, released carbon dioxide is causing global heating. Coal burning also releases mercury and other pollutants. Tainter (1988) views human society as an energy processing system that tends to collapse when its strategy for energy use is subject to the law of diminishing return. Recent studies (e.g., Homer-Dixon, 2006) have indicated that the energy return on investment (EROI) has diminished in the United States from 25 to 1 in the early 1970s to 15 to 1 at present. Black (2006) notes that the global network of agricultural research centers warns that famines lie ahead unless new crop strains adapted to a warmer future are developed. The Consultative Group on International Agricultural Research notes that yields of existing varieties will fail. New forecasts indicate that global heating will shrink South Asia's wheat area by half.

Coping with these crises will not succeed unless a consensus on standard of proof is reached in the law and in science. One case on global heating before the US Supreme Court (Dean, 2006) is not reassuring, at least in the early stages of this case. Typically, scientists do not accept a finding unless, statistically, the odds are less than 1 in 20 that it occurred by chance (Dean, 2006). This standard is higher than the typical standard of proof in civil trials (preponderance of evidence) and lower than the standard for criminal trials (beyond a reasonable doubt) (Dean, 2006). As Dean (2006) notes, the justices may also consider that, when scientists confront a problem, they collect all the information they can about it and then draw conclusions; however, lawyers use a different strategy. They know the desired outcome at the outset, so they gather arguments to support it. Scientists face peer review and cannot omit publications uncovered in their research that do not fit their hypothesis. This case before the US Supreme Court is crucial since mainstream science agrees that the planet's climate is changing and human activities (e.g., greenhouse gases) are major components of this change. At present, voluntary reduction of greenhouse gases is not working for most individuals or corporations, so effective legislation and enforcement are essential. Reduction is a matter of utmost urgency since humankind may be approaching a global tipping point on both global heating and energy availability.

Phantom Carrying Capacity

Borgstrom (1972) devotes an entire chapter of his book to the concept of "ghost acreage." This concept explains why countries, such as The Netherlands, appear to be living well with a large population on relatively little land. The explanation is that the space they occupy supplies only $1/14^{th}$ of their needs. The remainder comes from outside the country. Arguably, two even more important problems also exist:

(1) The scientific process is not designed to study global-level phenomena. The reductionist scientific method of isolating an important variable and studying it under carefully controlled conditions simply is not suitable for complex, multivariate global-level studies.

(2) Humankind is carrying out a massive global experiment on global heating with no control planet to document the differences between treatment (*i.e.*, human-produced greenhouse gases) and no treatment.

As a consequence, prudence dictates reduction in the release of human-produced greenhouse gases from the use of fossil fuels, which would also conserve unused fuel for future use. Excessive use of fossil fuels has already endangered crop production through drought, floods, and other types of climate change.

Energy Use

The average Canadian uses an amount of energy equivalent to what 200 men would expend while working 24-hour days continuously (Campbell, 2000). These hypothetical "individuals" are "energy slaves." What will humankind do as availability diminishes after peak oil has been passed (e.g., Bériault, 2005 ? The food humans eat results from a huge amount of energy from production, to processing, to delivery, to cooking, to dishwashing (e.g., food travels an average of 2080 km from farm to plate) (Heinberg, 2005). Because of inexpensive oil, one farmer can feed 100 people. However, this advantage will substantially diminish when the peak oil threshold has been passed and the end of readily available cheap oil has passed.

The Transition to Low Per Capita Energy

Some illustrative components follow:

(1) Earth's carrying capacity for humans will markedly diminish. Since the ecological overshoot is already 24%, population stabilization is mandatory, as is reduction of population size to suit the new carrying capacity.

Adjusting society to meet the needs of natural systems will not be easy, despite the fact that they constitute the biospheric life support system.
(2) Travel, especially by aeroplanes, will be greatly reduced due to decreased availability of petroleum and increased costs to reduce greenhouse gas emissions. Humankind will mourn the loss of a significant number of ghost slaves, but the era of cheap energy is approaching its end.
(3) Stop being delusional! Humankind simply can not continue to use the amounts of energy that all too many consider normal. Biofuels must be grown on real land, not phantom land, so humans must be prepared to use fewer ghost slaves. Coal is a dirty source of energy and nuclear power produces long-term radioactive wastes.
(4) Attacks on science, when robust scientific evidence conflicts with political ideology, are endangering billions of lives by delaying for many years the effective control of greenhouse gas emissions. Harvard Professor Daniel P. Schrag (2006) claims that US Senator James Imhof, then Chair of the Senate Committee on Environment and Public Works, issued an erroneous press release that claims that Schrag agreed with him that the Kyoto Protocol would have almost no impact on the climate.

Vidal (2006) describes 2006 as the year humankind woke up to the adverse effects of global heating. However, the dangers of perpetual economic growth on a finite planet and the adverse effect (e.g., global heating) of the technologies that power it are not well appreciated. Heilbroner and Thurow (1987) define economic growth as an increase in the production and consumption of goods and services; it is a function of population size and per capita consumption. The human population continues to grow and consume resources at an ever increasing rate. These and other factors accelerate the depletion of finite fossil fuel reserves, especially oil. Czech (2001) remarked "The United States is a bellwether nation with respect to democratic politics, economic development, and environmental policy. At the beginning of 2007, much of this ethical and moral leadership has been lost. The United States has approximately 5% of the planet's population and contributes nearly 30% of anthropogenic greenhouse gases*".*

In an era when resources (e.g., oil and food stuffs) have probably peaked and may soon suffer declines in production, the kind of excessive consumerism flaunted by the ultra-rich is becoming both archaic and immoral. In short, an individual may be able to afford large quantities of material goods and energy, but the planet cannot afford such purchases. However, in the United States, many consumers are going deeply into debt to increase their material possessions. In many cases, large storage spaces are rented by the year to store the overflow (i.e., beyond the capacity of their dwelling[s]). Very probably, these possessions will not be used by the original owners after storage. Fewer possessions per capita would reduce and might even eliminate the 24% ecological overshoot. An economic system that produces a 24% ecological overshoot is clearly not sustainable. Yet, exponential economic growth is still worshipped globally, and most people and their leaders are either unaware of the ecological overshoot or uncertain about it.

The Elephant in the Room

The present "joke" is that population is like an elephant in the room. Everyone sees the elephant, but no one is willing to talk about it. The World Population Growth Chart (http://www.atmos.umd.edu/~owen/CHPI/IMAGES/pop.html) projects that an additional 1 billion people will be added to the planet between 1998 and 2009 (*i.e.*, 11 years). Heinberg (2005, p. 31) estimates that world population will drop from 7 billion in the early 21st century to less than 4 billion in 2200 due to a decrease in oil availability. However, even as the population rises, Australia, an exporter of meat and grain, has a dramatically decreased supply of mutton and grain as a result of a drought that has lasted 5 years already (Mercer, 2006). The drought could break in 2007 or 2008, but might not break until 2050. China is also experiencing a reduction in grain supply due to global heating (Buckley and Aizhu, 2006). Climate change and water shortages exacerbate these problems. Lou Yong, a deputy director of China's National Climate Centre, stated: "The most direct impact of climate change will be on China's grain production."

However, at present, the human population continues to grow (Motavalli, 2006). In Niger, Salamatow said "I am exhausted" as she struggled through labor with child number 13. She is a 37-year old widow. In some countries, such as Russia, the "birth dearth" (births less than deaths) is definitely real, but it is far from universal. For example, the United States (a leading consumer of energy and resources), which has a fertility level just above replacement, has just reached the 300-million population mark, primarily due to legal and illegal immigration. The United Nations projects a world population of 9.1 billion (as the middle of three possible scenarios) in 2050 (Motavalli, 2006). Given all the bad news about droughts and the food supply, loss of arable land due to desertification, and sea level rise, clearly present unsustainable practices cannot continue (*e.g.,* Markowitz and Rosner, 2002). The much publicized fertility decline has not halted global human population growth and ignores the fact that the human population has more than doubled between 1950 and 2000. In fact, many countries (*e.g.*, Saudi Arabia) have a very young citizenry (*i.e.*, nearly half under age 15).

This youth increases population growth momentum since a huge percentage of the population is at or soon will enter the breeding age.

Segelken (2004) quotes agricultural ecologist David Pimentel: "Every trend – from decreasing per capita availability of food and cropland to population growth - shows the predicament becoming even more dire." Pimentel also notes that the present level of malnutrition among nearly half the world's population of 6.3 billion is unprecedented in human history. Despite this evidence, corn to ethanol production continues. Pimentel (2007) reports that 18% of the US corn crop and the same fraction of the corn crop land produced less than 1% of the total automotive fuel used in the United States. If 100% of the corn crop were dedicated to ethanol production, it would only satisfy about 5% of US energy needs. Since humankind is already using Earth's resources 24% faster than that of their regeneration (ecological overshoot), a major catastrophe would be inevitable if current rates of resource consumption continue, even if population growth ceased. However, it has not ceased, so an even greater catastrophe lies in the near future unless major changes in human behavior are made immediately.

Humankind's exponential growth should be accompanied by comparable growth in all the factors now associated with civilization - schools, health care facilities, etc. The remedy to this situation is not readily apparent since the planet is finite. In addition, present resources are distributed very unevenly. The richest 2% of the world's adults own more than half the world's wealth (Glantz, 2006). The wealth gap has increased dramatically in recent years, which is likely to produce social instability, just when stability is needed to cope with the concomitant crisis in population, energy, food production, and climate change.

Even in a relatively new country, the United States, the original inhabitants were deprived of the buffalo so they would move to reservations established by the US government. However, the relationship of the human to the animal community that supplied its food, clothing, and housing (e.g., teepees) had been the central, pivotal concern of the rigorously maintained social order (Campbell, 1972, p. 89). As a consequence, the loss of the buffalo meant the loss of the binding symbol. In the 21st century, the loss of energy (e.g., phantom land and ghost slaves) will almost certainly have a more dramatic impact because the effects will be global. As Campbell (1972, p. 89) notes, the first and most important effect of a living mythological symbol is to waken and give guidance to the energies of life. The symbol requires functioning in a certain way, which will be conducive to participation in the life and purposes of a functioning social group. Campbell further notes that, when the symbols provided by the social group no longer work and the symbols that do work are no longer of the group, the individual cracks away, becomes dissociated and disoriented, and is confronted with what can only be named the pathology of the symbol. Humankind is embedded in natural systems but is assaulting nature (e.g., greenhouse gases) as if its dependence on natural systems were not true. Humans have made energy a central unifying symbol and are acquiring and using energy in ways that affect nature adversely.

Moral and Ethical Leadership

In many cultures, especially in the United States, many people believe in a conflict between science and religion. As Campbell (1972, p. 90) notes "the famous conflict of science and religion has actually nothing to do with religion, but is simply of two sciences: that of 4000 BC and that of AD 2000." The driving sources of human society (the computer, cheap energy, the automobile, television, airlines, nation sates, space exploration, fast food, global heating and globalization) are drastically different from the forces that drove the early societies in which religions developed. Given this perspective, the perception of a conflict between science and religion is not surprising.

What does this perceived conflict have to do with the present situation? The solution often given for the problems of overpopulation, diminished energy, global heating, resource wars, ethnic conflict, and religious confrontations is that some deity will solve the problems. However, the people who state this solution are usually not among the approximately 3 billion humans who are malnourished. Presumably, the same deity provided brains and intelligence, so one wonders why those humans feel no responsibility to use their brains and intelligence to solve the many problems. One also wonders why the intelligence is not used to live harmoniously with other life forms that collectively constitute humankind's biospheric life support system.

Three of the myths humankind lives by in the 21st century are: (1) a technological solution exists to every problem humans have caused, (2) the rising tide of economic growth will "raise all boats," (3) the status quo will endure forever - exponential population growth can continue indefinitely on a finite planet, the automobile culture will endure, pollutants harmful to the environment will not affect humans. If the first myth is true, why are peak oil, environmental pollution, AIDS, and global heating major problems? If the second myth is true, why is disparity in the distribution of wealth increasing so dramatically? The third myth is really a denial of reality, which can be very powerful.

Much cognitive dissonance is present in humankind's response to present problems. The Calvert Group, Ltd., an investment rating service, endorses 52 of the largest 100 US companies based on market capitalization, but flags the other 48 for transgressions against social responsibility (Piller et al., 2007). For example, the Gates Foundation assets total more than the gross domestic products of 70% of the world's nations. The Gates Foundation awards grants in support of public education in the United States and for social welfare programs in the US Pacific Northwest. In contrast, the Gates Foundation has major holdings in:

• companies ranked among the worst US and Canadian polluters, including Conoco Phillips, Dow Chemical Company, and Tyco International, Ltd.

• many of the world's other major polluters, including companies that own an oil refinery and one that owns a paper mill; both of these types of companies can sicken children at the same time that the Foundation is trying to save their parents from AIDS

• pharmaceutical companies that price drugs beyond the reach of AIDS patients.

Paul Hawken, who directs the Natural Capital Institute, notes that, while foundations fund groups trying to benefit posterity, their investments steal from the future. This type of "blind-eye" investing rewards bad behavior. However, anyone who has tried to achieve ethical investment (even by one's personal standards), using overall good or bad performance of the majority of corporate operations, has found this task incredibly difficult. Clearly, foundations, corporations, political leaders, and the general public must develop a more holistic perspective on environmental ethics and morals, particularly with the energy crisis and all of its manifestations.

On Monday, January 6, 2007, with wars in Iraq and Afghanistan and an air attack on a suspected terrorist site in Somalia, worsening global heating, and an unsettling national debt, the US Congress suspended its activities so that some members could fly to the US State of Arizona to watch the football game between Ohio State University (ranked #1) and the University of Florida (ranked #2), thus increasing the global supply of greenhouse gases. Not to be outdone, Prime Minister Tony Blair (UK) stated: "I would frankly be reluctant to give up my holiday abroad" (Etchingham, 2007). However, he does recycle and uses energy efficient light bulbs. Do these two conservative activities offset vacations in the US and Caribbean? Blair has labeled as "impractical" any personal sacrifices to cut greenhouse gas emissions (Watt, 2007). In contrast, the Prince of Wales declared that he will cut back on domestic and international flying. Blair made an unpersuasive effort to offset British fury over his personal flight policy by using carbon emissions offsets, but at least some newspaper columnists are not persuaded (e.g., Grice, 2007). Street-Porter (2007) feels Blair should set an example and holiday in Britain. Monbiot (2007) calls attention to US President George Bush's six years of obfuscation and denial of climate change, which was followed by a memo to the Intergovernmental Panel on Climate Change that advocated "modifying solar radiance" rather than advocating cutting greenhouse gas emissions.

Energy and Nation-States

Fossil fuels have provided humankind with incredible amounts of energy. However, this extra energy enables nation-states to flourish and extend, economically and militarily, their power far beyond their borders. The United States has fought wars, and is still doing so, in Iraq and Afghanistan. Initially, much of the US part of each war involved aircraft carriers far from the field of battle. However, the period of abundant, cheap energy ends with peak oil or soon thereafter. Presumably, then, the power of nation-states will diminish.

At present, with a major global crisis in heating and other types of climate change, humankind needs a universal ethic for survival. Failure to develop such an ethic will make the probable outcome one of severe stress upon humans, possibly extinction. Since the biota of the planet has survived five great extinctions, it is probable it will survive a sixth. However, a major reduction of human potential is a violation of humankind's sacred obligation to posterity. Humankind has a second ethical responsibility also to other life forms, not only because they constitute the planetary life support system but primarily because desecration of other life forms is a sacrilege. However, if one listens to what most societies and their leaders profess, endangering or actually harming economic growth is of greater concern than the survival of polar bears and other megafauna, including non-human mammals. A global ethic for all life forms is essential for sustainable use of the planet and development of a harmonious relationship between humans and other life forms.

With approximately half the world's population living in urban areas and the other half living primarily in humanized landscapes, development of an eco-ethic will be difficult, especially since phantom land and ghost slaves will decrease each year. Internet based organizations should be most helpful in this situation. Also, loss of both phantom land and ghost slaves should diminish humankind's deleterious environmental impact, which is primarily, but not entirely, technology based. Technology can also adversely affect humans by producing greenhouse gases. As John Holdren (2007), President of the American Association for the Advancement of Science, remarked, in conjunction with the 2007 Annual Meeting, on the problem of energy:

> Well-being has environmental, sociopolitical, and cultural dimensions as well as economic ones, and the goal of
> sustainable well-being entails improving all of these dimensions in ways and to end points that are consistent with maintaining the improvement indefinitely. This challenge includes not only improving substantially the
> standard of living in developing countries, but also converting to a sustainable basis the currently unsustainable practices supporting the standard of living in industrialized ones.

And, one might add, stabilizing the human population so that it does not exceed Earth's carrying capacity. Very little progress is being made in any of the important categories just mentioned. Greenhouse gas emissions are increasing - dramatically in some cases, such as China and the United States. The world population continues to increase at the rate of 91 million per year. All too often the daily news has some unpleasant new surprise. For example, the long-term stability of the massive Antarctic ice sheets, which have the potential to raise sea levels substantially, has been called into question with the discovery of fast-moving rivers of water sliding beneath their base (Connor, 2007). Other findings show substantial subglacial lakes under ice that is moving a couple of meters per day. Most of the plans to address global heating and other types of climate change have end dates such as 2020 and 2050. It is probable that within that time frame, one or more critical ecological and societal thresholds will be passed. For many disequilibrium situations caused by exceeding a threshold, remedial action may not be possible within time frames of interest to human society.

Despite the clear connection between combustion of fuels and anthropogenic carbon dioxide, Americans (and other automobile cultures) continue to search for ways to replace petroleum, despite the warning to US lawmakers not to rely on biofuels for energy security (Seba, 2007). Of course, these executives also recommended opening up more offshore areas to drilling. The era of cheap, abundant fuel is over but few people accept this fact.

Small Group Species vs Large Group Species

Abundant, cheap energy has made it possible for *Homo sapiens* to evolve from a small to a large group species in an extremely short period in evolutionary time. However, this abundant, cheap energy has also made it possible for humankind to seriously damage the biospheric life support system. If this damage continues at the present rate, the result will probably be a precipitous decline in human numbers, especially if resource wars involve nuclear and/or biological/chemical weaponry. Sagan's (2006) posthumous book predicted part of this scenario - he warned of the danger that a leader under the sway of religious fundamentalism might not try too hard to avoid a nuclear Armageddon, reasoning that it was God's plan. The urgency with which actions are taken to reduce anthropogenic greenhouse gases will determine how severe the consequences will be for humankind and the extent of the necessary remedial actions.

At present, atmospheric carbon is markedly increasing (over 3 billion metric tons emitted in 2007; *http://www.worldometers.info*). Statements from political leaders of two of the biggest contributors, the United States and China, do not indicate that an emissions tax on carbon is likely soon. Of course, in the United States, California and some other states are taking substantial remedial measures on their own. However, a global problem will not be solved unless all nations, especially the largest contributors, join in effectively reducing anthropogenic greenhouse emissions. Global cooperation will be difficult to achieve since some countries, such as Bangladesh, are more at risk than others (Huggler, 2007). In addition, a truly staggering quantity of unreported carbon dioxide is emitted around the world by the top ten companies on the London Stock Exchange (Black, 2007). Presumably, this situation occurs elsewhere in the world. Finally, the ice caps may not be saved (Adam, 2007), and such melting would raise sea levels by 4 to 6 meters (Adam, 2007).

Epic Changes

Pimentel (1998) states:

> Approximately 90% of the energy in crop production is oil and natural gas. About one-third of the energy is to reduce the labor input from 500 hours per acre to 4 hours per acre in grain production. About two-thirds of the energy is for production, of which about one-third of this is for fertilizers alone.

Youngquist (1999) remarks:

> A future without oil is difficult to visualize in detail, but some aspects of the post-petroleum paradigm can be anticipated with some degree of certainty.

All possible economic energy sources will have to be used, but replacing oil in its great energy use versatility probably will not be completely possible. Replacing the role of both oil and gas in agricultural production will be the most critical problem and may not be entirely solvable.

With a still growing human population, finite agricultural land, and reserves of petroleum (a primary source of income) diminishing, a major social crisis in the first half of this century is highly probable. As Fleay (1995) noted many years ago: "A very large proportion of the world's population depends for food from high agricultural yields achieved by use of fossil fuels." Epic change will result from: (1) the end of the cheap, abundant fossil era, (2) a global freshwater crisis that will have a major impact on agriculture, (3) and severe deleterious effects of global heating and other types of climate change on agricultural productivity.

Bartlett (1994, p. 28) wrote about the general complacency about the future:

> There will always be popular and persuasive technological optimists who believe that population increases are good, and who believe the human mind has unlimited capacity to find technological solutions to all problems of crowding, environmental destruction, and resource shortages. These technological optimists are not usually biological or physical scientists. Politicians and business people tend to be eager disciples of the technological optimists.

Well over a decade later, not much has changed, although there appears to be a modest trend to abandon these thought processes and recognize the findings of science. At present, depending on unproven technology is not enough to meet the epic changes humankind faces.

Humankind has faced starvation and disease before, but never on the scale likely to occur in the 21st century because the global population is far larger than it was even a century ago. The petroleum age is nearly over. There are alternatives, but as Youngquist (1999) notes: "The inability of fuels to be easily interchangeable in their end uses is a major problem." Youngquist (1999) also makes a major additional point:

> It is important to note that the end product of many alternative energy sources such as nuclear, hydro-electric power, wind, solar, geothermal, and tides is electricity, which is not a replacement for oil or natural gas in their important roles of raw material for a host of products ranging from paints and plastics, to medicines, and inks. But probably the most vital of all uses is to make the chemicals which are the basis for modern agriculture. Electricity is no substitute.

Ethical/Moral Issues

What should humankind do when the nations of the Middle East have diminished funds to buy food because their main source of income - petroleum - is less available? Even at US$200 per barrel, adequate purchasing power for foodstuffs will not last forever. They are mostly beyond sustainable long-term carrying capacity. Anarchy, even while oil remains, would impede delivery to other parts of the world as the war in Iraq has already done. Armed conflict is not a good, or even adequate, way to resolve these issues!

The current (March, 2007), estimated population of Saudi Arabia is 27,019,731 million, of which 5,576,076 are not citizens. The freshwater supply is negligible, so food is imported and purchased primarily with funds from the sale of petroleum. In 2006, Kuwait's population was estimated at 2,014,100 million and the area had a negligible agricultural base. In 2006, Iran had an estimated population of 68,688,433 and a significant amount of water and arable land. All these countries will be affected eventually by a decreasing oil supply, even if the price per barrel rises four fold or more. Millions of individuals will be added to the high number of environmental refugees. Iraq, population estimate for 2006 of 26,783,383, has already produced millions of resource depletion refugees, and their numbers will almost certainly increase dramatically until the civil war ends and social stability is achieved. Present indications are that both British and American military forces will not be able to end the civil war, but neither the precise departure dates nor the effects the departure will have is clear.

The ethical/moral question of how to cope with more millions of refugees has not been adequately addressed. A large part of the problem is the result of mismanagement of energy use from phantom land. This has produced global heating and other types of climate change, as well as a rapid population growth based on

depletion of a finite resource - petroleum. The problem must be addressed before the human/environmental crisis worsens.

Path Forward

Eric Hoffer stated: "In times of change, learners inherit the Earth, while the learned find themselves beautifully equipped to deal with a world that no longer exists" (from Future Quotes - *http://www. wisdom quotes.com/cat_future.html*). The scientific evidence on global heating increases almost daily. All too much evidence indicates the rate of environmental damage is greater than expected. However, humankind cannot adapt to the new conditions by ignoring them, nor can effective remedial measures be taken unless a realistic appraisal of the problems is undertaken. Political leaders were reluctant to accept the evidence of global heating and, at present, refuse to implement the strong remedial measures that would probably diminish the high rate of change, fearing it would damage the economy. However, protecting the economy at the expense of the biospheric life support system is not a sound strategy. Sagan (2006, pp. 53-54) has a lucid statement of the problem:

> But what is interesting is that in a number of respects the universe is very fine-tuned, so that if things were a little different, if the laws of nature were a little different, if the constants that determine these laws of nature were a little different, then the universe might be so different as to be incompatible with life.

Sagan (2006, p. 35) notes: "Now there is another tendency from the psychological or social sphere projected upon the natural world. And that is the idea of privilege. These prophetic statements describe why humans put the economy ahead of natural systems. We feel privileged and nothing bad can happen to us." The evidence of global heating and other types of climate change are causing humankind to reluctantly abandon these ideas. Will they be abandoned in time to take effective remedial action?

Phase 1 - Reducing Anthropogenic Greenhouse Gas Emissions

Many people in the United States have faith that a supreme being will step in and save them from the consequences of unsustainable practices. Others believe unproven technology will save humankind. What both groups have in common is the conviction that the status quo in energy use can be maintained without changing unsustainable lifestyles and practices. Phase 1 will begin when these delusions are abandoned and energy efficient policies and programs are embraced. Phase 1 will end when sustainable energy policies and practices are in place globally (i.e., greenhouse gas emissions maintained at a level that will not result in climate change).

A concomitant component of Phase 1 is the stabilization of the human population within the planet's long-term carrying capacity. The actual number will depend on the quality of life chosen. Most people would not choose disease and starvation as the prime limiting factors, but those will be the default factors in the absence of strong, effective population control measures.

Phase 2 - Fine-tuning Greenhouse Gas Emissions to Match Global Assimilative Capacity

Ecosystems are dynamic and, therefore, their greenhouse gas assimilative capacity varies. The assimilative capacity will vary both seasonally and regionally. This situation will require development of predictive models and biological/chemical/physical monitoring systems to validate their efficacy and make corrections when necessary. At first, this vision appears to be utopian, but is essential to sustainable use of the planet. In a period of climate disequilibrium, much work will be necessary for the experimental sciences, and enough appropriately experienced personnel may not be available. The National Research Council (1977) devotes an entire book to the problem of environmental manpower, which was difficult to resolve even before global heating and peak oil had been recognized as major problems.

Conclusions

Humankind is rapidly creating an alien planet that will probably be quite different from the hospitable planet that has nurtured humans for approximately 160,000 years. Already, global events are sufficiently unprecedented to make scientifically sound predictions of future conditions difficult. Worse yet, humankind appears unwilling to abandon the unsustainable practices that are causing an already precarious situation to worsen. Adapting to markedly altered conditions will require a continuous flow of scientific information as well as dramatic changes in individual and social behavior. Stabilizing the human population so that it is within Earth's carrying capacity and reducing greenhouse gas emissions so they are within Earth's assimilative capacity will

require a higher degree of environmental literacy than is now present, as well as a willingness of individuals to sacrifice some of their perceived "needs" for the common good. The balance of life on Earth is the greatest ethical/moral issue today. Humankind has a responsibility to other life forms as well as members of its own species. May humankind be up to the challenge!

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