DEPLETION OF NATURAL RESOURCES WILL CAUSE

THE DECLINE OF MANKIND

TABLE OF CONENTS:

1. ABSTRACT

In the past decade the author has been studying energy, “global warming” our population growth, the increase in consumption per capita, and the depletion of finite natural resources. When we integrate all of those factors with their magnitudes and rates of change we see that depletion of natural resources is going to cause a major decline of mankind within the foreseeable future.

2. THE BIG PICTURE

In order to thoroughly understand humanity's total relationship to the globe we must have the broadest possible view__to see as much of this complex picture as we can. We must use the equivalent of a very-wide-angle lens. Probably the reason we haven't been looking at this big picture enough is that when the population was much smaller the earth seemed infinite by comparison. But our planet is far from infinite, far from an endless source of everything forever, and earth's population has expanded enormously. Early Homo sapiens didn't use most of our currently essential resources at all, but resource mining and harvesting has increased exponentially as both populations and modern technologies have developed, especially in the last two centuries. Relative dearth of attention to the macro interrelationships between humanity and the globe has left us with a dangerously distorted view of the future. Part of the trouble is probably due to the Pollyanna nature of mankind: we much prefer to feel that everything will turn out fine regardless of the difficulty of the problem or our limited understanding of it. We are good at burying our heads in the sand. Also, businesses and advertising paint unrealistically rosy pictures of the future in order to increase their profits, politicians do it to get elected, and highly religious peoples trust God to protect them from harm.

3. POPULATION

World population continues to rise rapidly. Joel Kotkin wrote that increases in population will be "a good thing".1 Wrong. That will be one of the worst things that will happen to near-future humanity. In *Scientific American* magazine for July 2010 the writers of several Letters to the Editor blamed population growth and excessive population for our most serious current and future ecological problems. They wrote that we must eliminate population growth and economic growth in order to reduce further destruction of the earth.2 Right on. The United Nations announced

that on October 31, 2011 the global population reached seven billion, and it is currently growing at around 300,000 persons per day.3

4. ENERGY

We can, will, and are converting to various types of solar-energy systems, and the globe still has plenty of gas, oil and coal for the interim. The sun will continue to provide earth with constant radiant energy for millions of years. Solar energy is free, no delivery charge, no pollution, no recycling, no middlemen, it is relatively non-injurious, and we humans can never deplete it. *But it has been said that the moon is more important than the sun ___ because it shines at night when we need the light.*

Future nuclear *fission* energy is going to be limited by the depletion of uranium resources. According to *Scientific American,* practicable nuclear *fusion* energy, if it can be produced on earth at all, will require billions of dollars and take a long time to develop.4 But does our trying to compete with the ample free fusion power from the sun make sense?

Plants use solar energy to convert carbon dioxide from the atmosphere into carbon-rich foods and fuels, and oxygen that is returned to the atmosphere. Animals (including humans) on the other hand, breathe oxygen from the atmosphere, compound it with carbon-containing foods, and exhale carbon dioxide back to the atmosphere. Note that the energy in our food is almost all transformed solar energy since radiant energy from the sun is first converted to chemical energy by plants. In undisturbed nature this plant/animal energy cycle was stable, balanced, and continuous.

But mostly starting with The Industrial Revolution, humans began inventing, developing and manufacturing “heat engines” (steam and internal-combustion engines) in quantity. Fuel-burning power-plants, engines, and heaters are like animals in that they use

second-hand solar energy (that was then fossilized) and expel CO2. Mankind thus upset the balance and sustainability of the natural carbon-energy cycle by using fossil fuels. Enormous accessible fossil-fuel resources that took millions of years for nature to create have been roughly half depleted in the last two or three hundred years. But since we will soon be using direct solar energy in place of fossil solar energy, the depletion of the fossil fuels wouldn't be all that serious in the long run. But we must save enough of them for raw material to manufacture plastics, lubricants, paints, dyes, and myriad chemicals.

5. NATURAL RESOURCE DEPLETIONS

Our resources larder is limited to earth. We can never have economical and practical access to resources in the asteroids, moon, other planets, or, most ridiculous of all, the planets of other stars. Science fiction is just that: fiction.

Our resource depletion problems are already plentiful, and they will become enormous. Following is a partial list of vital resources that are now, or soon will be, in short supply. These have all been listed as endangered by reputable sources:

COBALT, COPPER, FOOD, GOLD, HELIUM, INDIUM, IRON, LEAD, LITHIUM, MOLYBDENUM, NEODYMIUM, NIOBIUM, PHOSPHOROUS, PLATINUM, POTASSIUM, SAMARIUM, SAND & GRAVEL, SILVER, STONE, TREES, URANIUM, FOOD, and FRESH WATER.

An article in the October 2011 *Scientific American* reminds us that there are seventeen so called "Rare Earth" elements in the periodic table.5 Most of them are little known outside of the field of industrial chemistry. These elements are: YTTRIUM SCANDIUM, LANTHANUM, CERIUM, PRASEODYMIUM, NEODYMIUM, PROMETHIUM, SAMARIUM, EUROPIUM, GADOLINIUM, TERBIUM, DYSPROSIUM, HOLMIUM, ERBIUM, THULIUM, YTTERBIUM, and LUTETIUM.

The "ium" endings and a lone "um" tell us that all of them are

metals. There are modern needs for every one of them: hundreds of uses in total. One or more rare earths are vital to most high-technology products, including the computer I am writing on, cell phones, and all other electronic wonders. Global usage of these rare elements has more than doubled in only sixteen years. And according to the *U. S. Geological Survey*, "New demand has strained supply and there is growing concern that the world may soon face a shortage of the rare earths."6

6. FOSSIL FUELS

Fifty percent of the electric power in the United States now comes from coal. But coal is very dirty in terms of acid rain and particulate pollution, and it is the largest producer of carbon dioxide. Since we will be going to solar energy, and global-warming weather changes are so destructive, the continuing use of fossil carbon fuels is much more serious than their depletion. As soon as possible we should leave the rest of the coal, oil, and natural gas in the ground (except for raw materials as discussed above). Note that I chose to omit fossil fuels from my list of natural-resource depletions, because globally they are nowhere near depletion. But the burning of fossil fuels is the villain in our war against climate change: We should stop it as soon as possible.

7. ROCKS

The earth's crust is mostly rock. We use an amazing amount of it for a great many things, and we need different kinds of rock or stone for different purposes. Further, rock is heavy, so we want our rock sources to be close to the points of use. In May 2010 a coalition of geologists claimed: "Unless smarter methods of preservation are developed, mankind will eventually run out of rocks."7

8. FRESH WATER

Water shortages are probably going to be the most serious contributors to the decline of mankind. Agriculture requires far

more water than we use personally. Raising meat takes the most water since the animals need to drink, and growing their food requires lots of water for a long time per animal. Including the water it takes to raise, process and cook our food, manufacture all of the other things we buy, water our lawns, wash our clothes and dishes, bathe, flush the toilet, and for drinking and other beverages, the current per-capita consumption of H2O is enormous. A United Nations Development Report listed the United States as using 570 liters of fresh water per capita per day in 2006. *Scientific American* of Dec. 2010 told us, "One in six people worldwide now lack access to clean water."9 Peter Rogers, Harvard University Professor of Environmental Engineering reports, "Global use of water by humans has increased nine-fold since 1900."9 In another *Scientific American* article Peter Gleick wrote, "Energy makes modern life possible; water makes survival possible."10 Again according to the *United Nations*, "By 2025 the freshwater resources of more than half of the countries of the globe will undergo stress."

We already seriously overuse fresh-water sources in most parts of the world. Our water wells may have lowered the ground-water tables and aquifers so far in some places that the oil required to pump up a barrel of water could be comparable to the oil required to pump up a barrel of oil. Hundreds or thousands of aquifers are being seriously depleted. Aquifer water in arid regions, where water shortages are the greatest, is prehistoric like petroleum: it will not be replenished. The depletion of this "fossil" water will be much more serious in those areas than the depletion of the fossil fuels. The coming weather changes will probably improve some "essential" water supplies, but make others worse.

Most rivers worldwide are in trouble. Some are now "used up" before they can reach their mouths. For example: the Colorado River once flowed, but no longer flows, into the Gulf of California. Now it all flows into thousands of square miles of agriculture; and

it supplies water to Las Vegas, Los Angeles, and San Diego.

We have literally oceans of water, but desalinating sea water is expensive, requires a lot of energy, and the seashores are far from the centers of thirsty continents.
We can fix the energy problem, but the only fixes for global water shortages are major population reductions and simpler lifestyles.

9. FOOD

The surface of the globe is 79% oceans, but a *Washington Post* article of December 4, 2010 reported that popular fish such as cod and halibut were severely depleted decades ago, so millions of us are now eating types of fish that we never heard of before.11 According to Daniel Pauly at the *University of British Columbia Fisheries Centre*, "The world's fish catch increased from 19 million metric tons in 1950 to 90 million tons in the late 1980s, but it declined to 79.5 million tons in 2008. It is dropping, because there are few places left to catch fish." 12

An *Associated Press* article of November 8, 2010, reported, "Wheat yields are not keeping up with a world growing hungrier. Rising prices may put bread out of reach of millions more of the world's poor. Based on population predictions, feeding the world in 2050 will require boosting food output globally by 70%. But wheat, the biggest source of protein in poorer countries, is falling behind. Global population grows one-and-a half percent a year but the increase in wheat production has slipped below one percent a year"13. Food production already suffers from global-warming climate changes, but soon it will also decline because of depletions of the main ingredients of synthetic fertilizers: phosphorous, potassium and nitrogen compounds.

Scientific American for November 2011 included an article titled "Can We Feed the World & Sustain the Planet?" by Jonathan S. Foley, director of The Institute on the Environment at University

of Minnesota. He wrote: “By 2050 the world’s population will increase by two or three billion, which will likely double the demand for food. Agriculture already consumes a large percentage of the earth’s land surface and is destroying habitat, using up fresh water, and polluting rivers and oceans. Humans use an astounding 4,000 Cubic Kilometers of water per year, mostly drawn from rivers and aquifers. Irrigation accounts for 70% of the draw.” 14

10. TREES AND PAPER

Trees are bio resources, but they are a special case in that they take so long to grow that in practice they are considerably like fossil resources. Wood, of course, is the primary ingredient of paper. According to Sam Martin in *Ecology Global Network*, “Nearly four billion trees worldwide are cut down each year for paper, representing about 35% of all harvested trees.”15 And J. Henry Fair wrote, in *Smithsonian* of January 2011, “Eleven percent of the world’s fresh water goes to make paper.”16 Those are really scary numbers. The U.S. is by far the world’s largest consumer of paper and cardboard.

The biggest uses of paper are in the publication of books, telephone yellow pages, newspapers, magazines, and other advertisements. And don’t forget packaging: “Five million tons of additional waste paper is generated in the United States during the holidays. Four million tons of this is wrapping paper and shopping bags.” *Reader’s Digest*, December 2010.16

11. ADVERTISING

What percentage of your postal mail is advertising that you never read? Most people receive far more “junk” mail than wanted mail. That is an enormous waste of trees, chemicals, electricity, and fuel. Many magazines are more than half ads. Excessive consumption is a major reason why humanity is already in resource-depletion trouble that is rapidly getting worse. Advertising is at the heart of excessive consumption: Ads, and fads and styles initiated by ads,

create apparent needs where no real needs exist. Ads encourage us to buy things in order to keep up with the Joneses. Our persona for ego-satisfaction and admiration needs to become, “See how frugal I am,” instead of “See what I have that you don’t have.”

12. RECYCLING

Recycling is important, but it has many limitations. The recycling truck picking up our trash at the curb is only the first step in a long, expensive, energy-consuming, and pollution-generating series of steps. It is far better to avoid as much recycling as possible by conservation: Leave far more trees standing and far more ores in the ground for future generations.

Science tells us that, except for radioactive elements and E=MC2, matter can neither be created nor destroyed, so if we could economically and completely recycle all of the natural resources we use we would never “deplete” them, and the future for mankind would look much rosier. But we can’t begin to recycle 100% of anything, and never will. One example: The *United Nations Environmental Program* estimates, “Thirty-four metals out of 60 are recycled at a rate of less than one percent.” 17

13. INFRASTRUCTURE

Huge quantities of hundreds of different natural resources have been used to make existing infrastructures. But most of these water-supply systems, sewers, highways, streets, bridges, tunnels, railways, airports, docks, dams, levies, marine locks, canals, jails, libraries, courthouses, museums, concert halls, power plants, power lines, communication systems and homes were built long ago; some of them over a hundred years ago when the resources they required were plentiful and usually close by. But now a high percentage of this essential infrastructure is worn out, obsolete, inadequate, too small, or has become dangerous, and needs to be replaced.

Most of these must continue to function while their replacements are being built. Therefore the resources each contains must remain on the job and additional natural resources will be required for the replacements. Thus the resources in existing infrastructures can't be recycled until the replacement infrastructures are up and running. Since most of the new items will be bigger than the originals (to serve a larger and more demanding population) over twice the original resources may be in use in the interim. We will be hard-pressed to find enough of all of the required materials for these duplicate infrastructures.

What have we done to our Earth? Let us compare the endless massive things man has built to the endless massive holes in the ground we have produced in obtaining materials for building those things. Think of the deep open-pit copper mines, strip coal mines that used to be mountains, dry river beds, huge stone-quarry pits, sink-holes caused by abandoned mines, mountains of waste rock and slag, square miles of toxic chemical wasteland, huge uranium-mine pits, officially homeless radioactive nuclear wastes, polluted rivers, and enormous clear-cut areas that used to be forests. These and similar monstrosities are behind the facades of manmade structures.

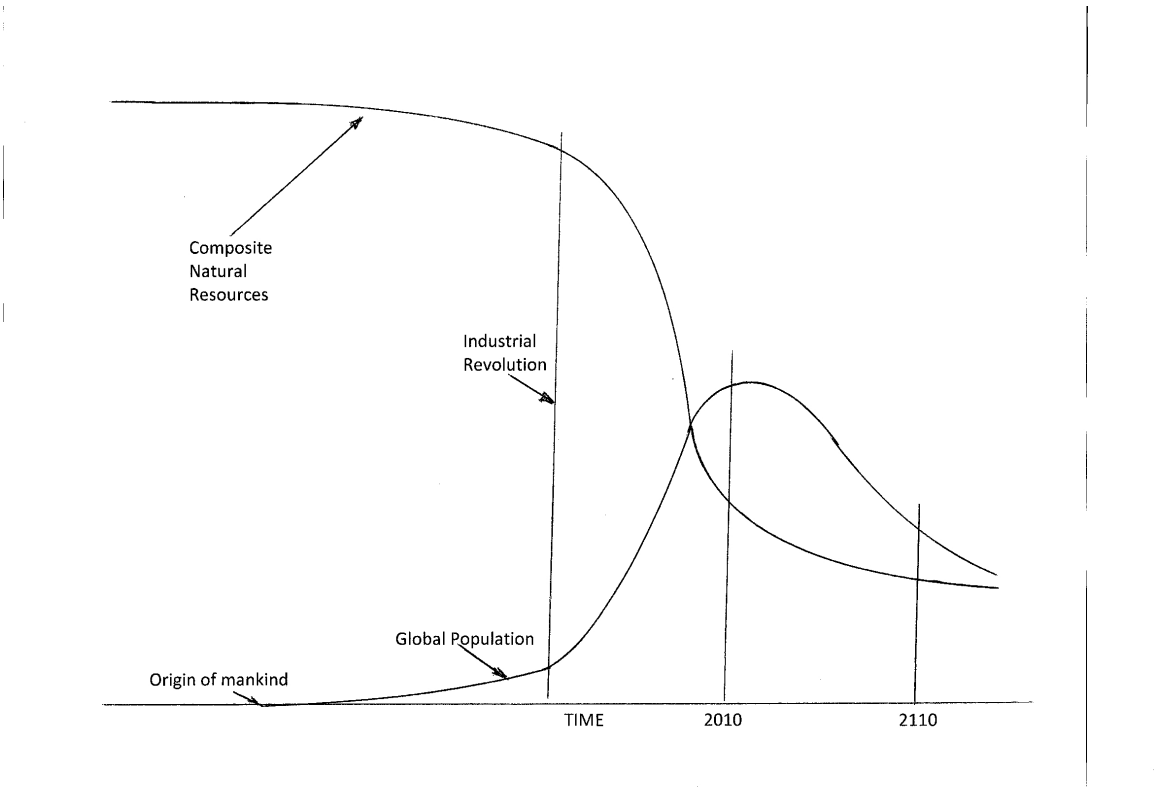
14. THE RISE AND FALL OF THE HUMAN EMPIRE

History tells us of a number of empires: Roman, Spanish, British, etc. These were formed when advanced countries conquered less-developed peoples, usurped their lands, robbed them of resources, prospered, expanded, became decadent, stagnated, and finally declined and fell. We might view the enormous proliferation of civilized humans on earth as the growth of a super empire: The Human Empire. We, as a species, have conquered, polluted, and depleted nature. We have been successful—in the sense that conquerors consider themselves successful regardless of how immoral and destructive their actions may have been.

Earth's Human Empire has expanded immensely; but now it is entering its decline. Mother Nature, like some human mothers, has spoiled us by overindulgence. We have now grown too numerous and greedy for her to continue mothering us in the style to which we have become accustomed. Mother Nature's mammary glands are rapidly becoming permanently exhausted, and our weaning to sustainable consumption levels is long overdue.

You and I and our families happened to be born at approximately the peak of the Human Empire. The present generations, on average, are living fuller lives than any generations before us, and better than any future generations will be able to. We are roughly at the top of the mountain and are now being forced into a steep, rocky, painful, unpleasant descent because of the irreparable damage we have done to our planet. Man has conquered nature, but now nature is beginning to get even by conquering man. But the fall of the Human Empire will be different from the falls of historic empires, because here our "enemy" is not some stronger, smarter, larger, or better-armed fellow human tribe. In an old comic strip, Pogo said, "We have met the enemy, and it is us."

We will have very little control over the coming decline of humanity. We cannot replace the huge amounts of vital resources we have used and will continue to use. The politicians will argue with each other, and give us big promises, but they won't be able change things much. However if our collective concerns for the future exceed our collective wasteful greed we can soften the coming blows a bit. But we can't retrace our steps, because resource depletions are largely permanent.



15. SUSTAINABILITY

The current financial and business objective is economic growth, but because of declining resources it should be just the opposite: The civilized world must wind down rather than continue to build up. Sustainability must be the new watchword, not growth. The lower animals live sustainable lives in the wild. The only humans who are not part of the problem now are a very few aboriginal tribes who have not yet been exposed to and led astray by natural-resource-destroying civilizations.

How long might our decline to approximately sustainable levels take—a thousand years? No one knows of course, but based upon history and the rate at which weather changes and natural-resource shortages are already occurring, this prognosticator guesstimates that in ten years many things will be significantly worse than they are now. And a hundred years from now we might reach some degree of sustainable coexistence with our damaged planet.

These ugly curves (representing ugly problems) are the author's guesstimations as to how the depletion of earth's resources and global population have varied and will vary with time. The time line is shown very greatly foreshortened in the early millennia, and no numbers are available for either the population curve or the resources curve. These sketches are only provided to give readers a general feeling for what is happening at the humanity/global level.

Most of earth's natural resources existed many millions of years before humans evolved. Early in the history of Homo sapiens there was no use of resources other than a bit of those on the surface, such as small trees, rocks, bones, water, and raw food sources. Those primitive conditions changed only slowly until The Industrial Revolution, beginning roughly between 1760 and 1830. It started mostly in England and rapidly spread to the United States and other developing countries.

The Industrial Revolution saw the development of basic engines and machines that permitted the mass production of old and new products of all kinds. This resulted in safer easier living, led to much higher populations, and caused far greater use of resources. The consumption of resources per capita also greatly increased. The excess CO2 emitted by the fossil-fueled machines and stoves used by the increasing population was the primary start of global warming.

Now, looking at the big picture of the future, we see many other likely interactions. One scenario might be: The beef cattle, which we raise in enormous numbers, emit a lot of methane (CH4, a twenty-times-worse global-warming gas than CO2). The higher global temperatures resulting from excess CO2 and CH4 will probably melt hundreds of thousands of square miles of arctic permafrost. This will release huge amounts of methane from both surface and shallow fossil tundra. That will result in strongly positive global-warming feedback producing still higher

temperatures and runaway methane release. That in turn will result in much lower food production, more starvation causing rapid reduction of population, lower consumption, slower resource depletions, and extension of the sustainability time scale.

If the methane release is more moderate and positive-feedback doesn't occur, the food supply will be less affected, more people will survive so the rate of depletion of other resources will be higher, and semi sustainability will occur earlier.

16. THE FUTURE

Human life after the coming major decline might be something like life was before the Industrial Revolution, but it will be eased by the use of our advanced knowledge, and by whatever "essential" modern equipment can still be manufactured from the much-depleted resources of the planet.

The future of mankind is far more important than today's stock market levels and the GNP—or is it? In public most people would say that the future is more important, but far fewer will actually sacrifice very much personally toward making the next hundred years less painful. We should take actions to eliminate both population growth and economic growth, but will we? Are we the living more important than those who will come later? There will be no clear consensus on that question. Both population growth and economic growth will stop and go negative due to resource depletions whether we like it or not, but we can influence the rates of those actions.

I am usually an optimist, but here I find myself to be a consolidator and bearer of long-term scary news. I repeat: Our depletion of natural resources will cause the decline of mankind. Please prove me wrong.

Francis D. Reynolds
JANUARY 2014

17. REFERENCES

1. Kotkin, Joel. Population 2010 *Smithsonian Magazine* July-August.
2. (Letters to the Editor). Excessive population 2010 *Scientific American,* July.
3. (United Nations). 2011, "Global Population reached seven billion and is currently growing at around 300,000 persons per day" October.
4. Brumfiel, Geoff. 2012. "Fusion's Missing Pieces". *Scientific American,* June, pp 56—61.
5. (Editor). 2011. The Rare Earths. *Scientific American,* October.
6. (Editor). 2012. Rare Earths demand has strained supply. *U. S. Geological Survey*.
7. (A coalition of geologists) May 2010 "Unless smarter methods of preservation are developed, mankind will eventually run out of rocks."
8. (U.N. Data). 2011, "By 2025 the freshwater resources of more than half of the globe will undergo stress."
9. (Editor). 2010. One in six people worldwide now lack access to clean water. *Scientific American,* December.
10. Gleick, Peter. 2011."Energy makes modern life possible; water makes survival possible". *Scientific American*
11. (Editor). 2010. Reported that millions of us are now eating types of fish that we never heard of before. *Washington Post,* December 4.
12. Pauly, Daniel. 2010. "The world's fish catch is dropping, … … because there are few places left to catch fish." *University of British Columbia Fisheries Centre*.
13. (Editor). 2010, reported, "Wheat yields are not keeping up with a world growing hungrier. *Associated Press,* November 8.
14. Foley, Jonathan S. 2011. "Can We Feed the World & Sustain the Planet?" The Institute On The Environment at University of Minnesota. *Scientific American,* Nov.
15. Martin, Sam. 2011. "Nearly four billion trees worldwide are

cut down each year for paper, about 35% of all harvested trees." *Ecology Global Network.*
16. Fair, J. Henry. 2011, "Eleven percent of the world's fresh water goes to make paper." *Smithsonian,* January.
17. (Editor). 2012. "Thirty-four metals out of 60 are recycled at a rate of less than one percent." *United Nations Environmental Program.*

18. ABOUT THE AUTHOR

Francis D. Reynolds, PE, an Engineering graduate of the University of Washington is now retired from a long career in Boeing Engineering Management. He has eight patents (both private and corporate). His book, *Crackpot or Genius? A complete guide to the Uncommon Art of Inventing* was published in paperback and hardcover, and he taught university-level evening courses on inventing for twenty years. His book, *The Revolutionary Dualmode Transportation System,* is online at http://faculty.washington.edu/jbs/rev/revcontents.htm. He has had roughly 175 articles published in Journals, magazines and newspapers, and has lectured nationally including the presentation of an Engineering Colloquium at NASA Goddard in Oct. 1994. Reynolds is an Associate Fellow of the American Institute of Aeronautics and Astronautics, and is a member of the Hall Of Fame of the Academy of Model Aeronautics.