

THE EARTH IS FINITE

This essay has three purposes—1) To show that both the human population of the planet and the economies of all nations will continue to grow unless every aspect society is changed; 2) Continuous economic and/or population growth will lead to one or more major world-wide catastrophes that will cause the collapse of civilization, the deaths of billions, and even the possible extinction of the human species; and 3) The steps that must be taken by humanity to not only stop growth, but to reduce both the population and world-wide economic activity such that the collapse of civilization does not occur anytime in the foreseeable future.

How high is up? Since you probably have not analyzed the future of humanity on the finite earth, you probably believe that the previous question is ridiculous. However, this essay is intended to convince you that it is one of the most important questions humanity has ever faced or will face in the future. Those that favor or propose economic growth never state when economic growth will cease, thereby implying that economic growth can continue forever into the future. Anyone who implies that economic growth can continue forever into the future on the finite earth is totally and completely wrong and is misleading humanity and causing the collapse of civilization.

The earth is finite in size. No action taken by humanity today or in the future can increase the number of atoms of each of the 92 naturally occurring elements presently on the earth. Anyone who believes that humanity can increase the number of those atoms has a position that cannot be defended

Anyone who believes that humanity can import resources from nearby star systems in time and in sufficient amounts to prevent the collapse of civilization has a position that cannot be defended. The nearest star system is about 4.3 light years from the earth. Light in a vacuum travels approximately 186,000 miles per second. Our present spaceships travel at a rate of about 18,600 per hour. In order to reach a speed of only 10% of the speed of light (18,600 miles per second) our present spaceships would have to increase their speed by a factor of 3,600 (60 minutes in an hour and 60 seconds in a minute). It is an absolute certainty that the speed of 18,600 miles per second will not be achieved in time to permit the importation of resources from other star systems. Even if a speed of 18,600 miles per second were achieved, it would require about 43 years of traveling to the nearest star system and an additional 43 years to return to earth. And our nearest star system does not have planets from which we can obtain resources. If a star system were 100 light years from Earth (and that star system would be very, very close to earth) and that star system had planets that could provide resources to humanity, it would take 1,000 years at 10% of the speed of light to get there and 1,000 years to return. And at 10% of the speed of light the time dilation predicted by Einstein is unimportant.

There are only two choices available to humanity relating to economic growth-- economic growth can continue forever into the future or economic growth must cease at some point of time in the future. Anyone who believes that economic growth can forever continue on the earth has a position that cannot be defended. To use a ridiculous number to make a point, anyone who believes the economy of the planet can grow by a factor of 1 trillion has no understanding of the resources the planet can provide to humanity. We can debate how far in the future economic growth must cease, but cease it must. The economy of the planet and the economies of the nations of the world grow in a compound (percentage) manner.

And compound growth is the most powerful force in the universe. In this essay I will use a time span of 2,160 years, slightly more than the time from the birth of Jesus until today (2019). 2160 years is a very, very, small length of time compared to the dinosaurs that ruled the earth for about 60 million years. 2160 years is an infinitely small amount of time compared to the 3.5 billion years life existed on this planet. At an annual growth rate of 1%, something doubles about every 72 years. In 720 there would be 10 doublings result in a growth factor of 1,024—2,4,8,16,32,64,128,256,512,1,024. In 1,440 years at 1% annual growth the growth factor would be over 1 million (actually 1,024 times 1,024) and in 2160 years the growth factor would be over a billion (actually 1,024 times 1,024 times 1,024 or 1,073, 741,824). In the next few sentences I will use a growth factor of 1,000 for simplicity purposes rather than the actual growth factor of 1,024. At an annual growth rate of 2% there would be 10 doublings in 360 years representing a growth factor of 1,000 and in 2,160 years that growth factor would be 1,000,000,000,000,000—you can do the math yourself. At an annual growth rate of 3%, there would be 10 doublings in about 240 years resulting in a growth factor of 1,000. At an annual growth rate of 3%, in 2160 years the growth factor would be 1,000,000,000,000,000,000,000,000,000—you can do the math for yourself. Lastly, at an annual growth rate of 4%, the growth factor in 2160 years would be 1,000,000,000,000,000,000,000,000,000,000. And remember I have used the growth rate of 1,000 rather than the correct rate of 1,024.

Economic growth cannot and will not be completely decoupled from the use of physical resources. While substitution of one resource for another resource and/or technological improvements and/or any other action taken by humanity can delay the time when economic growth must cease, none of those actions can permit infinite economic growth on the finite earth. Economic growth must stop and anyone who believes it can continue forever into the future has a position that cannot be defended. Anyone who takes the position that the intelligence and creativity of humanity will permit continuous economic growth on a finite earth has a position that cannot be defended. The only questions are when, how and at what levels will both population and economic growth cease?

The economy of the planet is nothing more than a system that turns the resources the earth provides humanity into waste and garbage. That system permits the economy of the planet to exist. I challenge anyone to describe an economic system that does not produce waste and garbage. Since every economic system produces waste and garbage,(and almost all of the waste and garbage produced by humanity is not recyclable and most likely will not be recyclable in the future), economic growth must cease.

The 2nd Law of Thermodynamics states that in a closed system Entropy must increase. By definition, increasing Entropy represents increasing disorder in a system until the system collapses. No action by humanity, no matter how sophisticated, can change the 2nd Law of Thermodynamics. And the Earth is a closed system, except for the energy it receives from the sun. No one has shown that the energy the Earth receives from the sun will stop the increase in Entropy, such that the system that permits humanity to function will not collapse. No one can dispute that the Earth receives a great deal of energy from the sun. However, the energy received from the sun must be converted into a form of energy that humanity can use to stop the increase in Entropy. In simple and direct terms, if Entropy continues to increase our civilization must collapse and no action by humanity can prevent that from occurring. To the best of my knowledge, no one has shown that humanity can convert the energy it receives from the sun into a form that would stop Entropy from increasing. At present the best humanity can do is to use the sun's energy to decrease the rate at which entropy is increasing and entropy is increasing on this planet. Prior to the evolution of the human species entropy was increasing at a minimal rate and that increase was offset by the energy the earth received from the sun so that the net gain in entropy was

zero or very close to zero. The human species has increased entropy and that increase is now in the process of destroying industrialized civilization

How long will it take for the economic system of the planet to grow by a factor of 1,000? If the annual growth rate were 1% it would take about 720 years, at 2% about 360 years, at about 3% about 240 years, and at 4% about 180 years. While no one can establish the relationship between economy growth and the use of physical resources the earth provides to humanity, such a relationship exists—a growing economy uses an increasing amount of physical resources—economic growth cannot and will not be completely decoupled from the use of physical resources. At a 10 to 1 ratio, if the economy were to grow by a factor of 1,000, its use of resources would grow by a factor of 100, at a 20 to 1 ratio the usage of resource would grow by a factor of 50, and at a 50 to 1 ratio the use of resources would increase by a factor of 20. Anyone who takes the position that the earth can provide 20 times the amount of resources it currently provides to humanity has a position that cannot be defended. I challenge anyone to show that if the economy of the planet, no matter how defined or described, were to grow by a factor of 1,000 that the resource usage would grow by less than a factor of 20. No matter what action is taken by humanity today, or in the future, the earth will never supply humanity 20 times the resources it currently provides humanity.

All the genius of humanity, all the new technologies, the capitalistic system and everything else humanity can do will never permit the economy of the planet to grow by a factor of 1,000 and not use at least 20 times more of the earth's resources than are presently being used by humanity. And if any economist, or any person disputes, what I have written above, I just raise the economic growth factor to 1,000,000—at 1% 1,440 years, at 2% 720 years, at 3% 480 years, and at 4% 360 years---all of the times substantially less than the time from the birth of Jesus until now. Any economist, any social leader, any political leader, any religious leader, and any person who advocates economic growth is advocating the collapse of civilization and the deaths of billions. Anyone who believes the capitalistic system will save civilization from future collapse is totally wrong. Capitalism can only delay the day of reckoning. Those that advocate capitalism are leading humanity to destruction.

The above two paragraphs were highly over optimistic. Almost certainly every increase in economic activity will require a substantially greater increase in the use of resources provided by the earth to humanity. Why? The answer is very simple. Humanity has always used the resources that were most easy to obtain, the resources in the highest concentrations, the resources easiest to process, the resources nearest to the place of usage and similar concepts. A growing economy will use resources that are more difficult to obtain, resources in lower concentrations, resources more difficult to process, resources not close to place of usage and similar concepts. More likely, if the economy of the planet were to grow by a factor of 1,000, resource usage would grow by a factor substantially greater than 1,000. The best example of this is oil that is now being obtained thousands of feet below the ocean bottom and from tar sands in Canada. Other examples include Fracking and the dramatic reduction in copper in the copper ore.

The earth provides humanity with two types of resources—nonrenewable resources (fossil fuels and all minerals are examples) and theoretically renewable resources (fish in the oceans that reproduce and underground aquifers that are recharged by rainwater are examples). However, almost all theoretically renewable resources are presently being used by humanity at a rate faster than they can be replenished by nature and, therefore, in reality are nonrenewable. Some people argue that humanity doesn't have to worry about fish in the oceans (humanity will farm fish so that humanity will have enough fish

available to satisfy an ever growing population) and humanity does not have to worry about water (humanity will have enough energy to desalinate all the water necessary for an ever growing population and the ability to pump that water from the limitless oceans to wherever on the planet it is needed and that will be achieved before civilization collapses). For every problem faced by humanity today, some person has a pie-in-the sky scheme to solve that problem. Humanity cannot and must not gamble its survival on those pie-in-the-sky schemes. And none of those schemes will solve any problem, if the economy of the planet were 1,000 times as large as the current economy.

Let us consider fossil fuels for a moment. Since fossil fuels are finite, at some time in the future, they will no longer be available to humanity. That statement cannot be disputed. The only question is when will they no longer be available to humanity? At present fossil fuels provide about 86 % of the world's energy. (See page 137 of the paperback edition of the book entitled "Enlightenment Now" written by Harvard Professor Steven Pinker). If humanity cannot replace fossil fuels in all, or almost all, of its uses before fossil fuels are no longer available to humanity, civilization will collapse. It is that simple. Therefore, humanity has a simple choice—immediately start reducing population today or guarantee, with at least 90% certainty, that fossil fuels will be replaced in all, or almost all, of its uses such that civilization does not collapse in the future. And any such guarantee cannot be based on a pie-in-the-sky method. Any such guarantee must be based on the best scientific knowledge presently available. Fracking is not the solution to humanity's fossil fuel problem. Fracking will only delay the moment of truth. See the writings of Richard Heinberg of the Post Carbon Institute explaining why Fracking is not the solution to humanity's energy problem.

Any discussion of fossil fuels must discuss their relation to airplane travel and international trade. Airplanes are an integral part of modern industrialized society and if airplanes were to become unavailable for use by humanity many parts of our modern industrial society would have to be modified or eliminated. Many industries depend on airplanes to survive. The best example of this is vacation travel and the cruise industry. At this point in time there is nothing available for the foreseeable future to replace fossil fuels as the energy source necessary for airplanes to fly. There is nothing in the foreseeable future that has a necessary weight, volume and intense power that will permit airplanes to fly. And without airplanes many parts of our modern industrialized civilization will be unable to exist. I challenge anyone reading this essay to describe any other form of energy that will be able to permit an airplane carrying a few hundred passengers to travel from Los Angeles to London or between any two major cities a few thousand miles apart.

Without the ability to transfer resources, food and manufactured items between nations by the means of water transportation our modern industrialized society will cease to exist. What are the alternatives to power a 100,000 ton freighter from China to the United States or from North Africa to the United States? A few possibilities—wind power, human power, nuclear power, and battery/ electric power. If anyone can think of any other power source other than those I've listed in the previous sentence, please contact me at jbrent6179@aol.com. Nuclear power, in my view is the only realistic alternative to her fossil fuels. However, there are many problems with converting all freighters and, in reality, all means of water transportation and all fishing vessels to nuclear power. Just to name a few of those problems-- a shortage of uranium, cost of conversion of current vessels or the building of new vessels, the ability to reduce the size of the equipment needed for nuclear power to fit into smaller local coastal vessels and fishing vessels, safety concerns about having hundreds if not thousands of ships being powered by nuclear energy, disposal of nuclear waste, and refusal of some/many nations to permit nuclear powered vessels in their ports. Nuclear power, in my view cannot and will not replace fossil fuels in powering oceangoing or even in powering any type of vessel traveling on water.

If humanity does not have the ability provide the necessary energy to permit airplanes to continue to fly and/or ocean transportation to continue to transport goods and services from point A to point B and/or fishing vessels to provide fish to humanity, humanity will have a choice--- the collapse of civilization or a dramatic reduction in the human population. The latest numbers I could easily find, indicated that 2012 the USA imported over 35.5 million tons of fertilizer. Repeat that number over 35.5 million tons. While I could not find what proportion came by water, the amount that came by water had to be very large. And I can almost guarantee that without fossil fuels to power very large cargo ships containing fertilizers, food production in the USA will substantially decrease. Even if the conclusion I stated only has a 50% chance of being correct that should scare the living hell out of you.

Let me make my position very clear. I support every effort to reduce or even eliminate the usage of fossil fuels. However, to be realistic any attempt to reduce or even eliminate fossil fuels must consider what is written in the paragraphs above relating to airplanes and international trade. At present, the best estimate is that there are about 1.2 billion automobiles on the road and that number will increase to about 2 billion by the year 2030. I cannot envision the ability of the economy of the world to provide enough "green" power and add enough locations to eliminate fossil fuel powered automobiles by the year 2030. As stated elsewhere in this essay, at present fossil fuels provide about 86% of all the energy used by humanity. To the best of my knowledge, there are no realistic proposals, from an economic and/or scientific point of view, that will permit the elimination of fossil fuels as an energy source by the year 2030.

Humanity must examine every problem it faces today that could cause the collapse of civilization within the next 360 years (that period of time was chosen because at an annual growth rate of 2% the economy of the planet will grow by a factor of 1,000). As to each such problem humanity faces the same choice as set forth above---immediately start population reduction or determine if there is a greater than 90% chance that future action by humanity can prevent the collapse of civilization. And that determination must be made based upon the best scientific evidence presently available and not by some pie-in-the-sky method.

The collapse of civilization will be caused by the inability of the planet to provide the resources needed by humanity. And that inability will be determined by two factors---the human population and the average per capita usage of resources. Notwithstanding possible future technological developments and notwithstanding the abilities of humanity, to be on the conservative and safe side, humanity must assume that due to the desires of the billions in the Third World for a better life, the average per capita usage of resources will increase in the future. To be very direct, almost every human being on the planet would like to live at the American standard of living and use the same amount of resources used by the average American. And there are billions of people in the third world and their population is growing. Also to be very direct, the Americans and the people living in the industrialized nations of the planet are not going to dramatically reduce their per capita usage of resources. The failure of any economist or person, when considering, or writing about, the future of humanity to take those facts into consideration is misleading the leaders of humanity.

Every person, including every economist, who states that the resource problem facing humanity has been solved (that there are presently sufficient resources provided by the earth to humanity such that humanity need not presently worry about resources and that humanity need not worry about the availability of resources for the foreseeable future) is totally wrong.

GLOBAL FOOTPRINT NETWORK

According to the Global Footprint Network, an organization that examines theoretically renewable resources presently used by humanity, that at present humanity is using the theoretically renewable resources of 1.7 Earths. This can only continue for a very short period of time-- humanity is drawing down its capital. This is similar to withdrawing 3% of your money on deposit in the bank, when the bank only pays 2% interest--- eventually you will have no money in the bank. And almost every theoretically renewable resource is in reality nonrenewable because humanity is using it faster than it can be replaced by nature. Since population and the average per capita usage of resources is continually increasing, any future number has to be greater than 1.7 earths. The Global Footprint Network did not discuss nonrenewable resources as, by definition, any such resource used today will not be available to humanity for use tomorrow.

Other findings by the Global Footprint Network-- if the current population of about 7.6 billion were to enjoy a European standard of living, which is about half the consumption of the average American- the Earth could sustainably support only about 2 billion people; global aquifers are being pumped 3.5 faster than rainfall can naturally recharge them; topsoil is being lost 10-40 times faster that is formed; oceans are being overfished, and a primary protein source for over 2 billion people is in jeopardy; and worldwide we have lost over half the vertebrate species in the air, water and land since 1970.

The Global Footprint Network then asks the question--- how many more species can humanity lose and how many more ecosystems can humanity destroy before humanity's own existence is threatened? The Global Footprint Network makes the comment that if nonrenewable resources were used by all the nations of the planet equal to the American standard of living, the upper limit of a sustainable global population would be about two billion. It also points out that global warming will affect the amount of people the earth can support due to reducing crop yields, rising sea levels, increasing migration by the millions and other actions. In simple terms—if humanity does not stop global warming the sustainable population will be substantially lower than two billion. Those who have stated that the population problem has been solved have not addressed in an intelligent manner the concerns set forth by the Global Footprint Network.

There is something known as the web of life. Humanity is just one species among the millions of species that exist on the planet. If humanity destroys enough of those other species, our species cannot and will not survive. No one knows exactly relationship between our species and the millions of other species that exist on the earth. However, the previous statement that if we destroy the other species our species will no longer exist cannot be disputed by any intelligent person. And we are destroying species at an unprecedented rate and that cannot be disputed.

In this paragraph I will assume that each human being on the planet produces, on average, 1 pound of CO₂ per year. I'm using that number to make the answer come out in percentages. The actual number is irrelevant to the answer, since the answer will be in percentages. Based on that assumption the annual production of CO₂ is 7.6 billion pounds (assuming the current population is 7.6 billion). If the UN is correct in its median variant prediction that the population in the year 2100 will reach 11.2 billion, then the average production of CO₂ will have to be reduced to 0.678 pounds per person or a reduction of about 32% (.678 times 11.2= 7.6) to remain at the current level, not increase. Even if the population reached only 9.0 billion in the year 2100, an average reduction in the production of CO₂ would be about 14% to remain at the current level and not increase. To maintain the overall worldwide production of the greenhouse gas, CO₂, at its current level, the average per capita production would have to be reduced by either 32% or 14%, based upon the population in the year 2100.

I can make a very strong argument that due increasing economic activity of the nations of the world, and in particular the nations of Third World, and due to the increasing usage of resources by the nations of the world, in particular nations of Third World, the average worldwide per capita production of greenhouse gases will dramatically increase between now and the year 2100. There is, of course, a counter argument--- that the genius of the capitalist system, new science, and new technologies will offset the combined effect of the increasing population and the increasing usage of resources by the nations of the world causing a net reduction in the overall production of CO2 by the year 2100. However, the best of my knowledge as of today no system has been produced to support the counter argument. Humanity cannot and must not rely upon pie-in-the-sky theoretical solutions to solve the global warming problem. Since we are talking about the possible collapse of civilization, or at least your creation of hundreds of millions of refugees, any pie-in-the-sky theoretical solution that has a chance of failure of greater than 10% must be thrown out. And I challenge anyone on the face of the earth to state with 90% certainty that the annual output of CO2 in the year 2100 will be less that it is in the year 2019.

There is one thing wrong in what I have written above. I have not considered the probability that other far more potent greenhouse gases will play a substantial part in the future. There is a possibility, and more likely there is a probability, that due to the current increasing temperature of the planet substantial amounts of methane (and methane is a far more potent greenhouse gas) will leak into the atmosphere causing a further increase in the temperature that will cause a further increase in the amount of methane leaking into the atmosphere in a never-ending cycle until one or more major catastrophes occurs.

To summarize the situation, any new technologies to control greenhouse gases will have to overcome the increase in the output of greenhouse gases due to an increase in population, due to an increase in the average per capita output of greenhouse gases caused by the increasing economic activity of the nations of the world, due to an ever increasing temperature caused by the leakage of methane into the atmosphere and due to the fact that humanity had previously used the resources easiest to obtain and process.. And to gamble future of humanity on any pie-in-the-sky solutions is more than ridiculous.

By definition, every use of a nonrenewable resource limits the availability of that nonrenewable resource for use by future generations. Technological developments, substitution of one resource for another resource, efficiency of resource usage and every other action that humanity can take will only delay the time when a nonrenewable resource will no longer be available to humanity. The actions of humanity cannot cause a nonrenewable resource to be available forever into the future. Anyone who believes that a nonrenewable resource will be available to humanity forever into the future is totally and completely wrong.

To the best of my knowledge, no economist and no person have written about how the average per capita usage of resources will increase in the future because of the increasing standard of living of the increasing billions of those living in the Third World. And the population of those living in the Third World will increase in the future. Also consideration must be given to the increasing usage of resources by the rest of humanity. There cannot be any doubt that actions taken by humanity in the future could attempt to reduce the per capita usage of resources needed for each unit of economic activity. However, any attempt to make that determination must be made on the best scientific knowledge presently available and not on any pie-in-the-sky basis of theoretical inventions and modifications that could possibly happen in the future. The failure to consider the almost certain increase in per capita usage of resources in the future by economists and others will be a disaster for all of humanity.

According to numbers issued by the World Bank in 2018, close to 46% of the world's population was living on less than \$5.50 per day in the year 2015. That works out to about 3.5 billion people living on \$2000 per year or less in 2015. If that group of people were able to raise their incomes to \$10,000 per year (and that is a low-level compared to the average American level), a fair assumption would be that their per capita usage of resources would increase by a factor of four or five. Since according to the Global Footprint Network humanity is using the resources of 1.7 Earth's, increasing the per capita usage of resources by 3.5 billion people by a factor of four or five could/would be devastating and destructive for all of humanity. They can't be any doubt that in the future the lowest economic level of the world's population will attempt to substantially increase their per capita usage of resources and short of war the industrialized nations of the world will be unable to prevent that from occurring. Any such increase in per capita uses resources will continue forever into the future. And even 100 years into the future is a very long period of time. If the world's poor were able to increase their economic level to \$10,000 per year, is highly likely that the rest of humanity would demand to live at the same economic level and use the same amount per capita resources as were used by the average American. And if every human being on the planet were to use the resources of the earth at the same level as the average American that would result in the almost instantaneous collapse of civilization. Of course, the economists will say don't worry, the earth can provide an infinite amount of resources for an infinitely large level of population. The economists would not only be wrong, they would be mass murderers. Moralists would say that Americans don't have the right to rape the earth and force everyone else to live in poverty and they would be absolutely correct. However, correctness in this situation is totally irrelevant and unimportant. A different solution must be found to save humanity from extinction.

Now let us consider obsolescence, waste and garbage. A simple example to have some fun with! Assume that each human being uses just one shirt or blouse per year. Here I will use the estimate put out by the UN for the population in 2100 of 11.2 billion. You may disagree with that number and desire using a smaller number. However, the number of human beings will still be in the multiple billions. Using 11.2 billion requires that each day (365 days per year) the number of shirts or blouses produced would be about 30.7 million (11.2 billion divided by 365= 30.7 million) Since shirts and blouses normally cannot be recycled, the earth must absorb those 30.7 million shirts and blouses as waste every day and every day into the future. If my assumption that each person used only one shirt or blouse per year is incorrect and the average is really three per year, then over 91 million have to be produced and also dumped as waste each day. In the last paragraph on page 1 above I used 2160 years. At one shirt or blouse for 11.2 billion people for the next 2,160 years requires the production and waste absorption of 2,160 times 11,200,000,000 or over 24 trillion. A rather large number for material that most likely cannot and will never be recycled—those resources will be lost and gone forever. The analysis set forth in this paragraph applies to many things produced and used by humanity. Shirts and blouses were merely used as an example. Some economists and some other individuals that are prepared to gamble the survival of our species on the capitalist system will state-- don't worry a genius will come along in the future that will make shirts and blouses last forever and never wind up in the garbage, that is the benefit of a capitalist system. Do not bet your money on that possibility.

Now let us consider recycling. Assume that every car has a lifespan of 30 years, and that is a very, very favorable assumption. Another assumption--- assume that at the end of the lifespan 90% of all the material that went into a car was recyclable, and that also is a very, very favorable assumption. In 2160 years there would be 72 generations of cars (2160 divided by 30 =72). The material that would remain in year 2,160 would equal 0.90 to the 72nd power and if my math is correct there would be less than 1% of the material remaining. You don't like my choice of a lifespan of 30 years. Assume something is constructed with a lifespan of 100 years and at the end of 100 years 90% of the item can be recycled. In

2160 years there would be 21.6 cycles and the best of my math 0.90 to 21^{st} power is less than 10%. Based on those assumptions, 90% of all the material that went into create the item would no longer be available to humanity at the end of 2160 years—again, about the time from the birth of Jesus until today

This analysis also applies to everything produced and used by humanity. Everything created by humanity has a limited lifespan and must be replaced sometime in the future. At the time it is replaced it becomes waste and garbage, though a portion of it may be attempted to be recycled and no recycling is 100% efficient.

Substitution of one resource for another resource cannot and will not be the solution to any of humanity's problems. In almost every case a substitution is made due to the unavailability of a nonrenewable resource, the substitution is also a nonrenewable resource and finite and limited. Even if the substitute were theoretically a renewable resource, almost every theoretically renewable resource over time actually becomes nonrenewable. In simple and direct terms, sometime in the future industrialize civilization must collapse due to one or more resource shortages.

A small discussion of physics! Einstein showed that in addition to the three physical directions, (left and right, up and down, and back and front) there was fourth dimension---space/time. Note that space/time is only one dimension and not two dimensions, one for space and one for time. The same concept of one dimension applies to any discussion of the future of humanity in relation to the fact that the earth is finite. There is only one concept and that concept is resources/population. Anyone who writes about only resources separate from population or population separate from resources has no understanding of the problem he/she is writing about. The combination of both resources and population determines the future of humanity. Anyone who has written about the future of humanity and stated that the population problem has been solved has no understanding of the problem he/she is writing about. Anyone who has written about the future of humanity and stated that the resource problem has been solved or who has stated that humanity need not worry about running out of resources has no understanding of the problem he/she is writing about. The problem that must be solved is the resources/population problem. Average worldwide per capita usage of resources times the number of people on the planet will determine when civilization collapses.

The average per capita worldwide usage of resources times the number of people on the planet must reach a maximum. That number cannot be infinitely large--- recycling, substitution of one resource for another resource, new technologies, more efficient uses of resources and anything else humanity can do and cannot make that number infinitely large. We can debate how large that number will be and when humanity will reach that number, but we cannot debate that number exists and is finite. In fact the number not only is finite, but the number is being reduced every day due to the usage of resources by humanity. Once that number is reached, an increase in population must reduce the average per capita usage of resources and in the alternative, once that number is reached an increase in the average per capita usage of resources must result in a reduction in the population. Anyone who takes the position that average worldwide per capita uses resources times the number of people on the planet can continue to grow forever into the future, has a position that cannot be defended.

There are only three levels at which the human population can be stabilized ---1) At a level higher than today's population of about 7.6 billion; 2) At a level equal to today's population; or 3) At a level lower than today's population. There isn't a fourth level at which population can be stabilized. What level of

stabilization is best for the long-term survival of humanity? There is one only one answer to that question-- the best level of stabilization for the long-term survival of humanity is lower than today's level of 7.6 billion. I challenge anyone to show that stabilizing the population at today's level or a level higher than today's level is in the best interest of humanity. The best population level to stabilize humanity is the lowest level of population that will provide sufficient genetic diversity to permit survival of the species. The long-term survival of humanity depends upon how fast humanity can reach that level. It is in the best interest of humanity to reach the lowest level described above as quickly as possible. During any period of delay humanity would be using essential nonrenewable resources that would no longer be available for future generations. In addition, during any period of the delay humanity will be using theoretically renewable resources that were, in reality, nonrenewable.

Modern medical science could cause the extinction of humanity. Modern medical science has caused and is causing a substantial increase in the average human lifespan. Assume that modern medical science will be able to extend the average lifespan, in very good health, of a human being to 200 years of age. That extension would dramatically increase the population of humanity causing almost the instant collapse of civilization. At some point in time something that is beneficial will become something that is harmful. The point is very simple-- at some point in the future the extension of life no longer is beneficial to humanity. Humanity does not know when extending life turns from being beneficial to being destructive. However, humanity must not sweep the life extension problem under the rug. I challenge anyone to show that extending the average life expectancy for a human being in good health to the age of 200 would be beneficial to humanity. If you cannot show that extending the average life span of humanity to 200 years would be beneficial, then you must agree that at some point in time an increasing average lifespan becomes destructive of humanity. A short-term solution-- every increase in the average lifespan of humanity must be offset by a decrease in the fertility rate such that population decreases. While no one knows at what level of life expectancy turns from being beneficial to harmful, I would guess that if the average person lived to see his/her great, great, great grandchild that life expectancy would be extremely harmful to humanity.

A number of economists and others have stated and taken the position that the growing human population is no longer a serious problem for humanity due to the fact that some nations have reduced, and other nations will reduce in the future, their fertility rates to below replacement levels. They have taken the position that by about year 2060 the human population will reach a peak of about 9 billion and then start to decline. However, the latest numbers (median variant) issued by the UN (and their demographers are among the best on the planet) is that the human population will exceed 11.2 billion in the year 2100 and still be growing. To the best of my knowledge none of those who have taken the position that population growth is no longer a problem for humanity, have produced a detailed country by country analysis similar to the one issued by the UN and then compared the two of them to show country by country why population growth is no longer a problem. For example, the UN predicts/estimates/projects that the population of Egypt will grow from about 100 million in 2020 to about 200 million 2100. I would love to see what those who have taken the position that population growth is no longer a problem predict/estimate/project the population of Egypt will be in the year 2100 and why their prediction is different from the UN's prediction. More importantly, before anyone can consider the position that the human population is no longer a problem for humanity is valid or invalid, a similar comparison must be done for each and every country on the planet. A generalization that because the fertility rates of some countries are below replacement level or will become below replacement level in the future does not support the position that population growth is no longer a problem for humanity. There isn't any guarantee that fertility rates will forever remain below replacement level or even forever remain at replacement level. I challenge anyone reading this essay to

show with 90% assurance, or even 50% assurance, that the human population will decline to whatever level is necessary to prevent a major worldwide catastrophe and remain at that level forever into the future.

At this point I want to examine the claim of some individuals that the human population will peak at about 9 billion in the year 2060 and then start to decline. According to www.worldmeters.info/world-population the population of the planet was 7.7 billion as of April 28, 2019. There are 41 years between 2019 and 2060. If the population were to reach a peak of 9.0 billion in 2060 the average increase over those 41 years would be 31.7 million ($9.0 \text{ billion} - 7.7 \text{ billion} = 1.3 \text{ billion}$ and $1.3 \text{ billion} \div 41 = 31.7 \text{ million}$). The annual population increases ranged from 83.0 million in 1985, to 84.9 million in 2015, to 84.0 million in 2016, to 83.3 million in 2017, to 82.6 million in 2018, and the increase is projected to be 81.8 million in 2019. In round numbers the overall annual increase in population from 1985 to 2019 was slightly over 81 million. In simple terms during a 34 year period from 1985 to 2019 the average annual increase in worldwide population was over 81 million. In order to reach a peak of 9 billion in the year 2060 the average for the next 41 years (2019 to 2060) has to drop to about 31.7 million, a decrease greater than 50% compared to last 34 years. While I am not a demographer, in my view it is almost certain that decrease in the average annual growth rate will not happen. I cannot envision the circumstances that would cause the next 41 years to have an annual population increase of just 31.7 million compared with the previous 34 years of an average annual increase of over 81 million. Averages over extended time periods are very difficult to change. To get an average of 31.7 million, a high year of growth combined with a low year of growth cannot total more than 63.4 million ($31.7 \times 2 = 63.4$). Therefore, if a high year after the year 2019 had a growth of 80 million, a low year after 2019 would require a decline of 16.6 million—($80 - 16.6 = 63.4$) to get to an average of 63.4 million. Based upon the current growth rate predicted for the year 2019 and based upon the growth rates of the previous 34 years, to gamble survival of humanity on having average an annual growth rate of 31.7 million over the next 41 years is more than irrational, it is just plain wrong and highly destructive.

Those that take the position that population growth is no longer a problem for humanity fail to understand that population growth in specific limited situations can cause wars with weapons of mass destruction that will lead to the worldwide use of those weapons. For example, India and Pakistan hate each other's guts and both are armed with nuclear weapons. They also are physically close and compete for the same resources. According to the UN, the population of India will increase from 1.39 billion in 2020 to 1.66 billion in 2100 and the population of Pakistan during that same time period will increase from 208 million to 364 million—about an 80% increase. A similar situation exists between the Jews in Israel and the Arabs in the West Bank and in Gaza. Even if the population problem is solved in the rest of the world, those two situations (and similar situations) could initiate one or more catastrophes leading to the collapse of civilization.

It is essential to note that a stable or reducing population (no matter how achieved, either by voluntary action or coercion) causes many political, social, economic and other problems for a nation in which that is occurring. And those problems are horrible. It is essential to note that China is now asking its people to increase their fertility to eliminate or ameliorate those problems. Hungary also has undertaken steps to increase the fertility rate of its citizens. As those problems develop in other countries around the world, I doubt those countries will face those problems and instead request their citizens to increase their fertility rates. However, the additional people born today will grow old and will require additional people to be born tomorrow to support them in their old age causing ever-growing populations. To be very blunt and direct, humanity must suffer the problems caused by stable or decreasing populations and those problems will be horrible. In my view, it will require one or more major catastrophes before

the nations of the world understand they have a choice--- suffer the problems caused by stable or decreasing populations or delay the inevitable by reverting to increasing populations and then suffering major catastrophes caused by those increasing populations. It is highly likely that in the future the population of the planet will increase due to the fact that the nations of the world will choose not to face the problems caused by a stable or decreasing population. In simple terms, the nations of the world will take the cowardly way out and ask/demand their populations to increase so that they do not have to face the problems caused by a stable or decreasing population.

There are many facts that those who have stated or taken the position that population growth is no longer a problem for humanity has failed to consider. President Erdogan of Turkey has called upon Muslims to reject birth control in order to multiply. The followers of the church of the Latter Day Saints almost always have more than four of five children. Iran has changed his position from being in favor of family planning and birth control to one of encouraging its citizens to having large numbers of children. The present government of Iran has criticized the previous program as an ungodly and a destructive Western import. The present position of the government of Iran is that boy should marry at the age of 20 and girls at 16 or 17 thereby producing large numbers of children. The government of Iran a few years ago instituted a policy of population growth with financial incentives for every new child born. While we can debate what portion of the religious population today follows, or in the future will follow, the dictates of their religions relating to sex, birth control and the number of children they have, the fact that one or more major religions are opposed to abortion, are opposed to the usage of modern means of birth control, and/or demand the production of a large number of children, cannot and must not be ignored in relation to future worldwide population growth. While Catholics in some countries have controlled their population growth, the Catholic populations in the Philippines and in Africa are exploding. While reform Jews control the number of children they produce, Orthodox Jews produce children beyond counting. A small example--- a female Jewish Holocaust survivor living in the State of New York died a few years ago leaving over 2000 direct living descendants.

According to a report issued by the Pew Research Center, which I printed in July 2018, the Muslim population in 2010 was 1.619 billion and is expected to increase to 2.190 billion in the year 2030. That represents a gain of 571 million in just 20 years and that should scare the hell out of anybody who is concerned about the future of humanity. In my view is highly unlikely that the Muslim growth rate will decrease to zero by the year 2060.

According to Human Life International, an organization opposed to abortion, in a press release issued in April 2013, in the last 40 years (1973 to 2013) there were about 1.72 billion abortions world-wide (and other sources I have researched agree that number 1.72 billion is in the correct range) . If abortions had been made illegal as desired by many religions and if those abortions had not happened,, there would be at least three or four additional billion people living on the earth today--- the original 1.72 billion who are aborted plus their progeny of one, two or even three additional generations. While no one can guarantee the future, I doubt that those who have stated the population problem has been solved have considered the possibility that in the future abortions will be banned worldwide or even banned in multiple countries. If those abortions had not happened, instead of the current population being about 7.6 billion, it most likely would have been about 11.0 today. And all of the problems presently faced by humanity would have been far more dangerous and likely to cause the collapse of civilization.

According to the best estimates, about 40% of all pregnancies worldwide are unplanned and not desired. Without abortion being available to all humanity, at little or no cost, population growth will

continue into the future. In addition, in order to prevent continued population growth abortion must be socially acceptable for all humanity.

A very strong argument can be made that population growth will continue into the future, unless United States supports a realistic population solution, including providing funds for education and abortion. Based on the present political and social climate of the United States, it is highly unlikely that today, or in the foreseeable future, the United States will provide the leadership necessary to save humanity from the destruction caused by population growth. In fact, many states of the United States oppose the providing of intelligent and proper sex education relating to reproduction to their students. Most states merely limit proper sex education to abstinence. That position is not only insane; it is totally evil and immoral.

Some leaders of nations believe that a growing population represents growing political power for them. If nation A competes with nation B for political power in a region and if the population of nation A were to increase, the leaders of nation B could very well take steps to increase the population of their nation so that both nations are again equal in political power. I doubt that those who believe that the human population will decrease in the future have taken into consideration that simple fact. A hypothetical question for those that believe population will decrease in the future--- assume that religion A stabilized its population and that the population of religion B continued to increase, what are the chances that religion A will demand that its followers increase their production of children so that they remain equal political power to religion B? Breeding wars for political power could/would force the continuation of population growth.

In the last paragraph on page 1 I referred to the fact that dinosaurs ruled the earth for about 60 million years. At this point I would like to expand the discussion relating to that period of time. No action taken by the dinosaurs caused their extinction after ruling the earth for about 60 million years. Their extinction was caused by a meteor slamming into the earth. If the meteor had not slammed into the earth, it is almost certain that the dinosaurs would have continued to rule the earth for additional millions of years. Let's consider what it would take for humanity to rule the earth for the coming 60,000 years. That amount of time is just one thousandth (0.001) of the length of time that dinosaurs ruled the world. Since the human species claims to be more intelligent than the dinosaurs, it follows that humanity should be able to rule the earth for double the amount of time that the dinosaurs ruled the earth, or about 120 million years. The point is that 60,000 years is a very, very short period of time when considering the future of the human species. Anyone who takes the position that humanity cannot and should not plan for the coming 60,000 years is totally wrong. In the scheme of things, 60,000 years is less than instant time. Since life began on the earth about 3.5 billion years ago and will continue for billions of years into the future, 60,000 years is nothing compared to those periods of time.

No one on the face of the earth can guarantee today, with 90% certainty, that the population growth/resource problem will not cause the collapse of civilization and the deaths of billions in the coming 2,160 years, let alone in the coming 60,000 years. And to repeat myself, 60,000 years is infinitely short period of time compared to the length of time the dinosaurs ruled the world and compared to the length of time that life has existed and will exist in the future on this planet. The most intelligent action humanity can take is to immediately reduce the current human population as quickly as possible to the minimum number of human beings that will maintain the genetic diversity to attempt to ensure the survival of the human species.

Every human being and every industry on the planet produces waste that cannot be recycled today and will not be recycled in the future. The portion of waste that can be recycled compared to the portion of waste that cannot be recycled may change over time. However no matter what action is taken by humanity, our civilization cannot be completely decoupled from the use of physical resources and the production of garbage and waste that never will be recycled. Anyone who takes the position that all waste that humanity will produce in the future can be recycled takes a position that cannot be defended.

What will be the cumulative amount of waste created by humanity that cannot be recycled in the next 2,160 years and how will that amount of waste affect humanity? Anyone who takes the position that the earth can absorb an infinite amount of waste takes a position that cannot be defended.

I challenge every person reading this essay to do a little research and find out how much waste is produced daily by the 500 largest cities on the planet and then multiplying that amount by 365 days per year and again multiply that number by 2,160 years to determine the cumulative amount of waste that will be produced in the next 2,160 years. Of course, that number would have to be modified by an increase or decrease in population and modified by the increasing or decreasing efficiency in the production of waste and garbage per unit of economic output. However, after doing all that mathematics the conclusion is simple--- humanity, if it desires to survive on this planet for the coming 2,160 years, must reduce its production of garbage and waste and the best way to do that is to dramatically reduce the number of people on the planet. And to repeat myself, 2,160 is about the same length of time from the birth of Jesus until today--- a very short period of time. Some people take the position that waste and garbage is not a problem, but a resource: humanity will burn it to produce energy. There are many reasons why that position is incorrect---pollution of the air, not energy efficient, a large portion cannot be burned.

WATER

No one can deny that the level of water in many aquifers is rapidly going down--- the water being deposited in underground aquifers by natural processes is less than the water being withdrawn from those aquifers and used in irrigation to produce food for humanity. At some point in the future water being withdrawn from one or more of those aquifers will no longer be available to humanity, thereby decreasing the food produced for humanity. While no one can guarantee when and which aquifers will no longer be available to humanity, the entire water/irrigation/food problem must be considered in any discussion of the future of humanity. That discussion must include all possible means of replacing the food that will no longer be available to humanity, due to the inability of the aquifers to continue to provide water for irrigation purposes. And this is an extremely important problem that humanity will have to face in the near term. No one on the face of the earth can guarantee with 90% certainty that the aquifer/water/food problem will be solved in time to prevent massive starvation due to the lack of water from the aquifers of the world causing food production to decline. Of course there are many pie-in-the-sky proposals as to how the aquifer/water/food problem will be solved---desalinate water in the Gulf of Mexico and pump it hundreds of miles to Iowa and Kansas, desalinate water in the Pacific ocean and pump it over the Rocky Mountains, genetically modify plants so that they can grow with substantially less water or grow with salt water, grow food in metropolitan areas in 50 story buildings solely in water (without soil) with grow lights, etc. However, none of those proposals or other proposals is presently viable from a scientific or economic perspective

A very important and simple statement that cannot be disputed---any nonrenewable resource that is today used by humanity means that the amount of that nonrenewable resource available for use by humanity in the future will decline. And the small amount of that resource that may be reused or recycled does not change the truth of that statement.

UNITED NATIONS REPORT

To understand some of the problems facing humanity about resource usage I am going to quote extensively from a report entitled "Global Material Flows and Resource Productivity" issued by the United Nations Environment Programme –Assessment Report for the UNEP International Resources Panel. "It indicates that the level of development and well-being in wealthy industrial countries has been achieved largely through highly resource-intensive patterns of consumption and production, which are not sustainable, even less replicable to other parts of the world." "This report also shows that consumption is the main driver of increased material use, more important than population growth in recent decades." "Yet pressures on those natural resources are mounting. A growing population and heightened world economic demands in the past half century are rapidly depleting these vital resources, inflicting great harm on the natural environment and human health." "Global material use has been accelerating. Material extraction per capita has increased from 7 to 10 tonnes from 1970 to 2010, indicating improvements in the material standard living in many parts of the world." "This means that there is considerable inertia built into the global system of material use, which makes it difficult to reduce material use rapidly and on a sustained basis." "The material intensity of the world economy has been increasing for the past decade, driven by the great acceleration that has occurred since the year 2000. Globally more material per unit of GDP is now required." "Despite this, global material productivity has declined since the year 2000 and the global economy now needs more materials per unit of GDP than it did at the turn-of-the-century." "This has resulted in growing environmental pressure per unit of economic activity and works against the hypothesis of decoupling-- achieving more with less-- which is so important to the success of global sustainability." "Given the fact that global economy, at today's level of resource use, is already surpassing some environmental thresholds or planetary boundaries, this shows that the level of well-being achieved in wealthy industrialized countries cannot be generalized globally based on the same system of production and consumption. Large improvements decoupling are needed to service the needs and aspirations of a growing global population in an inclusive way." "The richest countries consume on average 10 times as many materials as the poorest countries, and twice the world average, which demonstrates very unequal distribution of materials to support the standard of living. It shows that the low income group of countries will require increasing quantities of materials, per capita, to achieve the sustainable development outcomes the global community aims for." "Assuming that the world will implement similar systems of production and systems of major services—housing, mobility, food, energy, and water supply-- nine billion people will require 180 billion tonnes (annually) of materials by 2050, almost three today's amounts." "Rising material use will result in climate change, higher levels of acidification and eutrophication of soils and water bodies, increased biodiversity loss, more soil erosion and increasing amounts of waste and air pollution. It will also have negative impacts on human health and quality of life. It will ultimately lead to the depletion of certain natural resources and will cause supply shortages for critical materials in the short and medium terms.

The report continues "While many resources will still be abundantly available over the medium and long terms, pollution and ecosystem degradation and a changing climate will dominate the political debate around using materials more effectively and efficiently. Fast-expanding demand for materials will,

however, require very large investments into new extraction and supply infrastructure and will contribute to local conflict over alternative uses of land, water, energy, and materials.”

You are urged to reread the previous two paragraphs very carefully. The paragraph that begins with the words “The report continues”, is in my view nothing more than an attempt to give humanity hope for its future and, in reality, the only hope for humanity to survive into the future is to revise every aspect of our industrialized civilization and to substantially and immediately reduce the human population. The paragraph that begins with the words “To understand some of the problems” above makes it absolutely clear that the planet cannot and will not supply the resources necessary to satisfy the demands of the nations of the world, and in particular the Third World nations, as to the materials necessary to increase the standard of living they desire to attain.

It is very important to note that the report I quoted above stated that humanity would be using 180 billion tonnes (annually) of materials in the year 2050 when population was 9 billion. The report did not cover the material usage in the year 2100 when the population could reach over 11 billion, and the latest numbers issued by the UN (medium variant) predicted/projected/estimated that the human population would reach about 11.2 billion in year 2100. In this paragraph I will use the figure set forth in the report-- 180 billion tonnes. Now let us look at the cumulative amount of materials that would be used for the next 2,160 years after the year 2050--- almost 389 trillion tons of materials would be used during that time period (2,160 times 180 million=388.8 trillion).

A friend of mine who read a draft of this essay recommended that I use a shorter period of time in relation to the previous paragraph. 200 years is a much shorter period of time. In 200 years the cumulative use of materials would be about 36 trillion tonnes (180 billion tonnes per year times 200 years =36 trillion tonnes) of material used. Still a number that indicates collapse is coming and coming very soon.

According to one article in the New York Times on February 26, 2009 toilet paper consumption in the United States required 7 million eucalyptus trees to be cut down and used in its production. At another place in this essay I show that the relationship of the population of the planet to the population of the USA was 23 to 1, or that the population of the USA was about 4% of the world’s total population. To be on the conservative side, I will assume that the world’s need for toilet paper required the destruction of 35 million eucalyptus trees (5 to 1 compared to 23 to1) per year. Admittedly that ratio is an assumption, but the number of trees required for toilet paper each year should scare the living hell out of you. Total trees that would be required over 2,160 years are 75.6 billion or 75,600.000.000. And 2,160 years is about only 40% as long as the time from the present to the time that the pyramids were built, about 5,000 years ago. An economist reading the above paragraph would say do not worry over 25 billion trees or a great capitalist will solve the toilet paper problem. I would not recommend a bet on that point of view.

Those that are frightened or disagree with what is written in this essay will argue that due to the genius of humanity and the capitalistic system the production of materials will increase in efficiency and, therefore, the total that is set forth above of 388.8 tonnes will be reduced to a much lower cost level. That argument is not only wrong, it is ridiculous. Report quoted above makes it clear that material usage per unit of GDP is increasing worldwide. The argument is also ridiculous due to the demands of the nations of the world, and in particular nations of the Third World, that their standard of living dramatically increase causing a very large increase in the average per capita usage of resources. The argument is also ridiculous due to the fact that humanity has previously used the resources easiest to

obtain and process and in the future will be required to spend more time, money, energy, effort and resources to obtain each new unit of resources in the future. Rather, then being high, the number of 388.8 trillion is almost certainly very low.

According to the Minerals Education Coalition each American born will use over his/her lifetime about 3.03 million pounds of minerals, metals and fuels. This amount is broken down as follows-salt 26,634 pounds, clays 11,190 pounds, phosphate 15,366 pounds, natural gas 6.92 million cubic feet ft.³, petroleum 73,334 gallons, cement 51,614 pounds, copper 1024 pounds, iron ore 19,227 pounds, zinc 473 pounds, gold 1.94 Troy ounces, stone, sand and gravel 1.28 million pounds, lead 867 pounds, coal 347,429 pounds, aluminum/bauxite 2,206 pounds and other minerals and metals 43,813 pounds. Restating the previous numbers in a slightly different form, on an annual basis every American born (and this includes all Americans no matter their age) will use 38,449 pounds of new materials every year--including 930 gallons of petroleum, 4,409 pounds of coal, 87,817 ft.³ of natural gas and 0.2 pounds of uranium.

Now let us have some fun with numbers. Assume that every person on the planet used resources at the same level as the average American. In 2017 the best estimate of the world population was 7.550 billion and the best estimate of the population of the USA was about 325.7 million, a ratio of about 23 to 1. In simple terms the USA represented about 4% of the world's population. The best estimate of oil consumption is that the world uses about 99.6 million barrels of oil per day. The three largest consumers are the USA 19.9 million barrels per day, the European Union 15.0 million and China 13.2 million. If everyone on the planet used oil at the same rate of the USA the total oil usage would be about 457 million barrels per day (19.9 times 23 =457). This represents 4.59 times the amount of oil used by the entire planet today (457 divided by 99.6 =4.59). Anyone who believes that the planet can produce 457 million barrels per day at any time in the future is just plain wrong.

Some people will respond to the above paragraph with the comment, humanity will replace oil and all other fossil fuels with alternative energy sources. Oil is being used only as an example: do not argue that in the future humanity will replace oil/fossil fuels in all their uses. The point is that to bring all of humanity to the same level as the Americans would require a monumental increase in all resources used by humanity and any attempt to achieve that level of resource usage would result in the collapse of civilization. If all the nations of the planet were to use resources at half of the level of American usage, it would require a multiplication factor of 11.5 (23 divided by 2=11.5). A very strong argument can be made that any attempt by all the nations of the planet to use resources at just half of the level used by Americans, would result in a large number of resources being unavailable leading to the collapse of civilization. For example, using oil, again as an example, it would require production of almost 229 (19.9 times 11.5 =228.85) million barrels per day compared to total current worldwide production of 99.6 million barrels per day.

It can be stated with almost absolute certainty that the Americans will not reduce their standard of living and will not reduce their per capita usage of resources any time in the foreseeable future, without a military dictatorship taking over the country and forcing, by the means of a gun, such a reduction. It is also very unlikely that the other industrialized nations will reduce their standards of living and per capita usage of resources, without a military dictatorship. And yet nothing will stop or even reduce the desires and demands of all humanity to dramatically increase their standards of living. Former President George H. W. Bush stated at an international conference held about 20 years ago that the American s' standard of living was not up for debate or discussion. If humanity does not solve that conundrum destruction must follow.

Assuming that the United States and industrialized nations of the world will not reduce their standards of living and per capita usage of resources and assuming that all humanity (especially the nations of the Third World) continues to demand additional resources to increase their standards of living, the conundrum posed above can only be solved in two ways-- reduce the population or provide the resources demanded by the nations of the world (especially Third World nations). At this point I would like to set forth my interpretation of the words "resources" and "reserves" as used by economists. According to economists the word "resources" mean something that humanity can extract from the earth with today's technologies and at today's price structure that will be beneficial for humanity. According to economists the word "reserves" describes something in the earth, but cannot be obtained today due to present technological difficulties, due to today's price structure or other reasons. As I understand the position of economists and others is that they will agree that one or more resources are in short supply today and other resources could become in short supply sometime in the future. However, their position is do not worry when a resource becomes in short supply the price will increase causing one or more geniuses to develop new technologies so that the reserve turns into a resource and/or the price increase, in and of earth itself, will cause the reserve to turn into a resource that can be used today by humanity. Even if that position were true, it does not follow reserves that turn into resources can permit economic growth to continue forever into the future. That position assumes that one or more technical geniuses will overcome any and all physical problems about turning reserves into resources. For example, assume that there is a reserve of 5 trillion barrels of oil under the Pacific Ocean at a location where the depth of the ocean is 25,000 feet and further that the oil is 50,000 feet below the ocean floor. To gamble the survival of humanity on the ability to turn that reserve into a resource in time to prevent the collapse of civilization is, in my view, ridiculous. For humanity to go forward in an intelligent manner, it must evaluate all reserves and determine what portion of them can be turned into resources based upon the best current estimate of technology and economics. In direct and simple terms—capitalism is not the solution to continued economic growth and resource shortages. Capitalism is not magic and cannot make resources appear from the earth. And to gamble the survival of the human species on that magic is just plain wrong. Conversion of reserves into resources will only delay the collapse of civilization and if humanity continues to grow economically destruction must follow.

No one knows for sure what reserves, or what portion of reserves if any, can be turned into resources or when this will happen for each reserve. Therefore, economists and others must not be permitted to use unknown and unknowable reserve-resource conversations to advocate for continued economic growth.

Based upon that evaluation, humanity must attempt to solve the conundrum posed above. If in realistic terms there aren't enough resources to satisfy the demands of the nations of the world for increasing standards of living and increasing per capita usage resources, humanity must consider worldwide population reduction.

Economic growth and population growth are tied together. If the economy cannot grow, population cannot grow; and if population cannot grow, the economy cannot grow. They cannot be separated when considering the future of humanity. If economy decreases, the population must decrease; and if the population decreases, the economy must decrease. I challenge anyone on the face of the earth to show that if the economy of the planet were 20 times as large as the current economy, the amount of resources used would stay the same as it is today or decline. If the economy of the planet were to grow by a factor of four (just two doublings) there use of resources would be substantially greater than it is today and I challenge anyone to show otherwise.

At this point I'm going to discuss forests of the world. In the natural state when a tree dies it collapses to the ground and eventually all of the resources that were in the tree are returned to the forest floor permitting new trees to grow. In our current industrialized society, all trees used by humanity are removed from the forest and, therefore, the resources contained in the trees are not returned to the forest floor. Eventually the forest must collapse and no longer produce trees-- no returned resources, no new trees can grow-- it is that simple. No one knows when this will occur for any particular forest, but it must happen for every forest on the planet when trees are removed from the forest. And economic growth requires more trees to be removed from the forests every single day. Anyone who believes that humanity can artificially replace, by the use of fertilizer or any other means, all of the resources removed from the forests when trees no longer return those resources to the forest floor is totally wrong. Planting new trees would be a complete failure as the forest floor would have the natural resources that would permit new plantings to grow to mature trees.

A challenge to every economist and every other person reading this essay-- state what you believe is the best (however you define the word "best") annual economic growth rate for the planet as a whole, state how long you believe this growth rate can continue on the earth, and then state your reasons for the first two items. Humanity faces an either/or situation, with no in between possible-- either economic growth can continue forever into the future or economic growth must stop at some time in the future. There are no other alternatives. And any economist or any person on the face of the earth that states economic growth can continue forever into the future is a total and complete fool. No action taken by humanity and no economic system can permit economic growth to continue forever into the future. The only questions that are facing humanity are--when, how, at what level will economic growth cease; upon cessation of economic growth will humanity forever remain at that level or will the level of economic activity start to decline after the peak level of economic activity has been reached; if economic activity will start to decline after the peak level has been reached, how long will it remain at the peak level, what will be the rate of decline, how long will decline last, and at what level if any will the decline cease?

I can state with absolute certainty, not merely 99.999% certainty that economic growth will cease no later than 720 years from today. Why? Humanity cannot change the laws of math and the laws of math rule the world. At an annual growth rate of 2%, in 720 years economy would be over a million times as large as the current economy and that cannot and will not happen. At any growth rate larger than 2% per year, in 720 years economy will be substantially greater million times as large as the current economy. Even at an annual growth rate of 1%, the economy would be over 1,000 times as large as the current economy. To be more realistic, a very strong argument can be made that economic growth must cease no later than 180 years from today. At an annual growth rate of 2%, in 180 years there would be five doublings representing a growth factor of 32 and is highly unlikely, in fact almost certain, that the economy of the planet will never be 32 times as large as the current economy.

Economists argue that shortages create price increases and price increases, in turn, cause additional capital, additional intellectual activity, new technologies, substitution of materials, and other actions that will solve the shortage problems. No one can dispute that the position of economists described in the previous sentence have worked in the past and have worked in many cases to solve many shortage problems. However, ultimately the position of economists set forth in the previous sentence must lead to the collapse of civilization. No action taken by humanity today and forever into the future can increase the number of atoms on the planet. No action taken by humanity today or forever into the future can make recycling 100% efficient in every case. Nothing humanity does can prevent the creation of waste and garbage that cannot be recycled. Nothing humanity does can assure forever into the future

that substitutions will be available to replace resources that are no longer available for use by humanity. Humanity cannot change the immutable laws of physics. The position of economists and others described in the first sentence in this paragraph implies continual economic growth forever into the future on the finite earth and that cannot and will not happen.

There are only three ways that will stop the growth of the human population on the planet—1) War, disease, starvation and other horrors. Since no one would desire that population stop in this manner, this choice can be ignored; 2) Voluntary population control-- this includes the education of both women and men, modifying religion to make women equal to men, providing the most modern means of birth control to all humanity at little or no cost, providing abortion services to all humanity at little or no cost, changing the culture to accept abortion and to believe it is in the best interest of humanity to stop population growth, and every other action that anyone can think of short of coercion; and 3) Coercive population control on a worldwide basis --- penalties can range from social exclusion to severe criminal penalties. In the past China applied social and economic oppression to limit each couple to one child. Except for that case, the best of my knowledge no other nation has applied any type of coercion to limit population growth. Today, the best of my knowledge, no nation on the planet is applying any type of coercion to force couples or people to limit their production to one and only one child.

No one on the face of the earth can guarantee with 100% certainty that voluntary population control will stop population growth and/or reduce the total number of people on the planet in time to prevent the collapse of civilization due to the clash between the ever-growing population, using an ever-growing amount of resources and the ability of the earth to provide the resources necessary to maintain industrialized civilization. Therefore, it is absolutely certain that voluntary population control has some chance of failure to prevent the collapse of civilization. Those facts (and they are facts that cannot be disputed) demand that humanity determine, as best it can be determined, the chance that voluntary population control will fail and then determine what chance of failure is acceptable. Since failure almost certainly will result in the collapse of civilization, the chance of failure must be very low in order for it to be acceptable to humanity.

There cannot be any doubt that any attempt to determine the chance of failure of voluntary population control will be highly contentious and very difficult to determine. However, humanity must make that attempt in order to plan for its future survival and depending upon the first determination humanity could very well be required to make that attempt periodically. There cannot be any doubt that any effort to determine what chance of failure should be acceptable to humanity will also be very difficult and highly contentious. Similarly, humanity must determine what chance of failure is acceptable in order to plan for its future. In my view, any chance of failure greater than 10% requires that humanity immediately undertakes a comparison of voluntary with coercive population control. You may disagree with my choice of 10%. However, the failure to make a comparison between voluntary and coercive population control if the chance of failure is greater than 30% would be in a foolish and irrational act.

The problem of the possibility of the collapse of civilization is a continuing problem and must be completely reviewed on a periodic basis. For example, at present there are at least two different viewpoints about continuing population growth. The UN's latest median variant predicts population will reach 11.2 billion in the year 2100 still be growing and the other viewpoint is that population will reach a peak in 2050 or 2060 at about 8 or 9 billion and then start to decline. Humanity must review the actual population growth in the year 2050 and every five years thereafter to determine which view of population growth is correct and to make necessary and appropriate decisions based on the actual population growth. This cannot be left to chance.

The UN and the nations of the world have established Sustainable Development Goals. There cannot be any doubt that every action to use resources more efficiently and to reduce the amount of resources necessary to produce a unit of economic growth is absolutely required. It is the position of the author of this essay that the concept of Sustainable Development Goals is the worst joke that ever has been perpetrated on humanity. Notice that the word "Sustainable" is not modified as to length of time, implying that Sustainable Development can continue forever into the future. To be very direct, Sustainable Development cannot and will not continue forever into the future. "Growth" cannot and will not continue forever into the future. Putting the word "Sustainable" in front of the word "Growth" does not change the fact that growth cannot and will not continue forever into the future. No one, the best of my knowledge, has produced a definition of "Sustainable Development" that is different from a definition of "Sustainable Growth". To be very direct, there isn't any difference between those two concepts and if "Sustainable Growth" cannot continue forever into the future, then "Sustainable Development" cannot continue forever into the future. The UN and the nations of the world are cowards and they have refused to advise humanity that economic growth cannot and will not continue forever into the future. The UN and the nations of the world are intentionally misleading all of humanity as to how long "growth" can continue on the finite earth. The failure to advise humanity of the truth is not only disgusting it is also very stupid and dangerous.

Most intelligent people understand that explosive population growth can cause the collapse of civilization and, therefore, they promote "family planning". Some nations and many groups promote family planning. However, family planning is not synonymous with birth control; they are two entirely different concepts. Family-planning implies voluntary action while birth control implies coercion. A wealthy couple come see you and advises you they want to plan their family-- have six children three years apart, they can afford the children and provide them with all reasonable necessities for their growth and well-being. How do you respond? Do you say to them-- that they are intelligent and acting in the best interests of humanity by planning their family or do you say to them--- you are fools and highly destructive by having six children that will use a very substantial amount of resources over their lifetimes? A person that supports family-planning would, in my view, find it extremely difficult to advise them that their action having six children is a highly destructive act. However, having six children in a wealthy family is a highly destructive act. The point is very simple--- notwithstanding the fact that birth control implies coercion; birth control is the only policy that will save humanity from destruction. The leaders of humanity must not be cowards and use the proper words in discussing the future of humanity-- birth control. Since it is almost certain that in order to survive on this planet for the longest possible period of time humanity has to reduce the population level substantially below the current level of about 7.6 billion, it is an act of madness not to use the proper words-- birth control. Humanity must understand that having more than one child is a highly destructive act, as having more than one child will not permit the human population to decline and decline is what is needed for the long-term survival of humanity.

Attached to this document is a four page copy of a warning to humanity signed in 2017 by almost 16,000 of the most important scientists on the planet from 184 countries, including almost every Nobel Prize winner alive in the disciplines of science. This is the second warning issued by scientists, the first such warning was issued in 1992. That document recommends various actions that humanity must take to prevent its extinction. However, my interpretation of that document is that in reality there is only one action that will prevent the collapse of civilization and that interpretation is a rapid and substantial decline in the human population. You may agree or disagree with my interpretation, but if you are concerned about the future of our species, you cannot ignore my interpretation. Unfortunately for all of humanity, the Trump administration has not read that document, or does not understand it and its

implications or refuses to give it any credibility. That failure will cause the deaths of billions and will cause Trump to go down in history (assuming anyone is alive after the collapse of civilization) as the greatest mass murderer who ever lived.

To summarize his long essay, the following facts cannot be disputed:

1. The earth is finite in size having a circumference of about 25,000 miles.
2. Number of atoms in the earth of finite.
3. Almost all of the resources the earth can provide humanity are finite.
4. Since resources the earth can provide humanity are finite, at some point in time economic growth must cease. To use a ridiculous example, the economy of the earth cannot be 1 trillion, trillion, trillion times as large as the current economy. The statement that economic growth must cease at some point time is true no matter what action humanity could or would take now or in the future.
5. Similarly, at some point in time population growth must cease. Again to use a ridiculous example, the earth never will be able to provide the resources necessary to support a population of a trillion, trillion, trillion human beings. The statement that population growth must cease sometime in the future is correct no matter what action is taken by humanity.
6. We can debate when, how and at what level both economic and population growth must cease, but cease it must.
7. Theoretically we can also debate at what level must both stabilize that will permit the human species to exist for the longest period of time.
8. In reality there are only three levels that both can stabilize at—the current level, a level greater than the current level, and a level lower than the current level. There cannot be any debate that the best population level of stabilization for the long term survival of humanity is the lowest number of human being sufficient to maintain genetic diversity necessary to permit the long term survival of the human species and that the best level of economic activity is lowest reasonable (however you define the word “reasonable”) level that is achievable with the lowest level of population.
9. In evaluation any course of future conduct and action by humanity, humanity must consider the risk/reward equation. The reward—if humanity does not take the correct actions today, the reward almost certainly will be the collapse of civilization and could even be the extinction of the species or at least very few survivors living at the level of the Early Stone Age.
10. For example—if humanity does not immediately impose coercive population control on a worldwide basis, there is a chance that voluntary population control (no matter how you define or describe voluntary population control) will fail causing the collapse of civilization. What level of chance is acceptable?