Available online at www.sciencedirect.com
ScienceDirect
Futures 39 (2007) 1097–1116
FUTURES
www.elsevier.com/locate/futures

Futures sustainability

Bruce E. Tonn*

Department of Political Science, University of Tennessee, McClung Tower, Room 1008, Knoxville, TN, USA

Available online 13 April 2007

Abstract

This article presents a strategic framework to guide public policy with respect to very long-term futures. The framework is based upon three fundamental principles. Threats to meeting the principles are assessed. Integrated planning responses to overcoming the threats are proposed. Significant changes in economic, political and social theory and organization required to support the strategic responses are discussed. It is argued that human civilization would need to pass through the mythic 'singularity' on the path to futures sustainability.

1. Introduction

Sustainability and future studies should be intimately related. The focus of the former is on how to 'keep things going.' Futurists address why this is important [1] and study 'where things could go' [2]. While both viewpoints are decidedly anthropogenic—the former is concerned mainly with sustaining the quality of human life and the latter has rigorously addressed obligations to future generations of humans [3]—it can be argued that implicit in both are broader concerns for all earth-life and its life support systems.

There is no one universally accepted definition of sustainability. Most definitions suggest that sustainability involves balancing environmental, social and economic factors [4–7]. Judicious use of resources and reduction of waste are other important factors [8]. For example, Donella Meadows has stated that "Our rational minds tell us that a sustainable world has to be one in which renewable resources are used no faster than they regenerate; in which pollution is emitted no faster than it can be recycled or rendered harmless; in

*Tel.: +1 865 974 7041.
E-mail address: btonn@utk.edu.

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doi:10.1016/j.futures.2007.03.018

which population is at least stable, maybe decreasing; in which prices internalize all costs; in which there is no hunger or poverty; in which there is true enduring democracy. But what else?'' [9].

One response to this question is that the concept of sustainability needs to have an extraordinarily long time perspective. Specifically, sustainability must be infused with futurism. This is because earth-life needs to be sustained on this planet until it has found and successfully inhabited at least one new home outside of the solar system. In other words, earth-life on earth needs to be sustained until it transcends the certain oblivion of the earth during the last, spectacular days of the sun [10].

How long could it take for earth-life to transcend oblivion? Scientists have only recently detected planets orbiting stars other than our sun but none of these seem even remotely inhabitable [11]. This is because most appear to be hot gas giants that orbit very close to their stars. It is very uncertain when a new home will be found or where it will be in the universe. It would be wise to send probes to all potential new homes to collect more detailed data about these planets before sending earth-life out on the risky journey to colonize unknown planets. Depending on the speed of the probes and the distance of the potential new homes from earth, it could take several thousand years at the very minimum to tens of thousands or even hundreds of thousands of years *simply to find somewhere else to live in the universe*! Additional thousands of years could be needed to actually successfully inhabit any new home.

Infused with futurism, sustainability is even more challenging than currently understood. In fact, the scope of 'sustainability' needs to be expanded to extend at least tens of thousands of years into the future and revised to include the goal of transcending oblivion. It is so important that futures and sustainability studies be linked that let's label this area of study *futures sustainability*.

The next section presents three fundamental principles of futures sustainability. The third section assesses threats to futures sustainability. The fourth section presents a long-term strategy for achieving futures sustainability. The paper concludes with a discussion about how economic, political and social theory and behavior will need to change to support futures sustainability goals and initiatives. So much change in human civilization will be required that it can be argued that for humans to survive into the distant future, our societies will have to transverse the mythic *singularity* [12].

2. Principles of futures sustainability

The three principles of futures sustainability are:

- *Principle* 1. Ensure survival of earth-life into the distant future.
- *Principle* 2. Ensure survival of *Homo sapiens* into the distant future.
- *Principle* 3. Protect the potential of earth-life to transcend oblivion.

The first principle is the most important because earth-life is needed to support earth-life. Ecosystems are composed of countless species that are mutually dependent upon each other for nutrients directly as food or as by-products of earth-life (e.g., as carbon dioxide and oxygen). If the biodiversity of an ecosystem is substantially compromised, then the entire system could collapse due to destructive negative nutrient cycle feedback effects. If enough ecosystems collapse worldwide, then the cascading impact on global nutrient cycles

could lead to catastrophic species extinction. Thus, to ensure the survival of earth-life into the distant future the earth's biodiversity must be protected.

It should be clear, though, that protecting biodiversity does not mean that it is necessary that the status quo of all ecosystems on earth be maintained [13]. Taken literally, that is an impossible goal because there will always be fluctuations in species populations if only due to annual changes in weather and precipitation.

Theoretically, pursuing this goal could also be counter-productive in the long run. Presumably, through the process of evolution, collections of species evolve to create even more resilient ecosystems. Preventing evolution through maintenance of the status quo, then, would restrict earth-life's ability to adapt to new conditions and situations. Given that it is certain that conditions on earth will change—for instance, we know that the continents will continue to drift and alter ocean currents, which, in turn, could lead to devastating global climate change—preventing the evolution in the composition of the totality of earth-life could actually lower the probability that earth-life will be able to survive into the distant future *under normal circumstances*. Thus, futures sustainability requires the maintenance of functioning bioregions, not the biological status quo.

However, it must be stressed that something more than natural evolution is needed to deal with *extraordinary circumstances* related to avoiding mass extinctions and transcending oblivion. That something is intelligence. Even though earth-life has a strong genetic pre-disposition to survive [14], this trait by itself is inadequate to ensure survival into the distant future. Sixty-five million years ago an asteroid smashed into the earth and caused the rapid and catastrophic global climate change that ended the era of the dinosaur. The most extensive extinction occurred roughly 250 million years ago, when approximately 96% of the species went extinct. A combination of climate change and a fatal decrease in the amount of oxygen in the atmosphere (which lead to the extinction of most oxygen breathing species) are cited as possible causes [15]. The 'non-intelligent' species alive at these times in the past had no capability to foresee impending doom nor to plan to prevent the catastrophes nor to save themselves. It was only by chance that earth-life survived those two and the three other massive extinction episodes.

The situation is different now. Earth-life does have the intellectual capability, in the form of humans, to practice foresight and to plan and to act proactively. In fact, the second principle of futures sustainability implies that *H. sapiens* are earth-life's best hope for surviving into the distant future. Here the term *H. sapiens* is used to broadly represent our species and any successor species. Over the very long-term, say several hundreds of thousands of years into the future, one could expect, given past history, that one or more new species of *Homo* would evolve naturally from our current species. Of course, even more likely is the creation of transhumans by *H. sapiens*. What form they will take and whether transhumans will be considered a new species are not yet known. In any event, from the perspective of futures sustainability, whether humans naturally evolve and/or are engineered into different forms are not as important as the point that intelligent life not become extinct.

Why? The most important reason is that if humans *writ large* were to become extinct, it is unlikely that intelligent life could re-evolve soon enough to lead earth-life's effort to transcend oblivion. People like Stephen Gould believe that evolution of intelligent life (e.g., *H. sapiens*) on this planet was a random event and a rather unlikely event at that [16]. If the

history of earth were re-run with only a few initial parameters changed, it is not certain and could be very unlikely that intelligent life would have evolved at all. If humans and most animal species became extinct in the near-term, could intelligent life re-evolve from bacteria in time (a few billion years at most and maybe only over several hundred million years [17]) to save earth-life from oblivion? Very possibly not.

The next logical questions that arise are whether indeed *H. sapiens* can avoid their own extinction and lead a successful effort to transcend oblivion. If humans cannot learn to change their behaviors to meet the goals of futures sustainability, then it would be better for earth-life if humans went extinct sooner rather than later in order to open up the possibilities for the evolution of new intelligent life more capable of benefiting all of earth-life. Many argue that human behaviors have already initiated a sixth massive species extinction [18] and are so disgusted with the negative impacts that humans are having on the planet that they argue that we deserve to go extinct. Is the extinction of humans earth-life's best survival strategy, even though re-emergence of new intelligent life might be highly problematic?

A simple thought experiment suggests that humans are earth-life's best bet. In this experiment there are three key factors: the probability that humans can avoid extinction and transcend oblivion; the probability that new intelligent life would re-evolve if humans became extinct; and the probability that a newly evolved intelligent species could avoid its own extinction and transcend oblivion, assuming there is enough time to do so. To favor extinction of humans, the product of the second and third probabilities must be greater than the first probability.

If the probability of new intelligent life re-evolving is less than the probability that humans will successfully avoid extinction and transcend oblivion then it does not make any difference what the value of the third probability is: it will always be best for humans to survive. If the second probability is greater than the first, it is still hard to favor the extinction of humans because it is hard to argue that the third probability will be much different from the first. Certainly, new intelligent life could be 'better' than humans but the chances are equal that such life could also be 'worse.' To favor extinction of humans, one would have to believe that the chances of humans succeeding are very low, the probability that new intelligent life re-evolving is not low, and that the probability of this new life succeeding where humans failed is very much higher than the first probability. The third belief, at least, is very hard to justify. In fact, if the first and third probabilities were assumed to be equal (low or high), then if the second probability is less than one, which is must be, then the only conclusion is to support the second principle of futures sustainability. Thus, *H. sapiens* must strive to survive not only for our own selfish reasons but simply because our survival is in the best interests of earth-life.

The third principle is a variant of the age-old advice: do not eat your seed corn. A plausible future could be one where the earth is rich in biodiversity and a handful of humans exist in relative bliss but where humans have completely lost the potential to transcend oblivion. It is possible that preceding generations consumed all concentrated energy resources. It is also possible that a series of catastrophes so devastated human civilization that our scientific and technical knowledge bases were lost to history. Without maintaining the potential to transcend oblivion, earth-life will not be able to do so, regardless of 'intelligence' and foresight abilities.

3. Threats to futures sustainability

3.1. Threats to biodiversity

Threats to biodiversity are numerous and well known. Studies suggest that the number of species on earth is decreasing faster than the 'natural' rate [19]. It can be strongly argued that the biodiversity of the earth is decreasing mostly as the result of human behavior. The relentless expansion of human settlements has resulted in widespread destruction of habitats. The loss of tropical rainforests, estuaries and wetlands to development have been particularly ruinous. Of course, over the course of history humans have also hunted numerous species into extinction [20] and are threatening to over-harvest many aquatic species to extinction. Industrial waste also has the capability to kill species outright and to prevent their reproduction. The transport of invasive species around the world is another near-term threat to the earth's biodiversity. Human-induced climate change is threatening many species in the near-term, such as the polar bear. Rapid global climate change and nuclear war could result in catastrophic species extinction similar to massive extinctions in the earth's geologic past.

There are also numerous natural threats to biodiversity. Naturally occurring viruses and other pathogens could become more virulent and uncontrollable and could threaten numerous flora and fauna alike. However, long-term threats to biodiversity mostly stem from extreme climate change. Volcanic eruptions, collisions with asteroids, plate tectonics, changes in ocean currents, and even minute changes in the energy output of the sun could cause rapid global cooling. Cooling could not only spread ice over most of the earth's surface again, killing the majority of species outright, but could also lower sea floors enough to foster massive oxidation, thereby reducing oxygen levels enough in the atmosphere to asphyxiate all oxygen breathing species [17].

3.2. Threats to humans

All of the threats mentioned above at least indirectly threaten humans if one believes that a massive extinction of species would also lead to the extinction of humans. Many of these threats also directly threaten humans. Nuclear war, collisions with asteroids, and massive volcanic eruptions could cause widespread loss of human life. Runaway global warming and reduction of oxygen in the atmosphere could almost certainly lead to the extinction of humans.

Human existence is also more fragile in some ways than is earth-life taken as a whole. One reason is because *H. sapiens* are a comparatively homogeneous species. There is not much difference in the DNA among humans, at least when compared to differences in among other primates and many other species. This makes humans more vulnerable to exceedingly virulent pathogens, for example, because human DNA may not have enough variation to survive some types of super-germs. Our reproductive systems may also not have enough variation to survive the toxic soup of chemically persistent endocrine disrupters that are continually being emitted into the environment.

Some risks are peculiar to our species. Humans have the capability and the willingness to kill each other in large numbers. Our scientific and technological curiosities have come under scrutiny from worriers: we might unleash an unstoppable nano-fabricator, the so called 'grey goo scenario' or conduct a high energy physics experiment that will warp

space-time so much that the earth will be destroyed [21]. We also have the psychology to commit suicide, despite a strong innate will to survive. Some speculate that conditions on earth could become so unbearable that humans could collectively decide to commit mass suicide. We could also simply dwindle way if people decide to stop having children. We are already seeing the beginnings of this phenomenon in several European countries.

Probably few if any threats listed above are capable of causing the extinction of humans by themselves. For example, it is unlikely that a nuclear war could kill all humans on the planet. Additionally, large numbers of healthy individuals could be quarantined if deadly pathogens became rampant. However, an unlikely sequence of events certainly has the potential to do so and it is these sequences of events that need to be assessed and dealt with.

3.3. Threats to transcending oblivion

Maintaining intelligent life on earth is a necessary but not sufficient condition for transcending oblivion. Much more is needed. Scientific knowledge is essential. Highly advanced space-faring technologies will also be required. Industrial and resource bases to support science and technology development are also necessary.

It has taken humans millions of years to develop our current level of technology. At first, the going was very slow. The development of even the simplest tools took millions of years. There was probably some correlation between having more sophisticated tools and the development of simple agriculture. Widespread, very organized agriculture followed, along with many other agricultural, language, and war-making tools. Around 150–200 years ago, technological change began its current rapid ascent. The Industrial Revolution of the 1800s was followed by the Information Revolution of the latter part of the last century. While this revolution is still relatively young, we are pushing ahead another revolution, the Bio-technology Revolution, and are hyping yet another revolution, this one driven by nano-technologies.

Unfortunately, the current technological society is not sustainable [22]. There are not enough natural resources and non-renewable energy sources. Depletion of concentrated energy resources (both fossil and nuclear fuels) may make it impossible to maintain an even higher level of technology. It can be argued that we have about 1000 years to create sustainable societies based on technologies that fall under the rubric of intelligent sustainable systems. Failure to achieve this goal will likely result in a collapse of our technological civilization and a precipitous decline in human population. It is conceivable that within a thousand years or two (a short period of time compared to the time needed to transcend oblivion) earth-life might lose its hard won scientific and technological knowledge and deplete key non-renewable resources needed to transcend oblivion.

4. Integrated 1000-year planning: foundation for futures sustainability policies

To help create sustainable societies, long-term planning is required, with time horizons of at least 1000 years. Why tackle 1000 years and not shorter, more imaginable and manageable time horizons? Why worry about the long-term when there is so much suffering in the world right now? The most direct answer is that the world needs to focus both on improving the plight of the world's poor in the short-term and protecting everyone's well being over the long-term. Focusing only on the short-term is like worrying

only about how to re-arrange the chairs on the deck of the ill-fated Titanic. All the good work at improving the arrangement of the chairs was lost because the longer-term issue (the survival of the ship) was completely mis-handled, in part through mis-placed overconfidence in the ability of the ship to withstand adversity. In the same way, short-term activities to improve people's lives, whose value should not be diminished in any way, could be completely washed away (literally in the case of global warming) by long-term problems orders of magnitude more serious.

Short time horizons can constrain if not completely mask the recognition of big picture issues and threats. For example, over the next 10 years, oil supplies may be manageable; over 1000 years, oil supplies and those of natural gas could be completely exhausted, raising the specter of the collapse of our technological civilization [23]. Over the next 50 years, rising sea levels may not be devastating, but within 1000 years, large swaths of countries like Bangladesh will most certainly disappear if global warming is not slowed down. Even though only a fraction of the earth's tropical rainforests disappear each year, add small destructive changes up over 1000 years and the tropical rainforests could completely disappear. Thus, by playing out important trends past normal policy horizons, 1000-year pictures could contain some very disturbing and dangerous potential future states-of-the-world.

The longer time horizon is also needed to facilitate a qualitative change in mindset from the short-term to the long-term. In a seeming paradox, with a longer time perspective, some actions will come to be seen as more urgent, such as actions needed to protect tropical rainforests and manage energy supplies. Longer-term perspectives indict the inherent selfishness of many of today's economic and social policies, based as they are on purportedly rational theories but in reality are based on irrational, self-fulfilling and dogmatic belief systems that temporally discount moral obligations to future generations. A 1000-year perspective is long enough to drive home the point that humans will most likely be living on this planet, with no other true alternatives, for many thousands if not millions of years into the future, as discussed above.

Lastly, a longer time horizon is also needed to expand conceptions of what is possible to achieve. Many of today's habitual naysayers preach inaction because they do not believe success is achievable, *in the near-term*. For example, we do not now have the technologies to defend the planet from collision with space-based objects and will not any time soon, so it can be argued that little money be spent on this endeavor. Of course, with that myopic view, conditions might never arise that would support the development of this capability. With a 1000-year perspective, the odds appreciably increase that such technology could be developed and deployed, so why not start today! The relatively small amounts of global funding allocated to fusion energy, space colonization, and carbon management are to some degree the result of myopic naysaying and would probably be increased if perspectives were lengthened and broadened. The longer time frame should foster the wisdom and allow the patience needed to envision the implementation of comprehensive, challenging and integrated global plans.

Thousand-year plans need to be comprehensive and integrated. These plans should include components that [24]:

- protect global biodiversity;
- identify best uses for the earth's land;
- direct the growth of human settlements to areas with high carrying capacities;

- manage human population growth;
- ensure adequate supplies of clean energy worldwide;
- address the management of carbon and other greenhouse gases in the atmosphere;
- manage ocean environments and resources;
- manage nuclear and hazardous wastes;
- manage the world's fresh water supplies;
- prevent the massive loss of human life;
- expand our knowledge of and presence in space;
- protect earth from space-based threats;
- protect earth-life from other extreme risks (e.g., grey goo) [25]; and
- protect our hard won science and technology knowledge bases.

Integrated 1000-year planning focuses on the whole of spaceship earth and simultaneously on all important systems and subsystems. Thus, all of the elements listed above must be integrated with each other. For example, the energy plan should be inter-related with the carbon management plan, which should be inter-related with the land use plan. Where people live should be determined not as much by historical accident as by the carrying capacities of ecosystems and the availability of fresh water and agricultural lands.

It is suggested that a risk framework be developed to guide 1000-year planning. This framework should revolve around threats to human extinction. Activities should be geared to respond to the probability of human extinction. For example, if it was deemed unacceptable for the risk of human extinction to exceed one in 10 billion at any time in the future, then current populations would be expected to devote more resources to futures sustainability efforts if this threshold is broached and less if it is not.

Lastly, more focused plans, spatially and temporally, should continue to be developed to protect human health, spur sustainable development, maintain important local infrastructure, and educate the citizens of the world. People will continue to plant crops, build homes, produce electricity, go to school, and drive their automobiles. Local plans related to agriculture, economic development, energy, education and transportation will still need to be developed but ought to be done in concert with the relevant elements of 1000-year plans and should also be integrated as much as possible.

5. Transcendent economics

The three principles of futures sustainability and the demands of integrated 1000-year planning have substantial implications for economic policies and theories. One major policy implication is that a much higher portion of 'economic' activity must be devoted to futures sustainability concerns. The research and development requirements implicit in the components listed above are numerous. Significant resources will need to be devoted to carbon management, space defense and space exploration. Concomitantly, it can be argued that even more resources should be devoted to energy-efficiency and renewable and fusion energy, human health research, nano-technology, and bio-technology. Even more powerful computer systems (e.g., quantum computers) will be needed to support climate modeling, drug and materials research, and science and technology development in general. To support all these activities, science and technology education will need to be improved, not only at our universities and colleges, but through K-12, too. It is very

conceivable that if the USA were to seriously address futures sustainability at least 20% of the workforce could be engaged in activities directly supporting futures sustainability [26].

A second major economic policy implication is that energy and material throughput ought to be reduced substantially. After all, the earth's resources, assisted by solar energy, must be able to support a technological civilization for tens of thousands of years into the future. Economic growth, in the form of increased utilization and exhaustion of resources, is simply not sustainable. Energy, especially fossil fuels [27], is probably the biggest concern. To reduce energy demands while increasing the quality of life for every human on the planet will require major re-conceptualizations of products and manufacturing, transportation, building designs and use, among many areas of contemporary life.

What are the implications of the futures sustainability world described above for economic theory and policy? One implication is that standard, market-based theories about how to manage a national economy may be found out-of-step, if not at cross-currents, with this kind of future economy. Current economic policy seeks to promote the growth of the gross national product (GNP). Macro-economic policies are designed to increase the exchange of money. Reducing unemployment and controlling inflation are also important goals of current macro-economic policy. The flow of money between market actors is taxed in various ways to fund the operation of government and its provision of social programs, such as social security, medicare, and welfare. Central banks act to manage the economy by manipulating the money supply; for example, by lowering interest rates and/or selling securities to increase the money supply in periods of economic downturn and doing the reverse to decrease the money supply during periods of inflation. Political pressures on central banks are great to increase the money supply when unemployment appears to be rising and GNP appears to be declining. At the foundation of current macro-economic policy is increasing consumption through a market-based economy.

In the future world described above, the increasing economic self-sufficiency of economic actors will most assuredly result in less exchange of money between economic agents. On one hand, people will need to purchase fewer goods and services, as they will be self-sufficient to a much greater degree with respect to energy, water, food, fabrics, entertainment, information, etc. through a convergence of new energy, bio-, information, and nano-technologies [28]. On the other hand, people will devote less hours to 'traditional' wage-based jobs, as they trade-off some hours in this sector to work at home and their communities to produce their own goods and services. Reduced consumption and less paid employment, given a stable population, will lead to a 'natural' decrease in GNP. Traditional economists would likely read this signal as a decrease in economic growth and implement policies to increase market-based consumption, policies antithetical to these trends and to the general goals of futures sustainability.

Of course, a decrease in GNP given this scenario does not mean that the 'national economy' will suffer. We will need to move 'beyond growth', in the worlds of Herman Daly [29], as the paradigm for economic policies. While classical economic growth, as measured by GNP, may not continue to increase, economic *development* will increase and benefit from the use of a combination of advanced technologies.

In an economy shifted toward self-sustainability facilitated by new technologies, GNP will be even a less useful metric of economic health than it is today. Yet, metrics to describe the new economy will still be needed. The question is, how should economic health be measured and monitored? In replacing GNP as a metric to guide policy, one must keep in

mind that the new metric needs to have tight relationship with economic policy 'tools'. Currently, if GNP seems to be stalling, then economic theory states that increasing the money supply needs to be considered. This is a tight relationship. Replacing GNP with something akin to the Human Development Index (HDI) is questionable from an economic policy perspective because the HDI has no obvious link to economic policy tools, although HDI metrics could suggest the need for new policies in areas such as health and education.

Also, any metric that replaces GNP needs to be time invariant. GNP is not time invariant. The goal of increasing GNP year after year for hundreds and thousands of years eventually makes no sense at all. What could an increase of GNP of 10,000% over time possibly mean except that we have completely lost our minds!

If the rate of exchange of money decreases and if the supply of money needed to 'fuel' the economy decreases, how should the economy be managed? If the tools available to central banks (e.g., controlling interest rates) become less relevant (along with the debate between supply-side and Keynesian economics) and effective, then what new tools could be created to help manage this new economy? If market-based consumption becomes a less important fraction of the future economy, what should be the goal of macro-economic policy? If more and more people 'work' in their homes and neighborhoods without receiving salaries (but do receive 'economic' benefits from their work), how should employment be measured? Or unemployment? Macro-economic theory tends to the conclusion that national economies cannot achieve full-employment because labor shortages would lead to wage and general inflation. In this new world, it can be argued that some type of 'full-employment' can be achieved without the resulting impacts on inflation. If so, how will we know whether 'full-employment' has been achieved?

As the exchange of money decreases, so will the receipt of sales and income taxes. As people move from a paradigm of 40-hour weeks and salaried employment to 'permanent part-time' employment and non-salaried work, the basis for pay-as-you-go the social security system begins to breakdown. What is it other than money that people could contribute to social security over their working lives to help them in 'retirement'? What does retirement mean in a world dominated by non-salaried work and permanent part-time employment? Unemployment payments, pensions, health benefits, and disability insurance and benefits are also tied to 'full-time' salaried work. Much of people's wealth is in the form of market-based debt, such as stocks and bonds. In the new economy, the role of traditional firms will decrease and the wealth generated by this part of the private sector will decrease. Many people rely on such wealth to help supplement Social Security and pensions after retirement. If people cannot build wealth as easily in the traditional sense but still have the need to build wealth to ensure their personal 'economic' security, how will wealth be built in the new economy? How should these types of issues be handled in a new economy?

Answering these types of questions will require economic theories that are more general than are today's economic theories. Government financing cannot be based almost solely on taxing the exchange of money. Societies should not have to rely on the sale and consumption of toilet paper to provide funds for public schools; one is not necessarily related to the other. In this new world, this link between economic consumption and provision of essential services can be broken. But, not only are new bases for taxes needed, but new methods to forecast these new 'resource' streams would also be needed.

Micro-economics will need to change along with macro-economics. Models of non-satiable, rational consumers will need to give way to more fundamental models of individual, household, and community-based economic behavior. Traditional labor-leisure models would need to be replaced with more sophisticated models that allow the blurring of home-based labor and leisure behavior, and allow home-based labor to take place while at 'work'. The famous income constraint in utility theory would become less important as one's stock of 'technology' available in the household and neighborhood and one's time constraint become more important. As 'money' becomes less important in the overall economy, basing economic (and even health and environmental) policy decisions on benefit-cost models where all benefits and costs are monetarized becomes even more problematic. In the future, people will not think primarily in terms of money yet they will still have strong beliefs, values, and preferences. Thus, more fundamental methods to guide policy making will also have to be developed.

Lastly, the new economy will not be dominated by markets and firms. This could be the biggest conceptual hurdle for traditional economists. In summary, futures sustainability promises a sea change in economic thought and substantial changes in the world's economies.

6. Political experimentation

The implications of futures sustainability upon political practice and theory rival those upon economic policy and theory in scope and profundity. The requirement that futures sustainability places upon national political systems is simply stated: they must implement and maintain stable policies and programs that help humanity meet the three principles of futures sustainability.

To meet this requirement, national political systems must practice foresight. They must contribute to the development of integrated 1000-year plans. Their policies must adhere to those plans. To accomplish this task, the national political systems themselves must be stable and committed to futures sustainability. It is not acceptable for national political systems to reverse policies when governments change. Domestic politics should not interfere with long-term commitments to futures sustainability. In summary, it should be expected that national political systems will pursue the goals of futures sustainability.

These are substantial requirements. They extend well beyond the usual requirement for a national government: that it has 'legitimacy.' Legitimacy is a difficult concept to define precisely. Roughly, it refers to whether the inhabitants of an area demarcated by generally accepted political borders accept the structure, processes, and legal framework of their national government. A legitimate government is not necessarily democratic or enlightened. Its citizens do not necessarily enjoy the entire range of freedoms. The important point is that the international community typically leaves legitimate governments alone, guided by the doctrine of national sovereignty.

With respect to futures sustainability, legitimacy is not a sufficient condition for a national government to continue in existence. This is because a legitimate government could implement policies that are antithetical to futures sustainability. These governments could be extraordinarily myopic. They could implement economic policies that lead to the destruction of irreplaceable ecosystems, thereby contributing to the violation of the first principle of futures sustainability. These governments could spend a disproportionate share of funds on the military instead of public health, thereby contributing to the

violation of the second principle. These governments could also encourage unrestrained consumption of fossil fuels and otherwise implement myopic, profit-driven 'public policies' that essentially violate all three principles of futures sustainability. These governments are not legitimate with respect to futures sustainability. It would be in the best interests of earth-life if these governments were replaced.

A major problem is that, in reality, we do not know how best to organize ourselves politically. 'Democracy' is a chimera term, a catchall that is used to describe most any government where an election of some sort is held. 'Democracies' are not always legitimate. Democracies are not necessarily futures-oriented [30]. Plus, democracies come in so many flavors that it is probably more useful to develop more precise terms to describe their differences. We do not know which types of democracies work best in which types of situations or with what cultures. We do not know whether there are better democratic structures that have yet to be imagined. We do not know whether there are better government structures that are so different from 'democracy' or other known forms of government that they would need to fall under newly coined rubrics.

These points lead to the conclusion that the world needs a radical change in its paradigm of 'national government'. With respect to futures sustainability, the goal is to have in place effective, far-seeing, and stable governments that can help the world meet the three principles and carry out long-term plans. Since we do not know how best to organize ourselves to do this, *each and every national government should be viewed as an experiment rather than as a sovereign government*. Experiments that fail need to be stopped and new experiments need to be initiated to take their place.

With respect to this paradigm, the goal is to have as many experiments running at a time as possible. This requirement is contrary to hegemonist tendencies in the West to replicate their 'democracies' everywhere around the world. In fact, in a stunning show of hubris, some in the West would argue that all governments and economies should be exactly alike because we know that our forms of democracy and capitalism represent the 'end of history' [31]. This attitude implies, first, that democracy and capitalism are completely meeting the needs of futures sustainability, an argument that is completely without merit. This point of view also implies that, in any case, we humans have in a mere several thousand years found the best ways to organize ourselves politically and economically. Surely, this is an extremely naive and egotistical outlook. Lastly, this viewpoint is completely antithetical to survival over the long-term because it prevents learning and adaptation. If every country in the world had the same political system, we would never learn whether any other system could be better!

Life on earth has survived mainly because of its diversity. Evolution can be viewed as a very long-term, trial and error learning process. Those life forms with the best designs, out of many millions of different designs, survived. It should be noted that not one best design survived, however. What has survived is the best collection of designs that work together to help ensure survival of all. Human societies need political diversity not only to be the engine of political learning but also to create a strong worldwide political ecosystem.

Thus, the world needs a rigorous, very long-term political experimental plan. The plan needs to identify different political systems that need to be tested, how many times each system needs to be tested, and how long a test ought to run before it can be considered a success. The experimental plan should also take into consideration different sizes of 'countries', their cultures, and their ecological circumstances. It should be emphasized that experiments can include whole new governmental systems, such as non-spatial

governments [32], as well as major changes to existing political systems, such as the establishment of the Court of Generations in the USA [33].

A political experimental plan, not surprisingly, could be a very long-term, even a never-ending, endeavor. For the sake of argument, let's assume that one can imagine a modest 100 different political systems to be the subject of the experiment. Let's next assume that a 'sample' of 100 experiments for each system is needed to determine whether a system is a success or not. Overall, we would need to run 10,000 political experiments. Let's further assume that it could take 300 years to determine whether a political system is a success (it may take a much shorter period of time to determine a failure). Lastly, let's assume that we can run about 200 experiments at any one point in time, which is approximately the number of countries on earth at the present time. Given these assumptions, we would need to run experiments for fifty 300-year periods or for a total of 15,000 years! This is a period of time approaching how long it may take for earth-life to send probes into space to confirm the existence of possible new homes in order to transcend oblivion.

Unfortunately, we do not have 15,000 years to find acceptable political systems. We have, at best, 1000-years to reach sustainability to prevent a collapse of technological civilization. Since the weight of evidence suggests that most current governments are failing most tests related to futures sustainability, we need to immediately change our mind sets about national governments from one of immutable national sovereignty to one of experimentation. We need to begin to test some new models of government or at least work to revolutionize existing models. We need to understand that even models that appear to work in the mid-term may not work in the longer-term because conditions, technologies, and even humanity will change over time. Willingness to change for the good of all and the goal of long-term survival needs to become an accepted value in political discourse.

7. Social change

In addition to significant economic and political change, futures sustainability requires several important social changes. Discussed below are the needs for universal responsibility and belongingness, sociodiversity, a futures-oriented noosphere, and longer human life spans.

7.1. Universal responsibility and belongingness

The underlying philosophy of futures sustainability is that 'the future is ours' [34]. Earth-life has responsibility for its own future. Its very existence empowers it to take care of itself. No supra-natural being can be expected to come to the rescue of earth-life just because. Neither is the future pre-determined. Certain events, such as the explosive death of our sun, may be predictable, but the course of earth-life is open. As discussed above, humans have the responsibility for ensuring the survival of earth-life into the distant future. To the extent that this responsibility extends far into the future and into space, then humans must shoulder 'universal responsibility' for earth-life.

Despite the heaviness of this responsibility, it should be noted that at its heart, futures sustainability is an optimistic worldview. It takes optimism to believe that the major problems facing humanity and the rest of earth-life can be overcome and that oblivion can be transcended. It takes optimism to believe that humans are earth-life's best bet. It takes

optimism to believe that we will be able to transcend oblivion. Futures sustainability can be considered the ultimate shared project for humankind.

In addition to accepting universal responsibilities, humans need to feel universal belongingness. In other words, people need to develop a psychological connection with future generations and with all of earth-life for them to behave in ways to help ensure the future of earth-life. Universal belongingness, then, captures the essence of people feeling part of the entire process of earth-life, a process that includes all humans, past, present and future, and all other earth-life, past, present, and future. Universal belongingness can allow us to feel a part of a phenomenon much bigger than ourselves. Indeed, there are few more powerful emotions than feeling part of something larger than ourselves.

Once universal belongingness takes hold, people will be more willing to meet their 'universal responsibilities' vis-a-vis futures sustainability. Similar to the need for belongingness, the needs for responsibility and achievement are also deeply ingrained in the human psyche [35]. Universal belongingness can also help satisfy other psychological needs. To the degree that people feel part of all earth-life, they could come to feel unconditional love from earth-life, in the words of Carl Rogers [36]. To the degree that one can find profound fulfillment from one's universal responsibilities and universal belongingness, one can become self-actualized, in the words of Abraham Maslow [37]. These viewpoints should also strongly resonate with humans' collective unconscious, especially the journey archetype discussed by Carl Jung [38]. At a very deep level, the universal belongingness experience flows from being-in-nature [39].

Thus, there are no fundamental social or psychological barriers to prevent people from accepting responsibilities that are broader in scope and longer in scale than more familiar everyday responsibilities. In fact, there is the potential for increased psychological health as people will have even more opportunities to achieve good things. Nevertheless, issues of scope and scale are paramount. People must be able to understand the scope and scale of universal responsibilities before they will be able to accept universal responsibilities. They must internalize the importance of universal responsibilities in order to create the cognitive conditions to receive psychological benefits from meeting universal responsibilities. Then, people need to see how changes in their behavior will help them to begin to meet universal responsibilities.

7.2. *Sociodiversity*

Universal belongingness has the potential to contribute to individuals' psychological well being. Its internalization may even increase the level of our psychological well being, all things being equal. However, it should be clear that universal belongingness cannot replace the need that people have to belong to smaller, more specific groups of people. The latter type of belongingness, by definition, creates categories of 'others' and often leads to conflict. This need developed over many millennia in response to survival pressures. It is too innate to be replaced only by universal belongingness. The challenge is how to create a world where both universal belongingness and traditional belongingness can co-exist.

The solution proposed here is to promote more rather than less sociodiversity. That is, the world needs more cultures and subcultures rather than fewer. This may seem somewhat paradoxical. Would not more sociodiversity create even more conflict? The answer is no if sociodiversity were a publicly stated goal related to futures sustainability. Encouraging people to create new social forms will, in turn, create a sense of social freedom. Instead of

being grimly focused on preserving their 'identifies' and 'ethnicities' and 'cultures', the freedom to evolve and change should lessen the primacy of one's specific belongingness ties, thereby opening up the opportunity for people to embrace universal belongingness.

Conventional wisdom foresees global cultural homogenization, characterized by market-based economies, the English language and Western popular culture. In this future world, the clash of cultures predicted by Huntington [40], and as appears to be playing out in the Middle East at this time, will slowly dissipate as all cultures fade into one large, homogeneous world culture.

Fortunately, it is easy to envision a world more like the heterogeneous distant past than the homogenizing present. The biggest difference will be that cultures will not, for the most part, need to have strict spatial delineations. In fact, the fabric of culture worldwide may come to resemble the Web, which Weinberger describes as 'small pieces loosely joined' [41].

The potential for cultural evolution is great. Murdock [42] conceptualized culture as having at least 67 universals of order. Building on this work, Hallpike [43] estimated that there could be approximately 10^{143} different variations of culture. Of course, this work was completed before the potentialities of the new technologies discussed herein were even imaginable. In any case, the point is that the 'solution space' of potential cultures is quite large and, historically, humans have only experimented with a few.

This observation is important with respect to futures sustainability. The same argument holds with respect to cultures as its does with respect to political systems. Learning is best supported when many different paths are tested. Sustainability is threatened by homogeneity in the face of a wide range of threats and continually changing conditions. Therefore, it is in humanity's best interests to foster 'sociodiversity' rather than compete to impose global cultural hegemony.

However, there is a crucial difference between political system diversity and sociodiversity. One is amenable to experimental design, the former, and one is not, the latter. Political systems can be designed and implemented from the 'top-down.' In fact, this is the typical process for political change in the modern era. Culture, on the other hand, is organic and bottom-up. Culture is not amenable to design and top-down implementation. Culture evolves and cannot be 'controlled' in any 'rational' manner. To foster sociodiversity, tolerance and freedom are needed, as well as commitments to futures sustainability, universal responsibilities, and universal belongingness.

7.3. Universal involvement and the noosphere

The fourth pre-requisite for the social transition towards the principles of futures sustainability relates to universal involvement. This term is meant to convey the need for every human being to part of the striving for futures sustainability. To foster universal involvement and to achieve all the remarkable goals set forth above requires communication. People need to interact with each other to know each other. People need to interact in order to collaborate. Futures sustainability requires people to share their values and goals. Futures sustainability also requires the contribution of every mind.

Pere Pierre Teilhard de Chardin envisioned the emergence of a global collective mind. In his words, ''And this amounts to imagining, above the animal biosphere a human sphere, a sphere of reflection, of conscious invention, of conscious souls (the noosphere, if you will)'' [44].

A 'nooshpere' for futures sustainability needs to be created to allow all minds to share and contribute to the goals of futures sustainability. Most of the infrastructure for the noosphere is already in place. The most important component is electronic. The internet and the World Wide Web now allow people to communicate with each other from just about anywhere on earth at any time on any topic. Many web pages already contain a plethora of information related to futures sustainability, from environmental statistics to population forecasts to designs and descriptions of energy-efficient technologies. Results from sophisticated global climate models are also available on-line, as are a few of the models themselves.

Yet, much more needs to be done to create a true noosphere dedicated to futures sustainability. Right now Web-interactions truly are small pieces loosely connected. There are few if any global discussions being hosted on the Web right now. So, one goal would be to develop the capability for a website to host global discussions about futures sustainability among not hundreds or even thousands of people but among millions if not tens of millions of people. People need ready access to data and information about their own regions and about 1000-year initiatives that are taking shape in their regions. They need to be able to communicate with each other, in the manner of strong democracy [45], to collaborate on local decisions that have global impacts. They need to have access to people elsewhere in the world to learn what they are doing and to coordinate activities as necessary. Information technology needs to be affordable and accessible, both physically and with respect to language. Information technology needs to be augmented by human resources dedicated to helping people participate in futures sustainability decision making.

The noosphere will come into being when every person on earth shares values related to futures sustainability and can contribute to the achievement of those goals. It will come into being when every person can communicate their concerns and have their voices heard. It will come into being when their minds are freed from crushing poverty and constant concern about their safety. The noosphere will become the substrate for universal involvement and belongingness.

7.4. Futures sustainability and extending human life spans

The last pre-requisite to futures sustainability discussed herein is human life span. It can be argued that humankind *writ large* will not become more futures-oriented without substantially extending the average life span of individual human beings.

A survey was conducted about how people think about the future [46]. Almost 600 people from around the world completed the survey. Among many questions, they were simply asked "When you hear someone say something like 'People should be more concerned about the future,' approximately how many years does this mean to you?" The average response was 14 years. The median response was only 10 years! The people who answered this web-based survey were, for the most part and as expected, highly educated and employed. If any group of people, other than professional futurists, would be expected to have a long-term view of the world, one would have predicted that this sample of people would.

One conclusion that can be made about these results is that people can imagine the future as long as they are part of the future. Ten to 14 years is a time period that mirrors the time frames of major blocks in one's life (e.g., basic education, early adult, parent with children at home, empty-nest middle age, young old age, old age). Thinking about the

future beyond the current block or the next block was not common. Thinking about the future 100–200 years into the future, way beyond one's lifetime, was exceedingly rare. Thus, it can be concluded that, in most cases, an individual needs to believe that he or she will be part of the future for him or her to actively consider that future.

It is argued in preceding sections that futures sustainability planning horizons should at least cover centuries if not millennia. Ten to 20 years is much too short a planning horizon to successfully implement 1000-year global futures sustainability initiatives. Even if most people agree in principle with the tenets of futures sustainability, their temporal psychology based on their relatively short life spans would probably prevent many if not most of them from constructively internalizing the long time horizons of futures sustainability.

Therefore, the human life span may need to be extended to at least 150–200 years, at a minimum, before humans will be able to psychologically internalize the principles and goals of futures sustainability. With an extended life span, it would certainly be clear that decisions made today will impact the lives of those same decision makers in the future. It is virtually inconceivable that if people believed that their decisions today would, with a high probability, literally create hell on earth 150 years into the future and that they and their children and their grandchildren would most certainly suffer horribly from these decisions, and that their children and grandchildren would most certainly hold them accountable for their cruelly myopic behavior, that people today would not be taking global climate change much more seriously. Similarly, it is equally inconceivable that if people believed that there was any possibility that the world's technological base would collapse due to exhaustion of fossil fuels within their lifetimes and that they would suffer immeasurably, that the world would not have an effective global energy plan.

Is a radically extended human life span in the offing? Ray Kurzweil and Terry Grossman argue very persuasively that it is [47]. They envision that a combination of better diet, exercise, medicines, preventive measures and treatments could substantially increase the human life span in the relatively short-term and that new technologies could then extend the human life span many more years. They are not alone in their up-beat assessment. Aubrey de Grey believes that technologies aimed at improving the performance and life spans of cells in the body could result in human life spans as long as 5000 years [48]. Still, a considerable amount of research and development is needed to make longer human life spans a reality.

8. Singularity

For earth-life to transcend oblivion, human life will have to pass through the mythic singularity. The potential of a 'social' singularity was first proposed by Verner Vinge [12], who envisioned a future world dominated by super-intelligent computers. More recently, the term has been used to describe future worlds dominated by technological change that are so different from our own experiences as to be unimaginable [49,50]. The term is used here to describe unfolding futures that are also radically different, yes, due in part to technological change, but mostly due to momentous changes in the way we think and behave.

Futures sustainability requires us to take responsibility for our actions; no supra-natural power will come to our rescue. Humans are seen as serving earth-life; earth-life is not seen as serving humans. The collective journey is emphasized over the individual journey.

Sustainability is valued over consumption. Cooperation is the basis of our political and economic institutions, not competition.

To achieve these goals, economic and political systems must undergo sea-changes. Economies dominated by market capitalism must morph into low throughput economies where much work is related to self-sufficiency and meeting the three goals of futures sustainability. National political systems have to have more than simple legitimacy; they must also legitimately contribute, and not detract, from futures sustainability efforts. Nationality and even cultural identities will become much more fluid as political experiments come and go and as sociodiversity flourishes around the globe. Humans will develop universal belongingness that will trump nationalistic, religious, ethnic and tribal attachments that have divided us for so long.

Of course, transcending oblivion would signify that humans have traversed the singularity. At that point, earth-life would have made a major step toward immortality. The probability of earth-life becoming extinct would be de-coupled from the fate of our sun. Presumably, having learned how to transcend oblivion once, earth-life would be able to avoid additional potential disasters posed by deaths of other suns yet to be discovered. As long as the universe contains suns that can support life, the probability of earth-life's extinction would be less than 1.0. This would be a watershed event in this entire history of earth-life. Speculation about whether earth-life could survive the death of this universe once it has mastered the art of transcending a series of oblivions is saved for future consideration.

The program outlined above poses enormous challenges for futurists and for legions of other concerned individuals. How can progress be made towards futures sustainability? What is the risk that humans will become extinct in the next several thousand years and is that risk acceptable? What institutions can be established to deal with integrated 1000-year planning and international political change? How can centuries of inertia be overcome to change the way we think about economics and politics? How can millennia of inertia be overcome to change the way we think about ourselves and our lives? There is prodigious amount of work for futurists and others to do for many years to come.

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