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**FUTURE GENERATIONS, ENVIRONMENTAL ETHICS,
AND GLOBAL ENVIRONMENTAL CHANGE**

Bruce E. Tonn

Oak Ridge National Laboratory†

P.O. Box 2008

Building 4500N, MS-6207

Oak Ridge, Tennessee 37831 U.S.A.

(615)574-4041

(615)574-3895 (Fax)

bet@ornl.gov

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Abstract

The elements of a methodology to be employed by the global community to investigate the consequences of global environmental change upon future generations and global ecosystems are outlined in this paper. The methodology is comprised of two major components: a possible future worlds model; and a formal, citizen-oriented process to judge whether the possible future worlds potentially inheritable by future generations meet obligational standards. A broad array of descriptors of future worlds can be encompassed within this framework, including survival of ecosystems and other species and satisfaction of human concerns. The methodology expresses fundamental psychological motivations and human myths—journey, renewal, mother earth, and being-in-nature—and incorporates several viewpoints on obligations to future generations—maintaining options, fairness, humility, and the cause of humanity. The methodology overcomes several severe drawbacks of the economic-based methods most commonly used for global environmental policy analysis.

INTRODUCTION

In the United States, public debate and research programs on the topic of global environmental change are driven by the twin concerns for future generations and protection of the earth's environment. There is a realization that humankind must learn to coexist with global ecosystems, lest both cease to exist. These concerns are eloquently

put forth by Vice President Albert Gore, who observes: "Global warming, ozone depletion, the loss of living species, deforestation—they all have a common cause: the new relationship between human civilization and the earth's balance."¹

Global environmental change *policy analyses* rarely reflect such sentiments in the United States. This is because policy methods used to study global environmental change issues are almost wholly drawn from the field of economics, and, therefore, reflect shorter-term, consumer-based, anthropogenic-economic concerns. The most commonly used method is cost-benefit analysis, which requires the monetization and time discounting of all variables related to the consequences of a potential policy. There are also several "integrated models," which incorporate reduced-form models of the global environment and models of national economic behavior, as typically represented by variables describing the energy sector and gross domestic product.²

These economic methods are severely deficient in their ability to investigate policies involving global environmental change, future generations, and long-term global ecological concerns because: (1) economic theory upon which the methods are based is not intended to be used to model the broad range of human behaviors and beliefs required to investigate issues related to future generations and the protection of global ecosystems; (2) many variables of importance ought not to be monetized;³ (3) discounting of expected values of costs and benefits trivializes impacts of today's decisions upon future generations;⁴ (4) the cost-benefit paradigm imposes an overly simplistic decision environment, that of collapsing all potential evaluation criteria to only one, a monetary unit, and then choosing which option promises higher monetary rewards; and (5) citizens are recipients of model results rather than full partners in the analytical process.

It is not enough for those of us who are advocates for future generations and ethical consideration of the environment to restate, again and again, the shortcomings of

the economic methods used for global climate change policy analysis, or any social policy analysis for that matter. It is also imprudent to reject economics as a legitimate concern of future generations. The challenge is to develop new methods that overcome the deficiencies of the economic methods in ways that synthesize all areas of human concern and provide valuable assistance to global decisionmakers.

It is imperative that this challenge be met because, at least in the United States, government bureaucrats and elected officials rely upon quantitative analyses in their decisionmaking about the global environment. In addition, given that the global climate change problem is quite complex, even the most vociferous advocates of future generations and the environment should admit there are trade-offs to consider in designing optimal policy responses and that sophisticated methods should be employed to manage uncertainty. Analyzing such trade-offs and handling uncertainty are better done within a systematic framework of thought that can be replicated, explained, and justified to even the most skeptical.

Presented herein is a methodology for synthesizing concerns for future generations and the global ecology into a rigorous and ethically sound framework for global environmental change policy analysis. The next section outlines several perspectives on environmental ethics that will be woven into the methodology. The second section presents statements of obligations to future generations that must also be represented within the methodology.⁵

The third section presents the modeling aspect of the methodology, which is based on possible future worlds analysis. Following in the fourth section is a discussion of how to incorporate ethical judgments into the possible future worlds framework. This paper concludes with a brief plan of action for implementing internationally the proposed methodology.

PERSPECTIVES ON THE ENVIRONMENT

There is no lack of problems related to global environmental change. Familiar concerns include: global warming; ozone depletion; accelerated species extinction; ecosystem destruction; deforestation; sea-level rise; and soil degradation. Taken together, these concerns raise the specter of environmental and human catastrophe. These concerns can be viewed from practical, ethical, and psychological perspectives.

Practical concerns about the environment involve sustainability. The World Commission on Environment and Development defines sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."⁶ E.O. Wilson states that "sustainability needs the most delicate, knowing stewardship of the living world that can be devised."⁷ Thus sustainability requires balance⁸ and the understanding, in the words of Aldo Leopold, "that the individual is a member of a community of interdependent parts."⁹

In addition to the issue of sustainability, there are deep ecological concerns that involve respect for life and the environment. David Suzuki and Peter Knudtson document very powerful statements of deep ecological ethics in their book *Wisdom of the Elders*.¹⁰

One of the most famous is:

"This we know: The earth does not belong to man: man belongs to the earth... Whatever befalls the earth, befalls the sons of the earth. Man did not weave the web of life: he is merely a strand in it. Whatever he does to the web, he does to himself." Chief Seattle, Patriarch of the Duwamish and Squamish Indians of Puget Sound, northwest North America.

Space limitations constrain the documentation of the numerous value systems, cultures, and institutions that revere the environment and its inhabitants, both animal and plant, and place great value upon future generations. The important point is that a robust

analytical methodology ought to be able to incorporate all such value systems to allow a truly international and cross-cultural analysis of global environmental change problems and policies.

The methodology should also be able to incorporate the deep psychological motivations and myths that underlie environmental sentiments and that are shared by all human beings. Fundamental psychological motivations as related to environmental ethics include: group belongingness,¹¹ rootedness,¹² being-in-nature,¹³ and unconditional self-regard.¹⁴ In other words, people form strong psychological attachments to the environment because "man desires natural roots; he wants to be an integral part of the world, to feel that he belongs."¹⁵

People use myths to attempt to explain their humanity and the world. In the words of Joseph Campbell, "myths grab you somewhere down inside."¹⁶ He has found that common themes run through myths from around the world and through time. Using his terminology, primal myths include: feeding; procreation; and overcoming. Mythic images include: mother earth, the hero, renewal, and the journey. (The underlined concepts are of particular interest for our methodology).

Carl Jung, along with Campbell, found common themes, which he termed archetypes, in peoples' dreams. The contents of the collective unconscious include: dismemberment and renewal; wholeness and self-realization; the God-man; the hero; the mandala; initiatory ordeals and rites of passage; the great mother; death and rebirth; the wise old man; the trickster figure; and spiritual journeys of ascent and descent.¹⁷ Thus, our methodology should be able to encompass protection of: "mother earth;" the ability of humans to continue their "journey" (i.e., process issues are as important as socioeconomic goals); life on earth and cycles of renewal; and the earth's ability to provide food.

In summary, the analytical methodology must be able to incorporate the concept of sustainability, peoples' deep ecological beliefs, and fundamental psychological motivations.

OBLIGATIONS TO FUTURE GENERATIONS

A strong thread of concern for future generations runs through deep ecological beliefs and myths. This section examines more specific viewpoints on obligations to future generations. The viewpoints fall under four headings: fairness, maintaining options, quality of life, and humility and humanity.

The fairness obligation concerns not imposing risks on future generations that present generations would also not accept. For example, Douglass MacLean's neutrality criterion states that: "levels of risk to which future generations will be subjected will be no greater than those of present person's."¹⁸ Risks can include risks of premature "death owing to environmental or other preventable catastrophes"¹⁹ or other risks to the quality of life. Fairness has an element of consent. According to Kristin Schrader-Frechette, "Until or unless a risk imposition receives the consent of those who are its potential victims, it cannot be justified."²⁰

The maintaining options obligation entails gifting to our posterity future worlds that are as free of man-made constraints as possible. In other words, there is a need to prevent environmental and other catastrophes "that would restrict the future of the human race by cutting off certain possible futures."²¹ By cutting off many futures, the ability of future societies to grow and mature is reduced²² as is the freedom for people to "reason about means and ends and evaluate preferences, to match desires and beliefs and then act."²³ Phillip Frankenfeld argues that current generations owe posterity a world as

simple, controllable, and affordable as possible.²⁴ Edith Weiss Brown's Principle of Conservation of Options holds that: "Each generation should conserve the diversity of the natural and cultural resource base so that it does not unduly restrict options available to future generations...."²⁵

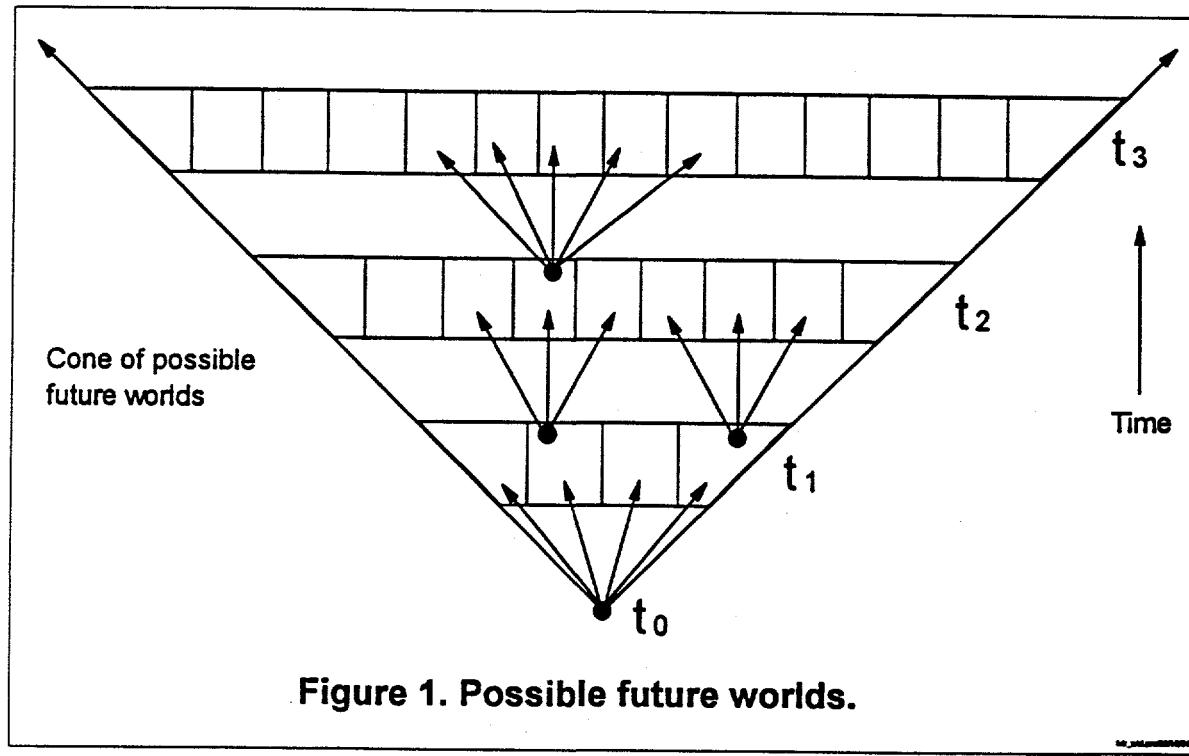
The quality of life obligation refers to ensuring that future generations enjoy all the most important aspects of life. From an international survey, Alan Tough distilled these quality of life obligations to future generations: peace and security, a healthy environment, a small risk of preventable catastrophe, stable governance, conservation of knowledge, a good life for children, and opportunities for living.²⁶ Joseph DesJardins' three quality of life obligations to future generations are: development of alternative energy sources, conservation of energy resources, and a reasonable chance of happiness.²⁷ Economic concerns relating to quality of work and increasing standards of living should be added to this list, in addition to other variables that are found important by the world's diversity of cultures.

Wendell Bell believes that humility and the cause of humanity create obligations to future generations.²⁸ In his own words, "Humble ignorance ought to lead present generations to act with prudence toward the well-being of future generations." In addition, he states that "there is a *prima facie* obligation of present generations to ensure that important business is not left unfinished." Thus, he is restating the journey myth and archetype within the context of obligations to future generations.

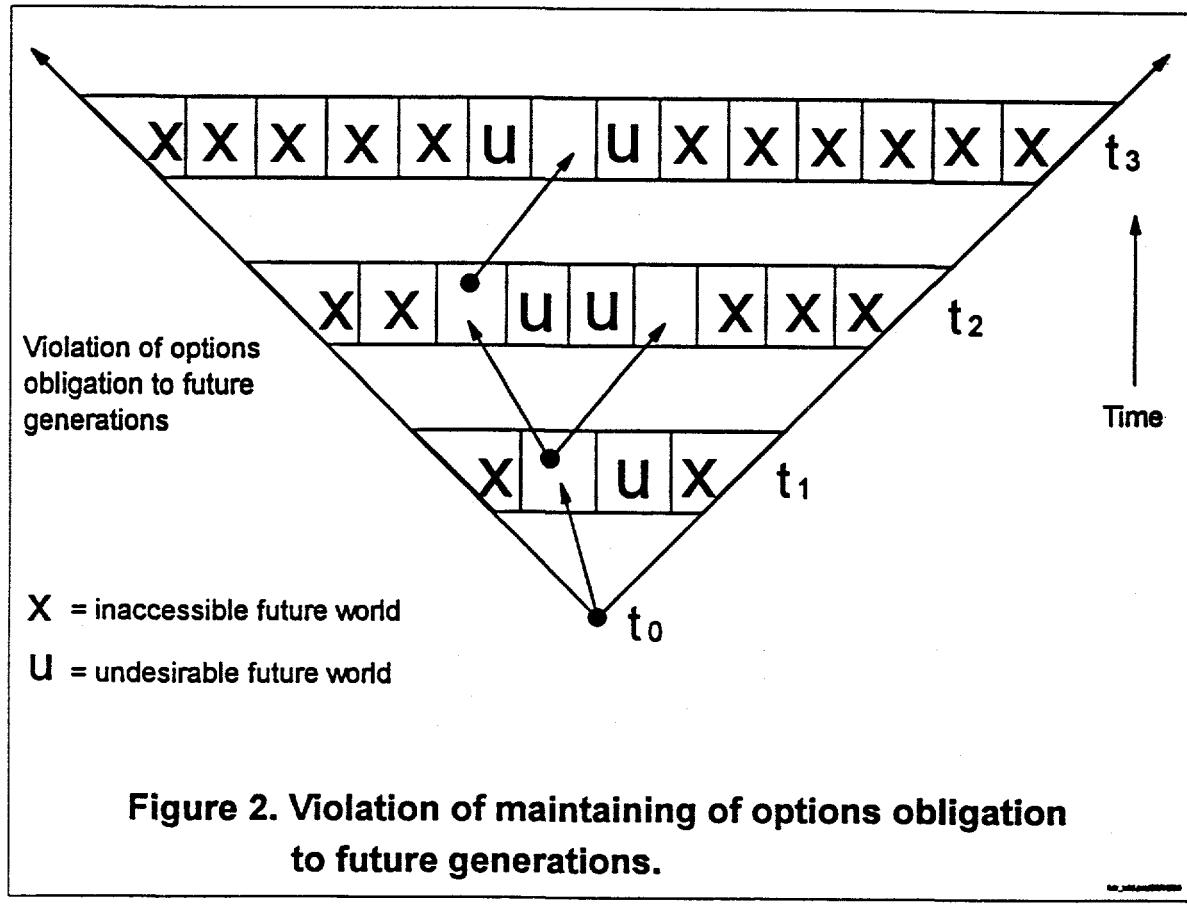
To summarize, our methodology must be designed to incorporate these four types of obligations to future generations: fairness, maintaining options, quality of life, and humility and humanity.

POSSIBLE FUTURE WORLDS MODELING FRAMEWORK

It is proposed that a modeling framework based on possible future worlds be adopted as the basis to evaluate the affects of current generation decisions upon future generations and the global environment. Figure 1 presents the basic idea. At time t_0 , a cone of possible future worlds stretches out in time. From the point t_0 , a small number of different worlds can be reached, depending on the state of technology, the world's population, and many other variables. However, each potential future world at t_1 can lead to a number of other different worlds, creating a combinatorial effect. The cone quickly widens to illustrate the potential freedom humanity possesses to chart its course through time. Thus, the framework captures the mythic image of the journey and the options concept mentioned above.



Within this framework, what is to be avoided are situations such as that depicted in Figure 2. In this case, for various reasons, the cone of possible future worlds is severely restricted, which threatens to violate the maintaining options obligation to future generations. The Xs represent worlds unattainable from the previous time period owing to various constraints (e.g., global climate change and population at t_1 preclude transition to worlds with low species extinction rates and low risks to human health). The Us represent worlds that can be transitioned to but are judged undesirable (e.g., high species extinction rates, loss of major ecosystems, and high risks to human health). In Figure 2, humanity is faced with little freedom and due to imponderables, may not be able to avoid the multitude of undesirable worlds.



In reality, humanity faces something like Figure 3. There is a great deal of uncertainty in every aspect of global climate change, from global science to man's interrelationships with the global environment.²⁹ We have some knowledge of worlds that we wish to avoid and implicitly understand that there are desirable worlds that we cannot reach within this or the next several generations. What we do not know with any certainty, because such modeling has not yet been done, is how constrained the past and current generations have made the cone of possible future worlds for our posterity or the characteristics of many possible future worlds, denoted by "?"s.³⁰

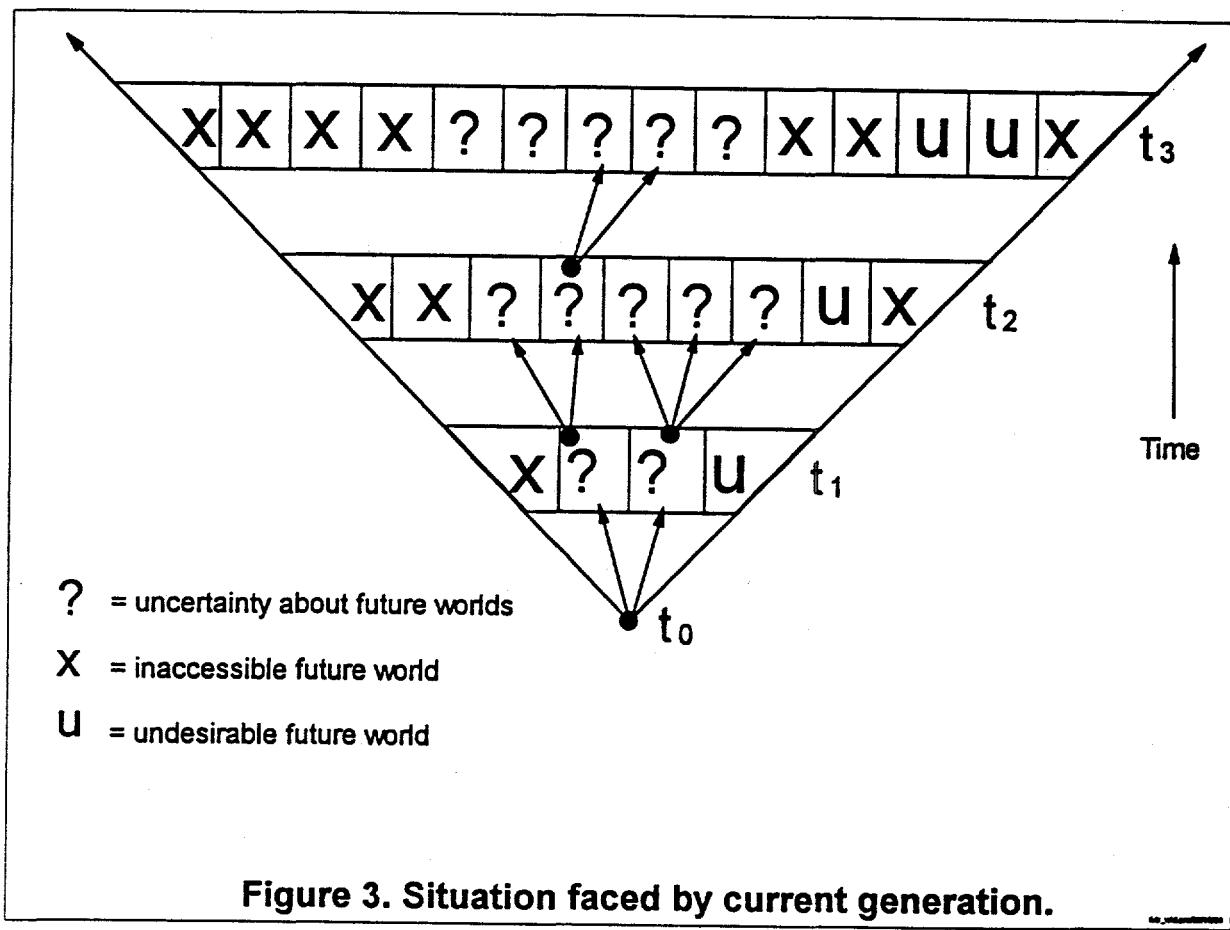


Figure 3. Situation faced by current generation.

To completely implement this modeling framework, a set of descriptors for the possible future worlds is needed. Table 1 presents an example set of descriptors that emanate from the ethical and psychological concerns and obligations to future generations discussed above. For example, several variables express concerns for animal species, sustainability, and the mythic image of mother earth. Issues of quality of life are easily incorporated into this framework. As is suggested in the *Action Plan* below, the set of descriptors should be developed through consultation with people around the world, including global climate scientists, ecologists, social scientists, philosophers, and ethicists as well as teachers, parents, farmers, factory workers, civil servants, and other people across the broad spectrum of life.

Building a computer-based possible future worlds modeling system that incorporates variables such as those presented in Table 1 is a very challenging endeavor. Managing the combinatorics is an obvious problem (e.g., how many time periods should be modeled, how many worlds can each world lead to) but the advent of massively parallel computers lessens this problem to a significant degree. The real challenge will be constructing the integrated models that contain the descriptors, which range over the disciplinary landscape. It may, and probably will, require an integrated theoretical framework—not just economic theory linked with political theory etc. but truly integrated concepts of human behavior—to accomplish this task. It is hoped that the framework presented here will spur social scientists to cross disciplinary boundaries to create the necessary theoretical framework.

TABLE 1. EXAMPLE POSSIBLE FUTURE WORLD DESCRIPTORS

Instrumental Variables	Measurable Variables
Survival of species	Species extinction rate; Species still surviving
Survival of ecosystems	Number of healthy major ecosystems; Number of threatened major ecosystems
Survival of the planetary ecosystem	Global indicators of air, soil, and water quality; concentration of greenhouse gases in atmosphere and global climate change; sea-level rise; Depletion of ozone layer
Survival of mankind	Lower and upper probabilities of global nuclear or ecocatastrophe that could result in significant reduction of human population
Preservation of individual freedoms	Hours per average day individuals devote to "self-protection from human-made hazards and self-verification of safety" ³¹
Preservation of societal options	Percentages of gross national product, government options expenditures, and research and development devoted to "self-protection from human-made hazards and self-verification of safety"
Conservation of natural resources	Reserves of non-renewables; human resources; quantity and quality of renewables; preservation of cultural past
Non-contamination environment	Total and net emissions of pollutants into the environment
Humane treatment of species	Exposure to toxins by representative species
Political stability	Percentage of world's population affected by war and social strife
Protection of human health	Risks of mortality and morbidity due to exposure to environmental toxins; infant mortality rates
Preservation of quality life	Indicators of overcrowding, food availability, technology, economic progress, quality of work, access to nature and open space, etc.

JUDGING MORAL OBLIGATIONS ASSOCIATED WITH GLOBAL CLIMATE CHANGE

Building the possible future worlds model is just one component of a comprehensive methodology that involves future generations, environmental ethics, and global environmental change. The second major component involves judging the cone of possible future worlds for violations of obligations to future generations. Based on those judgments, current generations may be morally obligated to undertake actions to bring obligational accounts into balance.

More formally, it is proposed that such judgments follow the *diagnosis and treatment* paradigm. The paradigm is quite straightforward, given a set of descriptors of a situation, a diagnosis is rendered (i.e., the situation is classified according to a standard set of diagnoses). Based on the diagnosis and other factors (i.e., technical knowledge, resources available), a treatment is decided upon, if indeed action is warranted. This model is the foundation for medicine—patient symptoms indicate a diagnosis, upon which treatments are decided—and law—facts of the case lead to a verdict and then, if guilt is found, to appropriate punishment. It can be argued that this paradigm is the foundation of human knowledge.³²

With respect to our problem, the "symptoms" correspond to the cone of possible future worlds, with the descriptors attached to each possible future world. People would examine the cone and the descriptors and make a diagnosis. Examination is facilitated by the visual nature of the cone itself—people will be able to see and feel the diagnosis. For discussion purposes, here are four possible diagnoses: *green* - future options are unconstrained and risks are acceptable; *yellow* - options are partially constrained and human health and ecosystem risks are somewhat unacceptable; *red* - options are greatly constrained and human health and ecosystem risks are clearly unacceptable; and *black* -

options are severely constrained and human and global ecosystem survival is questionable.

How people approach these diagnoses will be based upon their intuitive, common-sense notions of morality and ethics. People should be encouraged to represent humanity, not themselves when making these diagnoses.³³ One could argue that these judgments will informally express more formal decision rules, such as the neutrality and consent criteria mentioned above.

Based on the diagnosis, made by people from all over the world from all walks of life, certain actions may be morally obligated to protect future generations and the global environment. For discussion purposes, here are suggestions of morally obligated actions linked to the four diagnoses listed above: green - no action required; yellow - restrictions on current production are warranted and justifiable; red - restrictions on current production and consumption are warranted and justifiable; and black - restrictions on current production, consumption, and procreation are warranted and justifiable.

It is left to current generations, if so warranted, to implement these "treatments" within their own socioeconomic cultures and to implement programs within their own political processes. The diagnoses and actions themselves should be "timeless" in that they should be relevant to any generation living at any point in time within any type of technological and socioeconomic culture. As a final point, it needs to be noted that these judgments can be rendered without having to monetize all of the possible future world descriptors and without having to discount such variables, which would lessen *a priori* concerns for future generations. These two observations, combined with the ability of the entire framework to include noneconomic variables, indicates that the methodology overcomes the major criticisms of the economic methods presented in the *Introduction*.

ACTION PLAN

To summarize, presented herein is a methodology to analytically represent concerns for future generations and global ecosystems with respect to policy investigations related to global environmental change. This methodology is based on the possible future worlds framework and is complemented by the diagnosis - treatment paradigm. In combination, this methodology has the potential to incorporate a wide range of descriptors of possible future worlds and respect a broad range of obligations to future generations.

This methodology is presented as an alternative to the methodologies based solely on the economic paradigm that currently dominate global environmental change policy analysis in the United States. This methodology should be implemented quickly, not only to illustrate its value to government policy makers, but, more importantly, to begin to establish what indeed is the global diagnosis on the problem of global environmental change and future generations.

The following actions must be accomplished to implement this methodology:

(1) Determine elements of the set of descriptors of the possible future worlds.

People from all walks of life, all cultures and backgrounds, should be interviewed to build a baseline database for the set of descriptors. Social science techniques such as focus groups and surveys should be used to collect this data. Work will be needed to coalesce these variables into forms amenable for modeling and analysis. Widespread and earnest public involvement is necessary to build credibility for the outputs of the entire methodology.

- (2) Build possible future worlds model. Many pieces for such a model already exist (e.g., several general circulation models (GCMs) exist to forecast changes in mean global temperature due to doubling of CO₂ in the atmosphere). Many other pieces need original development (e.g., modules to forecast individual time and GNP spent on self-protection). Work is needed to integrate the pieces into a coherent modeling system within the possible future worlds framework. The result of this task should be an instantiated cone of possible worlds starting at the present time and extending for many generations into the future.
- (3) Determine set of potential future worlds diagnoses and corresponding ethical actions. The responsibility for this task should fall to ethicists and philosophers who represent a range of worldviews. These people should be joined by people whose expertise is in policy analysis and government decisionmaking to ensure that the diagnoses and actions are interpretable and of practical value within real political processes. A major challenge will be to resolve conflicts between worldviews to arrive at consensus. Draft diagnoses and ethical actions should be reviewed by people around the world to gain constructive criticism and then should be revised accordingly.
- (4) Present instantiated cone of possible worlds, and the sets of diagnoses and ethical actions to people around the world for evaluation and judgment. The cone of possible future worlds should be presented in a manner to allow effective visual interpretation across cultures. How diagnostic judgments are to be rendered should be kept as flexible as possible. However, it is preferable

that judgments be made in ways to involve people and communicate credibility and seriousness so that consensus upon a diagnosis implies commitment to undertake morally obligated actions if warranted. For example, judgments could be rendered by a special Court of Generations, empowered to speak on behalf of a nation of people on the topic of global environmental change and future generations.³⁴

- (5) Evaluate progress toward meeting obligations. This work will require the on-going and coordinated effort of the world's research institutions and researchers from numerous scientific disciplines. Much of the data needed for evaluation are already being collected or will soon be collected. Plans will need to be made and resources made available to collect other data needed for evaluation.
- (6) Institutionalize the process. It is recommended that the entire process be repeated every five or ten years. This will provide time in between global diagnoses to evaluate progress and is rare enough to engender "specialness" in the process.

ACKNOWLEDGEMENTS

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Endnotes

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26. Alan Tough, 1993. "What Future Generations Need From Us," *Futures*, Dec.
27. Joseph DesJardins, 1993. *Environmental Ethics: An Introduction to Environmental Philosophy*, Wadsworth Publishing Co., Belmont, CA, p. 90.
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30. It should be noted that we may not even understand the current world well enough to see how the past has constrained us.
31. Phillip Frankenfeld, 1993. "Simple Gifts: Complex Environmental Hazards and the Responsibility to Leave a Controllable World," *Futures*, Jan/Feb. p. 33.
32. It is interesting to note that in fields such as medicine, the treatments change more rapidly than the diagnoses. In other words, knowledge creation tends to focus on developing better treatments for diagnosed conditions, rather than on redefining the diagnoses themselves. Accomplishing the latter probably requires revolutionary shifts in intellectual paradigms as described by Thomas Kuhn, 1962. *The Structure of Scientific Revolutions*. The University of Chicago Press, Chicago, IL.
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