Branch Points:
Global Scenarios and Human Choice

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A Resource Paper of the *Global Scenario Group*

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This publication series is produced by Stockholm Environment Institute's PoleStar Project. Named after the star that guided voyagers through uncharted waters, the multi-year PoleStar Project addresses critical aspects of the transition to sustainability. *Scenario analysis illuminates* long-range problems and possibilities at global, regional, national, and local levels. *Capacity building* strengthens professional capabilities for a new era of development. *Policy studies* fashion strategies and actions. To aid these efforts, the project developed the PoleStar System©, a comprehensive, flexible, and user-friendly decision-support tool. The PoleStar System is now used internationally in diverse sustainability studies to organize pertinent data, formulate alternative development scenarios, and evaluate strategies for sustainable development.

To carry forward the global aspects of this work, a *Global Scenario Group (GSG)* was established to engage a diverse group of development professionals in a long-term commitment to examining the requirements for sustainability. The *GSG* is an independent, international, and inter-disciplinary body, representing a variety of geographic and professional experiences. It engages in an on-going process of global and regional scenario development, policy analysis, and public education. The diversity and continuity of the *GSG* offer a unique resource for the research and policy communities. The *GSG* pursues its objectives through research, publication, and collaboration with sustainable development projects at national and regional levels.

This report presents the perspective of the *GSG* on the sustainability challenge and on global futures. It is offered as a resource document to scientific, policy, and awareness-building efforts for fostering desirable social and environmental conditions in the 21st Century.

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6. *Accounting for Toxic Emissions from the Global Economy: The Case of Cadmium* (Jackson and MacGillivray)

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ABSTRACT

The quest for sustainability must be pursued at many levels -- local, national, regional, and global. Unique sets of issues, solutions, and institutional processes come into focus when the problem is viewed from these various perspectives. In addition, it is important to consider the interplay between levels. In our globalizing world, regional and national strategies for sustainable development will be myopic unless they also are informed by a global perspective.

Today, globalization takes many forms -- stresses on the biosphere, far-reaching cultural impacts of communication technology, the expansion of worldwide commerce, and the rise of new geo-political tensions. Driven by this powerful new constellation of forces, the world system is at an uncertain *branch point* from which a wide range of possible futures could unfold in the 21st Century. The transformation of human civilization could be profound, perhaps as significant as the transition to settled agriculture and the industrial revolution. The aim of this study is to explore scenarios of the future and to consider their implications.

The concept of sustainability implies the reconciliation of long-term development and environmental goals; it is concerned with the future. While the future is open and cannot be predicted, scenarios offer a powerful means for examining the forces shaping our world, the uncertainties that lie before us, and the implications for tomorrow of our actions today. A scenario is a story, told in words and numbers, concerning the manner in which future events could unfold and offering lessons on how to direct the flow of events towards desirable pathways and away from undesirable ones.

The report begins with a description of the sustainability problem and outlines criteria for a transition to sustainability. Key methodological concepts for scenario analysis are described. A taxonomy of scenarios is introduced based on a two-tier hierarchy: *classes* distinguished by fundamentally different social visions and *variants* reflecting a range of possible outcomes within each class.

Three broad scenario classes are depicted -- *Conventional Worlds*, *Barbarization*, and *Great Transitions* -- which are characterized by, respectively, essential continuity with current patterns, fundamental but undesirable social change, and fundamental and favorable social transformation. *Conventional Worlds* envision the global system of the 21st century evolving without major surprises, sharp discontinuities, or fundamental transformations in the basis for human civilization. The future is shaped by the continued evolution, expansion, and globalization of the dominant values and socio-economic relationships of industrial society. By contrast, the *Barbarization* and *Great Transition* scenario classes relax the notion of the long term continuity of dominant values and institutional arrangements.

Two variants are considered in detail for each class, for a total of six scenarios. Within *Conventional Worlds*, the *Reference* variant incorporates mid-range population and development projections and typical technological change assumptions. The *Policy Reform* variant adds strong, comprehensive, and coordinated government action, as called for in many policy-oriented discussions of sustainability, to achieve greater social equity and environmental protection. In

this scenario, the political will evolves for strengthening management systems and rapidly diffusing environmentally friendly technology. Whatever their differences, *Conventional Worlds* variants share the premises of the continuity of institutions and values, the rapid growth of the world economy, and the convergence of global regions toward the norms set by highly industrial countries. In the business-as usual *Reference* variant, the problem of resolving the social and environmental stress arising from global population and economic growth is left to the self-correcting logic of competitive markets. In the *Policy Reform* variant, sustainability is pursued as a proactive strategic priority.

 Barbarization scenarios envision the grim possibility that the social, economic, and moral underpinnings of civilization deteriorate, as emerging problems overwhelm the coping capacity of both markets and policy reforms. The *Breakdown* variant leads to unbridled conflict, institutional disintegration, and economic collapse. The *Fortress World* variant features an authoritarian response to the threat of breakdown. Ensconced in protected enclaves, elites safeguard their privilege by controlling an impoverished majority and managing critical natural resources, while outside the fortress there is repression, environmental destruction, and misery.

 Great Transitions explore visionary solutions to the sustainability challenge, including new socio-economic arrangements and fundamental changes in values. These scenarios depict a transition to a society that preserves natural systems, provides high levels of welfare through material sufficiency and equitable distribution, and enjoys a strong sense of social solidarity. Population levels are stabilized at moderate levels, and material flows through the economy are radically reduced through reduced consumerism and massive use of green technologies. The *Eco-communalism* variant incorporates a green vision of bio-regionalism, localism, face-to-face democracy, small technology, and economic autarky. The *New Sustainability Paradigm* variant shares some of these goals, but would seek to change the character of urban, industrial civilization rather than replace it, to build a more humane and equitable global civilization rather than retreat into localism.

 In a final section, future tasks for global scenario analysis in the areas of science, policy, and public education are discussed. The paper closes with a reflection at the branch point, noting that a business-as-usual *Conventional Worlds-Reference* future could put severe social and environmental stress on the global system in the next century and that such stress would increase the peril of lurches toward *Barbarization*. A *Conventional World-Policy Reform* future would counter these risks, but due to limited political will and the sheer scale of the problem policy initiatives alone may be inadequate to the sustainability challenge. New values and institutions, a *Great Transition,* may be both needed for sustainability and desired as a new stage of civilization. Policy scenarios warrant our near term attention since they mitigate risk, while keeping open opportunities for the development of a new sustainability paradigm.

1. The Challenge

We live in an age of accelerating change and uncertainty. The future is open: no one can predict with any certitude how history will unfold in the 21st century. Yet, more than ever, we must consider the possible futures that might emanate from the turbulent conditions of our time, and the implications for human choice and action. In this spirit, this paper offers a perspective and framework for reflecting on global scenarios as human civilization approaches critical branch points over the coming decades.

Global scenario analysis aims to illuminate the character of the current global system, the dynamics driving it forward, and the spectrum of possible future states and pathways. The endeavor is animated by a conviction. It assumes that informed human choice, mediated through governmental policies, civil initiatives, and individual decisions, can shape the future in essential ways. While reflecting realistically on the perils for the future, we retain the optimism that there are attractive possibilities, as well, for humanity and the environment in the 21st century.

1.1. The Human Predicament

For most of human history, the challenge for the human race has been survival against natural forces that have been often harsh and unpredictable. The power to shape, control, and transform nature evolved gradually over several million years. Then, the industrial revolution, in the context of the emergence of the capitalist economic system and the modern world-view, initiated a two hundred year process of rapid change in technology, population, the environment, and the social order.

The increasingly interdependent global system we observe today is a way-station in this sweeping process of growth, transformation, and expansion. But a new and ominous feature of the current phase of history is that human impacts on the environment have reached global scales. The contradiction between the growth imperative of the modern world system and the constraints of a finite planet will be resolved. The critical question is, how?

In the 20th century, humanity acquired military weapons of such power as to become a serious threat to itself. With the end of the Cold War, that threat has receded for now. But a new and more subtle challenge awaits humanity in the 21st century -- the challenge of creating a sustainable global civilization. There are unprecedented possibilities for technological and economic progress that could eradicate hunger and many diseases, improve the human condition, enrich the human stock of knowledge and cultural achievement, and increase opportunity and choice.

At the same time, the sheer scale of the human enterprise -- the number of people, the growing levels of material consumption and production -- may exceed the carrying capacity of the planet. Human lifestyles and the industrial systems that support them threaten to change the climate, degrade ecosystems, and deplete the earth's biological wealth, altering the natural environment on a global scale. And the 21st century may consign billions of the yet unborn to an existence of poverty, hunger, and hardship. The destitution of multitudes amidst unprecedented levels of wealth and comfort for the privileged could portend social unrest and violence on unprecedented scales, challenging the very notion of a global civilization.

How humanity will cope with such challenges is not certain. Nor is the outcome determined; it will be influenced by the individual and collective choices that we make. Will we be able to hand on to our grandchildren a global society -- and a planet -- that is richer in possibilities than our present one, or will we leave a more impoverished Earth as a patrimony for future generations? Will human existence and human institutions such as families and communities be more secure or more fragile in the global society of the mid-21st century?

1.2.   The Sustainability Notion

Sustainability is concerned with reconciling the long-term development of human society with the finite limits of the planet. Implicit in the notion of sustainability are such questions as: How shall we use the Earth? What kind of human society shall we build on it? And how can we leave future generations a world with more opportunities rather than fewer? The classic formulation that sustainable development "meets the needs of the present without compromising the ability of future generations to meet their own needs" reflects these broad notions (WCED, 1987).

Two legitimate moral and social imperatives must be reconciled: the needs of the present and the needs of the future. The living standards of the billions today who do not enjoy the benefits of human progress -- many of whom cannot satisfy even their basic needs -- must be improved. At the same time, development patterns in both rich and poor countries must be altered so as not to leave a bitter social and environmental legacy to future generations. For example, industrialization has relied on inexpensive and abundant fossil energy resources, particularly oil, natural gas, and coal. Yet continued reliance on these fuels for the expansion of industrial activity risks committing the world to significant climatic alterations and extreme weather events for centuries to come (IPCC, 1996).

Environmental degradation may not be the only sad bequest to our descendants. Equally grave could be the degradation of the notion of civilization itself. As the willful slaughter of millions in the Holocaust left a poisonous mark on the 20th century, the potential descent of whole regions into chaos, violence, or starvation could taint the 21st. If the disparity between rich and poor classes and countries continues to grow, the implications are not positive for building international stability and a global community.

What might characterize a sustainable world? What should our goals be? While the notion of sustainability, as an ideal, must accommodate a diversity of views, many people might agree that they would like their grandchildren and great-grandchildren to inherit a world, half a century hence, in which

- absolute poverty, malnutrition, and famine are eradicated, and access to basic health care and education is universal;
- quality of life is improving, with satisfactory material conditions and expanding opportunities for fulfillment for all;
- inequity between rich and poor is diminished;
- environmental quality is increasing, with critical biological resources recovering, pollution under control, and climate stability in sight;
- violence and armed conflict are infrequent;
- human solidarity is stronger at family, community, and global levels; and

- global population growth ceases.

This vision reflects widely held values -- freedom from want and from fear, desire for higher quality lifestyles and for a more equitable world, and a concern for environmental preservation. The goals are closely coupled. Stabilization of the global population, for example, probably also requires arranging a world economy in which access to shelter, food, health care, security, and education are universal. Also, poverty reduction and greater equity almost certainly are essential for preserving biological resources. Moreover, preventing increased violence and conflict may depend both on rising incomes and on increased equity within countries and between rich and poor regions.

Yet providing for economic growth and rising standards of living without increasing pollution and accelerating climate change requires a profound transformation in industrial processes, in the basis of modern lifestyles, and in the structure of economic development. The coupling across issues and sectors is at the heart of the idea of sustainability. It means that we may need to achieve these goals together, or not at all.

1.3. The Policy Context

The present period is one of change and confusion. The collapse of the Soviet Union ended the Cold War that dominated international policy for half a century. The ascendancy of the market model of economic organization has led to policy reforms in many countries encouraging privatization, deregulation, and free trade. While in some countries these efforts have fostered rapid economic growth, for many others, development has proven elusive or has benefited only a very few.

At the same time, the globalizing economy, with increasingly powerful multinational corporations and greater mobility of capital, has changed the conditions under which national economic development occurs. The Earth Summit in 1992 marked a recognition that environmental, social, and economic concerns are closely connected and must be pursued jointly. Yet structures of power and habits of mind change slowly. Many development efforts are still narrowly focused, and effective models, for more integrated approaches to sustainable development are still lacking. Moreover, many individuals and institutions have a strong stake in preserving existing arrangements. Large landowners often resist land reform, energy producers (companies and countries) often slow efforts to address climate issues, privileged groups often oppose efforts to help the poor, and multinational corporations seek unfettered access to natural resources. Social transition is difficult, especially without a widely-shared positive vision of the purpose of change and why it is necessary.

Despite globalization, the world is still sharply divided into rich countries and poor ones, who face very different constraints and opportunities. Advanced industrial countries, despite the often extreme dichotomies between their rich and poor citizens, could, in principle, decouple themselves from the developing world. This is because they are increasingly less dependent on natural resources, especially from the South. The developing countries, in contrast, are still highly dependent on trade, technology, and capital from the rich countries.

This notwithstanding, the destinies of rich and poor are more tightly coupled than ever before in history. The linkage is environmental and social. The environmental link derives from the fact that rich and poor share the same planet, and the social link, from the fact that poverty and social disintegration in the South can threaten the security and well-being of the North, due to the increased mobility of people in a global economy. If they can export nothing else, the poor can at least readily export their misery, through migration, crime, terrorism, and disease.

This coupling of destinies means that there are no separate solutions, one for the South and one for the North. Only a truly global solution can achieve a humane and sustainable future. This is why the level of discussion and planning must be moved higher, to the level of the human species, the biosphere, and the global society.

A source of hope is the growing realization that, once a sufficient level of material well-being is achieved, quality of life can expand without parallel increases in material requirements. The consumer society, with its presumption of ever expanding material wants, is not synonymous with development and greater human welfare. Sustainable economic development can be based on qualitative expansion -- growth in knowledge, in human capabilities, in social capital -- that does not imply ever-increasing material wealth and environmental pressure.

2.   The Scenario Approach

While the concept of sustainable development has stimulated considerable debate on specific interpretations, it is clear that inherent in the notion is a concern for the long-range future. Substantive analyses of the meaning and implications of sustainable development require a long view over at least several generations. Projections of trends in human affairs may be legitimate over the short term, but not as time horizons expand from months and years to decades and generations. Fundamental uncertainty is introduced both by our limited understanding of human and ecological processes and by the intrinsic indeterminism of complex dynamic systems. Moreover, social futures will depend on human choices which are yet to be made.

2.1.   Objectives

Scenario analysis offers a way to consider long range futures in light of these uncertainties and to examine the requirements for a transition to sustainability. Scenarios are not projections, forecasts, or projections. Rather, they are stories about the future with a logical plot and narrative governing the manner in which events unfold (Schwartz, 1991; Cole, 1981; Miles, 1981). Scenarios usually include images of the future -- snapshots of the major features of interest at various points in time -- and an account of the flow of events leading to such future conditions. Compelling scenarios need to be constructed with rigor, detail, and creativity and evaluated for plausibility, self-consistency and sustainability.

Scenario analysis challenges us to ponder critical issues and to explore the universe of possibilities for the future. Scenarios also clarify alternative world views and values, challenge conventional thinking, and encourage debate. Since scenarios embody the perspectives of their creators, either explicitly or implicitly, they are never value-free. They draw on both science -- an understanding of historical patterns, current conditions, and physical and social processes -- and imagination, to conceive, articulate and, evaluate a range of socio-ecological pathways (Raskin et al., 1996a).

To shed light on the problem of global sustainability, we wish to consider scenarios that incorporate alternative social visions and highlight significant causal processes and critical decision points. At such points, the choices of many actors and interests -- individuals, corporations, labor, policy makers, political institutions, cultural and spiritual leaders, and environmental activists -- can influence which global pathway emerges from the panoply of possible futures. Ultimately, the scenario approach can provide a common framework for diverse stakeholders to address the critical concerns of our time and a forum for discussion and debate on the sustainability transition. In the near term, scenarios can offer guidance to the national and international policy community for converting the sustainability principle into practical policies and actions.

2.2.   System Perspectives and Scenario Criteria

The evolving world system can be considered a *socio-ecological system*, comprised of environmental and human subsystems and their interactions (Gallopín et al., 1989), as illustrated in Figure 1. The environmental subsystem may in turn be decomposed into ecosystems,

biophysical processes, and other aspects of the natural world. The economic and social subsystems include various sectoral components and cultural and institutional processes. Because subsystems interact in numerous ways and are mutually conditioning, a sharp distinction between dependent and independent variables is not meaningful. However, at a given time, certain processes may dominate the dynamics of the whole system, and thus may be considered "driving forces".

Socio-ecological systems can be defined at multiple spatial levels -- global, regional, national, local. Different issues come into focus as one *zooms* in or out. For example, a planetary panorama is needed to reveal global economic, cultural, demographic, and environmental phenomena. A regional perspective is required to analyze the problems of acid rain, water allocation, and certain migration patterns. A national focus sheds light on many policies, trade patterns, and security issues. A local view often is appropriate for evaluating land-change patterns, biodiversity, and ground level pollution. Though our focus here will be global, all levels of resolution are needed to understand the entire system of interactions and to fully address the problem of sustainability.

Figure 1. The Socio-Ecological System
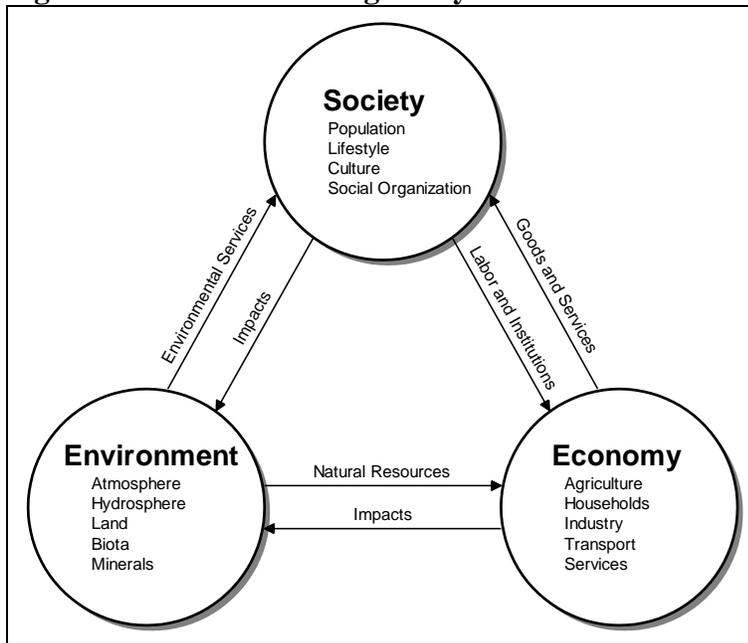
Source: Raskin et al. (1996a)

With the socio-ecological systems framework in mind, design criteria for policy-oriented scenario analyses may be identified (Swart et al., 1996). Ideally, scenarios would be

- *global*, with regional and, ultimately, subregional disaggregation;
- *comprehensive*, with integrated treatment of major environmental, social, and economic issues and interactions;
- *analytically sound* with regard to use of data and scientific theory; and

- *diverse* with representation of a range of future visions, values, and world views

Scenario development is best approached as an ongoing process. Scenarios become more refined in the course of time, benefiting from the feedback of policy, environmental, and public interest communities, better data, and advances in sustainability sciences. At the same time, scenarios can provide useful guidance to setting research agendas and prioritizing data development efforts. In this iterative manner, the degree of spatial resolution, the level of thematic detail, and the integration of scientific theory can evolve with time. The diversity criterion should be incorporated even in preliminary stages of scenario development so that a rich range of perspectives can inform the analysis, thus facilitating communication, consensus, and action.

2.3. Global Scenarios in Historical Perspective

Speculation on the future has been a constant in human history, embedded in mythology, religion, social visions, and literature. Since the 1970s, scenario explorations have brought the problem of the environment and development to the forefront of political attention. Early work included mathematical simulation models (Meadows et al., 1972; Herrera et al., 1976; Mesarovic and Pestel, 1974), qualitative exercises (Kahn and Wiener, 1967; Kahn, Brown and Martel, 1976), input-output analysis (Leontieff, 1976), and eclectic approaches (Barney, 1980). Reviews and critiques of global assessments introduced fresh insight (University of Sussex, 1973; Meadows et al., 1982).

More recently, a second wave of global scenario studies have included narrative scans of alternative futures (Burrows et al., 1991; Milbrath, 1989), an optimistic analysis by the Dutch Central Planning Bureau (1992), the pessimistic analysis by Kaplan (1994), a consideration of surprising futures (Svedin and Aniansson, 1987; Toth et al., 1989), and the United Nations Global Outlook (United Nations, 1990). The climate change issue gave rise to numerous model-based world energy scenarios, most importantly, those of the Intergovernmental Panel on Climate Change (IPCC, 1992), which generally remain within conventional notions of long-range development. In addition, authors have revisited first-wave studies and affirmed their essential findings despite intense and sometimes rancorous criticism in the interim (Barney et al., 1993; Meadows et al., 1992).

2.4. Methodological Elements

Many global studies rely heavily on complex mathematical models. The aim is a desirable one of establishing a disciplined and internally consistent basis for understanding complex processes. But formal models also have significant limitations for representing complex and open human systems, notwithstanding occasionally excessive claims for them. Models implicitly embody specific disciplinary paradigms (e.g., economics or ecology) and, even within these paradigms, can capture only those elements that are reasonably well-understood and amenable to quantification. Also, the high level of spatial aggregation in many models can mask the local specificity underlying calculated average global and regional trends.

Moreover, overzealous reliance on mathematical models downgrades the importance of the underlying qualitative narrative of scenarios, leaving the world behind the figures opaque. Well-articulated scenarios will certainly include quantitative insight from scientific models. But they will give due weight, as well, to the scenario narrative and to key elements that are not quantifiable either in principle (e.g., cultural influences, behavior and institutional responses to change) or in practice due to inadequacies in data or scientific theory. Thus, scenarios can provide a broader perspective than exercises which are heavily model-based, while at the same time making use of various quantitative tools such as accounting frameworks (Raskin et al., 1996b) and mathematical simulation models (Hornung, 1992). Quantitative analysis can offer a degree of structure, discipline, and rigor. Narrative can offer texture, richness, and insight. The art is in the balance.

The development of scenarios generally begins with a characterization of *current state* and *driving forces* (Figure 2). These provide a representation of the conditions of the socio-ecological system and the major factors propelling the system forward. The driving forces are associated with persistent and dominant phenomena and processes already in the pipeline. In addition, the scenario description should include the identification of *critical uncertainties*, the resolution of which will fundamentally alter the course of events. The current state, driving forces, and critical uncertainties form the backbone of the scenarios. In addition, all scenarios unfold according to an internal logic which links the elements into a coherent plot.

Long-range scenarios must recognize the role of deliberate human actions and choices in shaping the future. Human choice is influenced by cultural preferences, social visions, and psycho-social factors that are not well understood. As a complement to the driving forces, it is useful to introduce the concept of attractive and repulsive forces which can "substantially redirect beliefs, behaviors, policies and institutions towards some futures and away from others" (Raskin et al., 1996a). If the attractors and repellors are assumed to be weak, or if they are consistent with current driving forces, the future evolves in what is typically called a business-as-usual scenario (referred to in this study as the *Conventional Worlds-Reference* scenario). Visions of the future can motivate actions toward reaching desirable outcomes; one must imagine a future before acting to create it.   In this manner, subjective visions of future states, operating through human awareness, choice, and agency become objective forces conditioning the evolution of socio-ecological systems. Also, shown in Figure 2 are "sideswipes", major surprises that can influence the future strongly, such as a world war, "miracle" technologies, an extreme natural disaster, a pandemic, or a breakdown of the climate system.

Figure 2. Driving Forces, Attractors, Sideswipes
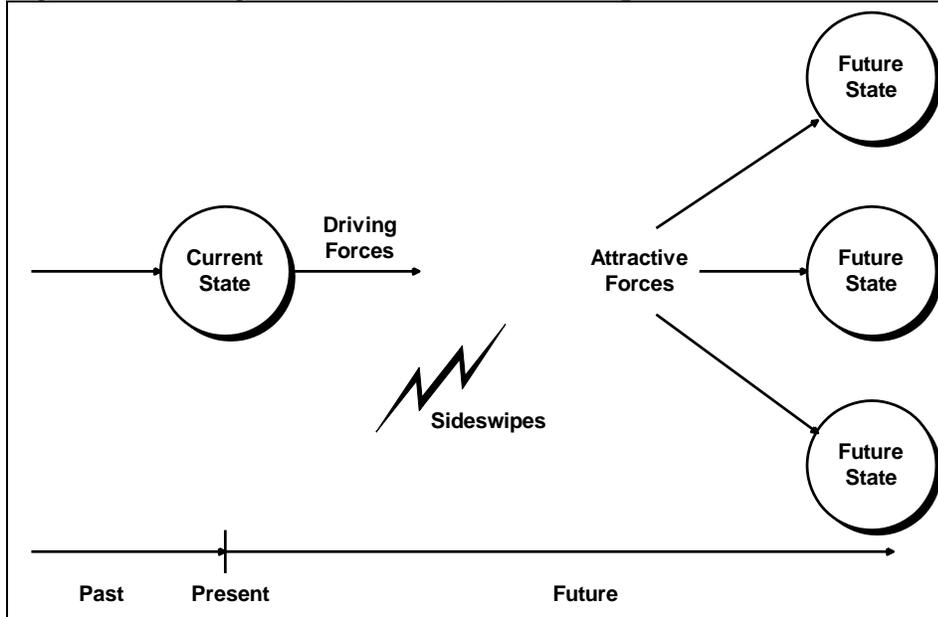
Source: Raskin et al. (1996a)

Finally, the construction and interpretation of a scenario will be influenced by the beliefs and theoretical assumptions of the analyst. The account of the mechanisms leading to alternative scenarios and judgment of the efficacy of alternative actions is guided by one's *world view*, although this is rarely made explicit.[1] Rarer still is the use of contrasting world-views to show the variation in scenario interpretation (Miles, 1981). Though always difficult, critical reflection and explication of the philosophical predisposition informing a scenario are essential aspects of scenario description and documentation.

Another important concept is the distinction between slow and fast dynamics operating within socio-ecological systems. High-level structures such as governance systems, economic modes of production, and cultural preferences tend to change relatively slowly. Environmental processes can also be slow; for example, significant climate response to human disturbances of the carbon cycle can take many decades.   By contrast, the dynamics of lower subsystems can be fast, like the changing behavior of individual consumers in response to financial signals or the quality of local water resources in response to emissions.

The tension between the slower processes of the whole and the more rapid changes of subsystems shapes the critical uncertainties in the system. Over the short term, the slower processes contain the faster processes. But as a system becomes progressively more complex, it can become more brittle and vulnerable to the influence of low-level, fast-dynamics (Holling, 1986). This can induce a rapid qualitative change to a new state. Notably, the growing extent and speed of global communications is accelerating high-level processes and injecting more potential for surprise into the global socio-ecological system (Gallopín, 1991).

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[1] A notable example was the Latin American World Model (Herrera et al., 1976).

Branch Points: Global Scenarios and Human Choice

The long-term persistence of the slow dynamics of large-scale structures is associated with scenarios in which the future is shaped strongly by the past without abrupt and fundamental discontinuities. We refer to this condition as *structural invariance*. For exploring a rich range of plausible long-term scenarios, however, the hypothesis of structural invariance has to be relaxed. We turn next to a structure for long-range global scenarios that goes beyond the assumption of the essential continuity of conventional structures.

3.   Scenario Overview

All scenario exercises must organize the bewildering zoo of possible futures into some kind of taxonomy. A practical structure for organizing global scenarios must balance between two competing considerations. The goal of analytic rigor invites an expansive range of scenario variations for exploring the full richness and texture of future possibilities. Conversely, the desire to communicate findings to a wide audience of non-specialists dictates brevity and clarity, not to mention resource constraints.

Generally, the exercises rely on a very few stylized scenarios for illuminating key issues, choices, and uncertainties concerning the future. In typical policy-oriented studies, a "mid-range" scenario is complemented by additional scenarios which are generated by varying key driving forces -- such as population, economic growth, and technological change -- across high-low ranges. Our intention here is to introduce a framework for transcending the practice of reducing the rich diversity of long-term possibilities to mere variation in quantitative assumptions.

It is useful to classify scenarios within a two-tier hierarchy: *classes* based on fundamentally different social visions and *variants* reflecting a range of possible outcomes within each class. This procedure highlights the plausible qualitative transitions in fundamental directions for society in light of today's driving forces, future uncertainties, and the many critical individual and collective decisions yet to be taken. We begin with three broad classes which we call *Conventional Worlds*, *Barbarization*, and *Great Transitions* -- distinguished by, respectively, essential continuity with current pattern, fundamental but undesirable social change, and fundamental and favorable social transformation.

Conventional Worlds envision the global system of the 21st century evolving without major surprises, sharp discontinuities, or fundamental transformations in the basis for human civilization. The future is shaped by the continued evolution, expansion, and globalization of the dominant values and socio-economic relationships of industrial society. By contrast, the *Barbarization* and *Great Transition* scenario classes relax the notion of the long- term continuity of dominant values and institutional arrangements. Indeed, these scenarios envision profound historical transformations over the next century in the fundamental organizing principles of society, perhaps as significant as the transition to settled agriculture and the industrial revolution.

For each class, we define two variants, for a total of six scenarios. Within *Conventional Worlds*, the *Reference* variant incorporates mid-range population and development projections and typical technological change assumptions. The *Policy Reform* scenario adds strong, comprehensive, and coordinated government action, as called for in many policy-oriented discussions of sustainability, to achieve greater social equity and environmental protection. In this variant, the political will for strengthening management systems and rapidly diffusing environmentally-friendly technology evolves. Whatever their differences, *Conventional Worlds* variants share the premises of the continuity of institutions and values, the rapid growth of the world economy, and the convergence of global regions toward the norms set by highly industrial countries. In the business-as-usual *Reference* variant, the problem of resolving the social and

environmental stress arising from global population and economic growth is left to the self-correcting logic of competitive markets. In the *Policy Reform* variant, sustainability is pursued as a proactive strategic priority.

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Many alternatives scenarios can be constructed as variations and blends of these pure cases. Scenarios more nuanced than the ideal types presented here would reflect regional variations and the possibilities of discontinuous jumps at critical points in the development trajectory. But the idealized taxonomy provides a useful framework and point of departure for more detailed explorations. *Conventional Worlds* is where the standard policy discussion occurs. *Barbarization* lurks as a danger, the punishment imposed on future generations for unwarranted complacency today. *Great Transitions* offer idealistic alternatives -- futures that may seem utopian, but are perhaps no less plausible than a sustainability transition without fundamental social transformation.

The scenario structure is summarized in Figure 3, along with indicative sketches of the behavior over time for six descriptive variables: population growth, economic scale, environmental quality, socio-economic equity, technological change, and degree of social and geopolitical conflict. The curves are intended only as rough illustrations of the possible patterns of change.
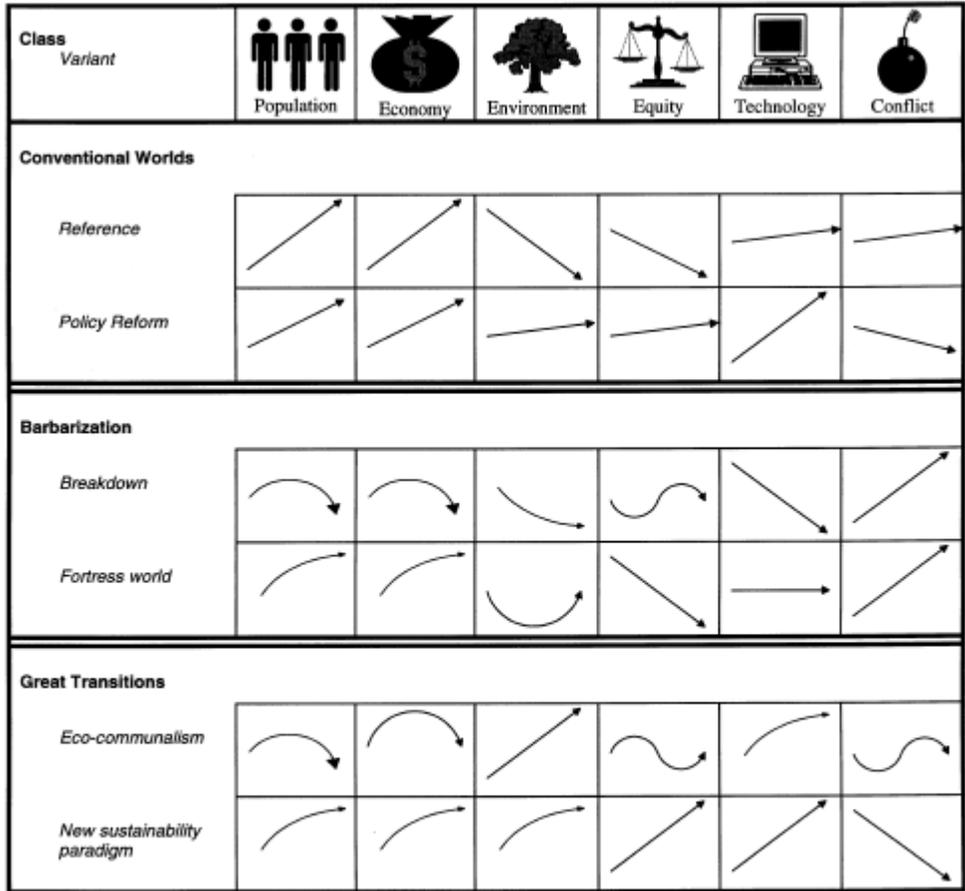
Figure 3. Scenarios Structure with Illustrative Patterns of Change

We expand on the scenario descriptions in the following sections. It is not our intention here to provide detailed quantitative characterization of scenario variants -- that shall remain a task for the future. Nevertheless, idealized and simplified scenario trajectories are illustrated in Figure 4 in a "space" defined by population along one axis and economic scale along the other. All scenarios depart from today's world, influenced by current driving forces. By the year 2100 -- the end of each trajectory in the figure -- the path has fractured into many possible future worlds due to different responses to critical conditions.

Conventional Worlds scenarios incorporate standard projections of population and economic growth. During the next century, population more than doubles and economic output increases by more than eleven-fold as developing regions gradually converge towards socio-economic patterns in rich countries. In *Barbarization-Fortress World*, global income grows very slowly as the few become much richer and the many get somewhat poorer. In *Breakdown*, world population peaks in the middle of the next century before falling because of famine,

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disintegration of health institutions and warfare, while income begin to fall with the collapse of the economic and technological base. In *Great Transitions*, population increases slowly to 2050, as the demographic momentum built into today's conditions plays out, then stabilizes or gradually decreases over the rest of the century, as a result of assumed increased availability of contraception, increased status of women, and decreased desire for child labor. This is plausible since some industrialized countries today have lower fertility rates than implied by even the lowest population growth levels shown.

Figure 3. Illustrative Global Economic Output and Population for Scenarios (1990-2100)
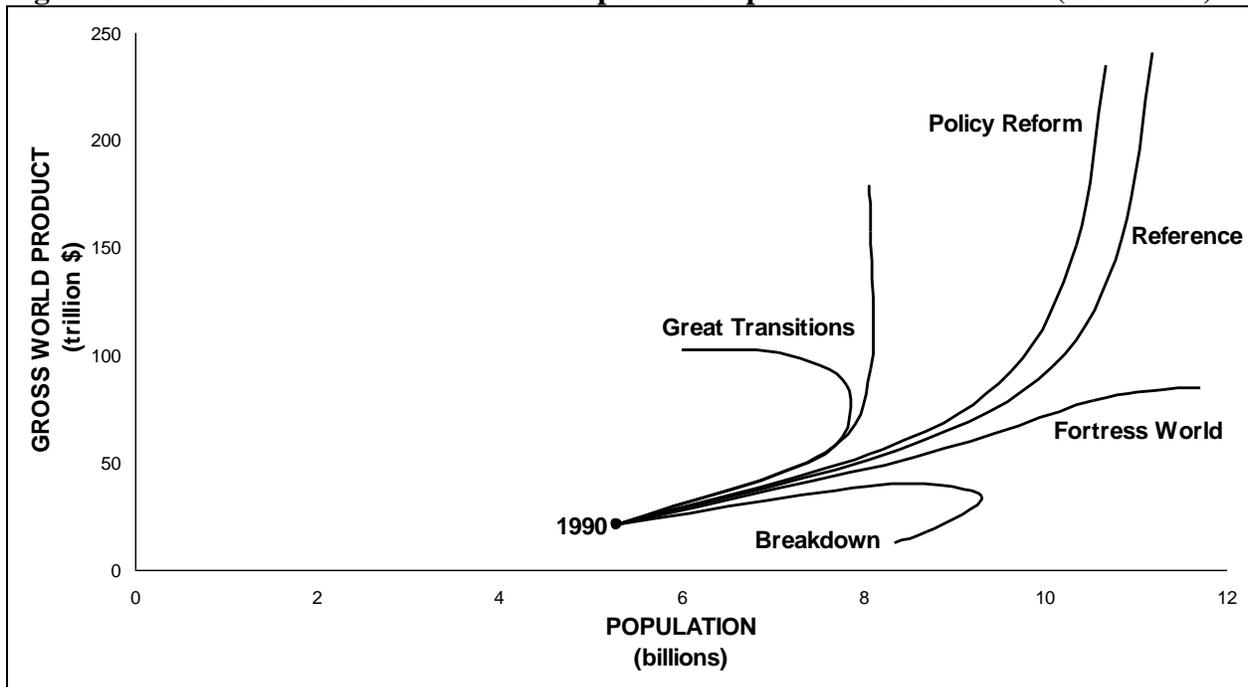
The global picture of Figure 4 can be disaggregated by region. To glean the broad patterns, we plot illustrative scenario patterns for two macro-regions in Figure 5, referred to as "rich and poor" regions (1990 figures are for the OECD and non-OECD regions). Figure 6 zooms in on the pattern in the rich regions.

Figure 4. Illustrative Economic Output and Population for Scenarios, by Macro-Region (1990-2100)
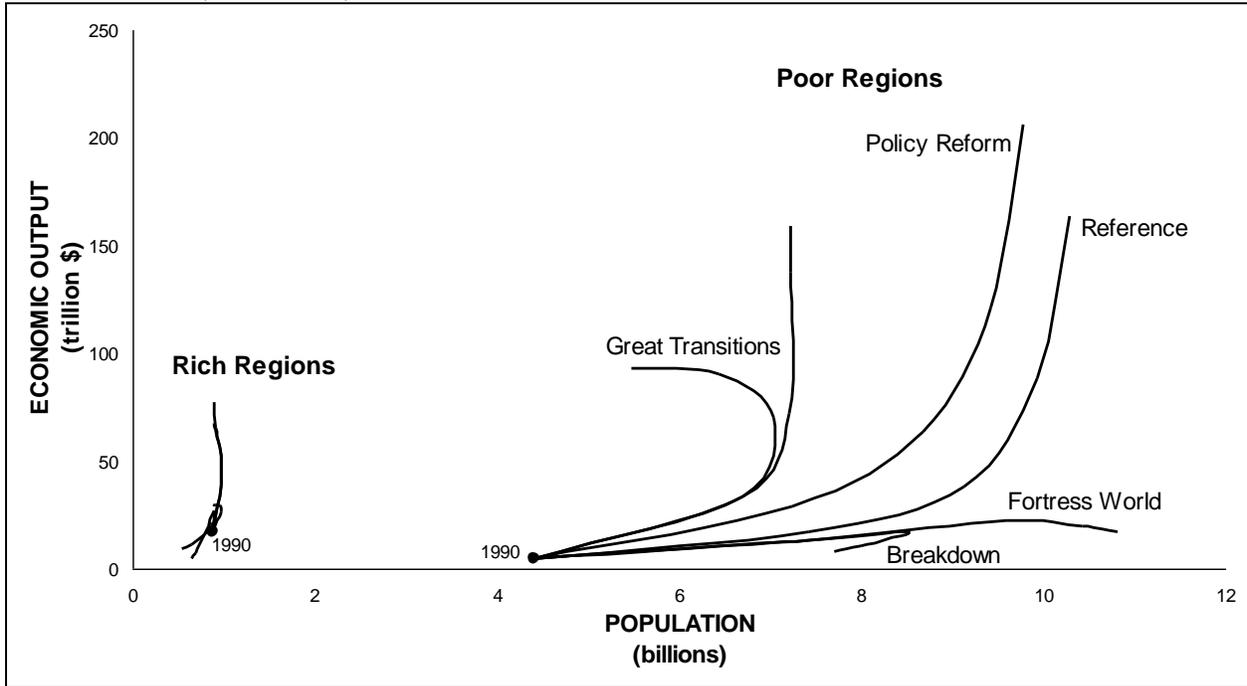
Figure 5. Economic Output and Population, Blow-up of Rich Regions (1990-2100)
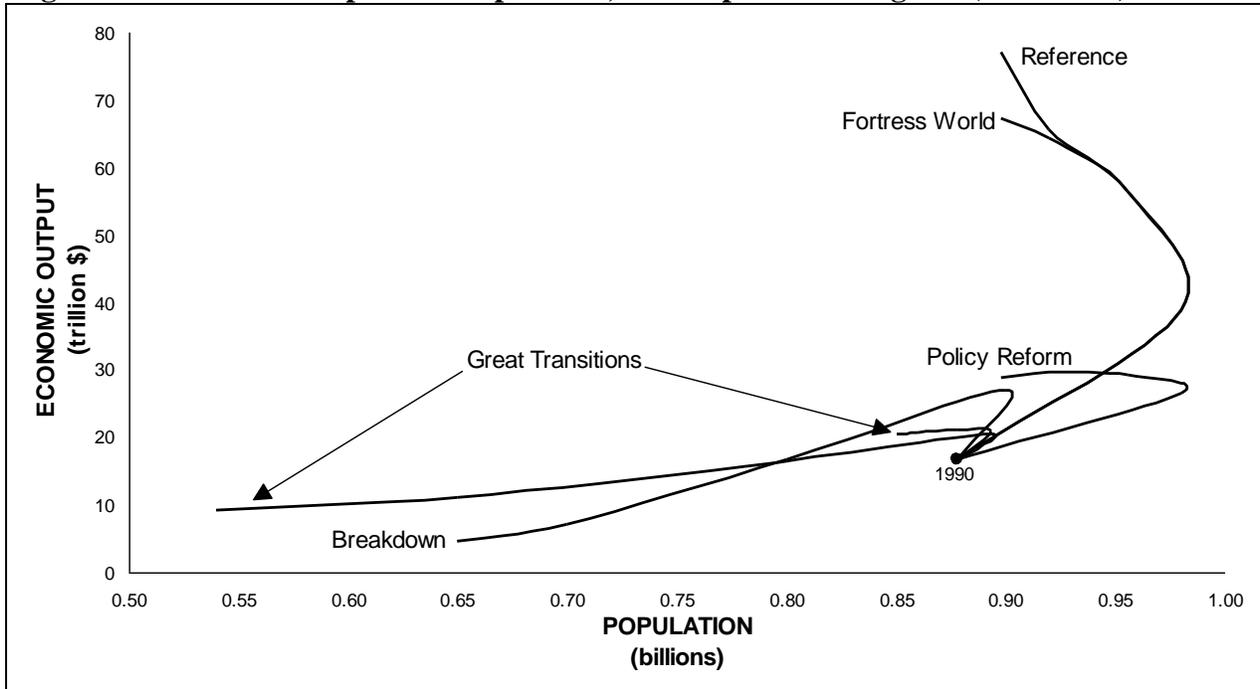
To get a better view of the equity implications of the scenarios, we plot the scenarios in an "equity space" (Figure 5). In this view, the axes are average incomes in rich and poor macro-regions (again, 1990 figures are for OECD and non-OECD, respectively). As a scenario approaches the *line of equity*, the difference between incomes in rich and poor areas diminishes. When a scenario moves parallel to the line of equity, the absolute difference in incomes between the regions is maintained. Despite relatively rapid annual percent growth of developing region economies assumed in standard projections, inequity persists in the *Conventional Worlds-Reference* scenario, as the curve moves away from the line of equity. In general, incomes gradually converge in the sense that the ratio of average GDP per capita in regions to other regions decreases. However, the *absolute* difference increases as incomes soar in rich countries.

By contrast, the trajectory of the *Policy Reform* variant approaches the line of equity. Nevertheless, substantial income disparities remain, even by 2100, despite the assumed moderate income growth rates in rich regions and substantial wealth transfers. In general, it is extremely difficult to redress fully the current global inequities under *Conventional Worlds* conditions that assume continuing economic growth in rich areas. *Barbarization-Breakdown* is a high-equity scenario but at low income levels, while the *Barbarization-Fortress World*, by definition, is a case of extreme inequity. The *Great Transitions* scenarios approach equity conditions rapidly.

Figure 6. Macro-Regional Equity Space for Scenarios (1990-2100)
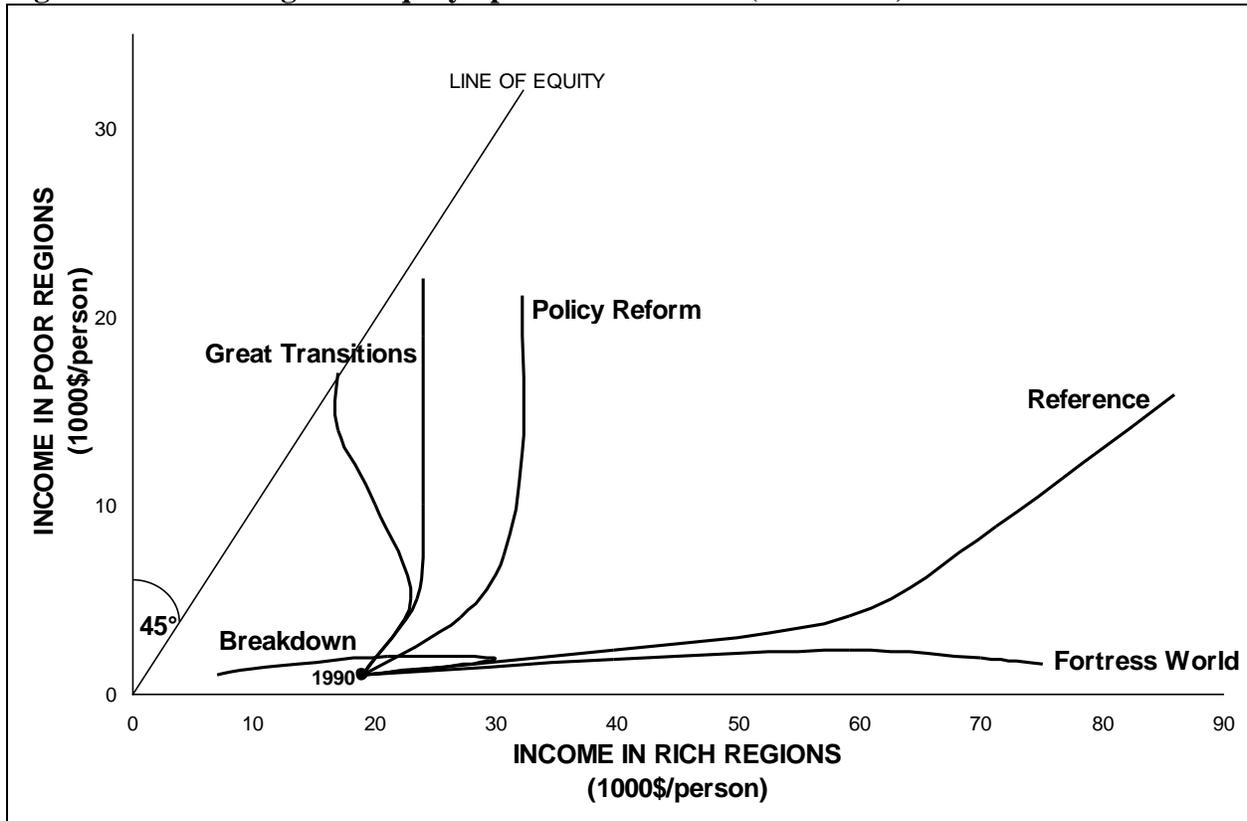
4.   Critical Trends

A number of conditions and processes now underway act as basic drivers of change. The momentum built into these drivers strongly influences the near-term evolution of the global system and reduces the likelihood, and even the possibility, of many long-range scenarios. While current trends are not inevitably persistent, they certainly condition the initial direction of economic, social, and environmental change and may strongly influence even the long term future. It is important to recognize, however, that ultimately these processes are themselves influenced by social, economic, and environmental conditions; they are human processes that can and do change as social attitudes and expectations adjust to altered circumstances.

4.1.   Population Growth

The human population is growing by about 900 million per decade -- the largest absolute increase in human history. Nearly all of this growth is occurring in developing countries. India's population, for example, is growing at 1.9 percent per year, as are the populations of Latin America and East Asia. Africa's population is growing much faster, 2.8 percent per year, while China, at 1.1 percent per year, is growing much more slowly, but on a large base. Developing countries are also experiencing a surge of urbanization, with over 90 percent of their population growth occurring in urban areas. Among the industrial and transitional economies, only the United States is experiencing any significant population growth, in part because of continuing migration, while other nations in these categories have stable or declining populations.

Rapid population growth appears unavoidable for at least the next two or three decades -- a consequence, in part, of rising life expectancies in most countries and the large proportion of the population in developing regions that is not yet of child-bearing age. Population patterns after about 2025 will depends on a number of factors, the most important of which is fertility. Any population with a fertility rate greater than replacement rate, about 2.1 children per woman, will continue to grow, while any population with a lesser fertility rate will eventually decline. Current fertility rates show very large regional variations. Fertility is highest in Africa, nearly 6 children per woman, which would lead to a doubling in that region's population in 24 years, assuming present life expectancies. By contrast, China's fertility has dropped below the replacement rate, which if maintained will stabilize that country's population within a generation. Fertility rates for other developing regions fall between these figures, while those for many developed countries are below the replacement rate.

Most population projections assume a gradual decline in fertility rates. The UN medium projection, for example, assumes that all countries reach replacement rate fertility by the year 2050. If the decline does not occur, then population growth could be significantly higher than projected. At the same time, if child-bearing attitudes and behavior were to change rapidly, or if mortality rates were to rise precipitously, global population growth could be less rapid than in standard projections.

4.2. Economic Growth

The global pattern of economic activity, now concentrated in the industrial countries, is likely to change. Economic growth rates in many developing regions are higher than in the present industrial countries, presaging their growing role in the world's economy. China's economy, for example, is already the third-largest in the world (when measured in terms of its relative purchasing power instead of at the current exchange value of its currency) and growing more than twice as fast as that of the United States. India, Southeast Asia, and Latin America are also growing more rapidly than the present industrial economies. If these trends continue, the world economy will no longer be dominated by the United States, Europe, and Japan, but will increasingly include a number of major new participants, possibly including a revitalized and resurgent Russia. Average per capita incomes in developing regions, however, are likely to remain far below those in the present industrial countries.

Global consumption of energy and raw materials is also rising. Indeed, although per capita consumption of raw materials and energy has generally reached a plateau in the industrial countries in recent decades, the developing countries' needs for basic infrastructure -- and still-growing populations -- mean that energy and materials consumption is likely to continue to rise rapidly for some time to come. Per capita levels of energy and materials consumption in these countries remain much lower than in developed countries. These historic gaps will persist over the next decades, closing only gradually with economic growth in the non-industrialized countries. Overall, rising consumption of natural resources is likely to lead to increased environmental degradation, especially in developing countries, although increasing efficiency in the use of energy and materials could partially offset these trends.

4.3. Technological Change

We live in a period of rapid, perhaps unprecedented technological innovation. One way to gain perspective on such changes is to compare them to an earlier period of equally fundamental technological change. The industrial revolution was marked by a roughly thousand-fold increase in the ability to harness energy for industrial purposes -- a change from one horsepower to a 1000-horsepower steam engine. The last third of the 20th century has been marked by great changes in the ability to manipulate and transmit information, including dramatic increases in computing power (an increase by a factor of about 100,000 in the number of transistors on a microchip) and in telecommunications capacity (an increase by a factor of about 10,000 in the number of bits per second that can be transmitted along a single optical fiber).

This double revolution in information technology is far from complete, and its social effects -- which may include a significant global impact on industrial organization and the structure of economic activity, employment patterns, and lifestyles -- are only beginning to be widely experienced. But it already is clear that they may be profound, displacing some forms of human mental activity (in much the same way that the industrial revolution displaced some forms of human physical activity) while enabling others, possibly including far more complex forms of social organization.

In addition, the biotechnology revolution -- the ability to manipulate genetic information and the biochemical mechanisms of living organisms -- and the materials revolution -- the ability to

craft new materials at the molecular level -- are both gathering momentum, though their full technological impact is uncertain and lies some decades in the future. Intense competition in the global market place provides incentive for rapid introduction and world-wide diffusion of new technologies. The technological ground rules are likely to change significantly over the next half century with the potential for immense impacts through employment displacement, life-style change, and the globalization of culture.

4.4. Decentralization of Authority

Currently, there is a strong trend toward decentralization of authority and greater individual autonomy. On an individual level, this trend is noticeable in increased emphasis on "rights" -- human rights, women's rights, and so on. In the private sector, this trend is reflected in the form of "flat" corporate structures and decentralized decision-making -- even in the rise of entities that have no formal authority structure, such as the internet. In the public sector, the trend is noticeable in the spread of democratic governments, in the devolution of governmental authority to smaller and more local units, and in separatist movements.

These trends and the rise of many new actors -- from citizens groups to global corporations -- make governance an increasingly complex process. Global capital markets, for example, are not under the control of any government and can destabilize even strong currencies. Global communications networks from CNN to cellular satellite phones to the internet convey information that is increasingly difficult for even determined governments to control. The growing strength of these global private sector entities is in marked contrast to the continuing weakness of global governance institutions. On a local and national level, the growing number and influence of non-governmental organizations and citizens groups is, in part, because of their ability to provide information and services that governments do not or cannot provide.

4.5. Equity Trends

A worrisome trend is the growing economic stratification between rich and poor both within and among countries. In the United States, for example, the distribution of family incomes has widened over the past 20 years. Families in the lower half of the income distribution have actually lost ground in constant dollars, while those in the upper 20 percent have done very well, many becoming extravagantly wealthy. The income gap between developing and developed countries has increased over the same period. For example, the gap between average per capita income in Japan and in China, has doubled, while that between the US and China has increased by 30 percent, despite rapid economic growth in China. An increasing percentage of global income and wealth accrues to the richest 20 percent of the world's population. Standard economic projections suggest that inequity is likely to become more extreme in coming decades within countries, as welfare policies are weakened, and among countries, where only very feeble international mechanisms exist for wealth transfer. Widening equity gaps within a society may threaten social stability; widening gaps among nations motivate illegal immigration and social tension, complicating attempts to forge joint solutions to global problems.

4.6.   Resource Depletion

The most accessible and economic nonrenewable resources, such as minerals or energy resources, are being depleted. Growing global demands eventually will require the more efficient use of these resources and the development of substitutes, a continuing challenge to technology. This challenge was met over the past twenty years, concerns with "limits to growth" notwithstanding, as known reserves (economically exploitable resources) are higher and real commodity prices are lower. Nevertheless, current trends could lead to shortages and dislocations in strategic materials over the next decades, for example, a re-emergence of oil shortages and, with it, the potentially explosive geo-politics of oil (Raskin and Margolis, 1995).

Of even greater concern is the depletion and degradation of so-called renewable resources such as fresh water, fish and shellfish, and forests in many parts of the world. The cause is both harvesting of resources at rates greater than they can be replenished and increasing damage to the natural systems that sustain renewable resources -- clearing of forests, degradation of fertile soils, exhaustion of fisheries, and damage to watersheds and estuaries. This trend has been dominated historically by the over-exploitation of resources to service industrialization, but has been linked also to the growing populations of impoverished people who depend on and are forced to over-use these resources for lack of other options. Depleted resources, in turn, undermine rural economies. Thus, this environmental trend is closely coupled to the problem of poverty.

4.7.   Pollution and Global Environmental Change

The rapidly growing urban areas in developing countries are subjecting larger and larger populations to urban pollution hazards, from shortages of both clean drinking water and sanitation to exposure to air pollution and toxic materials. Despite significant progress, the number of people who lack access to clean drinking water is still growing (WRI, 1996). Most megacities in developing countries fail to meet World Health Organization standards for air quality. Both trends are significant threats to human health.

On a global scale, worldwide emissions of carbon dioxide -- a major greenhouse gas -- are rising rapidly, a consequence of growing use of coal, oil, and natural gas. Projections of future energy demand suggest that energy use will double by the year 2020, for example, and that carbon dioxide emissions will rise by nearly the same amount, reflecting continuing high levels of energy use in developed countries and growing industrialization in many developing countries. The implication of this trend is that, far from stabilizing atmospheric levels of carbon dioxide, the world is accelerating the threat of global climate change.

Other social and environmental trends may also prove significant over the long term -- rapid shifts in labor markets in both developed countries (from manual to "knowledge-work" jobs with considerable labor displacement and structural unemployment) and developing countries (from agricultural labor to urban manufacturing and service jobs), the growing trend to violence in all societies, and the potential threat to human fertility and cognitive abilities from chronic exposures to toxic materials. At the same time, literacy is improving, incomes and health are generally rising (although not for everyone), and the risk of total war appears to be declining, although numerous hot spots persist.

5. Conventional Worlds

All scenarios unfold from a common point of departure, the initial conditions and driving forces as characterized in the previous section. The *Conventional Worlds* family of scenarios is distinguished by the assumptions of no major discontinuities, fundamental change in human values, or other structural ruptures. They have in common a vision of a world where development, governed by the growth dynamics of modern industrial society, is gradual and steady. Population grows at mid-range projections and aggregate economic output expands indefinitely while consumption and production practices in developing and transitional regions converge toward those of industrialized countries, even as the latter become much richer. The world becomes progressively more integrated both economically and culturally in *Conventional Worlds*, though scenario variants can diverge in many important ways on how, when, and to what degree this might happen.

5.1. The Paradigm

The present historical juncture is best understood in the context of the advance of the modern era, a long and continuing process of social transformation. The industrial revolution, a defining moment of this process, ushered in an era of accelerating cultural, technological, and geopolitical change which continues today. Based on the expansion of production and the penetration of new markets, the system of industrial capitalism has penetrated societies on its periphery and, overcoming traditionalist and socialist resistance nearly everywhere, incorporated them into the nexus of market relations. Contemporary globalization phenomena are a stage of this two hundred year process.

The conventional paradigm makes the apparently moderate, though not necessarily probable, assumption of the unimpeded unfolding of the values and socio-economic arrangements that evolved during the industrial era. There are several interlinked aspects of the *Conventional Worlds* vision. Competitive markets and private investment remain the engines for economic growth and wealth allocation. Globalization of product and labor markets continues apace, catalyzed by free trade agreements, unregulated capital and financial flows, and information technology. Transnational corporations dominate an increasingly borderless economy. Consumerism and possessive individualism endure as primary human motives. Consumption patterns and production practices in developing regions converge toward those of highly industrialized countries. The nation-state thrives as the dominant unit of governance. Consumer culture permeates all societies via electronic media, eventually reducing diversity despite fundamentalist, ethnic, and nationalist backlash.

5.2. Variations

Within these broad parameters, many *Conventional World* scenario variants are conceivable based on variations in a number of uncertain factors. These factors include long-range demographic patterns, the changing structure of regional economic and geo-political dominance, the severity of environmental feedbacks and constraints, the scale of economically recoverable

natural resources, and the pace of technological innovation. Other important characteristics of scenarios are the assumed degree and speed of socio-economic convergence between countries and the level of distributional equity within countries.

Finally, the policy dimension -- the character and timing of governmental action -- is critical for distinguishing among *Conventional Worlds* scenarios. At one extreme, a non-interventionist, business-as-usual attitude toward policy can be pictured -- a *Conventional World-Reference* variant where little policy adjustment is assumed. Depending on the philosophical predisposition of the observer, the risks of such a laissez-faire scenario will be weighed very differently. Free market optimists tend to downgrade environmental and social concerns, trusting in market adaptations and timely solutions to provide timely solutions. Pessimists about the adequacy of automatic market mechanisms would fear that a business-as-usual stance toward the future would endanger, perhaps catastrophically, the long-range health of social and ecological systems.

By contrast, policy-intensive scenarios assume the enactment of a comprehensive and vigorous set of actions with the aim of steering the system away from destabilizing social tension and environmental pressure and toward sustainability. The *Conventional World-Policy Reform* scenario is an example. Again, depending on one's world view, such scenarios may be perceived as unrealistic and even evil (if one favored unfettered competitive markets to optimize the social good) or, on the other hand, enlightened (if one believed collective action is needed to promote equity, ecology and other values). To disclose the obvious, the present authors tend toward the latter orientation.

The *Reference* scenario variant incorporates strong economic growth, mid-range population and development projections, and gradual technological change assumptions. The *Policy Reform* variant introduces measures to address two of the problematic aspects of the *Reference* scenario: poverty and threats to the environment. It attempts to balance the objective of high economic growth with strong policies for distributional equity and environmental protection, primarily through the rapid development and deployment of improved technology. Global scenario research must eventually explore the sensitivity to a reasonable range of demographic, economic, technological, and geo-political variables. For now, these variants offer a manageable glimpse of the problems and possibilities within a conventional development framework.

5.3.   Reference Variant: The Problem

In the *Reference* scenario, economic growth is given first priority as largely unregulated markets expand internationally. While some countries, groups, and firms lose the race and are excluded, many prosper. Population growth is uneven, with rapid increases in some of the poorer regions and slow or even negative change in some of the richer regions, while there is increasing migration pressure from poor to rich areas. The rich get richer, and even though new social strata achieve affluence, poverty persists. Indeed, income distribution becomes increasingly skewed both within most nations and between rich and poor countries despite some efforts to combat absolute poverty. Environmental quality improves in some of the rich areas and deteriorates in

the poor areas while the cumulative effects on global scales are exacerbated. Social friction is aggravated by migration pressure, competition for natural resources, and environmental deterioration. Discord is addressed piecemeal through conflict resolution mechanisms that tend to preserve the prerogatives of the powerful.

To this narrative, we can add a quantitative sketch of the scenario by incorporating current trends, policies, and mainstream assumptions on development (Raskin et al., 1996a; Raskin et al., 1997; Leach, 1995). Following UN projections, we assume that average fertility rates approach replacement levels (about 2.1 births per woman) over the next 50 years, as developing region development patterns in the scenario gradually converge toward those of highly developed regions (United Nations, 1992). This demographic shift is driven in part by family planning efforts and greater equality for women. Nevertheless, world population nearly doubles by the year 2050 to just over 10 billion people as it approaches equilibrium levels. Nearly all the increase is in developing regions, as populations in the rich regions as a share of world total decreases from about 20% today to 10% in 2050.

Economic assumptions for the scenario are based on 1990 figures drawn from World Bank (1993) data and mid-range projections from the IPCC (1992). The world economy grows from about $20 trillion in 1990 to $95 trillion in 2050 with continued growth thereafter (monetary figures are expressed in 1990 $). The economies of developing regions grow more rapidly than OECD regions, with average annual growth rates to the year 2050 at about 3.6% and 2%, respectively. Consequently, the OECD share of world output decreases from 80% in 1990 to 60% in 2050. Despite the relatively rapid growth in developing region economies, inequity persists in the *Conventional World-Reference* scenario. Because of high population growth rates, income growth rates are significantly less than total GDP growth rates in developing countries. In general, incomes gradually converge in the sense that the ratio of average GDP per capita in regions to other regions decreases from 20 in 1990 to 15 in 2050. However, the *absolute* difference increases from an average of 18,000 $/capita in 1990 to 55,000 $/capita by 2050 as incomes soar in rich countries.

In addition to these aggregate drivers, the *Reference* scenario assumes a number of underlying structural processes. A gradual shift continues in the composition of economic activity from industry to services in OECD countries (and, eventually, other regions). In particular, the share of material intensive industries decreases gradually, consistent with recent trends in industrialized countries. The penetration of new technology leads to more efficient use of energy and water, growing utilization of renewable energy resources, and cleaner industrial processes.

The aggregate patterns of the scenario are illustrated in Figure 8, which shows selected global indicators for the year 2025 and 2050 (relative to 1990 values). Note that energy and water use grows far less rapidly than GDP because of the structural and technological changes described above. Despite reductions in the *throughput* per unit of GDP (throughput refers to the materials input to the economy and waste output), pressure on resources and the environment increases as the growth in the scale of human activity overwhelms the greater levels of efficiency. As a measure of environmental pressure, we see that carbon dioxide emissions (CO_2), the major contributor to the risk of global climate change, increase substantially.

Figure 7. Global Patterns in *Conventional Worlds-Reference* Scenario
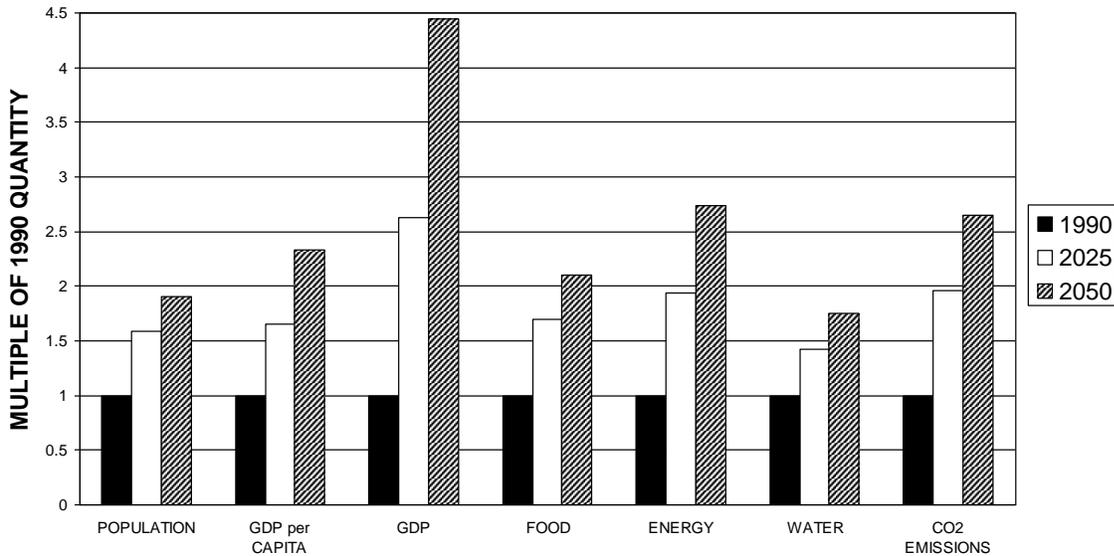
The *Conventional Worlds-Reference* scenario provides a benchmark for analyzing the constraints and obstacles to business-as-usual development and the timing and scale required for the adoption of alternative behaviors, institutions and technologies. There are strong indications that such a scenario is not likely to be either sustainable or desirable. Here, we identify only briefly some of the more serious environmental, resource, and social obstacles and risks that lie along this path of development (Raskin et al., 1996a).

First, the cumulative loads on biogeochemical cycles and ecosystems in the scenario could exceed natural assimilative capacities. This is exemplified by the sharp increase in CO_2, which contradicts radically the climate stabilization goal of reduced emissions. There are parallel problems in such areas as habitat destruction, biodiversity loss, and the accumulation of toxic chemicals in the environment.

Second, heightened pressure on resources could lead to disruption, dislocation, and conflict. In the absence of unexpected discoveries, sometime during the first few decades of the next century, oil would again become scarce, prices would rise, and the geopolitics of oil would return as a major theme in international affairs. Growing water demands and pollution loads would increasingly stress renewable water resources, threaten aquatic ecosystems, and generate discord over the allocation of scarce fresh water within and between countries (Raskin et al., 1995). Agricultural output would need to more than double by 2050 in order to feed a richer and larger population, which would lead to further conversion of forests and wetlands, increases in the pollution of soil and water systems, and the continued loss of degraded arable land because of unsustainable farming practices. Exacerbating the agriculture challenge is the near certainty that future expansion of irrigation, which played a significant role in the historic expansion of food production, will be seriously constrained by water shortage and lack of suitable sites. Unfavorable climate alterations would further complicate matters in many areas.

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Third, social and geopolitical stresses in the scenario would threaten socio-economic sustainability. The persistence of poverty on a large scale and continued inequity between and within nations, exacerbated by environmental degradation and resource constraint, would undermine social cohesion, stimulate migration, and weaken international security. We have seen, for example, that conflict over oil and water can be expected, while the impacts of climate change, though speculative, could be severely disruptive. Breakdowns in socio-political stability could provide, in turn, the conditions for authoritarianism, for the flaring of regional, ethnic, and religious conflict, and for the suppression of democratic institutions. That is, for a cataclysmic leap toward *Barbarization*.

5.4. Policy Reform Variant: The Answer?

Fortunately, there is the more salutary possibility that such risks would induce a comprehensive policy response to steer the system toward sustainability. The *Policy Reform* scenario is still growth-oriented but assumes a comprehensive policy response to the environmental and social risks encountered in the *Reference* scenario. The scenario does not assume major deviations in the conventional development paradigm, values, and institutional structures, but within those constraints incorporates rapid economic growth, far greater distributional equity, and vigorous attempts to protect the environment.

The definitive reference for this vision is *Our Common Future* (WCED, 1987), the report of the World Commission on Environment and Development (popularly referred to as "Brundtland" after the Commission's chairperson). This highly influential work offered a comprehensive appraisal of the "interlocking crises" threatening the future and an eloquent call for "a new era of economic growth, one that must be based on policies that sustain and expand the environmental resource base".

The Brundtland report popularized the concept of sustainable development, arguing that a healthy economy and a healthy ecology should be viewed as mutually dependent goals, not antagonistic values. Moreover, the report linked environmental protection to the eradication of poverty through economic growth. Greater social equity is therefore not only an ethical imperative for Brundtland, but an objective requirement for sustainable development. The Commission identified a set of policy directions for reducing poverty, creating better management systems, and accelerating the development, transfer and deployment of environmentally favorable technology, which were further elaborated in *Agenda 21*, a major agreement of the United Nations Conference on Environment and Development held in 1992 in Rio de Janeiro (UNCED, 1992).

The broad contours of a *Policy Reform* scenario were sketched in Figure 3 -- high income and economic growth, improving environmental conditions, greater equity, and reduced conflict. A hypothetical scenario was plotted in Figure 4 showing gross world trends in population and economic output. Note that population growth is somewhat moderated relative to *Reference* scenario (because of more rapid modernization in developing regions), average incomes are higher and the scale of the aggregate global economy remains high. The difference between the two scenarios is better revealed in Figures 5 and 6, which show scenario trajectories for each macro-region, and Figure 7. *Policy Reform* is shown to reflect a considerably more rapid

approach to equity than the *Reference* variant, but remains far from closing the gap between rich and poor regions.

     Policy Reform assumes a transition toward far greater efficiency of resource use, more reliance on renewable resources, and less environmental pressure.   For example, energy requirements and the use of fossil fuels fall sharply under *Policy Reform* assumptions. This is illustrated in Figures 9 and 10, which show possible long range global energy patterns in *Policy Reform* and *Reference* cases (Pontius and Raskin, 1996).

Figure 8. Global Energy Requirements for *Policy Reform* Scenario
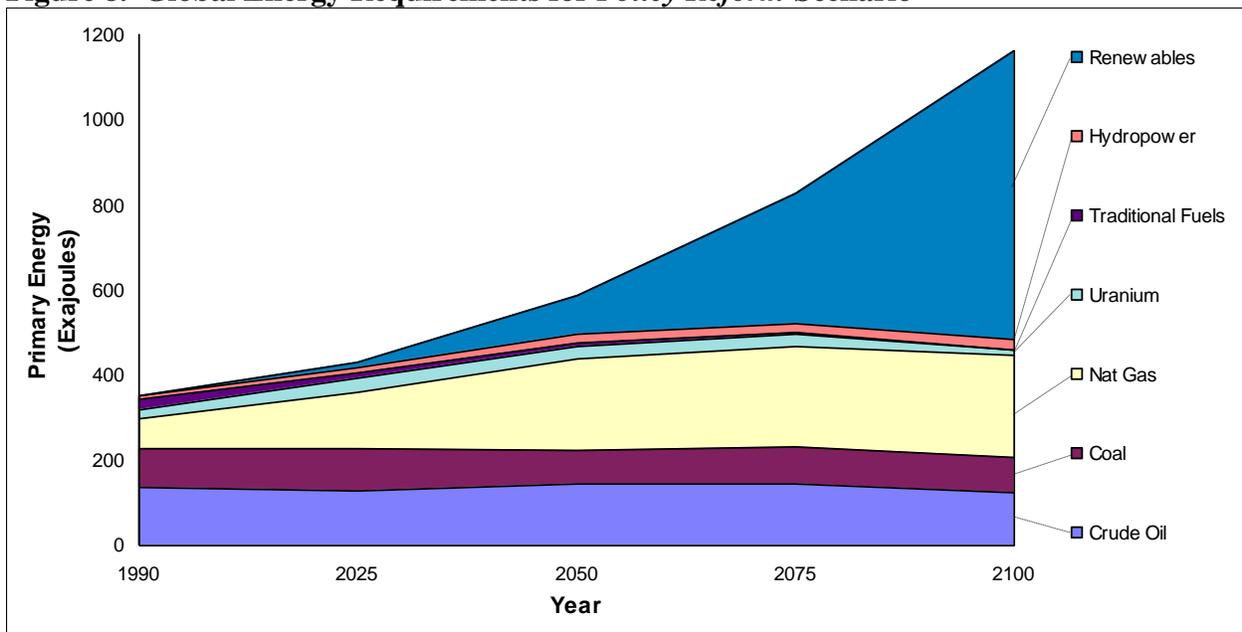
Figure 9. Global Energy Requirements for *Reference* Scenario
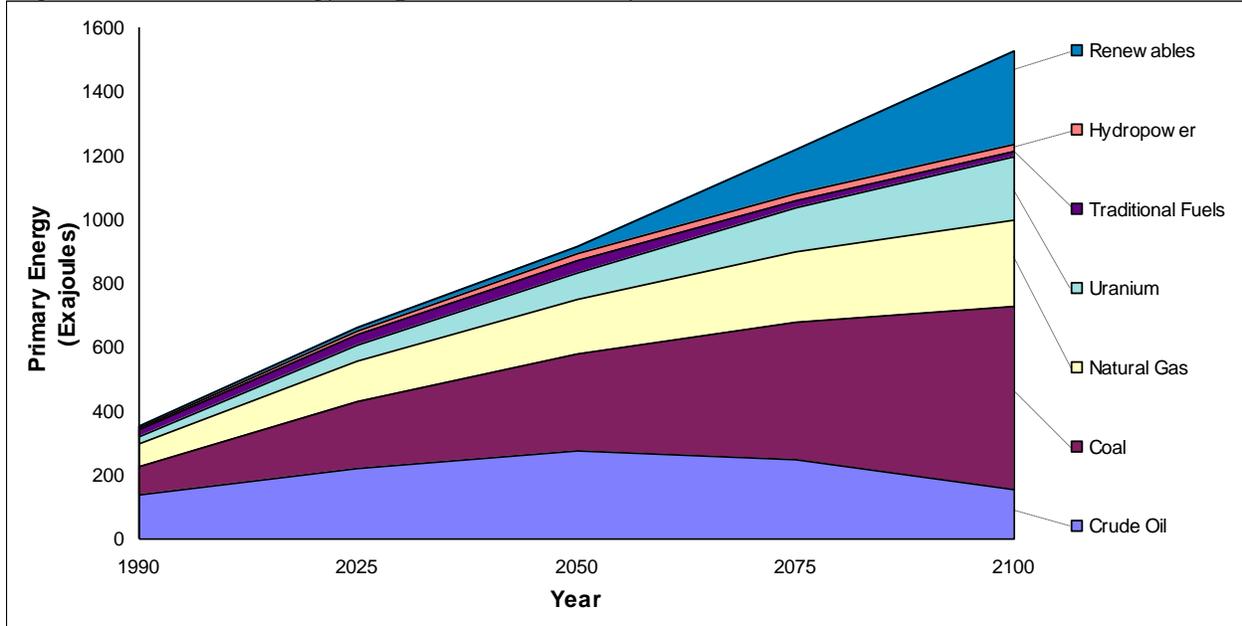
Policy Reform scenarios explore the scope for policy-driven improvements in technology and management systems for meeting sustainability goals. Two kinds of questions can be raised about this strategy, one pragmatic and one normative. A practical concern is whether *Policy Reform*, without fundamental structural change, offers a plausible pathway to sustainability. In the market-driven institutional context assumed, it would be an immense challenge to marshal the political will for the massive policy intervention required. This is underscored in Figure 11, which compares carbon dioxide emissions from energy for the two *Conventional Worlds* variants, based on the energy patterns discussed above. Cumulative emissions of carbon dioxide are curtailed in the *Policy Reform* case, but still grow despite dramatic shifts toward a sustainable energy system.

In addition to pragmatic questions, there is also a normative critique: the *Policy Reform* approach might achieve a sustainable world, but not one considered worth living in. The lifestyles and values offered by *Conventional Worlds* ultimately may be found undesirable on social, environmental, or ethical grounds. Alternative social visions -- *Great Transitions* -- may evolve that would accommodate nature more and engineer it less, while asserting the values of cooperation, community, culture and material sufficiency into a world seen to be driven by excessive competition, individualism, vulgarity, and greed. This perspective is developed further in Section 7.

Figure 10. Energy-related CO2 Emissions for *Conventional Worlds* Scenarios
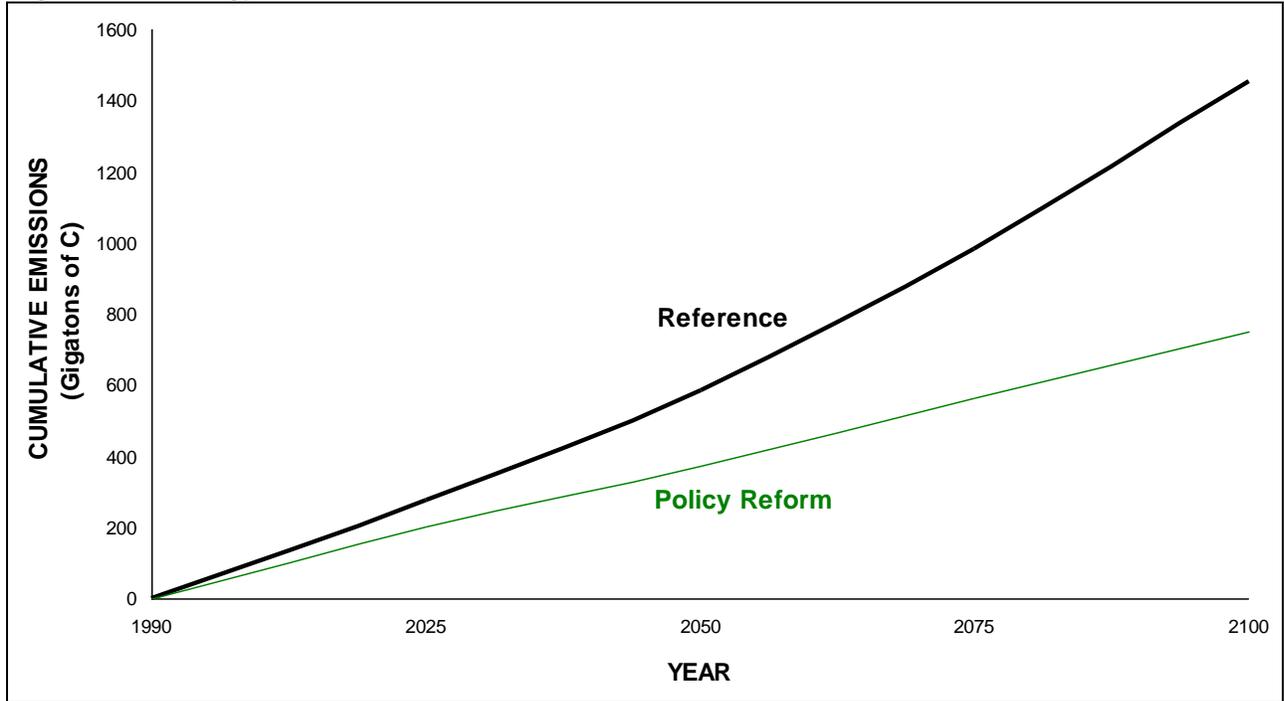
6.   Barbarization

Conventional Worlds assume that environmental and social tensions are resolved through the co-evolution of countervailing factors. In the *Reference* variant, the adaptations occur organically through the self-correcting logic of markets, social patterns, and human ingenuity, while in the *Policy Reform* variant, the necessary adjustments are a matter of active policy management. *Barbarization* scenarios explore the possibility that the coming century will be far grimmer, as the de-stabilizing stresses of *Conventional Worlds* overwhelm the coping capacity of markets and management institutions. The socio-ecological system veers toward worlds of sharply declining physical amenities and erosion of the social and moral underpinnings of civilization. We explore such scenarios to be forewarned, to help identify early warning signs, and to increase the readiness to counteract the conditions that could initiate them.

6.1.   The Scenarios Unfold

The major driving forces propelling this scenario include worldwide political and economic changes, inequity and persistent poverty, growing populations, environmental degradation, and technological innovation. Following the breakdown of the Soviet Union, capitalism is ascendant everywhere. A critical uncertainty, however, is whether the countries of the former Soviet Union and Eastern Europe will make a successful transition to market-based economies and democratic political systems.

Social concerns are radically downgraded as national governments gradually lose relevance and power relative to transnational corporations and global market forces. A growing disenchantment with the idea of development aid permeates industrial societies. Foreign assistance is reduced drastically and earmarked increasingly for disaster relief and peacekeeping operations, not genuine development (Mathews, 1994). Absolute poverty increases, and the gap between rich and poor -- both within and between rich and poor countries -- continues to grow.

The resentment of poor people rises. Increased exposure to global media and tourism in underdeveloped regions accentuates the immense differences in life styles between rich and poor. The conviction festers that the poor have been cheated out of development, that their options have been pre-empted by the wealthy. Among intellectuals in developing countries, awareness grows that high-consumption life styles will not be available to all who might aspire to it. A new social actor emerges – educated, downwardly mobile, and angry. Social polarization feeds off the disenchantment of the rich and resentment of the poor.

With rapid population growth in the poorer regions, a huge international youth culture emerges. Numbering in the billions, the ranks of the "global teenager" share remarkably similar expectations and attitudes, with consumerist and nihilist tendencies reinforced by ubiquitous entertainment and advertising imagery reaching every corner of the earth through the expanding information revolution. But the tantalizing visions and products of "McWorld" are largely unattainable, as increasing expectations and decreasing access collide (Barber, 1995). These tensions induce waves of legal and illegal migration to rich countries and to areas of prosperity within poor countries, as the young and mobile seek a better life.

Despite some successes, notably in the richest countries, environmental conditions continue to worsen. The unfettered expansion of market-based economies leads to increased industrial activity and rising pollution. Rapid urbanization displaces natural ecosystems and severely stresses local environments. Deepening rural poverty accelerates soil degradation and deforestation. As freshwater resources become increasingly scarce, conflict over water emerges among riverine countries. Already brittle marine fisheries collapse under additional pressure, depriving a billion people of their primary source of protein. Climate change causes hardship for subsistence farmers in many regions. Famine in Africa and elsewhere grows more frequent and more severe, while the response capacity of relief agencies slackens. Mortality rates increase in association with deepening environmental degradation, compounded by the emergence of new and the resurgence of old diseases (Miller, 1989).

Technological advance initially continues. But scientific and technical knowledge becomes increasingly a private commodity and decreasingly part of the public domain, slowing progress on fundamental problems. Control of innovation and access to information become part of the growing gap between rich and poor. While high-tech products are widely disseminated through the global market, technological innovation and its economic benefits are further concentrated in the rich countries and transnational corporations.

Severe social and military conflict spreads. Social tensions fester in the context of deepening socio-economic inequity, increased morbidity, and reduced access to natural resources. International discord is driven by widening inter-regional disparity, growing economic competition, and the progressive withdrawal of rich countries from significant engagement in development assistance. Rather than big wars, small-scale armed conflicts and violence become common, driven by a wide variety of causes: ethnic or religious differences, ideologically-based terrorism, resource scarcity, competing nationalisms, and commercial wars between economic groups, both legal and illegal (such as drug dealers).

Civil order breaks down in many areas leaving a kind of criminal anarchy in its wake (Kaplan, 1994). Within the rich countries, there is a growing perception that poor and growing populations in the developing regions threaten their well-being through migration, crime, terrorism, disease, and global environmental degradation. Conflict takes a toll increasingly on economic growth. Public and private resources are diverted to security, as international investment in troubled regions plummets. In societies consumed by conflict, both environmental protection and infrastructure maintenance are neglected, hastening degradation and decay -- reversing decades of development. The poor are increasingly vulnerable to floods, droughts, and other extreme weather events, which are more frequent and severe as global climate change proceeds apace.

An era of accelerating regional fragmentation, economic and political disorder, and a poisonous intolerance descends. Some countries devolve to a jagged-glass pattern of city-states, shanty-states, and nebulous regional formations. Some formerly prosperous industrial countries join the ranks of impoverished states. Incessant conflict, chaos, and uncertainty foster pervasive fear and hopelessness. Economic development ceases, technological progress stagnates (except for better security for the privileged), and no individual country is able to lead or control the others.

The reaction of the remaining powerful institutions -- country alliances, transnational corporations, international organizations, armed forces -- to this multidimensional crisis constitutes a critical uncertainty in the *Barbarization* process. In the *Breakdown* variant, the response is inadequate to cope with the rising tide of socio-economic chaos, as conflict and rivalry overwhelm all efforts to impose coherence. In the *Fortress World* variant, the response is sufficiently coherent and forceful to impose a form of authoritarian order. Key elements and decision points are summarized in Figure 12.

Figure 11. *Barbarization Unfolds*
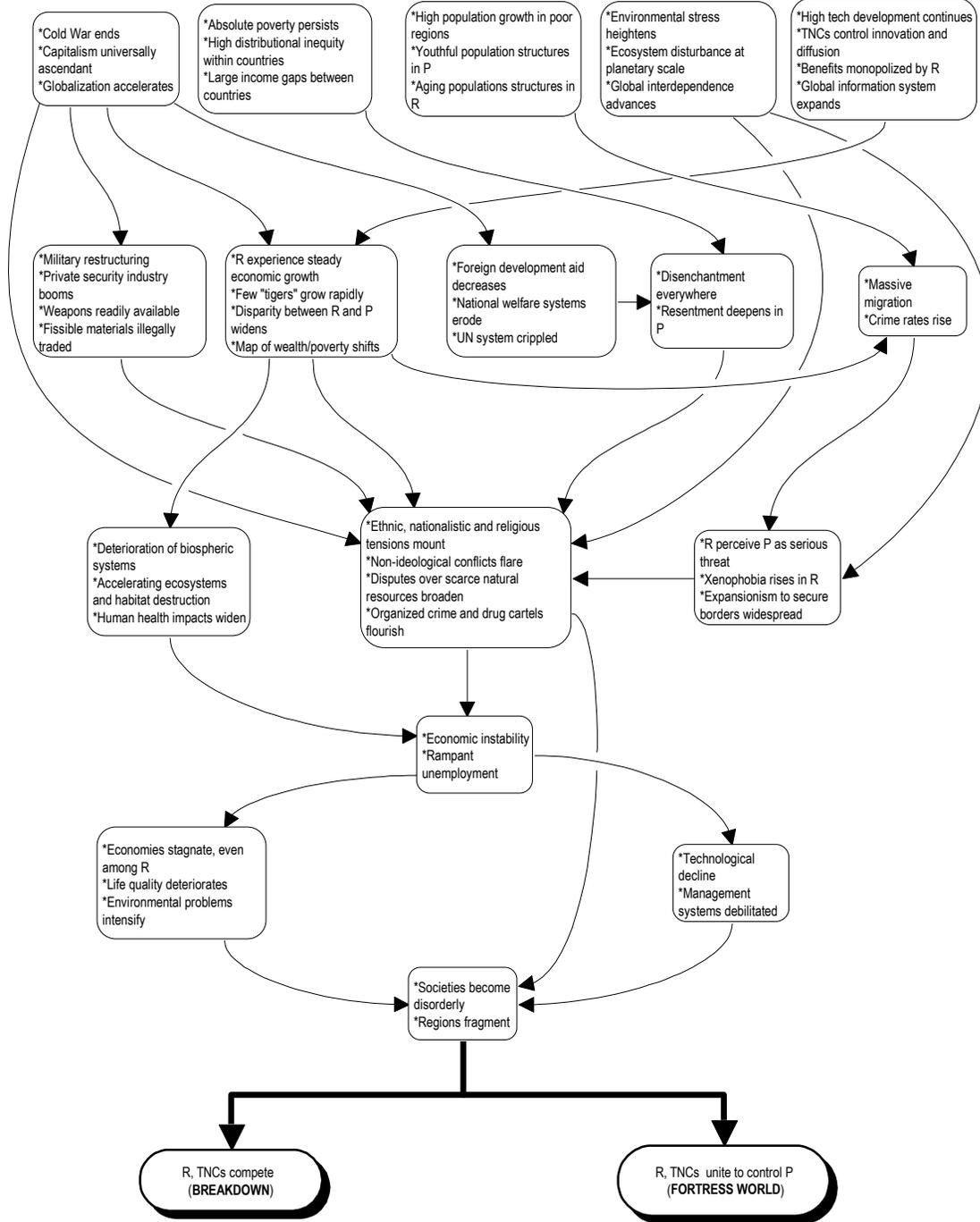
R=rich (countries, corporations, groups)
P=poor (countries, corporations, groups)
TNC=transnational corporations

6.2. **Breakdown**

In this variant, the vicious cycle of chaos, conflict, and desperation spiral out of control. The security apparatus within remaining privileged areas cannot contain the tide of violence from disaffected individuals, terrorist organizations, ethno-religious groups, economic factions, and organized crime. Collapse of civil order becomes widespread, as populations become increasingly desperate and governments weaken.

Refugees fleeing from chaotic zones destabilize neighboring areas, inadvertently contributing to widening waves of disorder. To stem migration, increasing resources are devoted to police powers, border security, and control of the activities of citizens. The global economic, finance, and governance systems founder, though the media lingers to spread fresh news of upheaval. The retreat of globalization is particularly devastating for industrial economies highly dependent on trade and imported natural resources. The result is rising unemployment, economic depression, political instability, and outbreaks of civil disorder, even in rich countries.

This self-reinforcing chain of events eventually leads to a general disintegration of social, cultural, and political institutions, deindustrialization (to varying degrees in different regions), and -- in many regions -- a return to semi-tribal or feudal societal structures. With the collapse of markets and investment generally, technological progress halts -- and the level of technological capability regresses. Population eventually begins to decrease as mortality rates surge with economic collapse and environmental degradation. Many couples, deeply pessimistic about the future, choose not to bring children into the world. In a bitter irony, equity increases but only because everybody gets poorer. *Breakdown* conditions could persist for many decades before social evolution to higher levels of civilization again becomes possible.

6.3. **Fortress World**

In the *Fortress World* variant, powerful regional and international actors comprehend the perilous forces leading to *Breakdown*. They are able to muster a sufficiently organized response to protect their own interests and to create lasting alliances between them. Arising within the cynical and pessimistic social mood of *Barbarization* conditions, these alliances are not directed at improving the general well-being, but at protecting the privileges of rich and powerful elites. This is viewed as a matter of necessity in a world in which wealth, resources, and conventional governance systems are eroding. The elite retreat to protected enclaves, mostly in historically rich nations, but in favored enclaves in poor nations, as well.

Outside the fortress, the majority is mired in poverty, denied access to scarce resources and restricted in mobility, expression, and basic rights. The authorities employ active means of repression to guarantee exclusive access to needed resources (such as oil fields and key mines) and to stop further degradation of the global commons of air and ocean resources. Draconian measures are required to control social unrest and migration. Strategic mineral reserves, fresh water, and important biological resources are put under military control.

Technology is maintained in the fortresses, even with some continued innovation, but deteriorates elsewhere. Local pollution within the fortress is reduced through increased

efficiency and recycling. Pollution is also exported outside the enclaves, contributing to the extreme environmental deterioration induced by the unsustainable practices of the desperately poor and by the extraction of resources for the wealthy. However, favored resort areas including nature and hunting preserves are declared ecological protection zones, from which the poor are excluded.

The elite have halted the advance of barbarism at their heavily guarded gates, but only by barbarizing the majority of the human race. They are entrenched in bubbles of privilege amidst oceans of misery, descendants of the "gated cities" and personal security industry of our own time. In this scenario, the major line of conflict is between the rich and the poor, a new functional divide replacing the old North-South notion. Global equity is very low, though it could be high within the fortress and outside of it. For those unfortunate enough to be born poor, life is Hobbesian: nasty, brutish, and short.

The sustainability of the *Fortress World* is contingent on the organizational ability of the privileged enclaves to maintain control over the disenfranchised. A general uprising of the excluded population, especially if rivalry opens fissures in the common front of the rich groups, could overturn the system. The scenario seems to contain the seeds of its own destruction, although it could last for decades. The collapse of the *Fortress World* could lead to a *Breakdown* trajectory or to the emergence of a new, more equitable world order.

7.   Great Transitions

Conventional Worlds offer visions of gradual adjustment and essential continuity of future values and institutions with those of the industrial era. *Barbarization* scenarios glimpse the unhappy possibility that conventional development fails to cope with the environmental and social stresses it induces and civilization unravels. We turn now to a third path, *Great Transitions* scenarios, in which global society, rather than descending into cruelty and chaos, evolves to a higher stage.

7.1.   Narrowing the Focus

Great Transitions may seem idealistic and improbable from today's perspective -- but they are possible, and may even be necessary to achieve the goals of sustainability and equity. They imply structural rather than incremental changes in social practices and, therefore, a discontinuity in the historical trajectory. They could emerge, if at all, either through a fundamental departure from the current path or as a new start following a destructive period of barbarization. The second possibility -- that a good society emerges from the ashes of desolation -- may be intriguing as a matter for contemplation and creative fiction. But it is not instructive for policy-making or for formulating actions to avoid barbarization -- unless a descent into barbarization was thought to be inevitable, in which case strategies might be considered for planting seeds now for renewal sometime in the future, and protecting them during the coming dark ages. Or, if one thought the only path to a great transition went through barbarization, the perverse conclusion might be drawn that it would be desirable to accelerate barbarization through fostering chaos and anarchy. It is our conviction, however, that barbarization is avoidable, so such extreme pessimism and dubious ethics, while not inconsistent, will concern us no further.

There is an immense range of possible *Great Transitions* scenarios. Reasonable people can disagree on the desirability, stability, and likelihood of alternative visions of a golden age in the next century. Our taxonomy of idealized scenarios (Section 4) introduced two variants to reflect at least some of this diversity: *Eco-communalism* and the *New Sustainability Paradigm*.

Eco-communalism envisions a patchwork of semi-isolated and self-reliant communities. If this world were ever to occur, it might be quite sustainable with high equity, low economic growth, and low populations. Advances in the understanding of human behavior, in psychological dynamics, and in holistic education could minimize the likelihood of the emergence of aggressive behavior. Nevertheless, a major threat to sustainability could come from the possibility that some of the more or less isolated communities develop into aggressive, expansionist forces which attempt to dominate neighboring communities.

That said, it is difficult to identify a plausible trajectory leading from the present situation to *Eco-communalism*. The acceleration of globalization and the complexity of modern economies suggest that, even if there were a transition to such a society, it would likely be mediated through a series of other social formations. There appear to be two possibilities.

First, *Eco-communalism* could emerge from a *New Sustainability Paradigm* world if a powerful consensus arose for localism, diversity, and autonomy. Then, perhaps, inter-regional economic, political, and social linkages could whither, especially if revolutionary advances in

small-scale technology make the maintenance of large-scale infrastructure and trade unnecessary. Second, *Eco-communalism* might emerge in the recovery from *Breakdown*. Under conditions of reduced population and a rupture in modern institutions, a network of societies guided by a "small-is-beautiful" philosophy conceivably could arise. In either case, our focus must turn to the *New Sustainability Paradigm*, as either a precursor of other social systems or as an alternative to barbarization.

7.2.   New Social Actors, New World View

Current driving forces have been discussed in earlier sections and are the common point of departure for all scenarios: global political and economic change, structural inequity and persistent poverty, growing population, environmental problems, and technological innovation. Here we expand on two aspects -- new social actors and an incipient new world outlook -- that are particularly germane pre-conditions for a *Great Transition*.

The second half of the 20th century saw the emergence of three important social actors: intergovernmental global organizations, transnational corporations, and non-governmental organizations. The United Nations and its constellation of specialized agencies are representative of intergovernmental organizations. Despite the scale and many achievements of the UN, hopes that it would play a major role in global governance -- from peacekeeping to development -- have not been fulfilled by the end of the century. Inefficiency, lack of funding, and the absence of any real power compromised the original vision of the UN as a global civil service, while the organization became a forum for airing national political tension, especially during the Cold War period. Still, it does represent the legitimate voice of the governments of the planet. Other supranational groups include the OECD (the "rich nations club"), the Group of 77 (Southern Group), the European Union, the regional development banks, and so on, each with its own mandate and viewpoint.

The second type of social actor, one whose power has been escalating since the end of World War II, is the multinational and transnational corporations. These huge business combines command immense human, financial, and natural resources. They have become a major economic force, with a truly planetary reach and a growing ability to shape world markets. As capitalist entities, they are competitive, expansionist, and, of course, driven by the bottom line of profit.

Citizens' groups, voluntary groups, and other kinds of non-governmental organizations (NGOs) constitute the third type of new social actor. More recent to explode on the scene, these voices of civil society cover a tremendous range in size and purpose. In general, they tend to be more dispersed, grassroots, and socially-oriented than other social entities. The rise in their numbers has been one of the most dramatic – and, for many, hopeful -- processes of the century. Increasingly joining in global campaigns addressing humanitarian, developmental, and environmental issues, they have become a significant force.

We have identified the rise of market economies and the values and behaviors they encourage -- competition, consumerism, individualism, materialism -- to be a dominant trend of our epoch. At the same time, a nascent oppositional outlook among many individuals and groups throughout the world may anticipate cultural changes that would become dominant in a *Great*

Transition. The new values flow from concerns for a sustainable relationship with nature, the resurrection of community, the rejection of material profligacy in favor of sufficiency, and the search for meaning and qualitative development. While inchoate and unsystematic today, this constellation of values may portend a new world view for a future day.

7.3.   A New Sustainability Paradigm Unfolds

As with earlier scenarios, the backdrop to the *New Sustainability Paradigm* is a cluster of deepening environmental and social tensions. However, a the new paradigm coalesces as a constructive and popular basis for social and environmental reconstruction, as articulate leaders emerge to both express and stimulate the process of change. Some of the major elements of the transition are sketched in Figure 13.

Three mutually reinforcing processes develop: social, environmental, and cultural. First, there is growing concern by governments, business, and the general public about the threat of social unrest and conflict. As increasing inequity combines with population growth and migration, the hopes for better living conditions of masses of people are lost. The rising tide of resentment and anger pose clear threats to security. The conviction grows that governance has grown too weak and that over reliance on the profit motive as an engine for economic growth has been environmentally and socially costly.

Second, many environmental problems worsen and new problems arise. Some environmental problems reach threshold levels (extreme climate events, acidification, pandemics). Meanwhile, a scientific consensus emerges that large-scale shifts in the planetary system are both possible and increasingly likely, reinforcing concern about sudden catastrophic changes in climate, life-support systems, and public health.

Third, there is increasing disenchantment with lifestyles focused on material acquisition within some segments of the population, particularly the young. The values of simplicity, tranquility and community begin to displace those of consumerism, competition and individualism. Many opt to reduce their working hours (and income) in favor of increased time to pursue study, artistic endeavors, interpersonal relations, craft production, and new searches for meaning.

Slowly, these processes coalesce into a world-wide ferment, with untold millions searching for new ideals, meaning, and forms of social existence. Some turn toward esoteric sects, but they are the minority. The youth of the globe discovers a new idealism and collective identity in the search for a planetary community. The exchange of ideas and sense of global unity is assisted by the now nearly universal networks that span the planet, linking individuals groups, organizations, and governments. The internet offers powerful new channels for communication, education, and democratic process.

Global meetings and festivals explore the new values of equity, the environment, alternative lifestyles, and human rights. Civil groups begin to organize international political movements, and governments and corporations alike begin to pay close attention. Eventually, many communities and some regions opt for alternative lifestyles and economic practices. Some stress high-technology solutions, some prefer frugality, and some practice small-is-beautiful utopian visions with an eco-mystical relationship to nature.

The tension between the forces of conventional development (or barbarization) and the new planetary consciousness has reached the critical moment. Does the planetary ferment and network of community-based movements continue to grow? Or is the movement absorbed by the system as occurred, for example, in India after Gandhi and with the counter-culture of the 1960s? Does the global teenager succumb to destructive nihilism or cynical ambition, or maintain idealism?

In the *New Sustainability Paradigm*, equity and sustainability, rather than economic growth, come to define development. Material sufficiency becomes the preferred lifestyle, while ostentatious consumption is viewed as primitive and a sign of bad taste. Some transnational corporations accept -- even advocate, in some notable cases -- the need for general limits and constraints around a new business ethic of eco-efficiency. Others resist change, but under popular pressure organized locally, nationally, and globally, governments and corporations begin negotiations around a New Planetary Deal. Building on intentional reductions in material consumption in rich countries, agreements are reached on international mechanisms for the redistribution of wealth. These transfers are tied to voluntary reductions in family size in countries with rapidly growing populations and to meeting globally agreed environmental targets.

A *new metropolitan vision* inspires the redesign of urban neighborhoods. Integrated settlement patterns place home, work, shops, and leisure activity in closer proximity. Automobile dependence is reduced radically, and a sense of community and connectedness is re-established. The basis for this renaissance of diverse and secure communities is the elimination of the urban underclass, the ubiquitous signal of social distress of the previous era. For many people, the town-within-the-city provides the ideal balance of a human scale with cosmopolitan cultural intensity.

Dispersed small towns also become popular as communication and information technologies increasingly allow for the decentralization of activities. The migration from rural to urban areas reverses as many opt for the lower stress level and increased contact with nature offered by smaller communities. A new spirit of community identification and participation is reinforced by changes in physical design, including decentralized renewable energy systems, more self-reliant production patterns, and pride in local environments. With attractive urban and rural alternatives, the mall culture fades as new urban and rural options underscore the sterility, hidden costs, and isolation of suburbia.

Technology transfer and joint sustainable development initiatives usher in a new era of cooperation between rich and poor regions. Poorer regions pioneer technologies and development approaches that conform to their unique climate, geography, resources, demographics, and religious and cultural traditions (Olson, 1994). Innovations flow increasingly from poor to rich regions.

In the new economic arrangements, markets are used to achieve production and allocation efficiency, but only within the limits of non-market constraints defined by social, cultural, and environmental goals. The time-horizon for economic decisions is lengthened to decades in order to take meaningful account of ecological processes. New technologies for sustainability flourish as public preferences and prices shift. A variety of policy mechanisms are used to achieve the sustainability program. These include a revised tax system and other market signals to discourage environmental "bads" and certain types of consumption. The polluter pays principle

is universally implemented.   Antisocial corporate behavior is discouraged further by thorough public disclosure of information. Well-designed environmental, economic, and social indicators measure the effectiveness of policies, giving the public an informed basis for seeking change.

Distributed forms of governance evolve, and mechanisms for decision-making are established from local to global scales. In this nested structure, regions and communities have considerable control over socio-economic decisions and approaches to environmental preservation, constrained only by the impacts on larger-scale environments and processes. For example, local energy systems vary greatly, but must meet per capita greenhouse gas emissions guidelines which are set by global-level agreements, while local water strategies must be compatible with allocation rules and ecosystem goals set at the river basin level. Global governance is based on a federation of regions which, through a rejuvenated United Nations and a truly global civil service, effectively fosters cooperation, security, and environmental health.

Population growth slows and then stabilizes at relatively low levels as poverty is eliminated and women become equal participants in the life of communities. Inherited environmental problems are abating, though some effects linger for many decades. Greenhouse emissions are reduced sharply as lifestyles become less energy intensive while renewable energy resources and highly efficient energy-using equipment become the norm. Chemical pollution is virtually eliminated with the gradual phase-in of clean production processes. Sustainable agriculture practices are adopted universally, tailored to local conditions and tightly linked to local markets (Gallopín, 1992, 1995).

Conflicts are resolved by negotiation, collaboration, and consensus. As armies are cut back and defense systems dismantled, a massive peace dividend is channeled toward the transition to sustainability and the eradication of the vestiges of poverty. Economic development continues indefinitely, mostly concentrated in the non-material realm -- services, culture, art, sports, research. A labor-intensive crafts economy rises spontaneously on the platform of the high technology base, providing a rewarding outlet for creative expression and a dizzying diversity of highly esthetic and treasured goods.

The exhilaration of pioneering a socially and environmentally superior way of life becomes a powerful attracting force in its own right, a self-fulfilling prophecy able to draw the present to itself. The human species has at last reached the End of Childhood.

Figure 12. *New Sustainability Paradigm* **Unfolds**
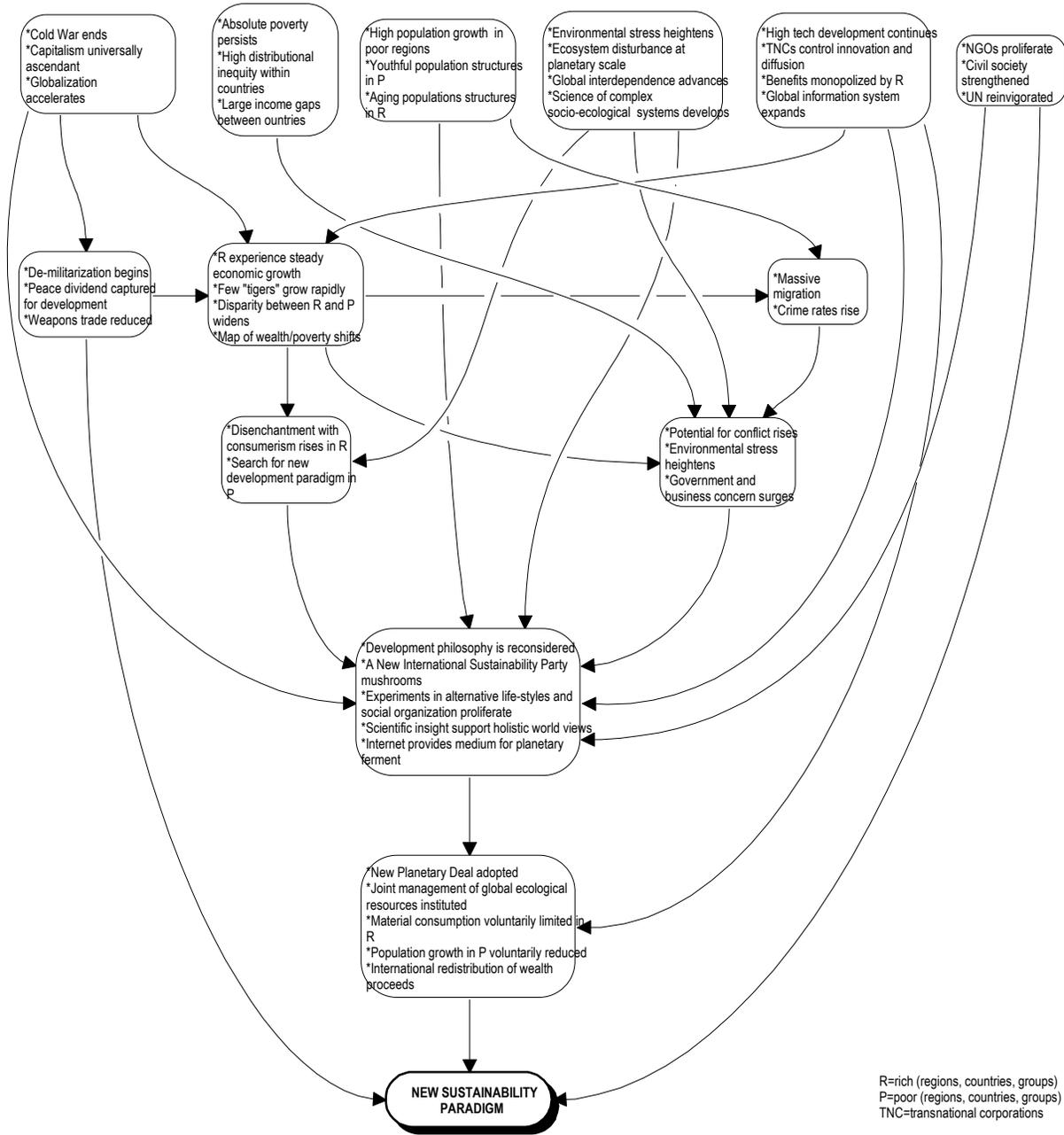
8.   The Tasks Ahead

We have presented an approach for exploring long range global futures and their implications for sustainability and the human enterprise in the 21st century. A structure was introduced for organizing the wide spectrum of scenarios that might branch from current conditions and trends. Based on that structure, we went on to sketch a range of alternative scenarios that represent very different visions of the future, including a discussion of key driving forces, critical uncertainties, and decision points. Here, we suggest directions for further elaboration and concluding remarks.

8.1.   Research Directions

Scenario inquiry has multiple purposes. These cluster into three areas: science, education, and policy.

First, the scenario approach can play an important role in advancing scientific understanding of biophysical processes. The interplay between scientific and scenario research is bi-directional. The elaboration of long-range socio-ecological scenarios must draw heavily on the insight, information, and concepts of various specialized studies and modeling efforts. Conversely, well-structured scenarios help direct scientific research by clarifying data gaps and conceptual uncertainties. Scenarios also set the range of interest for key parameters used to drive complex quantitative models.

Second, scenarios have a role in communicating issues and building public awareness. As they are developed into well-told stories about the future, stories that interweave imaginative narrative with quantitative rigor, scenarios can alert and educate on the problems of the future and the choices before us. The challenge is to make those stories compelling and accessible and to find effective mechanisms for popular communication. In addition to the use of traditional print and audio-visual media, interactive internet sites may be used eventually to stimulate a significant global discussion on scenarios for the future.

Finally, there is a strong link between the insight offered by scenarios and the policy process. Scenario analysis is a powerful tool for identifying emerging problems and risks as well as the processes driving them. Then, scenarios are used to set social, economic and environmental goals and to design appropriate actions. This offers a systematic basis for prioritizing issues for strategic attention and estimating the desired scale and timing of policy-induced changes. To advance these objectives, global scenarios will need to be given more thematic and spatial detail in order to reveal the policy implications for specific issue areas such as water, energy, food, land, health, demographics, ecological systems, and economic development.

It is essential that the scenario approach be applied directly to policy-oriented national, regional, and local sustainability studies (sometimes referred to as *Agenda 21* studies after the 1992 Rio conference document). The global perspective provides a framework for placing subglobal assessments in the context of the global dynamics which increasingly shape and constrain all regions. Bottom-up and top-down analysis will need to be harmonized by *zooming* in from global scales to consider the national implications of alternative scenarios, and from

there to local levels. At the same time, local and national sustainability exercises will enrich global scenarios in a cumulative and iterative process.

Ultimately, the policies for a sustainability transition must be matched to the conditions and priorities operating at global, national, and local levels. Likewise, the *instruments* employed for implement policy goals will vary -- taxes and fiscal structures, research and development, standards and regulation, education and outreach, market stimulation, income and industrial policy. Consequently, policy-relevant scenario research for sustainability must proceed down multiple and strongly interacting paths -- global and regional scenarios, national and local policy studies, and sectoral analyses. The challenge is to integrate over these dimensions in a continuing and open process that lends insight and motivation to sustainability initiatives.

8.2. *Reflections at the Branch Point*

The global system of today, in all its complexity and turbulence, is the consequence of sweeping historical transformations in the basis for human society. With roots in the industrial revolution of two hundred years ago, a ceaseless spiral of change in technology, values, social organization, and the degree of human impact on the biosphere has generated a vexing socio-economic and environmental predicament.

As crystallized in the modern notion of sustainability, human history may be on the cusp of a fundamental change. No more can we ignore the risks that unbridled and feckless growth visits on the future. No more, in this globalizing world, can a solution for the privileged be de-coupled from the fate of the poor. Taking the long-view is no longer a pastime for visionaries and dreamers. It has become a practical and scientific imperative for those concerned with the requirements today for a transition to sustainability tomorrow.

The future is not already written. Rather than simply "happening", the human future depends on collective and individual choices and actions. At the same time, the range of possible futures is strongly constrained by physical, social, and historical conditions and forces. The future path actually taken will be conditioned by the manner of interplay between material and institutional constraints, on the one hand, and human responses, on the other -- between necessity and freedom.

Under stable conditions, there are strong constraints to voluntary challenges to hegemonic values and institutions. However, in periods of instability, where dominant social processes become less binding, "choices" can ripple through the system in a kind of social tsunami. At such "branch points", institutional constraints abate and collective and individual decisions have greater potential to affect matters. This often, but not necessarily, finds expression through a strong leader, who, in turn, shapes history and the resolution of the branch point uncertainty.

So, the long-range future cannot be predicted mechanically from current conditions and driving forces. The arc of history can branch in fundamental ways. The outcome will depend on how global and ecological systems respond to critical uncertainties and crises and on human choices and actions. We have considered three qualitatively distinct and contrasting classes of scenarios for the global system -- *Conventional Worlds*, *Barbarization*, and *Great Transitions*. These envision, respectively, evolutionary outcomes which are continuous with modern

industrial development, highly unfavorable futures in which civilized norms collapse, and idealistic transformations to new paradigms for individual and social well-being.

It is natural that policy-oriented scenario analyses focus, in the first instance, on *Conventional Worlds* scenarios, since the contemporary discussion takes place here. The *Conventional Worlds-Policy Reform* scenario explores the possibilities for a comprehensive policy response to the sustainability challenge without assuming fundamental structural change in governance systems, institutions, and human values. Nevertheless, *Conventional Worlds* scenarios cannot be assumed to be likely. Nor can historic tilts toward *Barbarization* or *Great Transitions* worlds be ruled out -- indeed, one need not be a cynic to observe troubling portents of the former in the evolving socio-ecological conflicts of our time. Nobody can rigorously assign probabilities to such transformations since they depend on inherent uncertainties in complex systems -- and on human choices which are yet to be made.

Understanding the possible pathways to *Barbarization* can have fundamental implications for policy, as well. Though not yet in the realm of normal policy discourse, greater appreciation of the risk of social polarization and environmental crises can stimulate actions to mute critical tensions in the system. Policy initiatives suggested by a *Policy Reform* scenario would reduce the likelihood that the global system lurches toward undesirable futures, especially if the values underpinning the *New Sustainability Paradigm* are cultivated and spread. The weighty challenge for current generations is to think and act in ways that reduce social and ecological stress, while keeping future opportunities open for a *Great Transition*.

References

Barber, B. *Jihad vs. McWorld*. New York: Random House, 1995.

Barney, G.O. *The Global 2000 Report to the President of the US, Entering the 21st. Century* Washington, DC: US Government Printing Office, 1980.

———. *Global 2000 Revisited: What shall we do? The Critical Issues of the 21st Century*. Arlington, VA: Millennium Institute, 1993.

Burrows, B., A. Mayne, and P. Newbury. *Into the 21st Century: A Handbook for a sustainable future*. Twichenham, England: Adamantine, 1991.

Central Planning Bureau. *Scanning the Future: A Long-term Scenario Study of the World Economy 1990-2015*. The Hague: SDC Publishers, 1992.

Cole, S. "Methods of Analysis for Long-term Development Issues." In *Methods for Development Planning*. Paris: UNESCO Press, 1981.

Gallopín, G.C., P. Gutman and H. Maletta. "Global Impoverishment, Sustainable Development and the Environment: A conceptual approach." *International Social Science Journal* 121 (1989): 375-397.

Gallopín, G.C. "Rapport Ecologique sur Notre Planète." Relations 564 (1990): 247-250.

———. "Human Dimensions of Global Change: Linking the Global and the Local Processes." *International Social Science Journal* 130 (1991): 707-718.

———. "Science, Technology and the Ecological Future of Latin America." *World Development* 20 (1992): 1391-1400.

———, ed. *El Futuro Ecológico de un Continente. Una Visión Prospectiva de la América Latina*. Mexico City: United Nations University Press and Fondo de Cultura Económica, 1995.

Herrera, A.D., H. Scolnic, G. Chichilnisky, G. Gallopín, J. Hardoy, D. Mosovich, E. Oteiza, G. de Romero Brest, C. Suarez, and L. Talavera. *Catastrophe or New Society? A Latin American World Model.* Ottawa: IDRC, 1976.

Holling, C.S. "The Resilience of Terrestrial Ecosystems. Local Surprise and Global Change." In *Sustainable Development of the Biosphere*, edited by W.W. Clark and R. R. Munn. New York: Oxford University Press, 1986.

Hornung, B.R. "Qualitative Systems Analysis as a Tool for Development Studies." In *Dependence and Inequality: A Systems Approach to the Problems of Mexico and Other*

Branch Points: Global Scenarios and Human Choice
Developing Countries, edited by R.F. Geye and J. Van der Zouwen. Oxford: Pergamon Press, 1982.

IPCC (Intergovernmental Panel on Climate Change). *1992 IPCC Supplement*. Geneva: World Meteorological Organization, 1992.

_____. *Climate Change 1995: The Science of Climate Change*. Geneva: World Meteorological Organization, 1996.

Kahn, H., W. Brown and L. Martel. *The Next 2000 Years: A Scenario for America and the World*. New York: Morrow, 1976.

Kahn, H. and A. Wiener. *The Year 2000*. New York: MacMillan, 1967.

Kaplan, R.D. "The Coming Anarchy." *The Atlantic Monthly*, February 1, 1994.

Leontieff, W. *The Future of the World Economy: A Study on the Impact of Prospective Economic Issues and Policies on the International Development Strategy*. New York: United Nations, 1976.

Mathews, J. "Robbing Development to Pay for Disaster Relief." *The Washington Post*, June 6, 1994.

Meadows, D.H., D.L. Meadows, J. Randers, and W.W. Behrens. *Limits to Growth*. New York: Universe Books, 1972.

Meadows, D.L., J. Richardson, and G. Bruckmann. 1982. *Groping in the Dark: The First Decade of Global Modeling*. New York: Wiley and Sons, 1982.

Meadows, D.H., D.L. Meadows, and J. Randers. *Beyond the Limits*. London: Earthscan Publications, 1992.

Mesarovic, M.D. and E. Pestel. *Mankind at a Turning Point*. New York: Dutton, 1974.

Milbrath, L.W. *Envisioning a Sustainable Society: Learning Our Way Out*. Albany: State University of New York Press, 1989.

Miles, Ian. "Scenario Analysis: Identifying Ideologies and Issues." In *Methods for Development Planning*, edited by UNESCO. Paris: UNESCO Press, 1981.

Miller, J.A. "Diseases for our Future: Global Ecology and Emerging Viruses." *BioScience* 39 (1989): 509-517.

Olson, R.L. "Alternative Images of a Sustainable Future." *Futures* 26 (1994): 156-169.

Pontius, R. and P. Raskin. *Energy Resources and Sustainability: Research Report to Global Industrial and Social Progress Research Institute, Tokyo*. Boston: SEI-Boston, 1996.

Raskin, P., P. Gleick, P. Kirshen, G. Pontius and K. Strzepek. *Water Futures: Assessment of Long-range Patterns and Problems*. Background Document for the SEI/United Nations Comprehensive Assessment of the Freshwater Resources of the World. Boston: SEI-Boston, forthcoming.

Raskin, P., M. Chadwick, T. Jackson, and G. Leach. *The Sustainability Transition: Beyond Conventional Development*. Stockholm: Stockholm Environment Institute, 1996a.

Raskin, P., C. Heaps, J. Sieber, and G. Pontius. *Polestar Systems Manual: A tool for sustainability studies*. Stockholm: Stockholm Environment Institute, 1996b.

Raskin, P., E. Hansen, and R. Margolis. *Water and Sustainability: A Global Outlook*. Stockholm: Stockholm Environment Institute, 1995.

Raskin, P., and R. Margolis. *Global Energy in the 21st Century: Patterns, Projections and Problems*. Stockholm: Stockholm Environment Institute, 1995.

Schwartz, P. *The Art of the Long View*. New York: Currency Doubleday, 1991.

Svedin, U. and B. Aniansson, eds. *Surprising Futures: Notes from an International Workshop on Long-term World Development*. Stockholm: Swedish Council for Planning and Coordination of Research, 1987.

Swart, R.J., M. Berk, and H.J.M. de Vries. "Long-term Scenarios for Global Sustainable Development: a Basis for a Structured Debate." In *Proceedings of Conference on the Sustainable Future of the Global System*. Tokyo: United Nations University, 1996.

Toth, F.I., E. Hizsnyik, and W. Clark, eds. *Scenarios of Socio-economic Development for Studies of Global Environmental Change: A Critical Review*. Laxenburg, Austria: International Institute for Applied Systems Analysis, 1989.

United Nations. *Global Outlook 2000: An Economic, Social and Environmental Perspective*. New York: United Nations, 1990.

_____. *Long-Range World Population Projections: Two Centuries of Population Growth 1950-2150*. New York: United Nations Population Division, 1992.

UNCED (United Nations Conference on Environment and Development). *Agenda 21: Programme of Action for Sustainable Development*. New York: United Nations, 1992.

University of Sussex. Science Policy Research Unit. *Thinking about the Future: A Critique of the Limits to Growth*. London: Chatto and Windows, 1973.

WCED (World Commission on Environment and Development). *Our Common Future.* Oxford: Oxford University Press, 1987.

World Bank. *World Data Tables (Electronic Version).* Washington, DC: The World Bank, 1993.

WRI (World Resources Institute). *World Resources 1996-97.* New York: Oxford University Press, 1996.