METHODS

# World lines: A framework for exploring global pathways

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ABSTRACT

Sustainability research studies the dynamics and prospects of co-evolving human and ecological systems, a subject of inherent complexity and deep uncertainty. While work proceeds on facets of the overall problem, an overarching theoretical framework for giving coherence to this new discipline is lacking. Scenario analysis has been proposed as a promising integrative approach, while a recent wave of studies has significantly improved scenario methods. Still, these studies remain most compelling in their opening frames, where quantitative modeling can track unfolding trends, and their closing frames, where qualitative description can provide rich descriptions of long-term social visions. Not surprisingly, given the formidable uncertainties, the trajectories between "now" and "then", remain poorly specified, if addressed at all. This paper suggests ways of thinking about these pathways and pivots, the "world lines" through the terra incognita between current global realities and alternative futures. It outlines and illustrates a macro-framework, drawing fresh insight into the requirements for a transition to sustainability. It discusses major analytic elements – a systemic perspective, a scenario structure, critical uncertainties, human agency – and combines them into depictions of the broad contours of possible pathways. The analysis highlights two key uncertainties: the form of forthcoming crises and the quality of human response to global challenges. If institutional and cultural innovation fails to mute the precursor stressors of a systemic crisis, the world line could pivot toward a venal future. However, if the world begins to act with foresight, unity, and resolve, development would bend toward a resilient global civilization. This transition requires a sharp upswing in public awareness and engagement, a development that the evolving conditions of our planetary phase of history make possible, but by no means inevitable. Here, sustainability scenarios have a role in changing the future, as well as illuminating it, by expanding the horizon of what is thought possible and deemed desirable. The world lines framework offers a conceptual arena for advancing this effort.

## 1. Introduction and aims

With its profound challenges to the scientific imagination, the quest for sustainability is yielding a growing body of research into co-evolving social and environmental systems. The nascent field of "sustainability science" (Kates et al., 2001; Kemp and Martens, 2007) is an intrinsically integrative enterprise in several distinguishable ways. Thematically, it attempts to synthesize functionally interdependent bio-physical, institutional, and cultural dimensions into a systemic picture, drawing insight from the natural sciences, social sciences, and humanities. Spatially, it must consider a mosaic

of interacting, nested subsystems from local to planetary scales. Temporally, it strives to connect near-term actions to long-term outcomes, thereby addressing the core ethical imperative of sustainability: bequeathing an undiminished world to future generations.

Alluring scientifically and socially relevant, sustainability studies promise to be a great intellectual adventure of the coming decades. Yet, even as work proceeds on facets of the overall problem, an overarching theoretical and methodological framework for binding the new discipline and giving it coherence is lacking. In search of such a framework, "scenario analysis" has been advanced as an epistemological strategy well-matched to the inherent complexity of human–ecological systems and the deep uncertainty of their long-term prospects (Swart et al., 2004).

A recent wave of global studies has significantly improved scenario methodology, particularly through judicious blending of quantitative simulation and qualitative description (Raskin, 2005). Still, even sophisticated analyses seem most compelling in their opening and closing frames: data-rich representations of existing conditions and trends, and narrative-rich portrayals of alternative visions of society decades from now. Not surprisingly, in light of the formidable complexity and emergent dynamics of the global system, describing and specifying the paths between "now" and "then" present particularly daunting challenges. Unable to simulate structural reorganization, surprise, or systemic crisis, the "integrated assessment models" typically employed in global scenario simulations miss the discontinuities in many plausible long-range scenarios (Ayers, 2000). While better able to imagine and account for fundamental change, qualitative analyses of transitional dynamics tend to be sketchy, fragmentary, and impressionistic.

Reflecting on the terra incognita between current realities and alternative futures, this paper suggests ways of thinking about the pathways and pivots – the "world lines" – of the global system. In physics, the world line tracks an object's path through space and time; by contrast, the term is used here in the plural and with a double meaning: our concern is with the multiple world lines of the world itself. Unlike the inanimate bodies of physics, the global system is a subject, as well as an object, where the plausibility, even the possibility, of different world lines will depend on the choices of human actors.

The paper's theoretical aim is to outline and illustrate a macro-framework for considering alternative global trajectories. Its normative aim is to use the framework to draw fresh insight into the conditions and actions for a transition to sustainability. Sections 2–4 discuss key analytic elements — a systemic perspective, a scenario structure, and critical uncertainties on the path ahead. Section 5 uses these elements to sketch families of world lines and Section 6 concludes with a synopsis of lessons taken from this exercise.

## 2. Global systemics

The circle of social space has enlarged through history, from families, clans, and tribes, to villages, cities, and nations. The ambit of relationships widened through long processes of
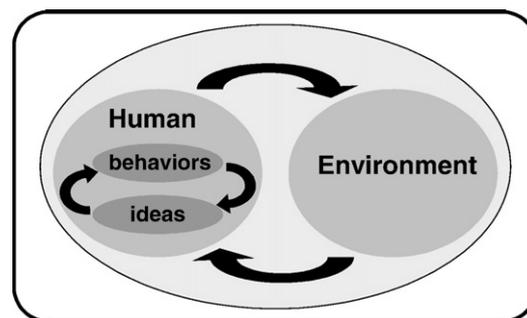


**Fig. 1 – Human–ecological system.**

cultural innovation and social adaptation, with more complex societies offering greater capacity for resilience, innovation, and domination. Emergent social forms were also realms of the heart that broadened the affective sphere of community and reciprocity (Heater, 2002). In the current era, the circle of connectivity is reaching toward the outer reaches of the earth, entwining humanity and the biosphere in a common fate. History has entered the *planetary phase* (Raskin et al., 2002).

Different observers highlight different aspects – economics, corporations, climate change, health, technology, terrorism, civil society, governance, culture, and so on – all introduced by the modifier "global". Although each of these is a critical issue in its own right, they are also expressions of a larger process that connects them: the formation of an integral global system. As the coupling between anthroposphere and biosphere becomes stronger and more multifarious, they become part of a unitary process of development, and the appropriate unit of analysis becomes the human–ecological system (HES).[1]

An HES is an exquisitely complex structure that can be unpacked in endless detail. At a high level of abstraction, it is useful to underscore a key distinction by considering two domains within the anthroposphere as shown in Fig. 1. *Behaviors* include political, economic, and social institutions, and technology. *Ideas* include values, knowledge, ideology, spirituality, arts, and culture. The *Environment* subsystem includes all the ecosystems, minerals, and hydrologic, climatic, physical, biological, and chemical processes of the biosphere.

The continuity of social structure depends on the coherent alignment of behaviors, ideas, and environment, the critical elements of the HES (Fig. 1). In order to survive, a society must reproduce itself materially, politically, culturally, and socially (Chirot, 1994; Sanderson, 1999). The forms of producing, deciding, thinking, and being must be in essential harmony, the strains among and within these activities remaining within certain tolerance levels. Of course, social continuity does not imply strict equilibrium, which is never found. Rather, continuity results from the internal coherence of functional elements and the capacity for adjustment to institutional, cultural, and environmental disturbance. In the process of adaptation, societies tend to become more complex

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[1] Various terms have been adopted for the concept of an integrated human and environmental system, including "human–ecological system" (Hassan et al., 2005), "socio-ecological system" (Gallopín et al., 1989), and "earth system" (Schellnhuber and Wenzel, 1998).

and stratified, generating increasingly differentiated subsystems with greater functional specialization and more elaborate patterns of interdependence.

In considering processes of change within human–ecological systems, it is useful to distinguish between adaptation – alterations of social relations within a given societal structure – and transformation — modification of the societal structure itself. Fig. 2 illustrates the distinction between adaptation and transformation. It shows a system that is subject to a "stress", some form of disturbance, strain, or tension that originates either outside or within the system boundaries. The stress perturbs the system, its subsystems, and the patterns of reciprocal influence among them. In the top row, the stress is "tolerable", allowing the system to adjust while maintaining its essential structure. In the second row, the stress is "destabilizing", pushing the system beyond its capacity to adapt and leading to a transformative reorganization.

The increasing turbulence of the global HES is consistent with the conditions that precede structural reorganization in complex systems of many kinds (Prigogine, 1997). Self-organizing systems maintain structural order far from thermodynamic equilibrium through energy and material exchanges with their environment. Such structures are resilient up to a point, able to absorb fluctuations and perturbations within certain tolerance limits. However, if disturbances exceed a critical threshold, transitions to qualitatively different states can ensue. After passing through a phase of instability and disorder, the system reaches a new equilibrium with a new structure.

Since adaptive capacity is the *sine qua non* of any long-lived HES, such systems are inherently conservative, seeking to accommodate novelty without structural re-adjustment. They resist change by managing disturbances through counterbalancing responses or new features that mute disruption. But severe and prolonged strains can overwhelm compensatory mechanisms and compromise coping capacity. When system elements become unsynchronized, structures destabilized, and behavior turbulent, a relatively rapid break may occur as institutional, cultural, and environmental patterns crack, rather than bend and recover. At such moments of systemic transformations, small perturbations can have large effects on the character of the structural shift.

In broad strokes, this answers the question, why do societies change? Tensions within and among behavioral, ideational, and environmental features can be accommodated only up to a point. When dissonance and incoherence exceed the capacity of an HES to adapt, the system becomes unstable and chaotic, and structural reorganization ensues. The post-transition phase evolves in a new quasi-stable state, with reorganized components, new dynamics, and novel properties — a change in the way change happens. Multiple factors – demographic, environmental, technological, environment, conflict, war, social movements, charismatic leaders – can be at play in forcing institutional change and pushing societies toward structural transformation. The transition to a planetary society is likely to be no exception.

## 3. A typology of scenarios

The global trajectory is a tangled web of possibilities. The story of the twenty-first century will be a tale of the dynamic interplay of natural process, social structure, and human agency, notwithstanding the tendency of analysts to fixate on a single aspect (Archer, 2000). In the face of such deep uncertainty, a wide range of alternative scenarios must be considered.

The many possibilities can be organized in different ways. One useful approach is to consider three broad channels radiating into the future – *Conventional Worlds*, *Barbarization*, and *Great Transitions* – of structural evolution, degeneration, and transformation (Raskin et al., 2002). Each of these scenario classes, in turn, has countless variations. To keep the discussion tractable, we shall include two variations for each as displayed in Fig. 3. Subsets of these archetypal scenarios recur in all major contemporary scenario exercises, albeit under different names (de Vries, 2005; Raskin et al., 2005).

*Conventional Worlds* emerge from the dominant forces of globalization — economic interdependence increases, dominant values spread, and patterns of production and consumption in developing countries converge toward those of the richer countries. In the *Market Forces* variation, powerful global actors advance the priority of economic growth through such neo-liberal policies as free trade, privatization, deregulation, and the integration of developing regions into the market nexus. The *Policy Reform* scenario adds comprehensive governmental initiatives to attune economic growth with a broad set of social and environmental goals. The strategic blueprint for *Policy Reform* was adopted at the 1992 Earth Summit (UNCED, 1992) and given concrete expression through international initiatives, such as those to cut poverty by half (MDG, 2000) and to stabilize the global climate at safe levels (UNFCCC, 1992).

*Conventional Worlds* visions face the immense challenge of muting destabilizing social, environmental, and economic trends, even as these approaches advance the consumerist values, economic growth, and cultural homogenization that drive such trends. Market adaptations are limited, while building effective mechanisms for global governance is difficult in a world of conventional values and institutions. If unattended crises were to deepen, global development could veer toward a *Barbarization* scenario, a tragic retreat from civilized norms. One form this might take is an authoritarian *Fortress World*, with elites in protected enclaves and an impoverished majority outside. Another is *Breakdown*, in which conflicts spiral out of control, waves of disorder spread, and institutions collapse.
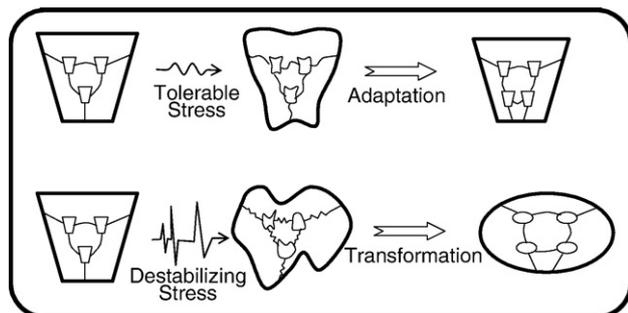


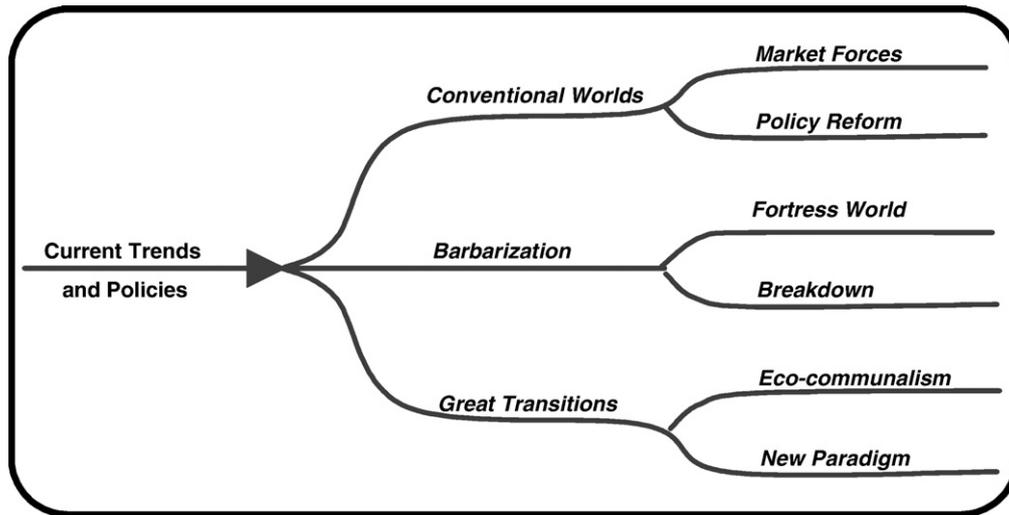Fig. 2 – Adaptation and transformation.

**Fig. 3 – Taxonomy of the future.**

By contrast, *Great Transitions* are transformative scenarios. A new suite of values – human solidarity, quality-of-life, and respect for nature – revises the very meaning of development and the "good life". In these visions, solidarity is the foundation for a more egalitarian social contract, poverty eradication, and democratic political engagement. Human fulfillment in all its dimensions is the measure of development, displacing consumerism and the false metric of GDP. An ecological sensibility that understands humanity as part of a wider community of life is the basis for true sustainability and the healing of the earth.

*Eco-communalism* is a highly localist *Great Transition* variation. Although attractive to many environmentalists, it is difficult to envision a world of radically detached, self-sufficient communities emerging from the interconnected planetary phase, except perhaps in the recovery from *Breakdown*. Instead, the *Great Transition* scenario is identified here with the *New Sustainability Paradigm*, which sees in globalization, not only a threat, but also an opportunity for forging new categories of consciousness — new bases for acting on behalf of humanity-as-a-whole, the wider web of life, and the well-being of future generations.

Rather than retreat into localism, the new paradigm would change the character of global civilization validating cultural and economic cross-fertilization, while seeking a humanistic and ecological transition. This *Great Transition* is a pluralistic vision that, within a context of global commitments, embraces diversity in regional approaches to development and multiple pathways to modernity (Raskin, 2006).

## 4.    Critical uncertainties

Whether the world line branches toward *Conventional World*, *Barbarization*, or *Great Transition* will depend on the character of two key uncertainties and interactions between them. The first is the timing, magnitude, and form of future global crises. The second is the mode of human response: the degree and quality of future institutional and cultural adjustments for buffering impacts and redirecting global development toward sustainability.

### 4.1.    Global crises

The unfolding global transition is a systems event operating at the planetary scale. As such, it entrains parallel transitions across all human–ecological subsystems. The tendency of systems to resist change, seeking to maintain structural continuity through adaptation, suggests a link between the notions of global transition and global crisis. Transitions may announce themselves in the language of crisis. While the form and hour of potential global upheavals are unknowable, we can imagine stylized "general crisis syndromes": multi-causal phenomena that cascade across sectors and subsystems to destabilize the global HES. Although each of the "crisis realms" shown in Fig. 4 includes numerous problems of major concern, general crises are located in the nexus where environmental, social, and geo-economic problems reinforce and amplify.
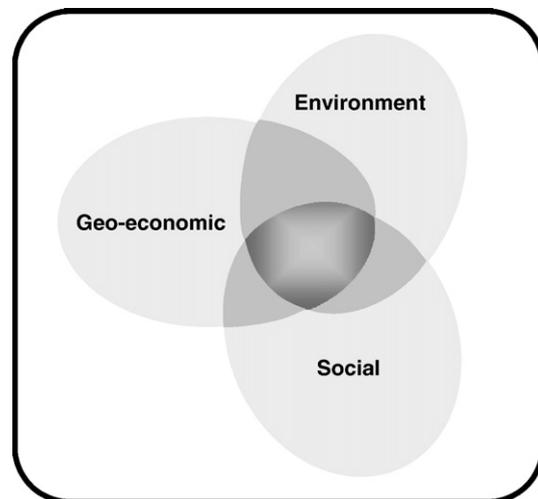


**Fig. 4 – Crisis realms.**

In the environment realm, climate change, ecosystem degradation, toxification and other disturbances are compromising the integrity of the planet's natural systems (UNEP, 2002). As these evolve and interact, the greatest danger lies in crossing thresholds of abrupt and irreversible transformation (NAS, 2002). While ominous environmental risks provide reason enough to doubt the likelihood of an orderly planetary transition, the social realm adds further challenges (BSD, 1998). Global inequality, poverty, injustice, and polarization foster a portentous cycle of antagonism, social schism, and violence that tears the fragile fabric of global understanding, peace, and cooperation.

The geo-economic realm refers to the suite of economic, political, and security challenges associated with increasing international interdependence. As globalized financial, capital, and product markets interlink national economies ever more tightly, local crises can spread, generating system-wide instabilities. The weakness of international regulatory frameworks heightens the risk of world economic crisis, while the post-Cold War geopolitical landscape is potentially volatile, especially as China and other rising powers flex their might. The struggle over access to oil will intensify as demand grows, supplies dwindle, and much of the world's reserves are held by a few countries of uncertain long-term stability (Leggett, 2005).

The possible modes of interplay among environment, social, and geo-economic domains are far too numerous to catalogue here. Broadly, though, environmental stress feeds poverty and conflict, undermines economic performance, and introduces new international security challenges. Geo-economic failure undermines efforts to protect nature and reduce poverty. The persistence of a global underclass, desperate for survival and looking to relocate to wealthier countries, undercuts resource preservation and global trust, a precondition for geo-economic cooperation; meanwhile, fed by fundamentalist reaction and the anguish of the excluded, global terrorism triggers superpower counter-reaction and together they aggravate cultural polarization.

A number of high-impact events could trigger a chain reaction of destabilization (Fig. 5). One chain begins with severe climate change leading to altered hydrological patterns, food shortages, economic collapse, social disruption, institutional breakdown, and international conflict. Another starts with a pandemic, perhaps a disease vector emerging from disrupted
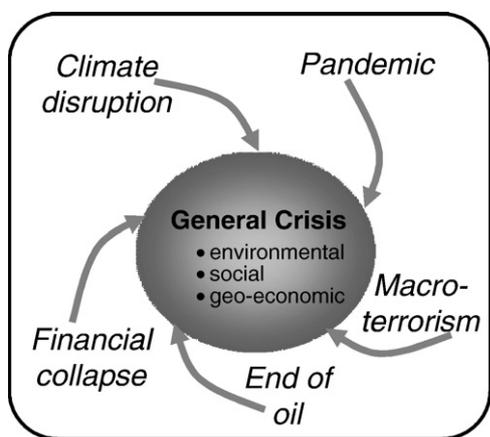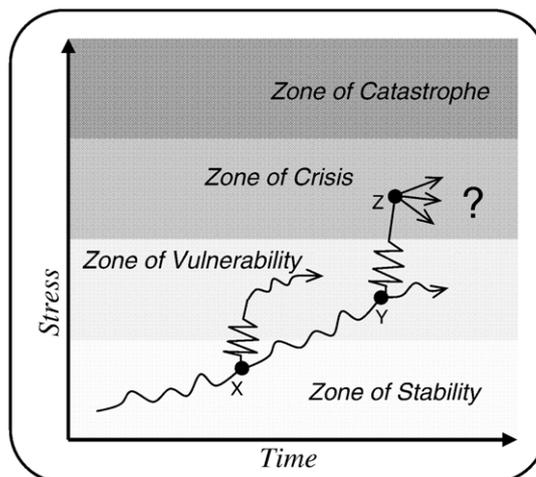


**Fig. 6 – Stress, bifurcation, and risk.**

ecosystems that is spread by the mobile affluent and desperate refugees fleeing rising chaos. A third sequence, sparked by a macro-terrorist attack, such as nuclear detonations in major cities or wide deployment of biological weapons with death counts orders of magnitude greater than previous attacks, leads to massive military mobilization, and an ongoing cycle of violence and disruption. A fourth cycle of destabilization, prompted by absolute oil shortages and huge spikes in cost, leads to economic destabilization and wide geopolitical conflict. Finally, a fifth, set off by a collapse in the global financial system, as the combined effects of excessive speculative investment, artificial exchange rates, and massive international debt reach a tipping point, and a global depression ensues, with profound social, environmental, and geopolitical reverberations.

The risk of an event triggering a general crisis depends both on its magnitude and the condition of the global system at the time of occurrence. If the system is vulnerable, a relatively modest triggering event may be sufficient. To illustrate, Fig. 6 shows global paths through stylized "zones", defined by level of stress on the global system. With the system in a zone of stability (point X in the figure), a modest triggering event may not cause an irreversible change of structure. The system may be kicked into a "zone of vulnerability", but can recover. However, such an event acting on a system that is already in a vulnerable condition (point Y) can force it into a "zone of crisis". Once there, the future of the system is highly uncertain and can branch in several directions depending on biophysical or institutional responses (point Z).

Finally, truly cataclysmic events, a popular topic of conjecture in the futurist literature, are conceivable. The dangers come from several directions: from space, a "killer asteroid" pulverizes the planet; from technology, self-replicating robots, nanotechnology, or genetically modified organisms overwhelm human defenses; from the environment, a climate transformation renders vast regions uninhabitable; from public health, a plague causes collapse of the human population; from geopolitics, a third world war erupts with massive use of weapons of mass destruction. These low-probability and high-impact events would kick the global trajectory into a "zone of catastrophe", upon which no further speculation is ventured



**Fig. 5 – Possible triggers of a general crisis.**

here. However, it should be underscored that efforts to reduce global stress and strengthen human resilience would decrease the risk of such nightmare scenarios.

### 4.2. Human resilience

Twenty-first century crises are brewing in a world of lingering twentieth century ideas and behaviors. Contemporary economic, political, and cultural institutions are ill-suited for addressing the destabilizing environmental, security, and social tensions that they have created (Held et al., 1999). Emerging dangers demand a coherent, cooperative, and sustained planetary response to enhance collective capacities to anticipate, mitigate, and adapt. This involves building institutional capacity for identifying and avoiding destabilizing stresses, reducing existing stresses to tolerable levels, and buffering people and ecosystems from the consequences of disruptions that cannot be prevented.

This historic task rests largely with nation-states, at once, the primary nodes of the international governance architecture and ardent defenders of their own sovereignty. Too often a narrow and myopic national calculus dominates the terms of engagement. Not surprisingly, the collective response of the community of nations to its common problems has been piecemeal and reactive, rather than integrated and anticipatory. Precious decades have been lost in which grand international proclamations have substituted for effective action.

The mismatch between the needs of the planetary phase and the sluggish progress to date raises urgent questions. Will the world continue to muddle through, reacting and adjusting to events, hoping that systemic crises fail to materialize? What social actors might appear on the stage to alter global politics? What new institutions and forms of conduct are necessary for a sustainable and livable world? Each of our global visions answers these questions with its own narrative.

*Conventional Worlds* assume evolutionary adjustments through the spread of dominant institutions and values. In the *Market Forces* variant, the key social actor is a globalized private sector. Institutional coping capacity rests largely with market adaptations through price signals that alter consumer demand, encourage entrepreneurship, and drive innovation. The flaw here, well known to readers of these pages, is that market signals do not adequately reflect the degradation of the environment and society, let alone the risks of far-flung and long-term disruptions. A general crisis would violate the premise of evolutionary change and render these scenarios, not only infeasible, but contradictory. Market-led scenarios are only plausible if, in the event, current concerns about unsustainable trends prove to be highly exaggerated and global stress remains within a tolerable range.

The *Policy Reform* variant assumes that policy-makers eventually act with conviction to align markets with social and environmental goals. Governments, working through strengthened multinational bodies, implement a comprehensive and ambitious suite of actions to reduce poverty, conflict, and environmental risk. This government-led vision of how human resilience might be strengthened is not inconceivable. In principle, the necessary technologies and policy instruments are available for the task of "bending the curve" toward a sustainable and just future (Gallopín and Raskin, 2002).

In practice, reversing the powerful trends feeding global instability would require immense resources, rapid diffusion of a new generation of appropriate technologies, and effective programmatic initiatives across a wide array of places and issues. To envision such adaptation is to imagine the emergence of great political will for a vast and cooperative global effort. But how would it be mobilized and sustained? Today, even the most far-sighted leaders are constrained by powerful, interested polities, while political cultures within states have failed to cultivate mass awareness and support for addressing global perils. Such public myopia is reinforced, in different ways, by the consumerism of the affluent and the desperation of the poor.

It seems a coherent planetary politics for a sustainable and just future will need a powerful new historical agent to drive it forward. Specifically, this is likely to require a far more aware and engaged global citizenry to broaden and deepen the political space for a *Policy Reform* platform, and to put the possibility of *Great Transition* on the agenda (Raskin et al., 2002). For concision, we shall refer to such a broad popular mobilization as a *global citizens movement* (GCM). The arrival and significance of a GCM as a new social actor on the global stage would be signaled by the level and quality of awareness, mobilization, solidarity, and political maturity of associated world citizens.

We are drawn to the proposition, then, that the quality of human response to planetary imperatives will be correlated to the development of a GCM. The recent explosion of civil society, with tens of thousands of international non-governmental organizations and citizen campaigns active on a full spectrum of concerns, may foreshadow such a movement. Yet, while tapping into deep reservoirs of public apprehension about the fate of people and the planet, civil society's fragmentation around separate issues, organizational entrenchment, and politics of protest and resistance limit its scope for mobilizing ordinary citizens.

A mature GCM would transcend these deficits. Its hallmarks would be a rigorously-based global vision, a shared identity as global citizens, and a sophisticated strategy for change. It would need to evolve an integrative framework for mutually supportive action, balancing the needs for unity and coherence, on the one hand, with respect for diversity and autonomy, on the other. The GCM would be a broad cultural and political project, a popular harbinger of a new planetary civilization (Kriegman et al., 2006).

The crystallization of an influential GCM in the coming decades would be a critical factor. Then, the government-led *Policy Reform* vision would become more plausible and, if the GCM were to surge, the values-led *Great Transition*, more conceivable. However, if public engagement and political will for sustainability remain weak, center stage would be left to the improvisations of *Market Forces* actors, or to go-it-alone super powers, fundamentalists, and isolationists driving *Barbarization*.

## 5. Long-range trajectories

We have drawn attention to the scale, form, and timing of two critical uncertainties – global crises and human response – in considering the pathways and pivots for the global future. By

combining assumptions, we can begin to envision the broad contours of major clusters of trajectories. To illustrate the approach, we analyze two families of world lines in the following subsections. The first set of trajectories assumes that institutional, political, and cultural responses remain inadequate (*Weak Response*), as a widespread outpouring of public concern and engagement (a global citizens movement) fails to materialize. The second set assumes the emergence of a growing GCM to drive the implementation of a coherent response to the challenges of sustainability and planetary governance (*Strong Response*).

## 5.1. Human response weak

These trajectories assume that a shift toward widespread global identity and politics fails to develop. Global governance institutions remain toothless, as sustainability-oriented policy-makers and civil society activists are unable to overcome special interests, short political time horizons, and public apathy. The implications are tracked in Fig. 7.

*Alternative Futures*, at the top of the figure, refer to the global visions summarized in Fig. 3; the shaded bar indicates their level of plausibility, with the darker central region deemed more plausible and the flanks less so. Note that *Great Transitions* are not included, on the grounds argued earlier, that their tenability is linked to the emergence of a strong GCM, assumed absent here. The solid lines represent possible global pathways. The amplitude of the waves signifies the degree of stress on the system. The black bullets represent bifurcation points beyond which the possible pathways diverge.

Focusing on node A at the bottom of Fig. 7, the contemporary global world line is shown entering from below. System stress is increasing as the suite of ecological, social, and geo-economic stressors continues to intensify. Meanwhile, as civil society fails to coalesce as a unified force, the GCM remains weak. The critical uncertainty concerns the character of forthcoming *global crises* in the face of increasing stress and weak human coping capacity. The world line branches into two broad streams, depending on whether the global crisis is tolerable (the left branch) or destabilizing (the right branch). The left branch shows a most fortunate development — biophysical and institutional resilience prove to be far greater than feared. The crisis takes the form of a series of *tolerable bumps* that can be managed with only incremental adjustments required. The counterpoint is shown in the right branch as stresses amplify into *destabilizing shocks* that trigger a general crisis.

Following the left branch toward node B in Fig. 7, we see the relatively gentle series of tolerable shocks entering from the bottom-right as dominant institutions driving market-led global development are able to adjust and persist. Without the twin spurs of a severe crisis and a popular political mobilization to challenge entrenched ideology, the trajectory continues in the general direction of a *Market Forces* world. The forces of reform and transformation do not vanish; they continue to advance the values of sustainability, equity, and alternative lifestyles, but are unable to gain traction. The sense of urgency is insufficient to mobilize either political will from above or a popular politics from below for a new global deal.

A key uncertainty (node B) then becomes whether *market adaptations*, as the primary coping mechanism, are sufficient for maintaining system integrity. If they are, as in the left fork, global development continues toward a *Market Forces* future. Although it is not inconceivable that unattended global
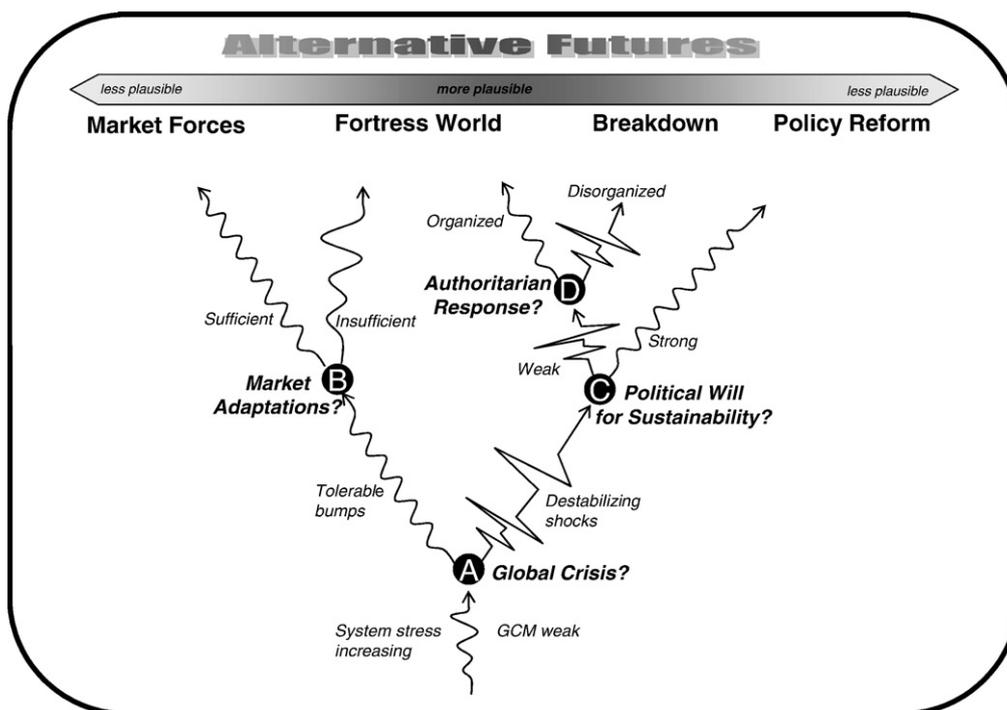


**Fig. 7 – Pathways I: Weak Response.**

stresses will remain tolerable indefinitely under these conditions, this outcome seems implausible, even utopian, in a world where social, geo-economic, and environmental pressures propagate along complex, far-flung, and novel chains of interaction, with long lags between cause and effect.

The right fork off node B shows the alternative possibility that market signals and adjustments are unable to induce adequate and timely behavioral responses. In a world with neither effective global governance nor a broad political base for reform, the pressure would mount on authorities to prevent a slide into chaos by imposing social order and environmental security. Under such circumstances, some form of *Fortress World* becomes plausible.

We turn now to the right half of Fig. 7. In this highly fragile sector of the trajectory space, gathering global stress manifests as destabilizing shocks that threaten system stability. At the same time, with public pressure for basic change weak, government action to cope with the growing crisis is highly circumscribed. The question, suggested at node C, is whether the necessary political will for sustainability could emerge in this context. If a massive policy program was to be implemented to rectify root environmental, social, and geo-economic stressors (the right branch), the crisis would gradually abate and the global pathway veer toward *Policy Reform*. Although not impossible, the political basis for such planetary stewardship would be difficult to establish in the midst of deep crisis and in the absence of a strong movement for democratic solutions. If political will remains weak (the left branch at node C), the crisis would deepen and the global emergency would stimulate the mobilization of the international forces of order. But would an effective *authoritarian response* of repression and control be possible under such unraveling conditions and deepening chaos (node D)? If it is, a

*Fortress World*-like future would ensue; if not, *Breakdown* would loom. Either is plausible in this sequence.

### 5.2.    *Human response strong*

The second family of pathways assumes that early and effective institutional adaptations to planetary challenges are stimulated by the emergence of a growing GCM. The branching world line structure is shown in Fig. 8. The assumption of a significant global movement is a critical new factor in the architecture of the future. Note that the spectrum of plausible futures has changed dramatically (compare the top portions of Figs. 7 and 8): *Policy Reform* and *Great Transitions* move to the central range of plausible alternative futures, rather than *Fortress World* and *Breakdown*.

At the bottom of Fig. 8, the global system is impelled forward as in Fig. 7, but now, instead of popular passivity, a GCM begins to take shape. A critical uncertainty, again, is whether the *global crisis* comes in the form of tolerable bumps or destabilizing shocks (node a). The "tolerable" branch may be more likely than in the parallel situation without the GCM because the political base for a government-led *Policy Reform* agenda would be strengthened. Since it is unlikely that a nascent GCM would have a powerful influence in the near term, the global system would remain at risk of destabilizing shocks.

Following out the left "tolerable" branch, we come to node b. As before, if market adaptations prove suffcent for coping with system stressors, the world line could take the left fork toward *Market Forces*. If market adaptations are insufficient, ominous global problems persist (the right fork at node b). In the analogous situation with a weak GCM (Fig. 7, node B), an authoritarian response leads to a *Fortress World* future. Here,
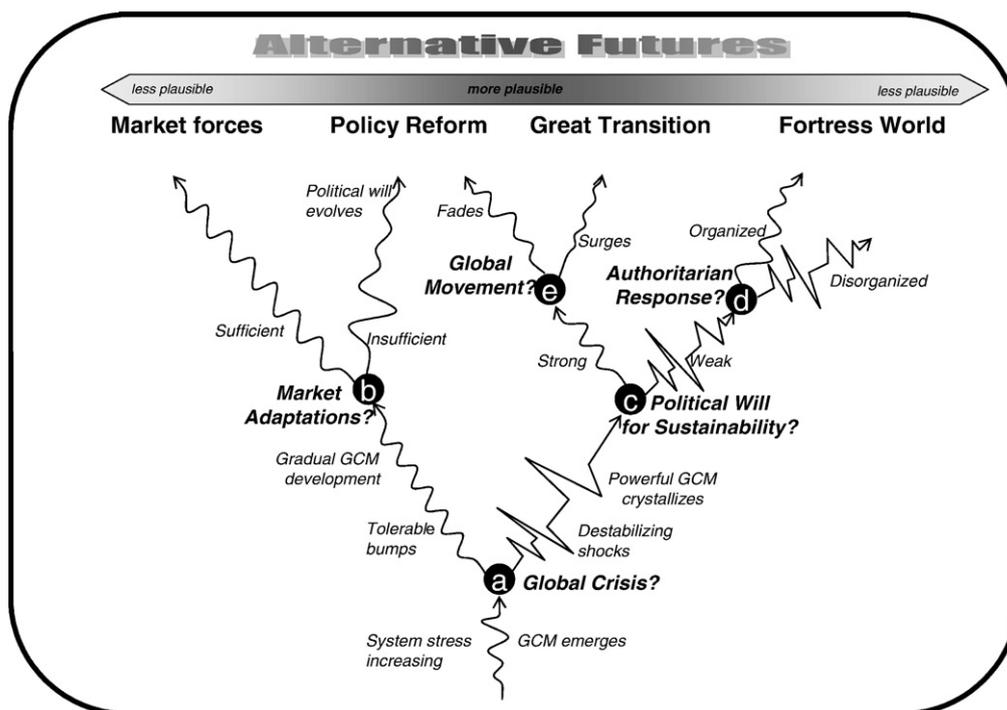


Fig. 8 – Pathways II: Strong Response.

as a result of the political prod of a popular movement for sustainability and good global governance, the conditions are in place for imposing corrective measures and for navigating toward a *Policy Reform* world.

Along the right branch from node a, global crises take the form of destabilizing systemic shocks. These ominous developments would likely galvanize growth of the blossoming GCM. The trajectory again faces the bifurcation point defined by the level of *political will for sustainability* (node c). This time, with a vibrant GCM altering the political landscape, the emergence of strong political will becomes more plausible, while the threat of *Fortress World* diminishes (node d). Even less likely would be a disorganized and chaotic *Breakdown* scenario, since higher levels of international coherence would be expected in pathways with a strong GCM to catalyze more cooperative governance. The GCM may *fade* or become instituionalized as the crisis abates, leading again to *Policy Reform*, or if it continues to *surge*, some form of *Great Transition* becomes plausible (node e).

## 6.    Understanding and shaping global evolution

This exposition has suggested a mode of inquiry for examining the broad contours of multi-decadal global development alternatives. These "world line" sketches can be elaborated in great detail, and with great variation. An organizing framework such as this provides an arena for joining issues, exposing different perspectives, and enriching scenario analysis as a collective enterprise, rather than a stream of separate studies.

Our provisional exploration of global pathways has drawn attention to two prospective uncertainties: the form of forthcoming crises and the quality of human response to the challenges of the planetary phase. If institutional and cultural innovation fails to mute the precursor stressors of a systemic crisis, the world line could pivot toward a venal future. If the world begins to act with foresight, unity, and resolve, as stewards of earth and in solidarity with unborn generations, the long transition toward a resilient global civilization could begin. Contemporary global actors – multinational bodies, corporations, NGOs – enfeebled, respectively, by nationalism, narrow self-interest, and fragmentation, have limited capacity for this grand task. To overcome the triple deficit of political will among myopic leaders, social responsibility among corporations, and unity in civil society, a sustainability transition is likely to require a sharp upswing in public awareness and engagement. A global citizens movement would strengthen the political basis for corrective policies and the cultural basis for a new paradigm of development.

In a world that seems to generate more resignation and anger than action and hope, this may seem improbable. Still it would not be the first time that an effervescence of popular political energy arrived unexpectedly to torque the direction of history. The historical precondition for the rise of a global movement is that the earth itself has become the locus of danger and opportunity. In the planetary phase, humanity-as-a-whole and the wider community of life become a community of fate, anchoring the imagined global community on a more objective foundation than the once imagined communities of nation-states, with their arbitrary boundaries (Anderson, 1983).

If the possibility of an upsurge of a political and cultural movement is latent in the cultural matrix, focus can turn to strategies for crystallizing it. Sustainability science has a key role to play by building the knowledge platform. In particular, global scenarios can widen the horizon of what is thought possible and deemed desirable, thereby becoming causative elements in their own narratives. By illuminating hopeful possibilities, scenario visions act as attractors, drawing the world line forward, influencing choice, and, thereby, adding a teleological aspect to global dynamics.

In the turbulence of planetary transition, one need not be a cynic to harbor deep foreboding — rigorous pessimists can mount considerable evidence to indict the future. Nevertheless, we return from our travels down different world lines with a tentative, hopeful message. The path actually taken will rest with the reflexivity of human consciousness: our capacity to think critically about why we think what we do — and then to think and act differently.

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