Climate Change
Redemption through Crisis

Sivan Kartha

GTI Paper Series
Frontiers of a Great Transition
13

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Prologue

Many who have pondered the route to a better society, a society underpinned by radically different values, have concluded that so radical a transformation could only be catalyzed by a dire crisis. And many have seen in the climate problem such a crisis. It is global in scale. It ties humanity's fate together like no other challenge. It threatens the very survival of humankind. Overcoming it will require an unprecedented degree of global solidarity and a newfound respect for our ecological constraints.

This essay examines the climate problem, and explores its links to a Great Transition—a global future based on global solidarity, human fulfillment, and ecological sustainability (Raskin et al., 2002). The first section presents some background to the climate problem. The second section looks ahead, envisioning the climate challenge eighty years hence and a Great Transition society living in peace with its climatic constraints. The third section muses on the paths by which we might become that society.

The Climate Challenge Today

Uncertainty is the defining characteristic of the climate challenge. We do not know how temperamental the global climate system is, and how angrily it will respond to our continued provocations. We cannot forecast the technological developments that will help us to live within our climatic constraints. We are incapable of predicting the evolution of those social norms and institutions that will underpin our efforts to rise to the unfolding climate crisis.

Yet there is still much that can be definitively asserted about the climate challenge. Climate scientists fully understand the primary mechanism underlying the problem. The atmosphere contains certain gases—"greenhouse gases"—that serve to blanket the earth, reflect its warmth back to its surface, and keep it warmer than it would otherwise be. Without greenhouse gases in the atmosphere, the earth would be colder by about 33°C. The Earth would be a frozen, lifeless wasteland.

What concerns us now is our meddling with this delicately balanced system. We are now witnessing an *enhanced* greenhouse effect caused by human activities that add more greenhouse gases to the atmosphere. Carbon dioxide is the main greenhouse gas we have been adding as we have burned fossil fuels and cleared forested land since the dawn of the industrial revolution. With this sudden pulse of emissions, the atmosphere now has one-third more carbon dioxide than it had stably contained for the several millennia during which human civilization evolved.

This is worrisome. Human civilization emerged and flourished with the onset of a warm and remarkably stable climate. Indeed, civilization was enabled by, and has been profoundly dependent on, this present stable climate. Food security and water security rely on consistent and favorable temperature and precipitation. Society's greatest urban centers have grown up hugging coastlines that have been unchallenged by rising seas for many millennia. Economies rely on materials, resources, and sustaining services such as

watershed protection, provided by ecosystems that are carefully tuned to the present climate.

Poor communities are most directly threatened. They depend for their livelihoods on a stable and hospitable climate; they often rely on rainfed subsistence agriculture and gathered natural resources, are deeply dependent on climatic phenomena such as the Asian monsoons, and are most vulnerable to the devastation of extreme weather events such as hurricanes. As the world's poor majority struggles to meet basic needs, humanity can ill afford a radical departure from the stable and hospitable climate it has thus far enjoyed.

Yet, the disruption of this climate is now well underway. The earth now stands 0.75°C warmer than it was at the dawn of the industrial age. The twenty warmest years on record have all occurred since 1980, and the impacts are evident. Ancient glaciers are retreating, permafrost is thawing, Arctic sea ice is diminishing. The rains and the ocean currents are shifting. The seas are warming, acidifying, and rising, while hurricanes are growing in destructive force (Moberg et al., 2005; Hansen et al., 2004; Church and White, 2006; Bryden et al., 2005; Webster et al., 2005; The Royal Society, 2005; Emanuel, 2005).

The very cycle of life is flexing in defense. Growing seasons are lengthening, responding with earlier tree-flowering, insect emergence, and egg-laying in birds. Other plants, animals, and diseases are migrating, shifting their ranges toward cooler zones. But often such resilience is impossible, or illusory. In mountainous South America, scores of species of the stunningly beautiful harlequin frog are now extinct. Their elegy is a tale of ecological complexity, interconnectedness, and vulnerability. Rising greenhouse gases warmed the region and produced cloudier mountainsides, which, in turn, enabled the relentless rise of a pathogenic fungus, which decimated the harlequin species in a matter of years (Patz et al., 2005; Pounds et al., 2006; Blaustein and Dobson, 2006).

But it is not just frogs that are suffering from climate change. As the seas have warmed, they have spawned hurricanes that are more intense, more long-lived, and more deadly. The destructive power of the most intense hurricanes—those ranked as Class 4 and 5—has nearly doubled over the past thirty years, rising in every ocean basin in a manner unprecedented over the past several thousand years. Hurricane Katrina killed more than 2,000 in the U.S. The supercyclone of Orissa, India, killed at least10,000. Hurricane Mitch took the lives of 20,000 Hondurans. The evidence increasingly suggests that fingerprints of climate change are on these scenes, driving the death tolls higher.

Even as these areas are ravaged by violent winds and relentless rains, elsewhere droughts and heat waves are mounting an equally deadly offensive. The European heat wave of 2003 killed more than 30,000 people, and we are now in the midst of an East African drought that has already claimed thousands of lives through famine, and threatens to claim millions more.

All this we see happening already. Yet, disturbingly, we have suffered only a fraction of the total warming that may be in store. The earth's temperature has not yet even caught up with the excess greenhouse gases already pumped into the atmosphere in recent decades. And, if we do nothing to curb our future emissions, the earth could heat up by an amount comparable to the temperature rise that ended the last global Ice Age—*in the span of a century, rather than several millennia*. It is no exaggeration to say that so dramatic a disruption could bring about the collapse of civilization.

But even much less warming could have serious or even devastating impacts. As little as 1°C temperature rise puts important ecosystems at risks. Coral reefs, highland tropical forests, Arctic ecosystems all stand to suffer losses. Several key biodiversity "hotspots"—those richest and most threatened reservoirs of life on earth—could face serious degradation and the extinction of endemic species (Hare, 2003; IPCC WG III, 2001). And all the while, droughts, floods, storms, and heat waves would be growing more intense and more deadly.

As the temperature rise approaches 2°C, which could happen in the next few decades given present trends, damage will have spread to a wider range of ecosystems. The loss of species could be devastating. Analyzing the distribution and sensitivity to warming of a large number of ecosystems scattered across the globe, a recent study found that fifteen percent to thirty-seven percent of species in this sample of ecosystems would be driven to extinction. People, too, would face mounting dangers. Many regions would face escalating threats to food security and water security (Thomas et al., 2004; Hare, 2003). Large populations in South America and Asia rely during the dry seasons on the steady release of water from glaciers and snowpack. The loss of this dry season water supply will cause water shortages, or exacerbate existing water problems that already cause hardship and set off conflicts.

A warming of 3°C would very likely be disastrous. The earth's history tells us that this much warming is sufficient to melt enough of the Greenland and Antarctic Ice Sheets to raise the seas twenty-five meters. The coastline would be radically reconfigured, submerging areas that today are booming metropolises. We don't know how long it would take the seas to rise this much, but once initiated it could be inevitable.

Much beyond 3°C, global damage would become unfathomable. The environment may profoundly transform, with large-scale extinctions, ecosystem collapses, serious undermining of food production and water resources, and rising seas. It is a world that we do not want to inhabit. Lesser climatic shifts, archeologists caution us, have precipitated the decline of major civilizations. From Mesopotamia to the Nile Valley to Mesoamerica, regimes have fallen with the loss of a stable climate (Fagan, 2004).

Not only does climate change threaten us with these dire impacts, but there are intrinsic features of the climate problem that amplify the challenge. The first of these is the *inertia* inherent in the complex and interconnected human and ecological systems involved in climate change. The climatic impacts of society's decisions will take decades or even centuries to come to pass. Today's decision to build a coal power plant will result in emission of carbon dioxide throughout the plant's several decades lifetime. Those carbon dioxide emissions are long-lived; they will keep warming the planet for the century or more that they remain in the atmosphere. Some of the impacts of that warming will happen quickly, but others will take a long time to fully manifest, such as the melting of glaciers that will continue to raise sea levels for several centuries. These impacts are inevitable once set in motion. Our children and grandchildren will bear the consequences of the reckless decisions we make today.

A second difficulty is the *irreversibility* inherent in the climate system. We could easily disrupt the climate, and damage ecosystems in ways that cannot be reversed even if greenhouse gas levels were brought back to their pre-industrial level. The destruction of coral reefs cannot be undone, at least not on a timescale of less than many centuries. The

extinction of species can never be undone. Nor could the destruction of the Greenland Ice Sheet. The massive, three kilometer thick Greenland Ice Sheet is not a product of our current climate, it is a self-sustaining gift left by the last Ice Age. If it loses too much mass and diminishes too much in altitude, it will no longer be able to create the cool local climate by which it keeps itself alive.

This raises a third inherent feature of the climate problem—it has the potential to bring on *catastrophic* damages. A sudden global realignment of the ocean currents is a lurking catastrophe. The ocean currents are not the timeless, ponderous flows that we imagine them to be. Ice cores and sea floor sediments yield a startling paleoclimatic record of massive ocean current shifts occurring over as little as one decade. The Gulf Stream, which conveys huge amounts of warmth from the tropics to the northern Atlantic, could falter as a result of climate change. Ironically, a warming world could plunge Western Europe into a much colder climate regime than today, while simultaneously bringing higher temperatures and "megadroughts" to parts of Africa, Asia, and North America.

A large rise in sea level could be catastrophic. The conventional wisdom—that ice sheets moving at the proverbial glacial pace could not cause this to happen for millennia—is now being anxiously rethought. The historical record seems to be telling us that while ice sheets grow by slow accretion of many thousands of years, they can suffer massive losses rapidly and tumultuously over a period of centuries or even decades (Hansen, 2005).

This relates to a fourth inherent feature of the climate problem—the existence of positive *feedbacks*. The climate system is complex and deeply interconnected, with its own internal dynamics far beyond our capacity to control. As warming progresses, it sets off processes that further amplify the warming. One major feedback is the melting of snow and ice, which reveals darker land and sea that are more effective at absorbing the sun's heat. This process accounts for the Ice Ages, in which the massive advance of snow and ice amplifies by a factor of a hundred a tiny seasonal shift in the pattern of the sun's warmth caused by variations in the earth's orbital cycles. Another set of feedbacks has to do with the earth's capacity to start releasing massive amounts of greenhouse gases on its own. Ecosystems threatened by climate change, such as the Amazon, could release huge amounts of carbon dioxide now stored in trees and soil if they become unviable and suffer serious declines. Permafrost in the cold boreal regions of the world contains enormous amounts of methane, a potent greenhouse gas that could escape into the atmosphere as the regions warm. The fear is that anthropogenic greenhouse gas emissions could tip the climate system to a point that it starts driving its own runaway warming.

These problems—the inertia, irreversibility, feedbacks, and potential for catastrophic damages—are all aggravated by the *uncertainty* inherent in the climate system. Scientists have a broad understanding of the mechanisms at play, but a frustrating ignorance about some key implications. We do not know how sensitively the earth will respond to our excess greenhouse gas pollution. As far as we know today, the earth could warm by as little as 1°C in response to a doubling of atmospheric greenhouse gas concentrations, or it could warm by much more. Warming as high as 4°C, 5°C, even 8°C is not ruled out by our current climate science (Hansen, 2005). We don't even know *when* we'll know.

Nor do we know how sensitively various parts of the climate system will respond to warming—the glaciers, the ocean currents, hurricanes, large-scale weather patterns like

El Nino and the Asian Monsoons. Nor do we know how sensitively ecosystems will respond to the climatic disruptions. We are already witnessing ecosystem impacts, and we have good reason to believe that many ecosystems are precariously balanced, on the verge of transforming or breaking down if pushed beyond certain climatic limits. We do not know where those limits lie.

All of these confounding features of the climate problem are imbedded in a social matrix. Profound equity concerns lie at the core of the climate challenge. There is no equity in the distribution of climate impacts. Those who will be most ruthlessly affected are overwhelmingly the poor and marginalized. They are least responsible for causing the climate problem—with the average Bangladeshi, for example, being responsible for emitting of one twenty-fifth as much carbon dioxide as the average U.S. citizen—and wield scant political influence over those who are responsible. They have little authority to define what actions should be taken to avert climate change, or what level of climate damage is "acceptable". They, like future generations, are voiceless victims.

Rising to the challenge

What can we do in this situation, with both the uncertainty and the stakes so high? Some experts most steeped in climate science are now starting to warn that we are dangerously close to a tipping point beyond which it will be impossible to avoid far-reaching, deeply regrettable damages (Hansen, 2005). If we are to preserve a good chance of avoiding catastrophic impacts, then greenhouse gas emissions, which are still on the rise, will almost certainly have to stabilize and then reverse within the next ten years. Within the two decades following, global emissions will need to drop to about one-half their current levels. In the wealthy, high-emitting countries, emissions will need to drop much more.

In a world fueled by fossil energy, such a radical change may seem inconceivable. Thankfully, it is in fact possible. There are technologically feasible and economically viable options. There are countless "no-regrets" options with no additional economic costs, especially when accounting for their co-benefits: reduced energy costs, improved air quality, increased energy security. There are further technological options that may now be more costly than today's fossil-based incumbents, but that will become more cost-effective as research progresses, markets develop, and society adapts (Vergragt, 2006). And there are options that will remain more costly, but that are justified by the critical nature of the climate problem. If we succeed, in the future we may be living and working in much more energy-efficient homes and buildings that are designed to take advantage of natural lighting and passive solar heating. Our communities may be laced with efficient public transit that eliminates the need for long commutes in private cars, while Information Age commerce might require less business travel. Our agriculture may rely less on inputs derived from fossil-fuels, and our diets may draw on locally produced food. Our fossil energy needs may be entirely supplanted by renewable energy resources such as solar, wind, hydroelectricity, geothermal and bioenergy.

But we should probably not count on technological deliverance alone. The most plausible and desirable pathways to a low-GHG future will most likely also include societal changes that make lifestyles possible which are less consumptive, less resource-intensive (Rajan, 2006), yet more fulfilling (Stutz, 2006; Kates, 2006). After all, beyond a certain level of affluence, the correlation between well-being and material wealth breaks

down. Affluent societies appear to be yearning for something beyond the ever-expanding material possessions that their economies are geared toward producing. A world focused more on well-being and less on consumption as an end in itself will allow us to more comfortably live within our ecological bounds.

Admittedly, accomplishing this would require a nearly unimaginable turn-around—technologically, politically, and culturally. A climate crisis may shock us into action, but by the time the earth's climate system is disrupted enough to force our collective hand, it may well be too late to avoid devastating impacts. Yet we must believe that humankind can be compelled to undertake so profound a transformation, and to do so fast enough.

Climate change is thus a life-or-death test of humanity's maturity—its willingness to anticipate the impacts of its actions, and act with alacrity, fairness, and prudence. As we enter a planetary phase of civilization, our very survival depends on our ability to rise to that challenge.

The Climate Challenge Tomorrow: a View from the Future

Dateline 2084: Four score and seven years ago our forebears convened in Kyoto…

By the time the Kyoto Protocol was drafted in 1997, we had been forewarned. Satellites had already surveyed the steady retreat of sea ice and the melting of glaciers. Deep ocean monitors cautioned that the thermohaline circulation was already slowing. Ice cores alerted us that the earth is fully capable of lurching into radically altered climate regimes. The earth's climate was already expressing its anger through increasingly fierce storms, floods, and droughts.

But the looming threat didn't move our leaders, didn't change our cultures, didn't penetrate our psyches. Starting with the Kyoto Protocol, our response was a haphazard and half-hearted series of emission reduction targets. These weren't guided by a scientific appraisal of our dire straights, but rather by what was considered politically acceptable. Global emissions continued to rise until mid-century, at which point they had grown by fifty percent, before we finally managed to reverse the trend. Although our emissions have fallen by about half since their mid-century peak, we have nonetheless dumped enough greenhouse gases into the atmosphere to boost their concentrations to twice the level at which they had stood stably for the several millennia during which human civilization emerged.*

In the meantime, we have pushed the climate into the unknown. We did this casually, assuming that the climate would respond benignly, with minimal, gradual, tolerable warming, even though our climate science told us that it may not, that it might instead lash back with a volatile, deadly fury. Yet, in a state of collective denial, humanity used

* This characterization is based on the "B1" scenario of the Intergovernmental Panel on Climate Change (IPCC) Special Report on Emission Scenarios (IPCC, 2000). Even though it is the SRES scenario with the lowest emission profile, and is characterized by relatively low population growth, "reductions in material intensity, and the introduction of clean and resource-efficient technologies," the B1 scenario nonetheless shows global emissions rising recklessly through the first half of the 21st century. Like all the SRES scenarios, it is a "baseline scenario" with no presumption of special efforts aimed at reducing GHG emissions. Still, of the SRES scenarios, the B1 storyline is the one with the greatest promise of ultimately evolving into a Great Transition world.

this uncertainty as a license to respond listlessly, presuming that the news would come out in our favor.

Since the uncertainty in the climate system is so fundamental to the climate problem, this narrative of the future offers two images looking back from 2084. The first depicts a world in which we have been blessed with a climate system that is forgiving and with ecosystems that are resilient. The earth responds fairly gradually and modestly to our emissions, and ecosystem damage is as low as we can reasonably hope. The second image depicts a world in which our climate system has proven itself unforgiving and ecosystems are revealed to be highly sensitive. The magnitude of warming is large, and the ecosystem damages are punishingly high. Both of these paths are well within the uncertainties of today's imperfect climate science. One is optimistic, the other pessimistic, but neither is extreme, and both are eminently plausible[*].

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[*] The two following descriptions are based on the potential range of warming that could result from the B1 scenario. There is a range, rather than a definitive amount of warming, because of the uncertainty in our current understanding of the climate system's response to our emissions. In the climate scientists' parlance, we do not know the "climate sensitivity", that is, the precise amount of warming that will result from stabilizing at a given level of greenhouse gases. The IPCC Fourth Assessment Report (IPCC, 2006) uses eleven different climate models, each with its own climate sensitivity, to provide estimates of the warming that would arise in each of the SRES scenarios. The warming assumed in the first case below ("The Blessed") is based on results of the model with the second lowest climate sensitivity of the eleven IPCC climate models. The warming assumed in the second case ("The Cursed") is based on the results of the model with the second highest climate sensitivity.

The Blessed

It is only now that we fully comprehend how reckless we were, and how lucky. The climate system has turned out to be more forgiving than we had any right to assume it would be. We knew, as we rocketed through the first decades of this century propelled by fossil fuels, that we were courting disaster. It is merely by good fortune that disaster hasn't come.

As it turned out, the climate sensitivity was well toward the low end of the uncertainty range that had characterized our knowledge of the climate system for much of this century. The tropical forests have not worsened our problem by turning into run-away sources of carbon dioxide—they have been spared massive pest outbreaks and devastating forest fires. Nor have the polar regions lost as much of their heat-reflecting ice as we had feared, or started releasing methane from their melting permafrost. With relief we've watched as large and worrisome uncertainties came out in our favor. In total, the warming to date has been about 1.8°C. Given our minimal efforts to reduce emissions through the first three decades of this century, humankind is lucky indeed that the earth has warmed so little.

That is not to say that no damage has occurred. Even 1.8°C is a massive disruption from the perspective of many ecosystems. Coral reefs have suffered greatly. By 2030, after less than a decade of annual coral bleaching, large areas of reefs in the Caribbean and the Indian Ocean had degraded to an unrecoverable point. Desperate efforts to quickly eliminate other stresses, like coastal run-off and sewage outflows, proved expensive and ineffective. Fishing bans and tourism restrictions were economically painful and politically contentious, and just as ineffective. As the reef systems continued to die, we quickly learned more than we had ever hoped to find out about just how vitally the entire marine ecosystem depends on coral reefs. Not only have coastal species of fish disappeared, but also several open-seas species. We are still watching the continued impacts on shoreline ecosystems unfold as dead coral reefs give way to gradual erosion, razing the protective barrier that seashores have enjoyed for millennia. Over the past few decades, fishing communities have collapsed and tourism destinations have disappeared from travelers' maps. Now, one finds ghost towns at the site of these previously vibrant communities.

Deep wounds have also been inflicted on the Arctic. As the Arctic environment has deteriorated, traditional Inuit culture has been virtually wiped out. Their main sources of food—seals, walrus, polar bears—have been hit hard by the loss of summer ice. Their communities have literally disintegrated as the permafrost that had underlain their homes has thawed and heaved. Other Arctic communities—the Saami and the Athabaskan—have suffered the same fate.

The Greenland Ice Sheet is losing ice at its periphery at an unprecedented rate. Ice streams are flowing into the seas at a speed thought implausible a few decades ago. We are just lucky that the increase over the last several decades in high-latitude precipitation has built up Greenland's interior quickly enough to compensate for the losses at its periphery. It is a delicate balance, and things could easily change in the future. That would be disastrous, as even the current rate of sea-level rise has amplified the impacts of the worsening hurricanes and has brought salt-water intrusion to areas already enduring water shortages.

We have also been watching as the extinctions continue worldwide. Tropical forest ecosystems are moving upslope and disappearing along with their endemic species. Amphibians have continued the decline that started in the twentieth century. Many species of migratory birds, especially those relying on wetlands and on Arctic feeding grounds, have suffered. At least for now, there have been no major ecosystem-wide collapses, although these individual losses are still painful. Repeatedly throughout this century, we have learned of some crucial node in the ecological web only upon its loss. As one barely noticed species has gone extinct, another "commercially valuable" one falls into rapid decline and several dependent human communities start grasping for alternatives.

Food supplies are adequate, though sometimes strained by regional droughts, and water stress is worsening in some regions but not yet a crisis. Humanity is, for the most part, being spared. But we now well understand that this is through no virtue of our own, but merely good fortune. And, knowing that our luck cannot last forever, we have over the past few decades initiated the massive societal transformation—the Great Transition—that is needed to sustain this planet and ensure the survival of the species.

The Cursed

Humankind has knowingly brought this tragedy upon itself. The climate sensitivity turned out to be well toward the high end of the uncertainty range. The rapid loss of tropical forests has added to the rise of carbon in the atmosphere, and the thawing permafrost has added a desperately unwanted dose of methane. The warming of the Arctic has amplified itself through the loss of ice and snow. Now, with atmospheric greenhouse gas concentrations more than doubled, the climate has warmed by 3.1°C. The earth and its people are now paying the price.

Several key ecosystems are severely damaged. The Arctic has massively transformed. Alpine ecosystems worldwide are fragmented, altered, and eliminated. Coral reefs are decimated. The warming occurred much too quickly for many ecosystems to adapt. In turn, those people dependent on the dying ecosystems have suffered. Arctic communities, hill tribes, fishing and tourism towns, are all under assault.

As is the entire global coastline. The Greenland and West Antarctic Ice Sheets show clear evidence of an inexorable decay. Seas have risen by roughly thirty centimeters already, and the problem is accelerating. It is not clear whether the ice sheets will stabilize or be lost entirely. Humanity has no choice but to prepare for a several meter rise in sea levels, which will hopefully not come too quickly to allow an orderly retreat from the coasts. Climate exiles from low-lying delta areas and from island states in the South Pacific, Indian Ocean, and Caribbean already number some twenty million, and will steadily grow over time.

Western Europe has endured the most unpredictable, volatile weather in its recorded history. It is entirely unclear what the continued weakening of the Gulf Stream will bring, and what sort of equilibrium Europe's regional climate will settle into. The summer heat waves and the winter deluges have taken their toll. The cost in infrastructure—to say nothing of the human toll—directly attributable to this climatic instability has been has been a continual reminder of our poor choices in the early decades of this century, and the false economic premises on which they were based.

But the greatest tragedy so far, the famines of 2023-2025, arose from a confluence of climate stresses and our own unprepared and ill-suited societal institutions. With the increasingly unreliable rains in the Sahel, Africa's famine was not a surprise. But Asia's was. Successive monsoon failures delivered repeated blows to South Asian and South East Asian food production. While it was climatic pressure that triggered the famines, they were exacerbated by heartless governance and soulless economics. In hindsight, it is scandalously clear that North American and Russian surpluses could have prevented the suffering in Africa and Asia, but there simply was not the political will. Countries chose instead to use their surpluses to secure their own food reserves. They justified it on the grounds that the climatic disruption of food supplies might continue and spread through the following years. They further argued that what food aid had been delivered was being wastefully administered. And, as many powerful corporations well knew, there were profits to be made.

Ultimately, more than one hundred million died. So stark was the tragedy that the rest of the world—for the first time—is unable to rationalize it as an inevitable natural catastrophe. The denial that had begun the twenty-first century has finally been penetrated. Humankind has passed through a nadir of utterly ignoble heedlessness and disunity, but is has since undergone the self-examination and transformation—the Great Transition—that was needed to sustain this planet and ensure the survival of the species.

While the climate system will determine whether we are blessed or cursed, it is we who will decide how to respond. Our fate is ultimately in our own hands. Thus, in either of these images one could perceive the seeds of a Great Transition. If the climate crisis presents us with an ordeal that is grave enough to rouse us from our complacency, yet not so insurmountable as to crush our hopes, it could spur human society to nurture those seeds and fundamentally invent itself. Our imperiled climate may prove to be an "optimal crisis".

[The essay now converges once again into a single narrative.]

Now, from the vantage point of 2084, we look back with relief. We could have deferred the mobilization that was ultimately demanded of us until it was far too late to save the climate. We could have continued to fool ourselves with engineering fixes for our degenerating environment. We could have descended into fragmentation and heedless abandon under the strains of a deteriorating climate. But, instead, as we beheld our ruinous impact on this planet and our self-defeating relations with each other, we chose to reinvent ourselves for the sake of our own survival. We chose to emerge from this crisis unified and matured.

Indeed, we now inhabit a world littered with monuments to loss. The last surviving specimens of noble species are sequestered in our zoos. Dwindling fragments of certain unique ecosystems dot our landscapes. Diasporic splinters of communities and cultures have dislocated from islands, from deltas, and from the Arctic into foreign lands.

But our climate is now being stabilized, and is being tended by a cautious and deferential steward. We have survived, and we have redeemed ourselves. We are now a sadder but wiser race.

Climate and the Great Transition

The Kyoto Protocol, and the series of incremental Declarations, Mandates, Protocols, Accords, and Plans of Action that succeeded it, were more than token efforts. Within a decade or so, they eventually overcame the strident opposition of the fossil-fuel partisans and started to produce results on the ground. These global agreements gave birth to new institutions such as carbon markets and global funds for adaptation. They helped usher new technologies into the marketplace. They reduced emissions to levels well below the most ominous projections issued at the end of the twentieth century.

But the process was sluggish, moving in fits and starts, and it came nowhere close to achieving the rapid transformation of the global energy economy that the climate science was warning us to urgently undertake. At the turn of the twenty-first century, just as the glaciers were speeding up, the climate negotiations were slowing down. In these fraught negotiations, nations were recklessly obstinate—or even maliciously obstructive—whenever they felt their narrowly-defined "national interests" to be at stake. The rich nations of the world felt no obligation to secure global welfare, nor even any compulsion to temper their wasteful ways. The world's hegemon—the United States of America—opted out of the fledgling climate regime on the grounds that it would "harm the economy and compromise the American way of life".

As for the elites of the developing world, their climate policy consisted of bemoaning the underdevelopment in their countries, and thereby rationalizing their nations' exclusion from any international climate obligations. This served their purpose nicely. The impoverished majority served as human shields against any meaningful climate obligations, while the elite minority merrily replicated the affluent lifestyles of their rich-country brethren.

Now, in 2084, we can say with relief that humankind is past this era of fragmentation and infantile bickering. This does not mean that forging a global consensus on climate has become easy. Within the World Parliament* and the multitude of citizens' organizations that inform it, climate still gives rise to contentious negotiations. But they are not nearly so divisive as negotiations had been previously.

They are not so divisive because a common ethos now binds us and a mature dialogue is possible. We now share a spirit of human solidarity, a sense of connection and unity that in an earlier age was scarcely imagined but is now the only viable option in the face of global crises that offer us the choice of hanging together or else hanging separately. We now focus on fulfillment and quality of life—not wealth and material consumption—as the primary measure of success and source of well-being. And we share a strong ecological sensibility, an understanding that the environment on which we depend is not an economic input to be exploited, but a complex and connected web of which we comprise a key part, at once both vulnerable and powerful.

This is the crux of the Great Transition. It came about through the combined will of millions—and ultimately billions—of actors. Even in the twentieth century, one can now look back and see how the climate challenge was helping to mobilize and coalesce disparate groups of individuals and organizations. In the 1960s, Rachel Carson's seminal *Silent Spring* may have awakened us to the realization that we could injure our planet. But it was the climate crisis that shocked us with the grim fact that we could destroy it.

The climate crisis was in fact a nexus of multiple profound crises. It laid bare our addiction to finite and geopolitically precarious energy resources. It keened a lament to the unending destruction of habitat and the relentless extinction of species. It leveled an accusing finger at the inadequacy of our institutions of equitable global governance. It called into question the internal logic of the acquisitive, materialistic, self-absorbed existence of the affluent minority. It starkly underscored the scandalous plight of the poor, vulnerable, and desperate majority.

Diverse groups came increasingly to appreciate these connections. If survival meant overcoming the climate crisis which, in turn, meant facing the profound problems of energy, land-use, global governance, materialism, and poverty, then the present crisis called for nothing less than a fundamental societal transformation. It called for a reinvention of society that transcended mere technological fixes, and that exposed the core of our economic, political, and social values.

In the early twenty-first century, various groups were taking the first tentative steps toward building alliances and forging a holistic understanding of the multiple crises facing the world. Climate was not always the central concern, but it was rarely far from the center. A "blue-green" movement found common ground between the labor unions and environmental NGOs to explore approaches to the climate problem. Corporate responsibility advocates joined with faith-based groups to raise awareness of "climate liability" and to examine the connection between ethical values and shareholder value. Concerned citizens examined their own lifestyles, and pressed municipal governments to adopt measures to reduce local greenhouse gas emissions.

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* See Rajan (2006) for a further discussion of the political institutions, such as the World Parliament, in 2084.

As the first unmistakable impacts of climate change were felt, these efforts grew broader. Some corporate sectors, such as the insurance industry, worked proactively with community groups to temper the impacts of extreme weather events. A broad coalition of groups—ranging from grass-roots development practitioners to large renewable energy firms—joined forces to compel the multilateral trade agreements such as the WTO to finally embrace substantive environmental conditions, with provisions related to greenhouse gas being chief among them. The entertainment industry, which had always had a few outlying celebrities who adopted quixotic political causes, increasingly acknowledged its role as a designer of social norms and accepted its responsibility to draw attention to global concerns, including the destabilizing climate and its links to development.

Such efforts gradually built momentum and grew more encompassing. As the ongoing climate disruption became more stark, and the understanding took hold that there was worse to come, these various strands gained an increasing level of coherence and urgency. One cannot assign a birth date to the Global Citizens Movement* (GCM) that materialized from these diverse efforts, nor even precisely mark the boundaries of this fluid movement. Yet it clearly played a crucial role in bringing about our Great Transition. The GCM propelled the social transformation that has taken place over the past few decades and provided a bulwark against the inevitable reactionary forces that clung to the status quo. The GCM helped combat the isolationist sentiments that would disavow any sense of global responsibility. It opposed the voices that contended that material wealth today is the best defense against environmental injury tomorrow. It forced us to continually examine the true meaning of well-being, and to ask whether our economic and political institutions were helping us attain it.

The worlds of the Blessed and the Cursed could each give rise to a GCM that launches a Great Transition. The GCMs in the two worlds would differ considerably, prioritizing different goals and being motivated by different constellations of events. In the world of the Blessed, the GCM might be less radically transformative than in the world of the Cursed, or it might emerge more gradually. In the two worlds, the GCM would even have different likelihoods of being spawned in the first place. Perhaps the world of the Blessed, with the climate less urgent would be slightly more inclined to muddle through inertially instead of embarking on the radical transformation of a Great Transition. Perhaps the world of the Cursed would be too damaged, as climate crisis compounds with other worsening problems, and would slip too easily into an unrecoverable downward spiral. In any event, the rise of a GCM is by no means an inevitability. It will rely on active, exceptional, visionary human engagement.

Now, the global community shares two fundamental premises that guide our response to common global challenges. They were hard-won lessons, emerging out of the mistakes of the preceding decades.

* See Kriegman et al. (2006) and Raskin (2006) for broader discussions of the role of a GCM in the Great Transition.

First, we are no longer in denial about our crude power to destroy our environment, nor do we any longer entertain a false pride in our ability to facilely adapt to environmental decline, substituting its degrading services with our own engineered solutions. *We thus believe, at a profound level, in our responsibility to respect the environment and steward it with utmost precaution, and to heal its wounds as best we can.*

We also now better understand the deep interdependence among humanity's diverse members. We are shedding the fragmentation that led nation-states to behave like players of some grand zero-sum game. It is with more than just enlightened self-interest that we believe that universal human development is an acute need and a common goal. *We thus commit ourselves to securing the common welfare of all humankind, of both current and future generations.*

A shared perspective on the climate challenge

The notion of a "global climate regime" seems quaint. It harkens back to a benighted time when nation-states tried to manage our interconnected world by parceling it into disparate international Conventions, Treaties, Protocols and Pacts. This seemed the "efficient" way to deal with problems, or at least the pragmatic way. To embrace the interconnected whole was well beyond our capacity.

Now, after a long, slow struggle, the global response to the climate challenge is embodied in our very development paradigm. Whereas in the early part of the century our nascent attempts to deal with climate were hampered by our trade regimes, they are now closely integrated. Whereas development aid was generally antagonistic to climate efforts, it is now harmonious. Whereas energy policy was driven by national security and sectoral interests, it now operates within the guardrails of climate constraints.

But, even in the absence of a distinct climate regime, we now embrace a shared global approach to the climate challenge. It is rooted in the above two fundamental premises of ecological sensibility and global solidarity.

Climate protection

Citizens across the planet are profoundly remorseful about our historic abuse of the environment, and most of all about the injury we have done to the global climate system. We are all deeply conscious that the earth is still in critical condition, a feverish instability in which it is weakened and vulnerable to the stresses of its seven billion human inhabitants, even as it still ravages us with its super-hurricanes, drought-fueled conflagrations, and glacial outbursts. We have learned the meaning of hubris.

Even though the climate is much better understood now, and we are better equipped—technologically, institutionally, and culturally—to deal with it, the climate is no less a challenge than before. Its inherent problematic features remain. It remains an inertial system with feedbacks and irreversibilities, verging close to the brink of catastrophe. It remains rife with uncertainty. Even as our understanding of the climate system has grown vastly more sophisticated, surprises still lurk. Indeed, we have pushed the earth into an unprecedented state.

In dealing with this problem, the global community has come a long way from the vague language of the late twentieth century Climate Treaty.* That first global climate accord obliged countries to prevent "dangerous anthropogenic interference with the climate system" and exhorted a "precautionary approach", but it then took several decades, and a Great Transition, before a global consensus started to emerge about what those phrases meant.

We now agree on the following. We have suffered tremendous impacts already, but much worse catastrophic possibilities are imaginable. Rapid sea-level rise is the most threatening of them, and it is disturbingly plausible given the current weakened state of the Greenland and West Antarctic Ice Sheets. Others lurk: massive and sudden release of methane that enormously amplifies climate change; the failure of a vital link in the global food web, such as the increasingly stressed phytoplankton in our steadily acidifying seas; the collapse of the already jittery thermohaline circulation. Such catastrophes must be prevented.

We also agree that—short of these major catastrophic disruptions—there are serious irreversible damages that we are still hoping to avoid. Some coral reef ecosystems still survive, although in a highly degraded state, and preventing their complete loss is still conceivable. While further sea-level rise is inevitable, we still hope to limit its total amount and rate. The Asian monsoons have proven alarmingly sensitive, but we hope to avoid thoroughly disrupting them and the ecosystems and agricultural systems that depend on them. The mid-latitudes are already under serious water stress with the decline in precipitation, and much more stress cannot be borne without grave dislocation.

We also agree that the inertia in the climate system means we cannot design our response in terms of incremental, short-term objectives alone, as was done in the early days of a global climate regime. In the first decades of this century, climate targets were defined in terms of national greenhouse gas targets set ten to fifteen years into the future†. These were necessary to motivate immediate action, but nearly useless with respect to affecting decisions whose ramifications were longer-term. We now define climate objectives in terms of both near-term and long-term targets, and we assign obligations accordingly. We allow these to be revisited and revised in light of new understanding and advances, but they still serve as helpful guardrails.

As a global community, we now understand that the simple cost-benefit analysis that was the favored policy tool of an earlier era cannot work in this domain. Its reductionism neglects the central fact that the costs of climate damages are highly uncertain, potentially enormous, unequally distributed, and heavily value-laden. It ignores the fact that the costs of mitigation are highly contingent, depending on our technological choices, on our institutional designs, on our very conception of well-being and attitudes toward sacrifice. Coming to decisions requires a recognition of—and respect for—considerations far beyond the cold calculus of climate science and economics, and an explicit accounting for equity and cultural preferences.

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* This is the United Nations Framework Convention on Climate Change, agreed to at the Earth Summit in Rio de Janeiro in 1992, and amended by the Kyoto Protocol and other subsequent agreements.

† This is the structure, for example of the Kyoto Protocol, which came into force in 2004 and assigned national emissions targets for the five-year period 2008-2012.

That is not to say that we do not bring quantitative, analytical, tools to bear on the climate problem. Our sophisticated World Science is a lithe merging of disparate disciplines—from glaciology to sociology—that has given us an expansive mode of inquiry into the human-ecological system. It has provided society with a much improved understanding of the impacts of climate change, and where those dreaded thresholds may lie. It reflects a much greater awareness of societal responses, and how to mobilize against a common threat. It has equipped us with better tools and broadened our consciousness about making value-laden decisions in uncertain times.

We now also agree that the uncertainty in the climate problem is an inherent trait that is here to stay. We cannot wait it out. We will simply never have the luxury of selecting the precise climate damages we choose to avoid, and confidently deriving a definitive, optimal, perfect-foresight emission path to follow. The best we can do is integrate over all our uncertainties, and identify a path that preserves, to the best of our imperfect knowledge, an acceptable probability of avoiding the feared damages. This makes things harder. It means we have to hedge, planning conservatively should the remaining uncertainties not resolve in our favor and, thus, cast us hurriedly onto an even more demanding path. We have to embed the precautionary principle into our very development path.

It also means that not only *must* we come to consensus on which damages we must avoid, but also on what constitutes an acceptable probability of avoiding those damages. We must do this mindful of the fact that damages are unequally distributed amongst different communities, and that different peoples have varying levels of societal dependence on the threatened ecological resources, and varying levels of cultural affinity and respect for them. They are also risk averse to varying degrees, and have differing definitions of what constitutes an "acceptable" probability of avoiding certain damage.

Thus, the course continues to be hard going. The target is demanding, and it is a moving target. In the last few decades we have responded heroically. A truly revolutionary transformation of our energy system and land-use practices occurred, with ramifications throughout our economies and cultures. We have built up wind farms as we have retired coal-fired power plants. We have designed compact communities and started dismantling the automobile culture that characterized the past century. We have raised a generation of children who comprehend and take responsibility for the environmental impacts of their actions. They see material extravagance as an insult to the environment, as well as an impediment to true fulfillment.

We have come far, but these efforts must continue. We may still find that emission reductions must accelerate even more. We may find that emission reductions—no matter how fast—are not enough, and that we have to start drawing greenhouse gases back from the atmosphere. We may find that averting a catastrophic breakdown will require fantastic, last-ditch engineering efforts, such as the damning of Jakobshavn and several other of Greenland's largest ice streams.

This is the challenge we face as we decide, as a global community, what climate protection means.

Adaptation

We passed a tipping point a long time ago. We had probably passed it early in the century, even before climate scientists first voiced their fears that it might be near. Ever since, we have been living with the worsening consequences.

And so, our ongoing struggle to protect the climate from further disruption has been paralleled by a struggle to adapt to the unavoidable climate change we have brought on ourselves.

Humankind remains deeply dependent on the climate, and its disruption has in turn disrupted human activities and hindered our efforts to achieve a decent level of welfare. We had once hoped that by this time we would have reached a post-scarcity society. It is true we are no longer hobbled by wars between nation-states, or their adversarial struggle for resources and political advantage. But we still struggle—though jointly now—to raise all humanity to a decent level of material security and common dignity. We now accept that the abundance of the early decades of this century was illusory, and that our race was undermining its own future with its heedless consumption.

As was amply demonstrated even as far back as the European heat wave of 2003 and Hurricane Katrina in 2005, it is the poor who suffer most from weather extremes, even in relatively affluent societies. We therefore agree that adaptation, first and foremost, is defined in terms of the needs of vulnerable communities. The most important components of adaptation have thus been closely integrated into the broader global effort to achieve a decent level of welfare for all. Taking climate impacts as one set of stressors among the many that vulnerable communities face, adaptation seeks to increase their overall resilience.

The most dramatic form of adaptation occurs when the ecosystems on which communities rely are so affected by climate change as to make them no longer viable as homes. Rising seas, thawing permafrost, deteriorating forests, parched lands—all these are contributing to a steady stream of climate exiles (Byravan and Rajan, 2005) that the world's communities must accommodate.

Adaptation is also needed to reduce the impacts of climate change on ecosystems. We have limited power to reverse the impacts of climate change, but we can anticipate in a precautionary way how ecosystems are under threat, and make modest but important efforts. In cases where human uses are preventing the expansion or migration of ecosystems, we can return land to nature. We can reduce our pressures on the most fragile of impacted ecosystems. We can, as a last resort, attempt interventions that mitigate the environmental damages of climate impacts.

An equitable global response

The world's peoples have come to a common understanding about the basic principles underlying an equitable global response to the climate challenge. Reduced to their simplest expression, they are the following:

> *Equality*: the principle that all humans have an equal right to the benefits of the global commons;
>
> *Need*: if there is a resource to be shared, priority goes to those who are most in need;
>
> *Responsibility*: the principle that those who have created a problem have the responsibility to solve it and make amends*; and
>
> *Capacity*: the principle that common burdens should be shouldered more heavily by those with the greatest resources.

There is a global consensus that all people have an obligation to contribute to addressing the climate problem. They also agree that the scale of one's obligations should increase as one's responsibility (i.e., contribution to the problem) increases, and also as one's capacity (ability to devote resources) increases. They agree that this applies both to the need to protect the climate and to invest in adaptation. They also agree that Regions first and foremost have a right to prioritize their struggle to achieve a decent level of welfare, before they are burdened with heavy obligations to address the climate problem. It is thus necessary to define responsibility and capacity in a manner that recognizes this right, and it implies that an equitable system will involve significant transfers of financial and technological resources from wealthier to poorer regions.

There is no simple, straightforward, universal approach for implementing these principles. Early attempts at a climate agreement based on equity principles, such as approaches that would allocate emissions allowances to nations on an equal per-capita basis†, were simple but inadequate. While they were successful at gaining attention for the first equity principle, they disregarded the other three. They also did not directly offer a strategy for addressing the adaptation side of the challenge by ensuring sufficient resources (financial, institutional, or technical) to enable adaptation.

Through sometimes arduous negotiations, the Regions have had to create and nurture an evolving consensus about how to implement these equity principles. It is possible for us to work together from this common set of equity principles because our underlying values have shifted in a more noble direction. Our Great Transition over the recent decades has taken us from an exploitative toward an ecological ethic, from a radical individualist to a planetary outlook, from an acquisitive to an experiential ambition. But

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* This is, of course, the basis of the "polluter pays" principle. One is held liable for damages for which one is responsible, and has an obligation to provide compensation. That said, no one has a *right* to cause damages even if they offer to provide compensation.

† Per-capita approaches have a long history, going back to the late 20th century. They were advocated by many, and widely popularized under the name "Contraction and Convergence".

that said, we are no less diverse a race than before. Different Regions range across a spectrum, and so too the communities within those Regions and the individuals within those communities. Our complex world presents us with complex choices. We continually find ourselves having to weigh our values and find compromises that balance them judiciously. Ecological sensibility, global solidarity, the desire for a life of fulfillment; these are all noble values. But it is the tensions between them that force us to meaningfully articulate them.

The climate crisis—a defining struggle of our age—brings those tensions to the fore. Directly affecting the global commons, the climate problem remains irreducibly a global problem. While subsidiarity requires that we devolve implementation to the lowest practical level, and heterogeneity recognizes the validity of a diversity of approaches, it is at the global level that consensus must be forged and fundamental decisions made.

And it is possible to forge this consensus because the world's diverse peoples trust one another. We trust each other to adhere to a shared set of values and to advance a common set of ultimate goals. Nationalistic claims and narrow, short-term, self-interest are no longer legitimate bases for negotiation. We can trust one another's motives, even while disagreeing with each other's positions. There are common aims, though there may be disagreements about the means.

This "Politics of Trust" (GTI Proposal, 2003; Rajan, 2006), by which these decisions are made bears little resemblance to the Byzantine machinations through which earlier treaties among nation-states were forged. At that time, civil society had only limited influence in forming even the environmental treaties. The key decisions were made behind closed doors, often driven by unrevealed horse-trading and arm-twisting. These disparate environmental treaties were in any event powerless cousins to the security and trade treaties that passed for global governance at that time.

The political process has fundamentally transformed. If the spirit of the old process was that of Machiavellian maneuverings among distrusting adversaries, the new one is more like the culture of inquiry shared by members of a research consortium struggling to advance understanding. Positions are not issued as demands, conditions, and ultimatums. They are proposed as hypotheses, subjected to the bright light of full inquiry, reconciled with other hypotheses, and integrated into a coherent, evolving consensus. An inherent system of checks and balances arises from the transparency and inclusiveness of the process. As much effort is spent seeking to understand, as to be understood. There is certainly passionate debate as we engage with each other and struggle to conceive consensus. But once that consensus is created, the Regions will, of course, act in good faith to comply with the World Parliament decisions.

A broad range of perspectives is held by citizens of the various Regions on how to translate their shared values and principles into concrete action and behavior. At the risk of stereotyping, a brief explanation is given of the perspectives held by citizens of three rough archetypes of our diverse Regions: Agoria, Ecodemia, and Arcadia.

Regions in a Great Transition World*

The fabric of planetary society is woven with hundreds of regions which are astonishingly diverse in character and size. Some correspond to the national boundaries of a century ago and others are federations of earlier states. Still others are parts of former states, forging a common identity around the boundaries of river basins and other ecosystems (so-called "bio-regions"), around urban centers, and around cultural traditions. Nevertheless, most regions can be clustered crudely into one of three major types, called *Agoria*, *Ecodemia*, and *Arcadia*, although few regions are pure cases.

Agoria

These regions would be most recognizable to a visitor from the year 2000. Some critics call *Agoria* "Sweden Supreme", with their more conventional consumer patterns, lifestyle and institutions, and their economies dominated by large shareholder corporations. However, when compared to even the most outstanding examples of social democratic models of the last century, the commitment to social equality, the environment, and democratic engagement from the level of the firm to the globe is of a different order. The key is a vast array of policies and regulations, supported by popular values, that align corporate behavior with social goals, stimulate sustainable technology, and moderate material consumption in order to maintain highly equitable, responsible, and environmental societies.

Ecodemia

The distinguishing feature of *Ecodemia* is its fundamental departure from the capitalist economic system. The new system, often referred to as "economic democracy", banishes the capitalist from two key arenas of economic life. First, the model of the firm as comprised of private owners and hired workers has been replaced by worker ownership in large-scale enterprises, complemented by non-profits and highly regulated small businesses. Second, private capitalist markets have given way to socialized investment processes. Worker ownership and workplace democracy has reduced the expansionary tendency of the traditional capitalist firm, since the focus is on profit per worker (rather than absolute profit) and the popular goal of "time affluence" shortens work weeks. Publicly-controlled regional and community investment banks, supported by participatory regulatory processes, re-cycle social savings and tax-generated capital funds. Their mandate is to ensure that successful applications from capital-seeking entrepreneurs satisfy social and environmental criteria, as well as traditional financial criteria.

Arcadia

Relative to other regions, the bias in *Arcadia* is toward self-reliant economies, small enterprises, face-to-face democracy (at least in cyberspace), community engagement, and love of nature. Lifestyles tend to emphasize material sufficiency, folk crafts, and reverence for tradition. While the local is emphasized, most people are highly connected with cosmopolitan culture and world affairs through advanced communication technology and transportation systems. *Arcadia* has centers of innovation in some technologies (organic agriculture, modular solar devices, human-scale transport devices, etc.) and arts (new music, craft products, etc.). Export of these products and services, along with eco-tourism, supports the modest trade requirements of these relatively time-rich and slow-moving societies.

This discussion of differences should be balanced by a reminder that the regions also have much in common. Relative to the nations of a century ago, contemporary regions enjoy a high degree of political participation, healthy environments, universal education and healthcare, high social cohesion, no absolute poverty, and more fulfilling lives. Finally, people the world over share the historically novel attribute of citizenship in a world community.

* Summarized from Raskin (2006b).

Agoria

Agorians feel it was appallingly reckless for humankind to allow greenhouse gas levels to double in the first part of the twenty-first century. They hold strongly that the climate—balanced precariously as it is—must not be allowed to wander any further toward potentially catastrophic thresholds, and should in fact be edged further away. Agorians have devoted massive resources to advancing human understanding, and are indisputably at the forefront of World Science. Their ambitious efforts have allowed humankind to greatly increase its confidence in our understanding of the human-ecological system, and to develop means to temper our impacts.

Based on the current—but ever evolving—state of World Science, Agorians maintain that a strenuous effort is warranted to prevent any further rise in greenhouse gas levels, and to return levels as soon as practical to 350 ppm—about one-third less than the present level. At one time, it would have been considered preposterous to propose reducing greenhouse gas levels like this. But Agorians, like citizens of all Regions, have greatly dematerialized their lifestyles and greatly curtailed their greenhouse gas emissions. On top of that, Agorian innovators have been dutifully developing technologies to accelerate the removal of carbon dioxide from the atmosphere. Among the more promising options are bio-agricultural practices that accelerate the generation of soil organic matter, carbon-based building materials that sequester carbon in long-lived capital infrastructure, and the judicious implementation of geological carbon sequestration with bioenergy. These innovations have yet to be fully developed, cautiously tested, and broadly adopted, but once they are, they could put the 350 ppm target within reach by the first few decades of the next century. It is an ambitious proposal, grounded in a precautionary and expansive World Science.

Reflecting on their proven success in tapping the innovative spirit of individuals and enterprises in the service of social goals, Agorians support the continued use of incentives and market mechanisms as the chief means of reaching climate objectives. They value the flexibility and believe it most effectively mobilizes resources. In keeping with this, they advocate that an important aspect of the global approach to climate should be tradable emission allowances and a global trading regime. Internally, they have implemented a carbon tax system, in conjunction with various other more targeted incentives and standards.

Arcadia

To the Arcadians, the Agorian proposal to target 350 ppm is not sufficient. Most Arcadians consider it incautious. Some call it appallingly reckless. Arcadians concede that the Agorians have vastly advanced our understanding of the earth's climate system and the pressures we exert on it. They admit that we now have a much better understanding of the ecosystem impacts of our disrupted climate. Indeed, the Arcadians themselves have contributed gallantly to these advances in understanding, especially in the realm of helping degraded ecosystems to heal. But they feel that while the earth's climate system is legitimately a subject of respectful study and insight, and it is inevitably a matter for prudent decision-making, it is much more than that. It is sacred, it is injured, and we are to blame.

The Arcadians bristle at the suggestion that humankind should trot out a handful of high-tech innovations and aim for a greenhouse gas target of 350 ppm. Yes, the World Scientists can convincingly show that at this greenhouse gas level the likelihood of a shutdown in the thermohaline circulation becomes an "acceptable" one percent, and the rise in the sea level becomes a "manageable" ten centimeters per century, and the collapse of the West Antarctic Ice Sheet becomes "virtually impossible". But to the Arcadians this calculus is heartless. The Arcadians are not only deeply respectful of nature—as are all citizens in this age—they are spiritually connected to it. They feel sympathy and shame for the earth's still-injured state. The thought that species are still becoming extinct is deeply disturbing, and they feel that the deployment of a few new technologies is a token response. They feel that the Agorian target of 350 ppm is irreverent, based on human convenience rather than a veneration of nature.

The Arcadians also harbor a healthy skepticism toward the Agorian approach, which they see as too close a descendent of the outmoded cost-benefit outlook of an earlier age. Admittedly, today's methods are much more sophisticated. They have discarded a unidimensional financial valuation in favor of more comprehensive multicriteria approaches. They take into account the inherent uncertainty and explicitly account for the risks involved. But still they are founded in the more instrumental Agorian sensibility than in the Arcadian spiritual concern for the integrity of the earth.

The Arcadians are more deeply connected to the natural world. They are more risk averse when the fate of the earth is at stake. To them, the climate catastrophes they are seeking to avoid are unthinkable apocalypses, and it is hard to conceive of a sacrifice they would not make to prevent them. Arcadians, steeped as they are in a localist ethic, are also deeply sympathetic to the indigenous cultures that climate disruption is putting at risk. Now, as indigenous homelands continue to be lost from the Pacific Islands to the Arctic, Arcadians see the climate exiles not just as a matter of relocation and compensation, but of human rights and cultural genocide.

Because of these deeply held beliefs about the dire nature of the climate crisis, Arcadians as individuals have gone to tremendous lengths to minimize their footprint on the earth, and they believe that Agorians could go much further. In view of the severe land-use pressures in our world of some eight billions, Arcadians have relinquished large amounts of land to nature to restore habitat and absorb carbon. They consider the Agorian habit of eating meat an unnecessary insult on the planet: it is an inefficient use of land, it contributes to methane emissions, and, can it ever be cruelty-free? Arcadians, in perhaps the ultimate sacrifice, have instituted through law and cultural norms an uncompromising approach to population, with the aim of tempering procreation and steadily reducing population over the next several generations.

The Arcadians strongly advocate a more encompassing response to the climate crisis. They welcome the Agorian contributions to advancing knowledge and innovation*, but

* Some Arcadians were initially suspicious of the technological strategies proposed by the Agorians, and wondered about the influence that certain carbon technology corporations had in the design of the Agorian approach. A series of inter-Regional dialogues among civil society organizations helped reassure these Arcadians that the Agorian proposal did indeed have the support of a broad range of Agorian stakeholders, and was not unduly influenced by any corporations with vested interests.

they see a much more precautionary approach as critical, and much more sacrifice as essential.

Ecodemia

Ecodemians, to a large degree, share with the Agorians a common perspective on climate protection, though they advocate a somewhat more stringent target. The Ecodemians are less focused on economic activity than the Agorians, and—like the Arcadians—more focused on leisure and shorter working hours. They thus have a simpler lifestyle, and see a lower target as being within reach with an acceptable amount of sacrifice, providing the Agorian technological innovations can also be successfully brought to bear.

The Ecodemians advocate a more structured regime than the Agorians. They have great trust in their sophisticated policymaking apparatus, and engage in close public participation. Whereas the Agorians favor a simple emissions allocation scheme and carbon markets as mechanisms for devolving responsibility to the Regions for greenhouse gas management, the Ecodemians feel the global agreement should determine obligations more explicitly and with greater coordination. They see climate obligations as taking many forms—implementation of emission reductions, development of new technologies, cooperation and technology transfer among Regions with disparate levels of wealth and technological advancement.

They also see the need to accommodate to different Regional circumstances. Some Regions have access to relatively abundant low-carbon energy resources, and some have relatively plentiful land-resources. The Ecodemians see the unequal geographic distribution of these important resources as something for which a climate agreement should aim to compensate.

All Regions agree that they are obliged to contribute according to their capacity and responsibility. The Ecodemians, like the Arcadians, have prioritized time affluence as opposed to material affluence, and have in general a lower level of capacity—in terms of financial and technological resources—than the Agorians. They have agreed to contribute labor in addition to financial and technological resources, in response to a proposal by the Agorians, who feel that they have adopted a work ethic that is industrious and not avaricious, and want to ensure that it is not unduly penalized. The Arcadians concur, but are quick to point out that the Agorian level of consumption and production contributes disproportionately to the strain on damaged ecosystems and climate, and to point to their population limits and simple lifestyles as being a significant contribution to the collective cause. The negotiations will need to define more specifically how capacity is to be compared across Regions, and how a Region's obligation to contribute to the global effort is to be assessed.

The Regions have also agreed that contributions to the global climate effort may include resources other than financing, technologies, and labor. It may require the allocation of in-kind efforts such as the accommodation of climate exiles, the provision of food to regions whose food security has been compromised, the allocation of land to natural uses to preserve biodiversity, and the remediation of affected ecosystems.

There clearly remains a wide range of components to be discussed and decisions to be negotiated. This will always be true as long as the climate problem persists. The formal

representatives of the Regions, along with the diversity of citizens' organizations that inform and oversee them, will continue to engage in a voluble, contentious, passionate discourse. The values and principles that they share form a bedrock of trust on which honest dialogue can be based. We no longer risk the obstruction of hegemons, the free-riding of elites, the heedless ignorance of the majority. We can work as allies.

Transitional Climate Regime: Getting from Here to There

At this moment in time, a Great Transition worldview seems depressingly out of reach, and humankind seems woefully unprepared to confront the monumental challenge it faces. The journey ahead is urgent, yet our first binding step, the Kyoto Protocol, has been tentative, even ambivalent. This hesitant start has come at very high cost. By the end of the Kyoto Protocol's term, fifteen precious years will have passed since its adoption, yet global greenhouse gas emissions are projected to have grown more than thirty percent, while incontrovertibly worsening impacts of climate change will have been witnessed and suffered. As the outcome of a hard-won international climate accord, this inexorable worsening of the climate predicament is sobering. It underscores how difficult it will be to design and take a next step that matches the urgency of the climate challenge—an accord that will somehow lead us quickly and efficiently toward the dramatic emission reductions and the far-reaching climate adaptations that are ultimately necessary.

At present, the set of realistic options that are both environmentally effective and politically viable may seem dismally empty. Any realistic definition of what is environmentally effective seems well beyond the present conception of what is politically viable. Conversely, any realistic definition of what is politically viable falls far short of what would be environmentally effective.

However, there are a few emerging signs that offer some hope that we may turn a corner.

First, momentum is building, slowly but perceptibly, for a serious response to climate change. Even in the United States, despite intransigence at the federal level, significant action is happening at the state level, in communities, among civil society, and within progressive institutions. Awareness and sensitivity is growing, and the retrograde forces of climate skeptics are growing weaker. Individuals, NGOs, and forward-thinking corporations are indeed taking those incipient steps that were optimistically interpreted in the foregoing narrative as a precursor to a GCM.

Second, the mixed blessing of early climate impacts is indisputably upon us. Hurricane Katrina was a heavy price to pay for a lesson that may or may not have penetrated—but, if any good has come of it, it has been a greater awareness among the powerful nations of the world of our vulnerability. Other nations are paying even higher prices, and many already know too well of their vulnerability.

Third, the realization will eventually dawn that practical necessity requires global cooperation. Currently, the global North insists obstinately that the South must help bear the burden of reducing greenhouse gases. The South insists just as obstinately that it cannot afford to help bear the burden, its priority is poverty alleviation and development. The only way forward is a compromise. The global North cannot solve the problem alone, and the South's cooperation depends on offering reassurance that Southern development prospects will not be diminished. A climate regime must directly link climate change and development.

This only makes sense. While human development is often invoked in discussions of climate change, the usual argument is that addressing climate change will help achieve development, as a sort of side benefit. People endlessly refer to "co-benefits" of climate

activities: improved air quality, access to energy services, and such. But the more important causal arrow probably points the other way. For there to be any effective climate activity, there must be a solid base of human development. Effective adaptation and mitigation require a solid base of adaptive and mitigative capacity, both of which are preconditioned on robust investments in human development. Adaptation especially requires a level of resilience far beyond that of the two billion currently living on less than two dollars a day. It requires improved access to financial resources, of course, but just as importantly it requires social capital and the knowledge and opportunities to adopt new or altered livelihoods. It also requires enfranchisement, and the ability to influence decisions and hold governments accountable. Mitigative capacity too is contingent on investments in human development. Reducing emissions to the level needed to protect the climate will require dramatic technological changes, amounting to a wholesale shift in the global energy infrastructure. In the South, this will require the investment in training, education, technical capacity to adopt, develop, and implement radical technical solutions while addressing the needs of growing populations and economies. Just as important, keeping greenhouse gas emissions within an acceptable global budget will be much easier to do with a global population of, say, eight billion than eleven billion, and this is only feasible if we take seriously the goal of eliminating poverty and enabling the demographic transition to take place among the poor and disenfranchised.

And among the wealthy, reducing emissions as drastically as the climate crisis requires will most likely be possible only if technological advances are accompanied by the evolution of values and behaviors toward a lifestyle that finds fulfillment in something other than material acquisition (Stutz, 2006).

Near-term steps

In the relatively near-term, certain steps are desperately needed to set the groundwork for a robust longer-term climate regime. A sound precautionary framework needs to be adopted. We cannot afford to take a haphazard approach, or even a measured iterative approach wherein society takes a step, assesses the climatic impacts, and uses that information to inform the next step. The impacts of the steps taken today will not fully manifest for decades or centuries. A precautionary approach would define the long-term impacts that we clearly need to avoid, and then identify the near-term steps that would preserve a high probability of avoiding those impacts.

Various scientists, analysts and policy-making bodies have identified a 2°C temperature rise as a threshold beyond which climate impacts become significantly more severe and the threat of major irreversible damages becomes more plausible (IPPR, 2005). Others suggest thresholds even lower than 2°C, driven by the fear of the disintegration of the major ice sheets and a disastrous rise in sea levels (Hansen 2005; O'Neill and Oppenheimer 2002). Translating such a threshold into a policy-relevant goal, such as an annual emissions budget, a global emissions trajectory, or an atmospheric GHG concentration target, is not straightforward. It is complicated by the existing uncertainties in the carbon cycle and the climatic response to greenhouse gases. The best that can be done is to define a policy-relevant target that preserves a high probability of keeping within the threshold, in view of the existing uncertainties. As empirical observations and improving science reduces the uncertainties, these policy-relevant goals can be revisited

and revised. In the meantime, the goals can serve as the benchmarks by which we decide on actions and measure progress.

The 2°C threshold appears to require that global emissions must peak and start to decline in the next decade. Any further delay means either giving up the high likelihood of keeping within the threshold, or committing ourselves to emissions declines in the ensuing decades that are extraordinarily rapid, and most likely extremely costly.

In addition to being environmentally adequate, a regime must be equitable. The several dimensions of equity—equality, need, responsibility and capacity—must be embodied in the obligations and rights underpinning the climate regime. Equity is not simply advisable on moral grounds, but practical grounds as well. An approach that is not equitable is unlikely to gain the buy-in of the countries that must be involved.

At the core of the equity issue is the question of basic human development. As long as nations—or communities within them—lack basic human needs, then it is pointless to ask them to contribute to reducing greenhouse gases (particularly when others are extravagantly consuming fossil fuels and emitting GHGs). Nor will it be possible for them to build resilience and protect themselves in the face of ongoing climate change. A climate regime must therefore not only acknowledge each country's level of development and define obligations accordingly, but must be constructed so as to catalyze the development of underdeveloped countries.

A recognition of inherent connections between climate change and human development offers a starting point from which to build a climate regime that starts to look more like a Great Transition approach—inherently global and with a basis in advancing the common welfare.

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