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A Realistic (Holistic) Approach to Climate Mitigation

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Abstract

At this time, most climate researchers are only using a limited range of futures approaches: for example, Intergovernmental Panel on Climate Change (IPCC) future scenarios have been developed primarily with empirical predictive methods that extrapolate trends. These seriously underestimate the risk of nonlinear developments and critical failures. This article examines the Paris Climate Conference (COP) 21 agreement on climate mitigation; explains why current efforts are based on false assumptions and likely to fail; argues that holistic, integrative methods are needed to avoid disaster; and uses these methods to develop a practical strategy for accelerating systemic transformation. Despite the impressive diplomatic achievements of the Paris Agreement, there is a dangerous lag between the pace of political, economic, and technological change and the rapid (nonnegotiable) rate of climate change. The challenge is to find ways to manage the conflict between the need to work within existing institutional frameworks and the reality that they are not (and may be structurally incapable of) acting quickly enough to prevent catastrophic outcomes. This dichotomy may be resolved by using a three-track strategy: the first track will focus on accelerating existing climate mitigation efforts by encouraging decision-makers to use holistic, critical-safety risk management methods. The second track will counter ideological opposition with constructive alternative narratives. The third track will help catalyze the global movement needed to empower structural transformation and the emergence of a sustainable global system. It will not be possible to resolve many complex global socioecological problems (climate, water, food, energy, growing inequality, etc.) without transformational change. Integrative, whole-systems methods are now needed to accelerate the evolution of a sustainable global system.

Keywords

climate, mitigation, holistic, integrative, transformation, strategy, COP 21, multitrack, sustainable, future

Overview

This article examines the 2015 international Paris Climate Conference (COP 21) agreement on climate mitigation, explains why current methods and efforts will not prevent catastrophe, argues the need for a holistic and integrative approach, and applies these methods to develop a practical strategy for accelerating systemic transformation.

In his analysis of the Paris Agreement, *The Guardian*'s George Monbiot said, "By comparison to what it could have been, it's a miracle. By comparison to what it should have been, it's a disaster" (Monbiot 2015). On one hand, the outcome was better than predicted as Article 2 states that parties to the agreement will

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hold global average temperature increases "to well below 2°C" and "pursue efforts" to limit this to 1.5°C (United Nations/Framework Convention on Climate Change [UNFCCC] 2015a).

On the other hand, these goals are only aspirational and current (voluntary) climate mitigation commitments are too limited and too slow to prevent catastrophic outcomes. There is an enormous (and currently unbridgeable) lag between the pace of political, economic, and technological change and the rapid (nonnegotiable) rate of climate change.

To ensure safe outcomes, the global economy will have to be rapidly restructured. This will require a massive response similar in scale and urgency to the Allied effort in World War II (Salamon 2016). However, at this time, strong international action is a distant dream.

The problem with the Paris Agreement starts with poor methods. Most climate researchers have been using a limited range of futures approaches (Gidley 2016). For example, most Intergovernmental Panel on Climate Change (IPCC) scenarios—the scientific reference point for international negotiations—have been developed with empirical predictive methods of trend analysis that seriously underestimate the likelihood of nonlinear developments and the risk of critical failures.

Most experts assume that even under the most optimistic scenarios, aggregate emissions will increase until midcentury, pushing global temperatures far past international goals (International Energy Agency [IEA] 2015). The hope is that this overshoot will be corrected over time with as yet undeveloped technologies for carbon capture and storage.

The IPCC scenarios also assume that during the period of overshoot, most human and natural systems will be able to adapt to changing conditions. Critics argue that these assumptions are dangerously wrong: many critical thresholds are being and will be passed with irreversible, catastrophic consequences, such as the loss of much of the cryosphere and ocean acidification (e.g., International Cryosphere Climate Initiative [ICCI] 2015). They also argue that forecasts that are primarily based on extrapolating trends gravely underestimate future temperatures and impacts. These risks are unacceptable.

In addition, the COP 21 negotiations were constrained by the need to work within existing political and economic frameworks. At the diplomatic level, strong initiatives are resisted by institutional inertia, opposed by vested interests, and hobbled by the fragmented nature of global governance. Because governments with differing priorities and interests tend to agree on the lowest common denominators, commitments have tended to support reactive, incremental, and partial responses: for example, prioritizing voluntary adaptation and technological solutions over mandatory prevention and systemic change.

For these reasons, existing strategies are unlikely to produce the radical transformations required to rapidly end carbon pollution: for example, no comprehensive plans exist for making the transition to a sustainable global system (Heinberg 2015).

An opposite approach is required: one that starts by determining what is necessary to achieve safe outcomes and then backcasts to design and develop viable solutions (G. Taylor 2014a). This proactive "critical-safety" approach is widely used to manage risk in complex industrial and military projects (e.g., aviation), but it is not being used by governments to manage climate risk. Although it will not be possible to preserve critical ecosystems without imposing internationally enforceable limits on pollution and consumption, all attempts to introduce enforceable limits are strongly resisted by both the world's economic institutions (designed to support constant growth), and by the fiercely independent political institutions of the nation-state system.

As a consequence, the fundamental challenge facing climate mitigation efforts is finding a way to manage the conflict between the need to work within existing institutional frameworks and the reality that they are not (and may be incapable of) acting quickly enough to prevent catastrophic outcomes. It will only be possible to resolve this dichotomy with holistic, integrative methods. This article proposes using a multitrack approach in which three different but complementary strategic campaigns work in parallel to accelerate systemic transformation.

The first track will focus on accelerating existing climate mitigation efforts by encouraging decision-makers to use holistic, critical-safety risk management methods. The second track will counter ideological opposition with constructive alternative narratives. The third track will help catalyze the global movement needed to empower structural transformation and the emergence of a sustainable global system.

In general, a realistic climate mitigation strategy must (1) clarify the requirements for a safe global climate, (2) develop a viable strategy for managing critical risks and ensuring safe outcomes (e.g., a multitrack approach capable of both accelerating change within existing institutions and catalyzing systemic transformation), (3) progressively build scientific and political support for this strategy, and (4) develop national and international alliances to educate, encourage, and pressure decision-makers at all levels to take effective action.

Why Current Climate Mitigation Efforts Are Failing: Good Diplomacy, Poor Science, Terrible Risk

The Achievements of the Paris Agreement

While the 2009 Copenhagen climate change conference was generally viewed as a failure, the Paris negotiations were widely hailed as a success. Corinne Le Quere, director of the Tyndall Centre for Climate Change Research, said,

> The final draft text recognises the imperatives of the science community to tackle climate change. The three key elements to do it are there in some form: keep warming well below 2°C [above the pre-industrial global mean temperature], practically move away from fossil fuels, and review each country's contribution every five years so they scale up to the challenge. (Le Quere 2015)

Diplomats learned from Copenhagen that most governments are not willing to accept mandatory, internationally enforced conditions. As a result, in Paris, governments were only asked to make voluntary commitments. This pragmatic approach produced a relatively successful outcome, and the long-term goals agreed to in COP 21 send a clear message to governments, businesses, and investors that the trend to decarbonization is irreversible (Norwood 2016).

However, these goals are only aspirational and the (nonbinding) climate mitigation commitments are too limited: an analysis by Climate Interactive and Massachusetts Institute of Technology (MIT) Sloan predicts that with current pledges, global temperatures will have risen 3.5°C by 2100 (Johnson 2016). Nevertheless, optimists expect that the pace of mitigation will accelerate (Gore 2016).

More resources are now being invested in renewable energies than in fossil fuels (Norwood 2016), many governments are planning on raising their climate targets (e.g., Deutsche Welle 2016), strong international business and governmental alliances are being formed to intensify climate mitigation efforts (e.g., Fragoso 2016), and significant technological breakthroughs are occurring frequently (e.g., Parkinson 2016).

There are good reasons for hope. But the critical question remains: are current initiatives likely to prevent dangerous climate change?

The Failures of the Paris Agreement

Critics argue that the Paris Agreement failed to deal with many crucial issues (e.g., Spratt 2016a). These include assessing and managing the real risks and costs of climate change; defining greenhouse gas (GHG) concentration safety limits; determining a time frame for emissions to peak; stopping fossil fuel subsidies; imposing carbon pollution taxes; limiting both fossil fuel supply and demand; developing clean substitutes for nonelectrical uses of fossil fuel energy; ensuring that climate change costs are borne equitably by rich and poor nations; reducing resistance to climate mitigation through developing alternative, nonpolluting uses for fossil fuels; and planning the transformation of the global political economy into a sustainable system.

The 2°C goal is not safe. In 1990, a Stockholm Environment Institute report proposed "on the basis of current understanding" that the international goal should be to limit the temperature increase to a maximum of 1.0°C above the preindustrial global mean temperature.

> If global mean temperature increases beyond this target, unpredictable and non-linear ecological responses may occur, leading to extensive ecosystem damage. An absolute temperature limit of 2°C can be viewed as an upper limit beyond which the risks of grave damage to ecosystems, and of non-linear responses, are expected to increase rapidly. (Heil and Hootsmans 1990)

Over the past twenty-five years, a consensus formed that it might be politically feasible to reach international agreement on this 2°C upper limit. Thomas Stocker, the IPCC's cochair, said, "The power of the 2°C target is that it is pragmatic, simple and straightforward to understand and communicate: all important elements when science is brought to policymakers" (Carbon Brief 2014). However, while COP 21 succeeded in enshrining this in an international treaty, it will not ensure sustainable outcomes, nor can it be achieved with current methods and commitments.

A 2015 study by United Nations (UN) experts concluded that 2°C is not a safe temperature cap: even "the observed impacts of climate change at 0.85°C of warming are consequential and wide-ranging, spanning all regions and sectors" (UNFCCC 2015b). Examples of current impacts are degrading ecosystems, rising sea levels, spreading desertification, increasingly extreme weather, and decreasing crop yields. Some impacts are already disastrous, such as the die-off of kelp forests (Wernberg et al. 2016); in other cases, catastrophic problems are emerging, for example, acidifying oceans (Hennige et al. 2014).

The fundamental question is: if the global climate is neither safe nor stable now (at +0.85°C), how could it be safely stabilized at a higher temperature? For example, in 2016, warmer ocean temperatures killed 25 percent of the corals on the Great Barrier Reef. Researchers noted that "climate change has increased temperatures in the hottest March months by just over 1°C . . . by 2034 temperature anomalies like March 2016 will be normal" (King et al. 2016). This will cause the extinction of most coral ecosystems by midcentury.

Many climate scientists believe that a 2°C increase would be highly dangerous (e.g., Hansen et al. 2016). An ICCI report warns that the Paris commitments will not prevent crossing irreversible thresholds: for example, melting glaciers that will result in the loss of reliable water resources for millions of people, melting polar ice sheets that will cause an eventual sea-level rise of 4 to 10 meters or more, the release of further GHGs from melting permafrost, and the loss of fisheries from polar ocean acidification. "Unless governments move quickly and effectively in Paris towards larger, earlier commitments . . . some of these changes may close during the 2020–2030 (Paris) commitment period." Cryosphere climate change is slow to manifest but once triggered "inevitably forces the Earth's climate system into a new state, one that most scientists believe has not existed for 35–50 million years" (ICCI 2015, v).

Experts also warn that,

> [A]n actual equilibrium in terms of temperature, notably of ocean waters, and sea level would only be reached after several centuries to millennia. To a large extent, anthropogenic climate change, including ocean acidification and many impacts, are irreversible on at least a multi-century to millennial timescale. (UNFCCC 2015b, 7)

For example, the 2015 ICCI report points out that while a global mean temperature increase of 1.6°C will melt most of the Greenland Ice Sheet, it will take another ice age to replace the lost ice. There are also no credible technological solutions for many other climate change problems, for example, if gigatonnes of methane are released from melting permafrost and warming oceans, the process cannot be reversed.

When one climate change tipping point is passed, it increases the likelihood of passing additional tipping points. Five major potential climate tipping points are the reorganization of the Atlantic meridional overturning circulation, the disintegration of the Greenland ice sheet, the collapse of the West Antarctic ice sheet, the dieback of the Amazon rainforest, and the shift to a more persistent El Niño regime. As these interacting factors multiply risks, modeling suggests that the real social cost of carbon pollution has been underestimated; it should be increased nearly eightfold from US$15 per tCO_2 to US$116 per tCO_2 (Cai et al. 2016).

The 2°C goal is not achievable with current approaches. Because the IPCC scenario analysis only explored the politically set 2°C target, it did not examine any literature relating to lower limits and failed to run any low emissions scenarios (Spash 2016). Nevertheless, Kevin Anderson argues that even the methodology used in these scenarios is questionable:

> Of the 400 scenarios that have a 50% or better chance of no more than 2°C warming . . . 344 assume the successful and large-scale uptake of negative-emission technologies. Even more worryingly, in all 56 scenarios without negative emissions, global emissions peak around 2010 . . . In plain language, the complete set of 400 IPCC scenarios for a 50% or better chance of meeting the 2°C target work on the basis of either an ability to change the past, or the successful and large-scale uptake of negative-emission technologies. (Anderson 2015, 899)

COP 21 produced an unprecedented agreement among 195 countries to act for zero net emissions in the second half of the century. All the same, at present, GHG emissions are increasing, not declining (Butler and Montzka 2016). At the earliest, energy-related emissions are not forecast to peak until the late 2020s (Frankfurt School-United Nations Environment Programme Centre and Bloomberg New Energy Finance 2016), and total atmospheric concentrations are not likely to peak until well after 2050 at around 600 ppm, which will cause more than 3°C of warming (ICCI 2015). Although the IPCC assumes that if "overshoot" occurs temperatures can be returned to safe limits through capturing and storing atmospheric carbon, in reality the world is still many decades away from ending GHG emissions, let alone deploying viable negative-emission technologies. For these reasons, Clive Spash observes that "Technological optimism is at the core of the IPCC projections and the assumptions that inform the Paris Agreement" (Spash 2016, 72).

Securing international agreement in Paris was facilitated by the general belief that governments and businesses will be able to gradually decarbonize their economies over many decades (with developed countries decarbonizing first). These views have been translated into the concept of a "carbon budget," which is the amount of carbon that can still be released into the atmosphere without causing average global temperatures to rise more than 2°C. However, as David Spratt points out,

> [T]he IPCC's most recent assessment says the carbon budget for 2°C is 385 billion tons of carbon (1,420 billion tons of CO_2) for a 66% risk of exceeding the target, but 275 billion tons of carbon (1,000 billion tons of CO_2) for a 33% risk of exceeding the target. What it doesn't say is that for a lower—say 10%—risk of exceeding the target, there is no carbon budget available. (Spratt 2016b, 3)

Some researchers argue that thermal inertia means that 2.4°C of long-term global warming is already locked in, although approximately 1°C of this is hidden by the cooling effect of the pollution emitted by industries (e.g., in the Asian Brown Cloud; Ramanathan and Feng 2008). As fossil fuels are phased out, these aerosols will no longer block sunlight and temperatures will rise. Temperatures over land are also likely to be warmer than the global average (Huntingford and Mercado 2016).

So there is no carbon budget left for 1.5°C, or even for 2°C,

> - If 2°C is considered a cap or upper boundary as per the Copenhagen Accord, rather than a hit-or-miss target that can be significantly exceeded;
> - If a low risk of exceeding 2°C is required;
> - If higher climate sensitivities incorporating carbon cycle feedbacks are taken into account;
> - For developed economies;
> - For fossil fuel emissions, after accounting for future food and deforestation emissions. (Spratt 2016b, 5)

The current level of risk is unacceptable. The IPCC scenarios assume levels of risk that would never be accepted by any regulatory agency: after all, who would take a flight that had even a 10 percent chance of dangerous outcomes, let alone 50 percent? Moreover, their models may seriously underestimate likely future temperature increases and impacts. The economist Nicholas Stern is not alone in his view that the IPCC Fifth Assessment Report "Essentially . . . reported on a body of literature that had systematically and grossly underestimated the risks of unmanaged climate change" (Stern 2016).

Recent studies consistently indicate high levels of risk. A 2016 report argues that global warming is likely to reduce the ability of clouds to reflect sunlight. This will increase likely temperature forecasts to between 5.0°C and 5.3°C by 2100 (Tan et al. 2016).

These temperatures are beyond dangerous. Not only is climate change already accelerating the sixth mass extinction of life on Earth (Ceballos et al. 2015), it is possible that the biosphere is now approaching a planetary-scale tipping point (Barnosky et al. 2012). This could have catastrophic consequences such as precipitating the loss of ecosystem services required to sustain human populations. Kevin Anderson states that among climate scientists "[T]here is a widespread view that a 4°C future is incompatible with any reasonable characterization of an organised, equitable and civilized global community. A 4°C future is also beyond what many people think we can reasonably adapt to" (Anderson 2012).

The scientific evidence is far from settled, and a wide range of future temperatures and impacts is possible. Nevertheless, many experts from fields as diverse as climatology, economics, biology, geology, and ecology are now warning about the risk of catastrophic climate change. A prudent risk management approach must examine and evaluate all possible risks, including low probability but potentially devastating "fat tail" events. A study published in *Nature Geoscience* emphasizes the need for caution because humanity has entered unknown territory. "[T]he present anthropogenic carbon release rate is unprecedented during the past 66 million years. We suggest that such a 'no-analogue' state represents a fundamental challenge in constraining future climate projections" (Zeebe et al. 2016).

Clive Spash observes that the Paris Agreement marks,

> a change in interpretation from the precautionary approach prevalent in 1992 to the risk cost-benefit approach of today, a shift from mitigation to adaptation. The benefits of growth, jobs and fossil fuels are to be weighed against the potential of climate catastrophe. (Spash 2016, 72)

The problem is that in many cases—such as the mass extinction of plants and animals—adaptation is not possible. *The Onion* joked that one of the goals of COP 21 was to "Provide aid to help developing island nations transition into fully underwater economies" (The Onion 2015).

The Paris Agreement will not work because it is not holistic. The Paris Agreement is unlikely to achieve its goals because it only addresses part of the problem. Because it does not take a holistic, precautionary risk management approach to climate modeling, it does not recognize that biophysical limits and timelines are nonnegotiable, and that passing critical thresholds creates the potential for systemic failure or state change. For example, the Paris Agreement does not place safety limits on atmospheric CO_2 and other GHG concentrations, an absolute cap on ocean and atmospheric temperature increases, an absolute cap on ocean acidification, or a specified timeline for reducing GHG emissions.

The lack of a whole-systems approach is also shown by the failure of the Agreement to address the need for sustainable solutions for the 80 percent of emissions that do not come from the production of electricity (Heinberg 2015). The Agreement also ignores the need for whole-systems accounting to accurately evaluate environmental, economic, and social costs, benefits and risks, and to put a realistic price on carbon (Hansen 2015). Nor is there any mention of the need to stop fossil fuel subsidies, which in 2014 were four times as large as subsidies for renewable energies (IEA 2015).

The partial nature of the Agreement is also reflected in the lack of practical plans. At present, no clear strategy exists for how any country—let alone the world—will make the transition to an environmentally and economically sustainable society. For example, a recent Climate Change, Agriculture and Food Security report estimates that up to one-third of all GHG emissions come from agriculture (Wollenberg et al. 2016). The program's leader, Lini Wollenberg, says, "[T]he options currently on offer won't make the dent in emissions needed to meet the global targets agreed to in Paris" (Climate Change, Agriculture and Food Security 2016).

Major investments are also needed to accelerate research, development, and demonstration (RD&D) in reducing emissions in other areas: for example, jet and bunker fuel, steel and cement. As well, alternative, nonpolluting uses for hydrocarbons need to be developed to reduce the resistance of fossil fuel producing countries and companies to climate mitigation (G. Taylor 2016).

It will be impossible to make a rapid transition to a clean energy economy without a viable business plan. There are large gaps between the aspirational goals agreed to in Paris and the disparate research and business efforts of companies and universities. Not many politicians or business leaders are likely to bet on new, unproven technologies and business models without government support and detailed plans that include precise assessments of risks, costs, benefits, and timelines.

The Global Emergency

Catastrophic climate change is already occurring. There is little likelihood that the Paris Agreement's targets can be reached with current approaches. For example, the International Energy Agency states, "If action to reduce CO_2 emissions is not taken before 2017, all the allowable CO_2 emissions would be locked-in by energy infrastructure existing at that time" (IEA 2012, 3).

Recent modeling based on predicted economic growth, population growth, and energy use per person indicates that continued economic and population growth will triple energy demand by 2050, with temperatures probably rising 1.5°C by 2020 and 2°C by 2030. This means that "To stay within a 1.5°C global warming limit, safely extractable reserves are forecast to be consumed by 2020 . . . . Even the 3°C limit . . . will be very challenging to meet by 2033" (Wagner et al. 2016, 12).

Moreover, as previously argued, a 2°C increase is not safe. Even the present average global temperature increase of approximately +1°C is dangerous. To reestablish a safe climate, it will be necessary to restore Earth's energy balance (the relationship between energy coming in and leaving the Earth's oceans and atmosphere) and to reestablish the relatively stable climate of the last 10,000 years (the Holocene epoch; Sutton 2015). To restore Earth's energy balance, it will be necessary to not only keep CO_2 concentrations from rising but to lower them to between the preindustrial level of ~280 ppm CO_2 and ~350 ppm (they are currently ~400 ppm; for example, Hansen et al. 2013).

This target will be very challenging, given that atmospheric concentrations of GHGs are on track to peak after 2050 at 600 ppm. Mitigation options are rapidly shrinking (Stocker 2013). An international emergency effort is needed to rapidly decarbonize the global economy, but given that emissions are still climbing from countries such as India and Russia, there is little chance of this happening in the near future (Le Page 2016).

Geoengineering is now unavoidable. At this point, only geoengineering can stop global temperatures from rising further over the next two decades: for example, by adding aerosols to the stratosphere to increase the amount of solar energy reflected back into space (Morton 2015). A Royal Society study concluded that the social and political inertia impeding climate mitigating must be overcome if we are to avoid dangerous climate change. If this is not possible, "geoengineering methods may provide a useful complement to mitigation and adaptation if they can be shown to be safe and cost effective" (The Royal Society 2009, 57).

Researchers are generally in agreement that while Solar Radiation Management strategies (e.g., using aerosols to reflect solar energy) could rapidly cool the planet's surface, they have potentially severe side effects and could not be stopped without causing rapid climate change (Keller et al. 2014). Moreover, as they will not prevent the oceans from acidifying, they are not a substitute for reducing carbon emissions. Carbon dioxide removal strategies (e.g., sequestering carbon with biochar) are better and safer but slower acting and more expensive. For this reason, more research is needed before any of these methods can be deployed at climate-altering scales (e.g., Committee on Geoengineering Climate 2015a, 2015b).

An increasing number of experts are now calling for climate geoengineering. For example, in a letter to *The Independent*, eleven top climate scientists wrote,

> [I]n five years . . . in all likelihood, the exponentially increasing atmospheric CO_2 levels mean it will be too late. . . . Our backs are against the wall and we must now start the process of preparing for geo-engineering. We must do this in the knowledge that its chances of success are small and the risks of implementation are great. . . . (Bawden 2016)

Geoengineering now has to be placed at the center of international climate discussions and made a top research priority. But while geoengineering can stop dangerous warming and buy time for the transition to a clean, sustainable global economy, it is not a long-term solution.

The need for an international emergency climate mobilization. The IPCC scenarios assume that the carbon overshoot will be clawed back with negative emissions. Even with geoengineering, negative emissions will be needed to prevent ocean acidification and stabilize temperatures at safe levels. For this reason, a massive coordinated international effort must be launched both to decarbonize the global economy and to develop and deploy negative emission technologies. But is mobilizing a global emergency response to dangerous climate change even possible?

Large global problems are frequently viewed as too complex to allow risk to be accurately evaluated, let alone managed. However, many policy decisions (e.g., military procurement and setting interest rates) are made with a greater range of uncertainty than exists in climate change science (Mabey et al. 2011). The enormous cost of mitigation is also seen to be a barrier to managing climate change risk. This view is countered by Frank Ackerman and Elizabeth Stanton:

> Protection against threats of incalculable magnitude—such as military defense of a nation's borders, or airport screening to keep terrorists off of planes—is rarely described as "too expensive." The conclusion that climate policy is too expensive thus implies that it is an option we can do without, rather than a response to an existential threat to our way of life. (Ackerman and Stanton 2013)

Political priorities can rapidly shift when leaders believe that there is a threat to national security. Whole economies can be mobilized to meet emergencies, as occurred in the Second World War, when many nations allocated 40 percent to 75 percent of their gross domestic product (GDP) to military production. Following the "9/11" attack on the United States, and the global financial crisis of 2008, politicians quickly overcame normal budgetary constraints, allowing trillions of dollars of new funds to be accessed.

At present, most decision-makers view climate change as a distant (and, therefore, low priority) environmental problem. Most political and business leaders are unlikely to take urgent action on climate change unless it is reframed as a security threat. Decision-makers need to understand that runaway climate change will damage more than the environment: because it will progressively destroy economic and social stability, it is a growing threat to the long-term survival of their societies.

To frame climate change (and other interacting socioecological problems) as a security emergency, policy advisors will have to focus on risk assessment and management: on identifying both dangerous threats and the requirements for safe outcomes. This will require a change of approach from reducing risks and damages and maximizing adaptation (e.g., U.S. Department of Homeland Security 2012) to ensuring the long-term viability and safe functioning of critical global systems.

Ban Ki Moon, the UN Secretary-General, says, "Too many leaders seem content to keep climate change at arm's length, and in its policy silo. Too few grasp the need to bring the threat to the centre of global security, economic and financial management" (Moon 2013).

The international community has the ability to mitigate major global issues. The most critical risks are well known, and credible solutions have been proposed. Decisive interventions could prevent catastrophic environmental, economic, and social collapses and accelerate the transformation to a sustainable world system. The problem is not that we can't, but that we don't.

Humanity's Dilemma

Our dependence on fossil fuels. Clive Spash points out that many important issues were not addressed in Paris for political reasons:

> Of the top 20 countries with the highest emissions of CO_2 per capita 15 are oil and gas based economies. . . . No wonder the Paris Agreement makes no mention at all of such inconvenient words as oil, gas, coal, petroleum, shale and fracking. There is a fundamental contradiction between the fossil fuel economy and addressing climate change. (Spash 2016, 71)

This contradiction underlies most of the resistance to climate mitigation. Humanity now faces a dangerous dilemma: on one hand, leading scientists predict that if we continue to burn coal, gas, and oil, the environmental consequences are likely to be catastrophic (e.g., Hansen et al. 2013); on the other hand, many economists argue that if we stop using fossil fuels, our industrial civilization will run out of energy and collapse (e.g., Canes 2015).

Although renewable technologies are beginning to compete with fossil fuels in the production of electricity, and electric vehicles are now being introduced, electricity is only 20 percent of energy use (IEA 2014). In other areas—for example, most heating, industrial production, and transport—renewable alternatives are either nonexistent or not yet cost-competitive.

Because the global economy still requires fossil fuels, any efforts to quickly cut carbon pollution will reduce output. This is an enormous problem as most people—especially those struggling to get by in developing countries—are not prepared to accept lower standards of living.

While most decision-makers accept that climate change poses growing threats, they are unwilling to enact policies likely to cripple their businesses and national economies. For example, many Middle Eastern and North African countries are caught between their economic reliance on the sale of oil and gas, and the long-term dangers posed by a rapidly changing climate: the region is warming and drying and many areas could be uninhabitable by midcentury (Lelieveld et al. 2016).

As George Monbiot put it, when it comes to fossil fuels, "In Paris the delegates have solemnly agreed to cut demand, but at home they seek to maximise supply" (Monbiot 2015). Until this dilemma is fully addressed (i.e., holistically), it is unlikely that international negotiations will succeed in securing agreement to rapidly reduce GHG emissions.

The need for systemic transformation. The failure of the Paris Agreement to deal with the full range of interacting environmental, economic, political, and technological issues reflects the absence of a whole-systems analysis. Climate issues reflect deeper structural problems in the global political economy: the climate energy imbalance is the product of an unsustainable economic system based on constant material growth, limitless personal consumption, growing social inequity, and worsening environmental degradation.

Because our world has finite biophysical limits, a sustainable global system must keep resource consumption and pollution at or below our planet's carrying capacity (Czech 2013). These biophysical constraints are not negotiable. It will not be possible to have a safe, stable climate without establishing a steady-state economy.

However, at present, not only is every country in the world trying to maximize economic growth, but the Paris Agreement specifically directs that climate mitigation should take place "in the context of sustainable development and efforts to eradicate poverty" (UNFCCC 2015a, Article 2). In other words, climate mitigation should not compromise the right of developing countries to raise living standards through increased economic growth, industrialization, and energy use.

The need for constant growth (the mantra of almost every politician and businessperson) makes the global economy grow like cancer without regard for the health of its host. Disaster can only be avoided through rapidly restructuring the current system to make it function within environmentally and socially sustainable boundaries.

Many experts are aware of the systemic nature of the problem. The United Nations 2030 Agenda for Sustainable Development calls for integrated solutions and a new approach to change unsustainable consumption and production patterns, including decoupling economic growth from environmental degradation (United Nations 2015). But while some leaders recognize the need for deep transformation (e.g., Thorgeirsson 2015), this is generally interpreted as being consistent with maintaining existing economic and social structures (Spash 2016).

Both the 2030 Agenda and the Paris Agreement place their hopes on technological and regulatory solutions (e.g., UNFCCC 2015a, Article 10). Unfortunately, technological fixes cannot solve social problems. Better technologies will only be useful to the extent that they help the global system operate within sustainable biophysical and social limits. It will not be possible to simultaneously reverse dangerous climate change and meet the needs of the developing world without a paradigm shift in economic and social values and structures.

Richard Heinberg points out the scale of this challenge. In the United States,

> The switch from one set of priorities and incentives (consumerism) to the other (conservation) implies not just a major change in American culture but also a vast shift in both the economy and in government policy. . . . We see little evidence of such planning currently . . . Nor do we yet see a culture shift powerful and broad-based enough to propel policy change. . . . (Heinberg 2015)

Applying a Holistic, Integrative Approach

The fundamental challenge facing climate mitigation efforts is the conflict between the need to work within existing institutions and the reality that they may be incapable of making the rapid structural transformations needed to prevent catastrophic outcomes. This problem may also be expressed as follows: How do we get from an unsustainable present to a sustainable future? Or, How can we transform our global consumer society into a conserver society (i.e., change a growth-based/industrial system into a steady-state/information system)?

This dichotomy reflects the reality that transformative change is a complex, disruptive process involving the restructuring or replacement of entire institutions by new world views, technologies, and social formations. Many of the forces driving disruptive change are external, such as changing environmental and economic conditions, innovative start-ups that challenge established business models, and social movements that challenge incumbent elites. While farseeing politicians and business leaders may support institutional change, it is usually resisted by vested interests. These internal and external processes interact with each other to variously reinforce or resist change.

An integral, integrative approach can help us understand how evolutionary change simultaneously takes place on multiple levels and in different domains (Wilber 1998). Every level and individual biological or social structure has its own constraints, dynamics, and perspectives. For example, because many politicians represent local interests and are elected for relatively short terms, it is difficult for them to give priority to long-term, global issues. On the other hand, although international nongovernmental organizations often have broader mandates, to implement policy changes, they must gain the support of political leaders.

We can see these different forces at work in the efforts presently being made by thousands of organizations in support of climate mitigation. Climate mitigation efforts are being made within official institutions: for example, by governments and by international organizations such as United Nations Environment Programme (UNEP) and the World Bank. The business world is also becoming increasingly active, with major transformational initiatives coming from organizations such as Ceres and the Ellen McArthur Foundation. At the same time, external pressure for change is being applied by unofficial, civil society organizations such as 350.org. and Oxfam and nontraditional political parties such as the Greens or Italy's Five Star Movement.

These efforts reflect a wide range of interests and perspectives. Although every perspective explains a particular experience of reality and is valid within a particular context, every perspective also tends to be selective, limiting, and self-legitimizing (Wilber 2005). A holistic, integrative approach can help identify the damaging limitations of partial perspectives, and reframe and integrate them into contextually wider metaperspectives that are more functional and healthier (Katz 2005). An integrative approach can also be used to develop a multilevel strategy for intensifying, aligning, and synergizing transformational change both inside and outside official structures.

A Three Track Strategy

An effective strategy must address both short- and long-term goals: the need to greatly intensify current climate mitigation efforts within the next five to ten years to avoid passing irreversible environmental tipping points, while simultaneously catalyzing the structural changes required to produce a safe, stable climate by midcentury. This article proposes that this can be done with a multitrack approach involving three different (but complementary and interacting) campaigns working in parallel to accelerate systemic transformation.

- The first track will work within official institutions to intensify climate mitigation efforts. It will argue that a proactive, critical-safety, whole-systems approach is needed to ensure safe outcomes and reframe climate change as an immediate existential threat requiring an international emergency response.
- The second track will clarify the need for transformational change: why creating a safe, sustainable future is both necessary and desirable. It will focus on subjective issues of ethics and meaning, and explore ways to reframe dysfunctional values and perspectives in ways that support conflict resolution and sustainable solutions. Its practical task will be to counter destructive myths through developing and spreading alternative positive narratives based on scientific facts and sustainable solutions.
- The third track will primarily work at the level of civil society to accelerate and empower structural transformation. It will focus on supporting the evolution of an environmentally and socially sustainable global system: for example, by defining the requirements for a sustainable system; identifying transformational technologies, social structures, and memes; aligning forces working to empower change; and developing a common strategic framework.

Track 1: A Strategic Campaign to Strengthen Climate Mitigation

The first track is a largely technical, systems science approach to redefining the problem in a way that inspires fear and compels collective action. It uses a holistic, critical-safety approach to assess and manage risk, and develop sustainable solutions.

Applying best practices in risk management to climate change. The International Energy Agency warns: "If we don't change direction soon, we'll end up where we're heading" (IEA 2011). It should be equally obvious that we will never achieve a safe climate unless we aim for one. To do this, we must make safe, viable outcomes our primary goal.

Sophisticated tools for assessing risk and ensuring safe outcomes are used in many arenas: we design and regulate almost everything in our built environment for safety. Why are we not applying the same methods and standards to manage humanity's biggest risks—the potentially catastrophic threats posed by climate change and other major socioecological problems?

Climate change is humanity's greatest failure in risk management. Rising global temperatures are rapidly passing critical environmental tipping points. This trend must be quickly stopped and reversed to prevent catastrophic environmental and economic damage. But at this time, there is little chance urgent action will be taken within the necessary time frame (the next five to ten years). It will not be possible to mobilize an emergency global response until the majority of political and business leaders realize that climate change threatens not only the economic and social well-being of their societies, but their very survival.

To reframe the climate/energy dilemma as a security emergency, policy advisors will have to focus on risk assessment and management: on identifying both dangerous threats and the requirements for safe, viable outcomes (G. Taylor 2014a). The need for a safe climate will also have to be tied to the need to develop secure, stable, and sustainable sources of clean energy and manufactured products.

This approach is proactive rather than reactive. It recognizes that current methods and structures are failing to solve "wicked" environmental and social problems. It starts by examining what is necessary to prevent potentially catastrophic risks rather than what is presently possible. Proven safety and mission critical methods are then used to manage critical socioecological problems and ensure safe, viable outcomes (e.g., Fowler 2009).

The Track 1 approach will reframe the current process by applying proactive, critical-safety, whole-systems methods. Climate mitigation efforts will be accelerated through (1) redefining climate change as an urgent international security risk (rather than as a primarily environmental problem), (2) clarifying the requirements for a safe global climate, (3) identifying the technologies and actions required to prevent dangerous climate change, (4) progressively building scientific and political support for these interventions, and (5) developing national and international alliances that both encourage and pressure decision-makers at all levels to take emergency global action.

Although creating a safe, stable climate will ultimately require systemic redesign, the Track 1 goals are more immediate: to build support for emergency measures to stop and reverse dangerous global warming (e.g., geoengineering), and for actions that facilitate the transformation to a sustainable system (e.g., introducing carbon taxes and accelerating RD&D into nonpolluting processes for producing energy and goods).

Using whole-systems accounting. We will only be able to explain global environmental problems and convince policy makers and the public of the need for urgent action if we are able to accurately value existing natural and social assets, and then estimate how different policies will affect these assets in the future. Fossil fuels only appear to be cheap because current accounting methods do not take into account environmental and social costs, for example, the effects of pollution and climate change on agricultural production, fisheries, and human health.

Many experts believe that the most cost-effective way to address climate change will be to combine a carbon pollution tax with support for clean innovation. The International Monetary Fund recommends a three-part strategy on taxing carbon fuel: "price it right, tax it smart, and do it now" (Lagarde 2015). "Price it right" means taking into account the true environmental and health costs of pollution while "tax it smart" means using tax revenues to fund climate action as well as to finance cuts in taxes on labor and capital that distort economic activity and harm growth. A successful example of this policy is the revenue neutral C$30 per tonne carbon tax imposed by British Columbia since 2008, which has simultaneously reduced carbon emissions and reduced taxes (Elgie 2014).

The introduction of a carbon pollution tax is critical for creating proper markets as the current price of fossil fuels ignores the high environmental and health costs of pollution. Because taxes will increase the prices of "dirty" fuels and products, they will greatly accelerate the development and deployment of cleaner, cost-competitive substitutes (Musk 2015). Subsidies for polluting fossil fuels also need to be eliminated (in 2014, subsidies favored fossil fuels over renewable energy by \$490 billion to \$112 billion) and government support shifted to developing and introducing clean energies (Sustainable Business 2015).

Holistic planning. The Paris Agreement failed to deal with all GHG sources: for example, industry and agriculture. Track 1 will highlight the requirement for integrated solutions that address all causes of climate change. There is also a need to develop alternative, nonpolluting uses for oil, gas, and coal to reduce the resistance of fossil fuel interests to climate mitigation (G. Taylor 2016).These solutions need to be rapidly researched and developed with the type of massive, targeted investment that was deployed in the space race.

Comprehensive plans also need to be created to provide investors and researchers with a clear strategic direction and the certainty that they will receive the support required to develop new products and take them to market. The Post Carbon Institute's Richard Heinberg has suggested a framework for a global transitional plan (Heinberg 2015); developing this plan (and a complete range of national plans) should be prioritized.

Developing national and international alliances. While strategies and plans are essential, by themselves, they are not enough. The role of leadership is critical to building consensus, mobilizing action, and ensuring that the plans are successfully implemented (e.g., Linsky and Heifetz 2002). To make the transition to a sustainable global system, we will need not only a clear vision of where we need to go and a viable strategy for getting there, but international support for the strategy from a coalition of credible leaders representing a wide spectrum of cultures, institutions, and political and religious views.

Track 2: A Strategic Campaign to Win the Ideological Debate

Track 2 will contrast the values and views that have produced our predicament with the understanding and value framing necessary for effective action. It will develop a positive narrative that clearly and simply explains why it is necessary, feasible, and desirable to create a safe, sustainable future. Its purpose will be to build support and inspire action.

Climate change is ultimately the by-product of a dysfunctional system, and the same values, interests, and institutions that cause the problem are neither willing nor able to solve it. The dominant global world view and political economy with its focus on endless growth, the consumer world view, and the fragmented nature of global governance present almost insuperable obstacles to climate mitigation. Because the major challenges are not technological but social (Stix 2012), we cannot make progress on climate change unless we oppose and transform obsolete world views, social institutions, and economic processes.

Ideological differences have to be addressed as advocates and opponents of climate mitigation tend to divide along ideological lines (Kahan et al. 2007). While most advocates believe that government intervention is necessary to protect environmental and social health, most opponents support limitless individual consumption and minimal government regulation. This is why fossil-fuel interests pay conservative think tanks to design campaigns opposing "green" initiatives, and why their messages (e.g., "clean energy is unaffordable") are readily disseminated by right-wing politicians and media.

Opposition is not confined to conservative elites. Anti-environmentalist campaigns resonate with large sectors of the business community and the general public because they reflect the views and values of the consumer society—the dominant global culture—and because they reinforce people's fears that changing existing political and economic structures will adversely impact their incomes and lifestyles.

Nevertheless, most politicians lag behind the general public in their awareness of the gravity of the situation and in their willingness to take action (Randle and Eckersley 2015). Neoliberal views have to be confronted because they are used to justify and mobilize opposition to constructive change. Not only do we need to counter falsehoods with empirical evidence but we also need to challenge the destructive myths that underpin our unsustainable global system (e.g., that it is possible to have limitless growth on a finite planet; that the bottom line is money).

The key is to reframe climate change in both security and ethical terms. Our strongest argument against the selfish, shortsighted values of consumerism is that we have a responsibility to our children to leave them a healthy, sustainable planet. The most effective way to eliminate dangerous myths is to replace them with alternative life-affirming values and narratives (e.g., that we must and can create a prosperous and sustainable world; that civilization is primarily about cooperation, not competition).

Driving our unsustainable global economy is an unethical culture. We will not be able to create a sustainable system without changing the culture from one based on the exploitation of nature and other humans to one based on respect and mutual benefit. The consumer culture creates false needs for power, status, and wealth ("greeds") instead of satisfying real needs for health, community, and meaning. Because consuming cannot satisfy social and spiritual needs, people will never feel that they have enough.

Climate mitigation requires a paradigm shift in the way we produce and consume energy and other resources—the cultural, economic, and technological transformation of our consumer society to a conserver society (G. Taylor 2008). This will not happen until people are convinced that change is both necessary and beneficial.

In particular, climate change must be reframed in terms of superordinate goals (common needs and values) capable of bridging the current environmental/economic divide. As Naomi Klein says,

> Indeed, a great deal of the work of deep social change involves having debates during which new stories can be told to replace the ones that have failed us. Because if we are to have any hope of making the kind of civilizational leap required of this fateful decade, we will need to start believing, once again, that humanity is not hopelessly selfish and greedy—the image ceaselessly sold to us by everything from reality shows to neoclassical economics . . . . (Klein 2014, 461)

Research at Climate Outreach confirms that while people often reject fear-based messages, they will accept climate change threats and solutions if they are framed within a larger positive vision of health, quality of life, and new opportunity. "[E]ffective communication creates narratives around people's values and identity. In particular . . . political change requires mobilising support across boundaries of class and politics. Top down information-driven media cannot compete with personal contact and peer-to-peer communication" (Marshall 2016).

Social movements such as the struggles for democracy, against slavery, or for women's rights required, demanded, and created structural changes. Climate mitigation requires even deeper structural change, and to be successful, it must have the moral force and dynamism of a social movement. This is happening: environmental organizations have already organized the largest global demonstrations in history (Milman 2016).

For these reasons, Track 2 will argue that our collective survival depends on replacing the unsustainable values of the consumer society with an ethical, caring culture that recognizes the interdependence of individuals, society, and nature; that focuses on meeting real needs rather than false greeds; that values health and happiness over wealth and status. Taj James, director of the Movement Strategy Center, says, "We help people to identify where they have a sense of common purpose . . . Because it's a lot easier to align people around what they want, than around what they believe" (White 2016).

Track 3: A Strategic Campaign to Accelerate Systemic Change

Many different societies have come into existence over the long course of human history. Most have disappeared, destroyed by diminishing resources, diseases, and/or wars. Fortunately, these collapses were relatively local and short term: new civilizations emerged to take their place. The danger that now threatens our species is entirely different in scale: a worldwide collapse involving the massive destruction of both natural and social capital.

The focus of the third track is on accelerating the structural changes needed to prevent the catastrophic collapse of nature and society. A whole-system paradigm shift is required to transform our exploitative, self-destructive consumer society into a caring, sustainable conserver society.

Because every living system depends on its environment for matter and energy, its sustainability is a function not only of its internal health but also of its environmental relevance (fitness), and the health of its environment. The survival of a society will be jeopardized if the society is unable to adapt to changing environmental conditions, and/or if its environment becomes less productive, for example, due to destructive economic practices.

When change forces a societal system to exceed its boundaries, it can move the system to another stable configuration within the existing evolutionary level, cause it to break down to a less complex level of organization, or cause it to break through (evolve) to a more complex level. New properties, structures, and environmental relationships emerge at more complex levels.

Evolutionary change is only possible when a new paradigm (in the form of a new world view) emerges that is capable of reorganizing the entire societal system into a more functional and environmentally relevant structure. While paradigm-changing innovations often appear first as new material technologies, societal transformation only occurs when a coherent new world view develops that is powerful enough to organize congruent values, social structures, and economic processes (A. Taylor 1999).

We are now in a period of evolutionary change. On one hand, the industrial system is no longer environmentally sustainable, which means that it must either evolve into a sustainable system or collapse. On the other hand, a new ecological paradigm has begun to emerge with the potential to organize a sustainable planetary civilization.

Because societal systems are organized by world views, the core requirement of a sustainable system is an ecologically relevant world view that recognizes the interdependence of all life on earth, and the need of all life for health and wholeness. The implication of this is that the development and spread of a systems-based paradigm is a prerequisite for the constructive transformation of the global system. This world view will only be viable if it organizes a congruent and functional societal system. This means that it must be able to support and coordinate the paradigm-changing values, social structures, economic processes, and technologies that are currently beginning to emerge (D. Taylor and Taylor 2007).

A precondition for an evolutionary shift is the creation of mutually supportive functional synergies (Corning 2008). Track 3 will accelerate structural transformation through helping the emerging elements of the new sustainable system come together through a process of collaboration, convergence, and confluence. The development of a constructive holistic alternative to our destructive global system (i.e., the existence of a coherent alternative system attractor) will support the rapid evolution of a new type of sustainable system (G. Taylor 2008).

Our species already has the knowledge and technology to create a clean, lean, and equitable economy capable of operating within our planet's carrying capacity. But because vested interests will resist efforts to regulate and ration the consumption of essential goods and services, major structural changes are unlikely to take place until the current system loses its ability to manage worsening global crises.

Because our global system is environmentally and socially unsustainable, environmental, economic, and political crises are likely to intensify over the coming decades. The worsening crises will expose the ideological and structural failings of existing institutions and increase demands for alternative approaches. Political tipping points will develop that will lead either to systemic transformation or collapse (G. Taylor 2014b).

On the positive side, three forces are growing and converging to support change: awareness that the greatest security threats we face are worsening environmental problems, opposition to widening economic and political inequality, and calls (from Pope Francis and other leaders) for a more ethical global system. Understanding that environmental, economic, and social problems are interconnected is the key to change. As Taj James points out, "In order to solve the economic problem, you actually have to solve the democratic problem, because the only way to shift the basis upon which our economy is organized is through the dramatic and rapid increase of democracy" (White 2016).

The international community has the ability to mitigate major global issues. The most critical risks are well known, and credible solutions have been proposed. Decisive interventions could prevent catastrophic environmental, economic, and social collapses and accelerate the transformation to a sustainable world system.

It will be possible to create a sustainable world if the current global system is restructured to,

- Regulate and restrict resource use to ensure that the economy operates within sustainable environmental and social parameters.
- Ensure that all humans, species, and ecosystems can access essential resources (those needed to maintain health and wholeness).
- Create an ethical, caring culture that recognizes the interdependence of individuals, society, and nature; that focuses on meeting real needs rather than false greeds; that values quality over quantity, and health and happiness over wealth and status.

Of course, clarifying the major systemic problems and solutions is only the first step. We then have to determine how we can implement the necessary changes. Here, systems theory can help. The most effective way to tip developments in constructive directions will be to create a viable alternative to the status quo (an alternative system attractor). This will require,

Vision: a positive, ethical narrative and vision that a peaceful, sustainable world is both necessary and possible.

Strategy: a clear strategy for global transformation.

Leadership: support for the vision and strategy from a coalition of credible leaders representing a wide spectrum of cultures, institutions, and political and religious views.

Empowerment: transformational media, social, and technological tools designed to inform, catalyze, and empower constructive change.

Organization: aligning the forces supporting sustainable outcomes, and facilitating the self-organization of a synergistic "super-campaign" pursued at all levels of our interdependent global system.

The Need for New Mental Models and Methods

Optimists point out that humanity is becoming better educated, wealthier, and more interconnected every year (Diamandis and Kotler 2014). In contrast, pessimists warn that business as usual is unsustainable: catastrophic climate change and increasing shortages of water, food, and cheap energy could collapse human civilizations by midcentury (Turner 2014).

Both views are correct. New technologies have the potential to double our life expectancies and create a prosperous future for every person on Earth. However, this will not happen unless we overcome the structural problems threatening our collective survival. We already produce enough to feed the world, yet a billion people go hungry. Our problems are not primarily technological, but social. For example, funding for the UN and its agencies (tasked with the world's biggest problems) is only 4 percent of global military budgets (Global Policy Forum 2012).

The role of futurists (and of scientists in general) is to help inform decisions that will lead to desirable outcomes. Although few futurists are complete pessimists, many agree that the world is facing an unprecedented "Global Megacrisis" caused by multiple interacting threats. The most important issues facing humanity concern our collective survival—"wicked" problems like climate change, nuclear war, and pandemics. Unfortunately, many of these issues receive insufficient attention. In 2002, Nick Bostrom observed, "There is more scholarly work on the life-habits of the dung fly than on existential risk" (Bostrom 2002).

Most futurists believe that we are in the midst of a historical transformation, and want to actively participate in creating a better world (Inayatullah 2001). Michael Marien describes this process: "If humanity is to have any future whatsoever, evolution is sustainability, taken seriously" (Marien 2015).

With time running out, we now need to challenge not only "business as usual" in governments and industry but also the "business as usual" mental models and methods of scientists. The failure of current climate mitigation efforts shows why major global issues (climate, water, food, energy, growing inequality, etc.) cannot be resolved with current methods and within existing political and economic structures.

Karen O'Brien and Gail Hochachka argue that an integral approach to climate change is needed. This places greater attention to world views, awareness, and motivation and "involves a radical transformation of the way that we think about change, from something that humans simply respond to and objectively manage, to something that humans can consciously create." These culturally and contextually sensitive ("all lines, all levels") transdisciplinary methods have been successfully applied to a number of complex local and regional, social and environmental problems; they now need to be used on a global scale (O'Brien and Hochachka 2009).

Members of the climate change and development communities are increasingly discussing the need for transformational change to prevent dangerous climate change and ensure sustainable development (Olsen and Fenhann 2016). Technological developments and policy adjustments will not be enough: we require an integrated paradigm shift in world views, institutions, and technologies (Beddoe et al. 2009). At this critical time, everyone concerned with the future of our species needs to support the conscious evolution of a sustainable global system.

It will be an enormous challenge to create a sustainable world, but one our species must and can accomplish. The future is not fate—it is our choice.

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