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Beyond sustainability: environmental management for the Anthropocene Epoch

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Human activities have vastly altered the Earth. Scientists posit that Earth has entered a new geological epoch, termed the 'Anthropocene'. Yet, although physical conditions have changed, human socio-economic endeavors still proceed as in the past, on the basis of increasingly obsolete assumptions about natural systems and resources ('business as usual'). As currently conceived, sustainable development is insufficient to cope with the global trends in environmental degradation and the emerging conditions of life on Earth. A holistic approach will be needed. Environmental management systems, designed for sustainable development, can help society adapt to the challenges of the Anthropocene, but their use remains marginal. Greater recourse to two fundamental principles, cooperation and resilience, is essential to build effectively toward holistic environmental stewardship. Copyright © 2012 John Wiley & Sons, Ltd.

Over the past two decades, sustainable development has become a normative guide for socio-economic growth. But is it too late?

During the two decades since the United Nations (UN) embraced its blueprint for sustainable development in Agenda 21, worldwide trends diverge away from sustainability in most sectors. 'Humanity stands at a defining point in its history'.[1] These opening words of Agenda 21 resound in 2012 with an ever sharper edge to them. The troubling conditions that prompted the global consensus for sustainable development when the UN Conference on Environment and Development met in Rio de Janeiro in 1992 persist, and many have become worse. Human population growth and technological innovations extracting wealth from natural resources are both accelerating rapidly. Despite some remarkable advances in reshaping socio-economic development into sustainable patterns, ecosystems across all regions of the Earth deteriorate, demands for fossil fuels grow, and cities expand without plans. Objective trends call into question the efficacy of contemporary notions of sustainable development.

Why have salutary reforms for sustainable development been overwhelmed by unsustainable 'business as usual' growth patterns?[2] This essay explores how public affairs discourse may bring into focus the disparities between aspirational sustainability norms and actual trends and raise questions about these gaps. Environmental management systems exist to make sustainable development effective but are implemented too thinly and mostly at the margins. Environmental management *can* guide actions toward sustainability. Yet, although the emerging capacities of environmental management systems are *necessary* to attain sustainability, they may not be *sufficient* in the present 'Anthropocene' conditions. Society needs to embrace deeper principles that can breathe new strength into sustainable development. If motivated to deploy environmental management systems widely, humanity can muddle resiliently through the challenges of the Anthropocene, this latest period of Earth's geophysical evolution.

QUESTIONS OF THE ANTHROPOCENE

The Economist featured 'geology's new age' on the cover of its issue at the end of 2011 May.[3] The cover led to a breezy, one-page essay entitled 'Welcome to the Anthropocene', which described changes to the

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[1]Agenda 21, paragraph 1.1, United Nations Conference on Environment and Development, UN Doc. A/CONF.151/26 (four volumes, 1992); see annotated edition, Nicholas A. Robinson (Editor), *Agenda 21: Earth's Action Plan* (Oceana Publications, 1993).

[2]This paper manuscript is based on a Keynote address to the Ashridge International Research Conference held on 10–12 June 2011 entitled 'The Sustainability Challenge: Organization Change and Transformational Vision'. It was delivered in the Concluding Panel on Public Policy Dimensions of Sustainability.
[3]*The Economist*, vol. 399, no 8735, cover and p. 11 (May 28, 2011).

Earth's carbon and nitrogen cycles, reshaping landscapes and eroding soils on a massive and global scale, and high rates species extinction rate. These are irreversible and geologically significant human changes to Earth. Yet, *The Economist*'s essay only touched the tip of a melting iceberg. *The Economist*'s message would have been better informed by citing the work of Dr. Paul Crutzen and others,[4] whose analysis is being reviewed by the International Commission on Statigraphy.[5] The effects of human change to Earth will profoundly alter every economic and management system. It is becoming apparent that the Anthropocene, an epoch shaped by man, has succeeded the Holocene, the 10 000-year epoch in which human civilization evolved.

'Welcome' is hardly the warning warranted. *The Economist* offered this bottom line:

> For humans to be intimately involved in many interconnected processes at a planetary scale carries huge risks. But it is possible to add to the planet's resilience, often through simple and piecemeal actions, if they are well thought through. And one of the messages of the Anthropocene is that piecemeal actions can quickly add up to planetary change.[6]

Humanity's *piecemeal* actions have irreparably altered the conditions on Earth that characterized the 10 000-year-long evolution of life during the Holocene Epoch. Can a new era of *piecemeal* measures, informed by environmental management 'sustainability' systems, help humans muddle through adapting to the new conditions for life on Earth? Because unsustainable patterns of 'business as usual' currently dominate, the question is what would make remedial piecemeal actions work? How could they be promoted widely, globally, at all levels, and fast enough to arrest further environmental degradation?

The Economist misapprehends the temporal dimension: it took centuries for humans irreparably to alter Earth, and there is no going back. Indeed, the on-going, rapid pace of change suggests that there may be too little time to rely on piecemeal responses to avert extensive socio-economic disruptions in all nations. Because unsustainable 'business as usual' practices are the drivers[7] of bio-geological changes, natural resource depletion and degradation in ecosystems, these trends will continue until either incremental reforms piecemeal change the drivers or

a radical shift is induced to a new culture of post-sustainable decision making for humans and nature to adapt and thrive in the emerging conditions of the Anthropocene. Within patterns of human evolution, are there instincts that can be highlighted to facilitate gradual or sudden shifts?

How might socio-economic growth be reconceived to move beyond 'business as usual'? Sustainable development was first advanced as a concept in 'Caring for the Earth', a program of the International Union for the Conservation of Nature and Natural Resources (IUCN) in 1980, as a central theme of its World Conservation Strategy.[8] IUCN's focus was on establishing stewardship of nature as a core socio-economic focus. The concept was ably articulated further in 1987 in the report of the UN World Commission on Environment and Development. Its report, *Our Common Future*, plainly observes in its opening words that '*The Earth is one but the world is not*'.[9] The study states the case for re-building balance into the relationships between the Earth's natural systems and the world of human endeavors. The Commission acknowledged the need for new legal principles to shift to a sustainable equilibrium, including an appendix on new environmental legal principles in its report. Many found their way into the Declaration of Rio de Janeiro on Environment and Development; but in Agenda 21, the core focus became again development, which could become durable (in French, sustainable is '*durable*'). The focus was not on nature, which supplies the context for development. The principles were not discussed in Agenda 21 itself.

Our Common Future launched a global quest to promote sustainable economic growth to and curb trends of advancing environmental degradation. Notwithstanding the report's impact, the gap between environment and development widens still. Where the assessment reports of the Intergovernmental Panel on Climate Change focus on the Earth's biosphere, reports by the World Bank address stimulating socio-economic growth by local, state, or national governments. To fuel the latter, humanity bankrupts the Earth's natural capital, in what Paul Crutzen and others call 'The Great Acceleration'.[10] Rates of growth in the past 60 years are historically unprecedented in all sectors measured.

Humanity has so irretrievably altered the Earth that a new epoch of geological time has begun. This new epoch demands different principles and

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[4]Will Steffen, Paul J. Crutzen, and John R. McNeill, 'The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?' Ambio, vol. 36. No 8, Dec. 2007.

[5]Anthropocene Working Group of the Subcommission on Quaternary Statigraphy of the International Commission on Statigraphy, www.quaternary.statigraphy.org.uk

[6]*The Economist*, vol. 399, no 8735, p. 11 (May 28, 2011).

[7]James Gustave Speth and Peter M. Haas, Global Environmental Governance (2006), p. 44, on the 'Underlying Drivers of Deterioration'.

[8]Martin Holdgate, *The Green Wed—A Union for World Conservation* (1999), p. 181, and Barbara Lausche, *Weaving A Web Of Environmental Law* (2008) p. 207.

[9]UN Commission on Environment and Development, *Our Common Future*, Chapter 1, (1987, Oxford University Press), also known as the Brundlund Commission report, named after its chairperson, the Prime Minister of Norway, Mme. Gro Harlem Brundlund.

[10]Will Steffen, Paul J. Crutzen, and John R. McNeill, 'The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?' Ambio, vol. 36. No 8, Dec. 2007].

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practices from those that humanity learned during 10 000 years of evolution during the Holocene Epoch. The scientific dimensions of this shift to a new epoch are being assessed by the International Commission on Statigraphy. To lay observers, however, the evidence of the new and permanent features of the Anthropocene is abundant: the melting of the cryosphere, the changes in the nitrogen and carbon cycles, acidification of the oceans absorbing carbon dioxide, new coastlines shaped by rising sea levels, an interrupted cycle toward recurrence of any ice age, radioactivity from atmospheric weapons testing, and the extinction of many species.[11] These are markers that did not exist in the Holocene.

It must be acknowledged that the public generally is unaware of, or passive, about such profound changes. The Economist's cover was featured akin to a quaint human interest story, with little awareness of the magnitude of what was being reported. Little political will exists to reshape 'business as usual' and shift to sustainability reforms. Public debate needs to question how and whether conventional wisdom that humanity can continue to grow with 'sustainable development'. Practices that served society during the agricultural and industrial revolutions are grounded in physical environmental conditions that have changed and will alter further. Some envision that humanity's inventiveness will usher in a new revolution, in green technologies and eco-cities, spurred on by instantaneous communication and social networking.[12] In this view, humanity may invent new easy ways to reset its socio-economic systems to reach a new equilibrium with Earth's changed conditions. But meanwhile, humanity continues the practices of the past that tipped humanity into the Anthropocene. Recourse to 'sustainable development' has even abetted a public passivity toward environmental problems. When 'sustainable development' is invoked to support the proposition that humanity can grow its way out of Earth's escalating problems, or to legitimize existing 'business as usual' practices, the concept promotes 'the great acceleration'. Employed thus, it contains the seeds of its own destruction.

As humanity adds soon two billion more individuals to the Earth, can basic human needs be met? As sea levels rise, many coastal dwellers will migrate inland. Governments will either meet their pressing needs or find larger numbers in poverty. Ushering in a new green revolution to cope with such

challenges will require widespread changes across all countries. New conceptions of growth and well-being will need to expand the scope of today's sustainable environmental management systems toward stewardship systems.

If humanity is to be stimulated to embrace such systems on a worldwide scale, it will need to be motivated by a pervasive and secular set of evolved, deeply seeded principles. Motivational impulses, embedded in human instincts for *cooperation* and *resilience*, can leverage the major shifts needed. Should society recognize both as fundamental principles of ethics and law and not only as a behavioral description of human traits? What obstacles would hinder remedial acts based upon these principles? Can these principles transform the tools of sustainable development, expressed as environmental management, into worldwide standard operating procedures?

These, and more, are the questions of the Anthropocene.

SUSTAINABILITY ASSUMPTIONS RECONSIDERED

Recall how nearly one century ago, the underground was invented and launched in London. From that rudimentary technological advance, cities designed modern mass transit systems—the New York subway, 'metros' in Paris, Moscow, and Tokyo, and mass transit in Singapore, Mexico City, Rio de Janeiro, or Washington, D.C. London's Underground meanders among the 13 rivers and brooks (now in pipes) that once flowed above ground to the Thames, their biodiversity now gone. Over the years, the heat of the train engines has raised the temperature in the surrounding clay and soil to a warm 19°C. In short, the inventions that make cities efficient today also have altered their environment.[13] Humans altered the environment of their habitats so profoundly that one generation forgot what prior generations had or lacked.

In the Anthropocene, it is increasingly the environment that will alter the cities. For example, New York's subways are threatened by heavier rainfalls flooding the system and require major redesign because sea levels around the city will rise perhaps one to two meters in the coming century. All elevations of all NY City airports are only a meter above sea level currently. New York City's Mayor Michael Bloomberg has developed a program, 'PLANYC', which inaugurates a far-reaching redesign of the city's infrastructure, including planting one million new trees to help residents cope with the 'heat island' that New York City has become. From innovative low-energy designs like those of Masdar in Abu Dhabi, to the ongoing re-invention of all

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[11]The report of the Millennium Ecosystem Assessment or the reports of the Intergovernmental Panel on Climate Change document such altered conditions. For example, the Antarctic ice core reveals 420 000 years of climate conditions. The current levels of carbon dioxide in the atmosphere are higher than at any time in this record. Already the Dutch government's Rhine Delta Commission has begun implementing a 200-year plan to protect the Netherlands from the effects of sea-level rise and the deeper fluctuations of floods and droughts and temperatures.

[12]See, e.g. Gunter Pauli, The Blue Economy: 10 Years, 100 Innovations, 100 Million Jobs (2010).

[13]Peter Ackroyd, *London Under* (2011).

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systems in the 'garden city' of Singapore, cities in all regions are struggling to create new coping mechanisms.

Whereas some cities have learned how to provide their large populations with imports of food and potable water, energy, and sanitary services and health, many others struggle still to do so. Globally, can 'business as usual' sustain this 'hit and miss'? The populations of some cities have grown faster than has their essential infrastructure.

Asia illustrates the urban challenge. One scientific study in 2007[14] evaluates how urban centers of industry, commerce, and services produce 50–80% of gross national product. Bangkok's metropolitan region yields 50% of Thailand's gross domestic product (GDP). Between 1995, when Southeast Asia's cities held 93 million people, and 2025, when patterns of growth project that they will hold 225 million people, the cities will host 60% of their nation's populations. This study cites 'incomplete urbanization' as an urgent problem. Many urban places lack the basic prerequisites to promote sustainable development, such as potable water, sanitation, housing, and education. Gradual measures to attain sustainability are lagging. The authors acknowledge that 'Cities are the cradles of discovery and innovation and this should expedite the introduction of technologies that can protect rather than damage the environment'. But their report also tellingly observes that 'Environmental management and policy have been a secondary consideration. The philosophy has been: grow first, clean up later'.

Across many nations, city dwellers already endure unsustainable urban living conditions. Demographic studies project a doubling of urban residents. These estimates are likely to be proven to be too conservative. All cities in the near future will accommodate ever larger numbers of residents than current demographic trends project, as a result of persons to be displaced by storms or by sea level rise from coastal plains and deltas. As they grow, cities may learn to adapt to new conditions, supplying much of their own food through hydroponic urban farming, and supplying a great deal of their own energy through photovoltaic cells and films on buildings and through a 'smart grid' for distributing and storing and redeploying electricity across many users and generators. Cities also may learn to harvest water as an asset, as Singapore does, and not waste it or even deem it a flooding threat; floods are feared, not managed, and the Common Law still deems rain run-off as 'a common enemy'.

Asian cities, holding more of the Earth's people than other regions, may become crucibles for innovation in planning and adapting. All cities

should study, for example, the 'eco-cities' that China is designing, after having studied Singapore's urban evolution. Wherever environmental management systems are robust, they can facilitate rapid adaptation to the new conditions of the Anthropocene. Yet, skills are everywhere in short supply. Such eco-cities and green revolutions will emerge unevenly around the Earth; and as result, cities that lack capacity to establish responsive with environmental management systems will face deteriorating conditions and challenges to public order and well-being.

Urban Asia's challenges are not unlike those the Anthropocene poses for humanity everywhere in the 21st century. Accelerating growth exceeds the grasp of the prescriptions for sustainable development fashioned at the end of the 20th century in Agenda 21. The UN promoted sustainable development in 1992 because socio-economic development was lagging acutely, pollution was widespread, and natural systems were deteriorating. By the year 2000, the UN rallied its member states to agree to attain sustainable conditions through adopting the Millennium Development Goals. In 2002, the UN World Conference on Sustainable Development adopted the Johannesburg Plan of Implementation for the recommendations of Agenda 21. Little new activity resulted. Ironically, declaring agreed norms is so welcome that it often relieves the social pressure to act further promptly and masks a correlative inactivity in actions for reforms. .

Worldwide, degradation of the environment prevents attaining the UN Millennium Development Goals in the short term. One remedy has been to propose adopting 'sustainability development goals', milestone objectives by which to chart a path to reaching the Millennium Development Goals. All such well-intentioned international agreements for sustainable development, although *necessary,* are not *sufficient* for sustaining human well-being. They cannot be realized without a more robust deployment of environmental management systems in all regions. Neither most nations individually nor the UN collectively has put into practice environmental management systems, without which none of the Millennium or 'sustainability' goals can be realized. Each successive rhetorical endorsement of 'sustainable development' emphasizes immediate human needs more and sustaining environmental systems less. Incanting the duty to attain sustainability does not make it so.

The World Commission on Environment and Development had sought to temper the growing human appetite for consuming Earth's bounty by articulating a human value, sharing with one's children. Inter-generational equity would spur nations and communities to become sustainable. Yet, today have not events rendered the definition for sustainable development in *Our Common Future,* obsolete? 'Sustainable development is development that meets the needs of the present without

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[14]START (Global Change SysTem for Analysis, Training and Research in Southeast Asia, www.start.org), *Critical States,* (Chiang Mai University, Malaysia, Unit for Social & Environmental Research, 2009).

compromising the ability of future generations to meet their own needs'.[15] After three decades seeking to establish sustainability practices, it is evident that defining sustainability in terms of inter-generation equity has motivated sufficiently pervasive reforms. Emergent conditions in the Anthropocene require rethinking the various definitions of sustainability, beginning with that offered by *Our Common Future*. In place of a definition for development, perhaps humanity requires concepts for living, grounded in principles of cooperation and resilience, as discussed in the succeeding texts.

Although greed and growth in consumption are often cited to be the reasons why humanity fails to implement sustainable development, there is another reason that is less acknowledged: the very concepts of 'sustainable development' are flawed. It is likely that the conditions in the Anthropocene will overwhelm sustainable development, despite misapprehensions about its meaning. Nonetheless, it may be insightful to probe the semantics of sustainability to avoid comparable misconceptions as reforms are fashioned to adapt to the Anthropocene.

MISCONCEPTIONS OF SUSTAINABLE DEVELOPMENT

Definitions of 'sustainable development' framed at the outset of the 21st century have internal inconsistencies. The 1992 UN Conference on Environment and Development in Rio de Janeiro sought to reconcile and integrate *two competing polities—environment* and *development*—which were deemed to be competing or incompatible. Then, as now, many perceived that those who protect nature's environment unreasonably restrict socio-economic development opportunities. To reconcile these differences, the nations assembled at Rio agreed by consensus to adopt a set of practices, in Agenda 21, and principles, in the Declaration of Rio on Environment and Development.

Although objectives for sustainable development were widely disseminated and endorsed, 'business as usual' persisted in most places. Warnings about environmental degradation were repeated in 2000 when the UN General Assembly adopted its Millennium Declaration, observing that

> Prudence must be shown in the management of all living beings and natural resources, in accordance with sustainable development. Only in this way can the immeasurable riches provided to us by nature be preserved and passed on to our descendants. The current unsustainable patterns of production and consumption must be changed in the interests of our future welfare and that of our descendants.

Thereafter, at the 2002 UN World Conference on Sustainable Development in South Africa, nations agreed that sustainable development rested equally on *three* pillars: '*economic development*, *social development*, and *environmental protection*'. Despite this declaration, most governments and enterprises continually devoted the lion's share of management and resources to the first pillar. The UN Environment Programme, with its modest staff, was left to monitor degradation trends and make recommendations for best practices. Nationally, environment ministries fared little better. In the Great Recession of 2008, cuts in budgets reduced support for the weaker other pillars.

Sustainable development advocates pay tribute to either the 1987 concept *intergenerational equity* for defining for sustainability or the *three pillars* of 2002 or the *two competing polities* of 1992. What are the flaws in each? These approaches each lack principles that unifying behavior across all sectors and time frames. Perpetuating distinctions between environment and development in these different ways precludes embracing sustainability as a *holistic* concept for humans living in Earth's biosphere. Many sectors still see environment as antithetical to development, rather than being the foundation for all socio-economic well-being. Most countries maintain traditional 'business as usual' practices. Many still believe that sustainable development only demands the patina of environmental nourishment to thrive. Some enterprises use a 'greenwash' to appear tasteful. Others support a role for environmental protection only to abate pollution, as 'end of pipe' fixes, but oppose process design to eliminate all wastes. Many accept government programs for parks or technological pollution controls but oppose environmental laws and policies that require 'life style' changes. The idea that all these different definitions are actually but facets of one holistic vision for sustainability is a re-conceptualization too foreign for many to grasp.

The upshot is that unsustainable practices continue, even while all pay lip service to the social norm of sustainable development. In contrast to the trend to continue 'business as usual' in reliance on these incomplete concepts of sustainable development, there are significant efforts to explore more deeply what *Our Common Future* sought. There are enterprises and communities that have formulated and implemented effective environmental management systems that do function sustainably. These are the exceptions that prove the rule, and despite many fine exemplars, reporting on successful case studies of holistic action has not excited widespread emulation. Worldwide meanwhile, the effects of business as usual overwhelm even these successful reforms.

Definitions do matter. One consequence of these flawed definitional concepts is that environmental management systems for sustainable development

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[15]*Our Common Future, supra* note viii, at Chapter 2, p. 43.

invariably are assigned low priority and are virtually never given parity with other socio-economic goals and programs. Governments in all regions are unwilling to act on the acknowledgement that environmental degradation trends threaten their own economic well-being. They promote traditional patterns for economic growth and see little necessity routinely to use environmental management systems.

There are many reasons why this is so. Some may be noted. The past six decades have enabled the generation that ushered in the 21st century to attain a standard of living that was inconceivable when London launched its underground. Globally, collective security has driven back the threat of international warfare, self-determination has ended colonial rule, and technological innovations have wrought huge advances in manufacturing, transportation, global trade, instantaneous communications (with social networking), and advances in agriculture and human health services. Many of these gains have come at the cost of exhausting much of the natural bounty of the Earth. GDP measures what economies make from using nature's bounty, but GDP fails to identify when nature's renewable assets are compromised and non-renewable assets are depleted. Preferring a liberal economic concept for 'growth', governance systems defer to markets and tend to disdain fashioning environmental regulations that constrain growth by regulating what otherwise would be economic externalities.

Governmental largess providing economic developers with largely unbridled access to natural resources also fuels the voracious finance and trade sectors of the economies.[16] Caught up in coping with The Great Recession of 2008 and dislocations in credit markets, including sovereign debt crises, most governments neglect the environment all the more. Shortcomings both in the rule of law and in prudent financial management leave little scope for debating ideas about the effectiveness of sustainable development or anticipating tomorrow's problems in the Anthropocene.

The same hubris by which governments chose not to regulate the financial markets adequately to avert the Great Depression of 1932 or the Great Recession of 2008 also excuses neglect of the environment. The 'economy of nature', based upon the 'laws of nature', constitutes the very foundation for both socio-economic systems and their organizing regimes of law and governance. It is convenient for finance ministers and governments to take for granted their reliance on the natural cycles of Earth's biosphere. In the Holocene, nature provided what markets took,

despite short-term and isolated dislocations. In consequence, insufficient attention is still given to the implementation of environmental and other laws mandating sustainable development practices. If the markets did well enough without needing environmental management in the past, business as usual finds historical reasons to resist recourse to such systems. The consequence is that most regimes still fail to deploy environmental management systems.

ENVIRONMENTAL MANAGEMENT—COMING OF AGE

Are there approaches to management that can serve a renewed, holistic conceptualization of sustainability? The quest to attain sustainable development has encouraged innovations in environmental management systems. Many tools for coping 'piecemeal' with the environmental challenges of the Anthropocene do exist.

Environmental management may come of age as societies begin to perceive their dual ecological and economic crises. The knowledge and methods of environmental management systems provide antidotes to the global patterns of environmental degradation and financial disruption. Environmental management is accessible alike for enterprises, governments, or civil society organizations as each seeks to cope with change in the Anthropocene. Relatively few universities undertake research and teaching of these systems. Because the velocity of climate disruptions will outpace the education of environmental managers, it may be necessary to produce a cadre of para-environmental managers, capable of quickly preparing and deploying environmental management systems appropriate to the different problems of the Anthropocene.

Evolved environmental management systems encompass the following three themes, together with the methodologies appropriate to each the techniques.

(I) Systems design

Holistic sustainability eliminates waste and reuses and redeploys all materials and energy associated with manufacturing, construction, extraction of natural resources, or other activities. Business-as-usual practices are profligate in producing waste. Efficiency in supply chain management exalts 'last minute' delivery of components over providing for holistic and systemic integration of materials with the availability of back-up resources to ensure resilience when confronted with disruptions. Growing scarcities of resources can stimulate innovations to treat 'waste' as a source of valuable resources.

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[16]Consider the complex manipulations of 'cap and trade' market mechanisms relevant to controlling pollution. See Nicholas A. Robinson, 'Hedging against Wider Collapse: Lessons from the "Meltdowns"', in Lin-Heng Lye, Janet E. Milne, Hope Ashiabor, Larry Krieser and Kurt Deketelaere, *Critical Issues in Environmental Taxation*, (vol. VII, 2009) at 625–663.

Several fields of environmental management address the knowledge and methods that design and redesign developmental systems toward such sustainable ends.

Industrial ecology

Through the study of how governmental, commercial, and social systems can be understood as analogous to the functioning of ecosystems, insights are derived to better design manufacturing, construction, and urban settlements, to reuse materials and energy, eliminate all wastes, and manage the flows of energy and materials. The field of industrial ecology provides holistic and integrated frameworks for sustainable development.

Life cycle analysis

The criteria and methods of the evaluation of the complete life cycle of a product, a building, or a service are essential tools for the environmental manager. Some specialized systems have emerged for given sectors, such as the Green Buildings Council's LEED program for energy efficient new construction. Life cycle analysis uses feedback systems, to learn and redesign continuously. This approach studies optimal designs and is informed by continual updates of standards, so as to take in to account new technological innovations or understanding.

Technology assessment

Specialized techniques for evaluating proposals for new technologies and their applications are significant components of design for sustainability. Evaluation of technological innovations and their uses can anticipate and avoid unintended adverse consequences. This assessment system should be essential for the 'green revolution', as well as for geo-engineering proposals. The early work of the now-abolished Congressional Office of Technology Assessment in the USA needs to be re-evaluated and may usually be re-instituted. Management techniques for technology assessments give realistic effect to the 'Precautionary Principle' and to get beyond unsubstantiated fears about new technologies and at the same time avert unintended consequences.

Green technology and economy

The development of innovations in generating electricity from wind, solar, wave, and other renewable sources, as well as enhanced ways to save energy though new designs in appliances buildings and vehicles, is spawning entirely new opportunities for environmental management. There remain many questions about how technology transfers will disseminate these innovations widely across all regions and nations. The endorsement of this growing dimension on environmental and energy design by the UN 'Rio + 20' Conference in 2012 brings this work under the rubric of Agenda 21, as a step toward sustainability, and capacity to supply energy without the need for carbon fuels.

(II) Legal and management norms

Markets alone do not ensure that wastes will be eliminated or stimulate redesign to support resilience in either ecological or socio-economic systems. Environmental laws guide society toward sustainable practices. The study and refinement of substantive and procedural environmental laws will be essential for coping with the rapidly changing conditions in the Anthropocene.

Environmental law norms and procedures

Nations continue to elaborate systems for environmental law, which may be complied with efficiently through environmental management techniques. Worldwide, many regions have contributed to shaping environmental legislation and administrative regimes. In the 19th century, Western European and the USA pioneered the laws for the conservation of nature and natural resources. From the 1920s and in particular in 1970–1990, the USA, with Canada and Australia, provided innovative legal concepts and reforms. The decade of the 1990s found developing nations, such as Brazil, enacting innovations in legal norms. Since 2000, it has been the European Union that has pioneered new refinements in environmental law, with China exploring innovations such as legal designs for eco-cities. Because environmental managers work across all national borders, their challenge is to compare, study, and learn about such environmental law developments. Environmental laws provide the vehicle by which society defines and established sustainability norms, such as recycling of wastewater or non-carbon-based generation of electricity.

Environmental management systems

As used by many companies and governments, an enterprise's environmental management system (EMS) integrates analysis and compliance with all environmental stewardship tasks and legal obligations. EMS is useful for companies, non-profit organizations, universities, military departments, agencies of government, and others. Although EMS norms and procedures have been promulgated in the UK and other developed states, they are by no means universally embraced. EMS increasingly is being reshaped as 'Sustainability Management Systems', to encourage a holistic approach adapted to the special characteristics of the entity employing the system.

Supply chain management

Establishing the standards and contractual obligations and capacity building measures to ensure that all links in the supply systems have their own EMS

and quality assurance. Procurement standards for shifting to ever more sustainable designs and products are important steps toward building sustainability and resilience. This methodology is informed by life cycle analysis but is the practical and applied dimension.

Annual sustainability reporting
The metrics and the information gathering and assessing systems are essential to an understanding of environmental sustainability. Such monitoring and reporting at a minimum demonstrates compliance with EMS and environmental laws. Many go beyond the minima to measure how an institution is meeting its voluntary and aspirational targets toward given for sustainability objectives. This reporting necessarily includes understanding how to maintain the independence of the reporting objectives and designing a system of multi-year measurements, which can mesh with and guide the financial reporting. Analytic approaches for identifying obsolete, but still used, metrics that falsely report the well-being of an enterprise or agency are important functions to help leverage to more holistic practices.

(III) Procedures for adapting

The Anthropocene will produce many surprises in ambient environmental conditions. Unexpected disruptions are likely, so iterative learning and re-learning procedures will be more important in environmental management. Existing procedures—like everything else—will need to be adapted and re-adapted to assess the evolving new conditions of the Anthropocene.

Environmental impact assessment
Procedures for undertaking, communicating, and constantly learning from and improving environmental impact assessment (EIA) are fundamental to sustainability. EIA should be developed as a process used widely and not only by governmental authorities. Private sector uses of EIA can integrate EMS into institutional practices, and promote greater rigor and transparency within other EIA systems, such as those used by governmental agencies. Comparative EIA learns from innovations in improved EIA systems and adapts the reforms to others. EIA needs to subsume the narrower body of lore and practice associated with 'cost/benefit' analysis. Routine updating of prior EIA determinations, to address changing environmental conditions, is now carried out in a few countries but will need to become a standard practice. Principle 17 of the Declaration of Rio de Janeiro on Environment and Development requires EIA for national decision making. Nonetheless, many nations do not yet observe this standard. To facilitate adapting to changing conditions in the Anthropocene, EIA will play a central role.

EIA can be used with every piecemeal action to explore how it can adapt to changing physical and social conditions.

International Standards Organization Best Management Practices
The International Standards Organization (ISO) system of auditing compliance with environmental and other obligations is a well-used system but essentially measures the routine compliance with environmental rules in place when a facility is located. The ISO has promulgated voluntary standards for ISO 9000 (quality in manufacturing), ISO 14 000 (environmental management), ISO 26 000 (social responsibility), ISO 30 000 (risk management) and ISO 50 000 (energy management). The ISO 14 000 environmental management standards are incorporated in the European Union's EMS requirements. ISO 14 000 establishes a common basic norm and thus test minimal expectations. As the ISO approach is revised, it may embrace a process to measure how an institution upgrades its performance on the basis of more advanced concepts of sustainability. Third-party auditing can facilitate such transitions to more sustainable patterns. Periodic revisions to ISO standards and more frequent and robust audits and certifications will be useful in addressing the changing conditions of the Anthropocene.

Public participation in environmental decision making
The rationale for and means by which all stakeholders are invited to participate in decisions affecting the public and associated interests. This includes access to environmental information and how such information is disclosed and accessed. Nations have enacted laws for disclosure of environmental information, rules for public participation, and access to justice. More than 350 environmental courts have been established. Like Agenda 21, Principle 10 of the Declaration of Rio de Janeiro on Environment and Development posits that active public participation is essential to sustainable development. The techniques for giving information and timely notice to the public about possible actions before taken, for educating the general public, and for consulting all stakeholders are essential to building resilience and sustainability in a society.

Corporate social responsibility
An organization's concepts about its obligations to the community in which it functions, to its employees and customers, to its supply chain relationships, and to the ambient natural environment establish its norms for responsible social behavior. Corporate social responsibility (CSR) policies and practices determine how an enterprise assesses the impacts of its decisions and activities on society, the environment, and its own prosperity. It accounts for its 'triple bottom line' of measuring how the organization

benefits people, the planet, and profits. The objective is to establish practices whereby responsible, sustainable, and transparent approaches build brands and reputations and help strengthen the community and the marketplace. A business plan aims to define organizational culture, values, and objectives through strategic CSR application.

These three fields or clusters of environmental management systems—*system and product design*, *substantive norms in laws and policies*, and *procedural or operational norms*—are often studied and practiced separately, as if they have little to do with one another. This is a mistake, generated out of the flawed definitions of 'sustainable development' and the extreme specialization encouraged as efficiency in the 'business as usual' approach. Because these environmental management systems have all emerged in the past three decades, they are often not widely understood or available. They are rarely central in management or governance studies in universities. Relatively few experts exist to develop each of these fields of environmental management. They still are not pervasively in practice in many developed countries and much less so in emerging markets. As practical means to attain sustainability, their efficacy has been demonstrated. It is worth debating, then, why these environmental management systems remain peripheral to socio-economic development. These systems are the framework for making development sustainable.

ADAPTIVE ENVIRONMENTAL MANAGEMENT FOR THE ANTHROPOCENE

As societies seek ways to cope with changes in the Anthropocene, they may find that these several dimensions of environmental management systems and techniques are increasingly useful. Studying instances where the systems work well will facilitate adapting and deploying comparable measures. An illustrative example of such systems at work in context suggests why this is so. Consider an example from Iceland.

One instructive exemplary application of holistic environmental management is the 'Resource Park Concept' (RPC), which is designed and operational. Designed by Albert. L. Albertsson for the geothermal electrical-generating facilities of Iceland's Svartsengi/Reykjaines Resource Park, with its famous 'Blue Lagoon', this RPC applies 'sustainability' norms on the basis of Albertsson's holistic approach. He went beyond merely the task of generating electricity without using carbon fuels. He directed the construction of a geothermal power plant that had to blend entirely with the cultural and natural values of the human and ecological communities where it was located. This means, in his words,

the power plant has to be the Power Plant of the local people, i.e. be an accepted and decent 'habitat' of the local community. The locals have to 'own' and 'operate' the plant and have access to it and are, *in situ*, educated about how it works.

By design, the generating plant can have no waste, and in order to attain the highest possible resource efficiency, all by-products must be made productive and of equal importance with the core process generating electricity.

Albertsson notes that 'the term "waste" is corrupting our mind set and there exist no waste, only value streams'. His plant creates more than just the value of power: 'it has to create meaningful jobs for locals which in a sustainable way develop further the old-line culture of the local area' such as farming, fish farming, and traditional product manufacturing. The RPC encourages people with different disciplines to collaborate, and as the Blue Lagoon medical and recreation spa illustrates, brings peoples of different cultures together. The RCP evaluates and compensates for any environmental impacts, even anticipating 'the foot print it leaves behind when it is abandoned'. [17] This RPC is a profitable commercial enterprise, which has financed its own cultural and ecological sustainable development, serving Iceland's society and its economy. How many power plants have such a holistic foundation and application?

Comparable examples of holistic development can become the initial benchmarks for development in the Anthropocene. Leading companies rely on environmental management systems to move in the direction of the Icelandic RPC example. Such sustainability innovations are encouraged by the two leading environmental sustainability consortia of and for multilateral businesses, the Business Council for Sustainable Development based in Switzerland and the World Environment Center based in Washington, D.C.

Although major multinational companies derive economic benefit from their many environmental management techniques, most production lines are not yet holistic. Progressive enterprises often have a chief environmental or sustainability management officer, at the highest level reporting directly to the president and CEO. They develop practices, with metrics to turn what some see as 'waste' into assets producing profits. These progressive companies have rejected the 'conventional wisdom' that it is expensive to protect the environment; they flip the proposition and work with the environment to find value and new products and profits. Companies such as IBM, Nestlé, Johnson's Wax, or DuPont exemplify this approach. To be sustainable, these companies

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[17]See www.hs.is. Quotes from author's interview in 2011 with Albert L. Albertsson, Dep. CEO, HS Orka hf, Brekkustig 36, 260 Reykjanesbæ, Iceland.

long ago ceased to pit environment against development. As the 3M Company learned in the 1970s, 'pollution prevention always pays'. These companies design elements of sustainability into their corporate business plan, human resources practices, and shareholder value propositions. The Anthropocene will require more. The holistic model of environmental management builds resilience and capacity to adapt.

Environmental management practices in use by leading companies are not yet used by most governmental and non-governmental agencies. Most governments remain grounded in 'business as usual' practices. Few city or national governments have sought to learn from the environmental management systems used in such companies. Few government agencies have built sustainability into their land use plans and municipal budgets. Rarely do mayors name a deputy mayor for sustainability. Most cities have not envisioned how urban planning can find 'new' sources of revenue to finance infrastructure development, as companies have carried out. Because the framework of government core to civil order and well-being, it is likely that, as governments guide society in adapting to the new conditions of the Anthropocene, they will come to know that they have an urgent need to use environmental management systems. Unsustainable government practices may come to be viewed as analogous to waste and corruption.

Education programs in public administration lag behind corporate best practices in what they teach about environmental management systems. Universities need to teach environmental management and holistic approaches to governance. In 2011, the National University of Singapore, for example, completed a decade of teaching environmental managements systems in its Masters of Science in Environmental Management degree and launched an undergraduate environmental studies major in which 25% of all its college students enroll. Education in environmental management systems will help Singapore adapt to the Anthropocene and provide capacity-building services to others to do so also.

Moreover, environmental management systems apply equally to non-profit organizations, corporations, and governmental agencies. Too often, local authorities expect companies to use such systems but fail to understand that governmental agencies also can benefit from integrating environmental management systems into their policies, practices, and metrics into city planning and governance. All governmental agencies will need to identify environmental management methods that function sustainably, and import those methods. They can do so by studying each other, examining the leading innovations in providing transport, housing, education, health, food, potable water, sanitation, biodiversity, and employment.

Realistically, however, most governments and enterprises are preoccupied with short-term objectives, busy struggling to cope with daily priorities. Few make the time to explore and discover and adapt innovations or plan for tomorrow. The example of the RPC electrical-generating development in Iceland illustrates what all enterprises should aspire to attain. However, disruptions caused by environmental events in the Anthropocene will produce new short-term priorities that compete with and reduce time available for planning for this sort of holistic development. Countries with cities situated at sea level, near coasts, and river deltas, and small island states such as those on Pacific atolls or the Maldives Islands in the Indian Ocean, will be relocating populations. Will they plan holistically or resettle their populations unsustainably? Holistic environmental management systems could design new human settlements that will receive communities displaced by sea level but only if governments know how.

Most sustainable development models of UN agencies, the World Bank, and other development agencies still promote the 'business as usual' models of flawed sustainable development. Institutionally, they are hardly capable of thinking holistically. In place of disaggregated, incremental, or sectoral development, multilateral development models need to adopt integrated and 'zero-waste' programs. When the expedient of dumping wastes is prohibited, development thinking tends toward a holistic approach.

The vision of *Our Common Future* for sustainability also stimulated the search for holistic approaches. It may seem self-evident to recall that human well-being encompasses equally contributions from the perspectives of public health, urban ecology, environmental quality, or finance. In the hyper-efficiencies of specialization, the links between these sectors weaken or are forgotten. EMS seeks to restore the links. Human well-being is holistic. Cities and their national governments can be expected to do more than sustain social order, public health, education, and markets. Where a government fails in any of these facets, it impairs the quality of life and the sustainability in all other facets. In the Anthropocene, as events disrupt socio-economic systems, how governments respond will determine whether they can adapt and evolve or suffer and decline. Governments need to accept a radical redesign of their systems and move quickly to establish holistic systems, with zero-waste regimes, that favor equally culture and nature along with an economic mission.

STIMULATING HOLISTIC SUSTAINABILITY IN THE ANTHROPOCENE EPOCH

When required to urgently respond to disruptions and new challenges in the Anthropocene Epoch, the question will be 'What works?' Answers can be

found by applying techniques of environmental management. Where environmental management systems are used, the costs of disruptions can be averted or minimized. If such systems are only deployed after the disruptions, the costs escalate. What will leverage governments and companies and others to deploy environmental management systems sooner rather than later, or not at all?

Motivational forces to do so already exist within humanity's shared values. Human endeavors need to rediscover and make core two fundamental principles. Acting conscientiously in reliance on these principles substantively could guide 'sustainable development' into making widespread use of environmental management systems.

To make the world one, like the Earth, humanity finds reciprocity with nature. Humans evolved amidst nature and can make common cause to balance ecological and human needs in the Anthropocene. Humanity can do so by adhering to the same fundamental principles pervasively, at all levels of human endeavors. All human relations, and the UN system of states, are founded on the well-accepted legal and moral principle of '*cooperation*'. The human instinct for cooperation can be promoted or neglected. In the Anthropocene, it should be emphasized anew and encouraged, not just taken for granted. An equally fundamental norm is found in that common virtue, '*resilience*'. Promoting resilience should have a high priority and be deemed to be both a moral and legal principle. These two principles can imbue techniques of environmental management with new robustness, as demands for the services of environmental managers grow.

Effective principles mold behavior. These principles would make it more likely than not that individuals would seek to deploy widely environmental management systems.[18]

PRINCIPLES MATTER

Turning first to 'cooperation', it is useful to recall that the UN system is grounded on the obligation of states to cooperate with each other. This ground norm in international law also is seen to exist in natural law,

derived from patterns in human-to-human relations. Cooperation is both an ethical norm and a duty of good neighborliness, which is a customary law norm in all legal systems (e.g. *droit de voisinage*). As all societies and their cities cope with the accelerating physical changes in the Earth's Biosphere, cooperation can make it possible for societies to muddle through. Governments and individuals alike instinctively cooperate when providing mutual aid for disaster relief. Coming 'climate change' and other global environmental threats call upon us to hone this capability.

From the perspective of Darwinian evolution, the human disposition to cooperation increases as the problems challenging human well-being also increase. This is the scientific finding of Samuel Bowles and Herbert Gintis, in their study of human social evolution.[19] They demonstrate how humans have evolved and matured patterns of cooperation among themselves throughout the Holocene Epoch. A part of their evidence is found in the ancient roots of this ethical norm. It exists in the 'golden rule', found in many religions and philosophies.[20] Mark Pagel's natural history of human co-operation corroborates this fundamental human trait.[21]

Resilience is a fundamental part of human character, but unlike cooperation, it is not yet explicitly recognized as an ethical and legal principle. Reciprocal human enlightened self-interest and compassion promote cooperation but to what end? One theme of cooperative behavior can be to maximize our human capacity for resilience. The principle of resilience is derived from the trait of human nature to be resilient. As a species, humans are resilient. The concept is well documented in scientific studies of resilience in ecosystems and also in associated human social systems. Ecologists and social scientists have identified and elaborated this principle of resilience.[22] The concept has been applied to social science settings also.[23] The Intergovernmental Panel on Climate Change has defined resilience as the 'amount of change a system can undergo without changing state', and the UN Development Programme has termed it 'a tendency to maintain integrity when subject to disturbance'.[24]

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[18]Not all principles are equally fundamental or accepted. The most fundamental principles are often taken for granted. Other principles relevant to sustainable development are important but not as fundamental as the two discussed here. For example, there are many other principles from the 1992 Rio Declaration that will support sustainability, such as Principle 10, public participation in environmental decision making, and Principle 17, on environmental impact assessment, expressed in the UN Declaration on Environment and Development. The Earth Charter synthesizes these and other principles into a holistic ethical framework that may appropriately guide environmental management techniques in meeting the challenges of the Anthropocene. Another principle endorsed by the European Parliament in 2011 is the Principle of Non-regression, which would prevent governments from reverting to environmentally destructive acts once they have been banned by law; repeals of environmental safeguards would be prohibited.

[19]*A Cooperative Species—Human Reciprocity and its Evolution* (Princeton University Press, 2011).
[20]For example, in *The Analects* (Book 15, chapter 23) of Confucius, it is written: 'Is there one word which may serve as a rule of practice all one's life?' The Master said, 'Is not reciprocity such a word?'
[21]Mark Pagel, *Wired for Culture: The Natural History of Human Co-operation* (Allen Lane, 2011).
[22]See B. Walker & D. Salt, *Resilience Thinking*.
[23]B. Walker, S.R. Carpenter & A. Kinzig, 'Resilience, Adaptability & Transformability in Socio-Ecological Systems,' in *Ecology & Society* (9) (2), which may be accessed at www.ecologyandsociety.org/vol9/iss2/art5/), and the studies of the Resilience Alliance, at Stockholm University, at www.resiliance.org.
[24]See the Intergovernmental Panel on Climate Change, www.ipcc.ch, and the UN Development Programme (UNDP) www.safecoast.org/editor/database/File/OECD%20Adapting%20to%20climate%20change.pdf.

The principle of resilience can be restated in legal terms, 'States shall conserve and enhance characteristics of resilience within all systems under their jurisdiction or control'. Governments would be obliged to embrace environmental managements systems, design redundancy into their operations, and eschew practices that exhaust natural resources and degrade the environment. Promoting resilience would guide the environmental management systems toward finding sustainability in the Anthropocene.

Environmental management systems should make explicit their implicit aim to enhance resilience. In return, EMS could be strengthened through reliance on the principle of resilience. Measurements to track resilience can be developed. One may inquire whether any or all of the following would be treated as higher societal priorities, if there was an acknowledged duty to promote resilience: recycling energy and materials to avert waste, providing everyone with access to systems of insurance, establishing buffer zones along watercourses, restoration of wetlands on coastal areas, proving buffer zones and land use rules adjacent to protected areas, reforestation of watersheds, providing distributed energy systems off the grid, extensive stockpiling of food supplies under the UN's World Food Program, or enhancing social support and resettlement system for persons dislocated by environmental disasters or sea-level rise?

MOVING TOWARD ROBUST AND SYSTEMIC USE OF ENVIRONMENTAL MANAGEMENT

Motivated to observe principles of cooperation and resilience, societies are more likely to move toward more robust and systematic use of environmental management. If nations are to benefit from application of the principles of *cooperation* and *resilience*, they will need to consider taking some specific and fundamental new actions. Although the very instability of today's financial and economic order might be expected to open the door for governments to be more receptive to innovation or using environmental management systems to save money and avoid waste, this is not happening. The preoccupation is with short-term restoration of 'business as usual' market conditions. Both the Group of 20 (G20) and the UN General Assembly acknowledge the promise of promoting energy efficiency and advantages of the 'green economy', and issues of environmental governance, but do not yet act to alter behavior.

Although cooperation and resilience can stimulate reliance on environmental management systems, there remain significant obstacles. The inertia of 'business as usual' practices is strong. Even if motivated to go beyond the practices and perspectives that humans know and believe in from their experiences in the Holocene, establishing EMS faces tough obstacles. Steps toward sustainability on the way to holistic thinking will not come easily. Five groupings of obstacles may be noted, which highlight why human instincts for cooperation and resilience are stifled.

First, the rule of law—honest and open governance—is essential. Environmental management systems require integrity in their deployment. Many regions lack the rule of law. Asia has become the world's leader in establishing environmental courts and tribunals toward this end. In 2010, India adopted its Green Tribunals Act and established its first regional environmental courts to vindicate the rule of law and apply environmental sustainability rules. China has more than 50 environmental courts, capable of hearing citizen complaints against polluters, in 14 provinces.[25] In April of 2010, the Philippines has environmental courts and has established the Writ of *Kalikasan* (nature) to facilitate vindicating environmental rights throughout the Philippine courts.[26] Cities and states that allow for public participation in environmental decision making build resilience and sustain stable social order at the same time; failure to do so can contribute to social unrest, as in conditions leading to the Arab Spring of 2011 or the electoral demonstrations of 2012 in Russia.

Second, to enhance Resilience, all societies need to establish insurance systems and require their use. Insurance will enable both public and private interests to finance recovery after suffering damage, as by floods. Mutual, cooperative insurance systems have a successful and proven history. Insurance is itself resilient, the cost of paying insurance premiums also induces precaution, and is a kind of shadow pricing of the risks and externalities addressed by the insurance. Many nations, especially in developing regions, lack universal insurance systems and laws. Expanding the insurance sector provides jobs and broadens financial services. Insurance systems require the rule of law. Without insurance, finances to recover from disruptions in the Anthropocene will be scarce.

Third, funds are needed to build capacity for establishing environmental management systems. Nations have little interest in providing sums via overseas development assistance, but sources within the financial systems can do so. The private financial sector would benefit from embracing CSR systems that serve the global economy as a whole and do not benefit private investment banks alone. Since

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[25]See George Pring and Catherine Pring, *Greening Justice: Creating and Improving Environmental Courts and Tribunals* (2009).
[26]The Asian Development Bank has been a leader in exploring how such courts can be effective. The courts implement Principles 10 (public participation) and 17 (environmental impact assessment) in the 1992 Rio Declaration on Environment and Development, which are being realized in Asian cities.

2008, governments increasingly require that the dealings of financial institutions, in particular those engaged in worldwide trading of equities, bonds, and their derivatives; and credit default swaps are transparent. They could also be subject to a very small transboundary fee (0.05%) on transactions of financial institutions. The banks and other financial institutions that caused the Great Recession of 2008 have also continued to reap profits during the recovery and have yet to articulate CSR plans that contribute to sustainability. They could so do without impairing their financial well-being. Worldwide, urban centers of finance need to establish a global economic financial transactions fee. Such a fee has variously been called a 'Financial Transfer Tax' or 'Tobin Tax' or 'Robin Hood Tax'. Globally, this fee on the financial sector's trading activities could produce income of $140bn per year to invest in urban sustainability. The Vatican Pontifical Council for Justice and Peace endorsed this proposal in 2011. Resistance by sovereign states to establishing any transnational financing system needs to be countered by the cooperation principle. Such a fee could establish the insurance systems that societies will depend upon for adaptive recoveries from the disruptions during the Anthropocene.

Fourth, comparative studies already identify ways to apply market reforms that foster resilience and thus sustainability. Such reform studies need to be acted upon. Many economies can 'mine' their wasteful practices to generate the funds to pay for urban adaptation to the environmental conditions of the Anthropocene. 'Business as usual' economic relations often are profligately wasteful and rely on improvident subsidies. The Chinese are promoting the concept of a 'circular economy', in which everything is reused and there would be no waste. This is akin to practices now used at a number of major companies. Waste is identified as a 'natural' resource to be mined, to extract value that in turn can finance urban environmental management programs for resilience and sustainability. Singapore is a leader in innovative eco-finance mechanisms, such as Electronic Road Pricing; and Singapore's experiences can usefully guide other cities and states, as was done when road pricing was used in the City of London. New York tried to do so also, but 'business as usual' forces opposed the road pricing, preventing its adoption. In Europe, the scholarly discussions of green markets and fiscal reform is being advanced through the organization 'GreenBudgetEurope' [GBE],[27] launched in 2008. Research should gather these diffuse initiatives and restate them as best practices in environmental management systems. In short, environmental laws and management practices can adapt markets by aligning the human economy with the economy of nature, to promote resilience in both systems. Without that reciprocity, the 'business as usual' forces will continue to retard moves to sustainability.

Fifth, throughout all sectors, it is essential to further public debate and education about how societies can best adapt to the unpredictable conditions coming in the Anthropocene. *Cooperation* can be encouraged, and approaches to *resilience* can be taught. Instruction through *formal* education has barely begun, as in the establishment of academic programs such as those of the Ashridge Business School or the environmental studies and environmental management programs at many other universities. The Yale University School of Forestry & Environmental Studies was the progenitor of such academic programs. Too few exist worldwide. Despite the efforts of the 150 law schools collaborating through the IUCN Academy of Environmental Law, whose secretariat is at the University of Ottawa, environmental law is still not taught across many regions of the world. Such programs are educating knowledgeable graduates, capable of employment in the environmental management and related sectors. Equally important is their civic support of sustainability reforms across all sectors. *Informal* continuing education is equally important. This will happen through public participation in EIA where specific questions of sustainability are addressed as new projects are studied prior to their approval. Governments can provide public participation specialist to help the public engage. Through programs hosted by civil society organizations, through continuing education, via journalism and the media, and through social networking, the informal sector will find opportunities for cooperation and bolstering resilience.

CLOSING THOUGHTS

Anticipating life in the Anthropocene—our new era of geological time—entails more questions than answers. Is it too late to sustain the levels of socio-economic development presently enjoyed across the Earth? Will what humanity has learned about the strengths and weakness of 'sustainable development' better inform how society redefines its core policies in the Anthropocene? Are the questions posed in this paper apt or blinkered by an incomplete understanding of the options that this new epoch of life on Earth present to humanity? What searching inquiries should governments and civil society alike make when confronting such emerging challenges as sea-level rise, intensified floods and droughts, and outbreaks of contagious diseases?

Public discourse on these and other inquiries is overdue. What will it take to stimulate the evolved human traits of *cooperation and resilience* to leverage societies across the Earth to use and adapt environmental management systems to better cope with the

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[27]See www.foes.de

challenges of the Anthropocene Epoch? Comparing how environmental management systems operate locally, regionally, and transnationally yields knowledge to make each system more robust and effective. Engaging all sectors of society in these systems is essential to their success; environmental management cannot be left to the technocrats alone. Adaptation requires all people to cooperate and foster resilience across all human activities. These principles are holistic in their scope. Education about the Anthropocene needs to advance so that people see where their enlightened self-interest lies. All regions need to know their interdependence in Earth's biosphere. When humans understand their risks and opportunities, their evolved cooperative instincts predictably may prompt them to seek together resilient and sustainable pathways forward. Holistic awareness can inform sharing and mutually supportive coping, in place of piecemeal reactions or going it alone.

Sustainability is seamless and is analogous to well-being and indeed to life itself. It has been a mistake these past 30 years to disaggregate the concept, describing it as either 'environment or development' or being the separate 'environmental protection' pillar apart from social or economic pillars. Not unlike a negotiating strategy to 'divide and conquer', these flawed definitions have enabled 'business as usual' patterns to avoid embracing reforms essential for sustainability. As humans stumble into the Anthropocene, it is incumbent to acknowledge that sustainability depends on cooperation and resilience and not on nostrums about the economic advantages alone of 'sustainable development'. Environmental management systems offer tools that all societies can deploy. These systems reflect the vision, knowledge, and skills to promote sustainable well-being over time. By bringing environmental management systems from the periphery to the center of decision making, societies can move beyond instrumental environmental management into the holistic realm of environmental stewardship.

BIOGRAPHICAL NOTES

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