JULIE ANN WRIGLEY
GLOBAL INSTITUTE of SUSTAINABILITY
ARIZONA STATE UNIVERSITY

PUBLICATION:
Thought Leader Series

VOLUME:
ONE

THEME AREAS:

Leadership and Decision-Making .....

Ecosystem Services .....

Business and Economics .....

Energy, Technology and Security .....

Inclusion and Social Justice .....

Urbanization and Sustainable Development ...

Climate Change and Resilience .....

Art, Design and Communications .....

INTRODUCTION:

Sustainability is a field that transcends disciplines, spans sectors and finds application in addressing considerable challenges throughout the world.

As the hub of sustainability at Arizona State University, the Julie Ann Wrigley Global Institute of Sustainability serves not only as an incubator of scalable solutions, but as an aggregator of impactful knowledge.

With the latter in mind, we established the Thought Leader Series – inviting essay contributions from some of sustainability's most celebrated thinkers and problem-solvers – nearly five years ago.

The following collection reflects contributions to-date, and represents the many arenas in which sustainability is applied – from art to economics, agriculture to social justice. Each author offers expertise that prompts reflection, provokes the imagination and encourages action. Just as the Thought Leader Series continues, the ASU Wrigley Institute advances its mission to secure a better, more sustainable future.

Join us.

Gary Dirks
Director, ASU Wrigley Institute

Rob Melnick
Executive Director and COO,
ASU Wrigley Institute and School of Sustainability

Christopher Boone
Dean, School of Sustainability

THEME AREA:

Leadership and Decision-Making

AUTHOR:
Grady Gammage, Jr.

ABOUT THE AUTHOR:

Grady Gammage, Jr. is a senior sustainability scholar in the Julie Ann Wrigley Global Institute of Sustainability, a senior research fellow in the Morrison Institute for Public Policy (College of Public Service & Community Solutions), and a practicing lawyer with Gammage & Burnham in Phoenix. An expert on land use and urban development, he has taught numerous classes at ASU in areas such as land use regulation, historic preservation, urban policy, and sustainability. Gammage is a past president of the board of directors of the Central Arizona Project, which oversees a key component of the state's water supply, and he was principal author of the 2011 Morrison Institute report, "Watering the Sun Corridor: Managing Choices in Arizona's Megapolitan Area."

AUTHOR:
Grady Gammage, Jr.

DATE:
November 3, 2011

TITLE:
Rating Phoenix Sustainability: What Matters Most?

THEME AREA:
Leadership and Decision-Making

In early October, Andrew Ross issued the latest indictment of Phoenix: *Bird on Fire: Lessons from the World's Least Sustainable City*. Ross's book represents the latest, longest, and most articulate examination of Arizona's capital – the nation's sixth largest city – as a kind of colossal demographic mistake. But he's not the first to go down this path.

In a 2006 radio interview, author Simon Winchester said that Phoenix "should never have been built" because "there's no water there." In 2008, Sustainlane.com rated Phoenix among the least sustainable cities in the U.S. for water supply, primarily because of the distance water must travel to reach the city. In 2010, the Natural Resources Defense Council (NRDC) found that Maricopa County, home to the Phoenix Metro area, was among the "most challenged" places in the U.S. for climate change – this conclusion based on the difference between rainfall and water use within the county. And in 2011, the Stockholm Environment Institute (SEI) found current patterns of Arizona water use to be "unsustainable," due to the large amount of water going to agriculture.

These views highlight the huge problems inherent in measuring urban sustainability. In large part, Phoenix seems to be everyone's favorite whipping boy essentially because it's hot in Arizona and doesn't rain very much. This view is too simplistic.

Cities, by their very definition, are concentrations of people supported by the resource base of a larger geographic area. Water is a resource like most others – transportable and subject to supply and demand pressures. That is apparently lost on Sustainlane.com, which found reliance on groundwater mining to be more sustainable than transported, renewable surface water because it is "closer." Never mind that groundwater is an exhaustible resource.

NRDC's rainfall deficit for Maricopa County similarly misses the point. Local precipitation has been insufficient for civilization in Central Arizona for more than a thousand years, but this is neither a revelation nor meaningful for the current situation. SEI's criticism boils down to "too much water being used to grow crops," based on their assumption that farming will continue at current levels as urbanization advances. That scenario hasn't been true for decades.

One feature of Ross's book is a repeated reference to the egregious carbon footprint of central Arizona's urban dwellers. Nowhere does he actually attempt to quantify that footprint, or actually compare it. The Center for Climate Strategies has done so: Arizona emits about 14 metric tons of carbon dioxide per person per year – 35% below the U.S. average of 22 tons. Why? It takes less energy to cool than to heat, and the state doesn't have a lot of heavy industry.

Yet Phoenix is just too attractive a

target. Surely it is running out of water? Hence it is unsustainable. Arizona State University's Morrison Institute for Public Policy, however, recently examined that issue in its report, *Watering the Sun Corridor*. The conclusion: Phoenix has some tough choices ahead, but the water supply of the Sun Corridor (a megalopolis including Phoenix and Tucson) has been managed to deal with change and uncertainty, and is remarkably resilient.

Phoenix should not be deemed unsustainable simply because it grew in a desert. Sustainability is not so simple as measuring rainfall or the distance from a watershed. It requires understanding complex systems, sorting through multiple choices, and managing through adversity.

This is not to say that cities are destined to just keep growing. They can shrink, too. Once proud and flourishing urban centers, such as Babylon and even Venice, have reached points of economic obsolescence and declined, often precipitously. Detroit, once the fourth-largest city in the U.S., is now half its previous size. And St. Louis, once the greatest boomtown in America, is now home to nearly 100,000 fewer residents than the Phoenix suburb of Mesa.

Ross's most trenchant criticism is when he looks at Phoenix's politics, and in particular its emblematic libertarian bent. This is an astute point. You cannot exist in a hot, arid, challenging environment as a rugged individualist. The significant challenges of sustainability are only met through collective action. The lesson of Central Arizona's water supply is that it has been examined and dealt with time and again through political decisions and institutions.

It is understandable that Phoenix strikes people as a fragile place. But at the end of the day, the verdict on urban sustainability is not about geography, but about politics. Before we brand Phoenix as "the world's least sustainable city," we need to figure out how to rate political foresight and willpower. The real measure of sustainability is in how a place responds to challenges.

AUTHOR:
Greg Stanton

ABOUT THE AUTHOR:

Greg Stanton is the mayor of Phoenix, Arizona, the capital and largest city in the state. A native of the city, he has dedicated most of his life to public service, serving as a member on the Phoenix city council from 2000 to 2009 and working as deputy attorney general for Arizona from 2009 to 2010. Stanton has also been active in many community organizations, including Big Brothers/Big Sisters of Central Arizona, the Arizona School Readiness Board, Arizona Theater Company, and the Flinn Foundation Arizona Bioscience Steering Committee. A graduate of University of Michigan law school, he spent five years in private practice as an education attorney.

AUTHOR:
Greg Stanton

DATE:
July 31, 2012

TITLE:
Living Like the Future Matters: Inspiring Urban Sustainability

THEME AREA:
Leadership and Decision-Making

Note: *ASU and Phoenix have collaborated on numerous big projects through the years, including development of the ASU campus in the heart of downtown. More recently, ASU's Julie Ann Wrigley Global Institute of Sustainability and Phoenix teamed up to win a $25 million federal grant from the U.S. Department of Energy to launch Energize Phoenix, a sustainable energy efficiency program that creates green jobs and reduces carbon emissions while transforming energy use in diverse neighborhoods along a 10-mile stretch of the Metro light rail.*

Sustainability is what turns big cities into great cities. It's a transformation that starts with good leadership and collaboration, then takes off with visionary thinking and long-term planning. Great cities thrive when sustainability permeates decisions, strategies, and operations.

Phoenix has long benefited from visionary leaders with long-term outlooks. These leaders provided the ideas and groundwork that made it possible to create a major city in a vast desert. They secured a multidimensional water supply that is one of the most reliable in the country. They established strong economic foundations for us in information technology, biotechnology, and other high-value industries that are at the core of a sustainable economy. And they set aside vast natural wonders as preserves for future generations.

Thus, Phoenix has paved the way and has become the sixth most populous city in the nation with 1.4 million people across almost 520square miles. More than that, Phoenix is the beating heart of a vibrant metropolitan region that encompasses more than 4 million people. It is also the capital of a huge and diverse state that is home to 6 million residents.

Thinking long-term

But we can't stop now. We must continue long-term thinking and planning or we will not thrive in the future. With sustainability infusing everything we do, we are better able to craft the prosperous shared future we all desire.

What are some of the sustainability challenges Phoenix faces today? We possess a huge built environment that underperforms in energy efficiency. Our economy needs more diversification involving sustainable businesses. We must expand access to solar and other clean energy supplies. We need to better unify our socially fragmented urban metro region. And we have to bolster our knowledge about how to protect our landscape and resources.

These challenges are much the same for many other growing cities around the world, particularly those in arid environments. That is why we in Phoenix are working to address these issues and provide workable models for others to adapt and build on. Here are a few examples.

Cleaning up energy

Phoenix is partnering with Arizona State University's Julie Ann Wrigley Global Institute of Sustainability and electricity provider Arizona Public Service, Co. on a landmark project — called Energize Phoenix — to

significantly improve energy efficiency on an urban scale. Focusing on a 10-square-mile area along our light rail corridor, we are applying incentives, loans, and expertise to upgrade approximately 1,700 homes and 30 million square feet of office and industrial space.

We believe this replicable project can shrink home energy consumption by 30 percent, reduce commercial energy use by 18 percent, and eliminate carbon emissions by as much as 50,000 metric tons per year. At the same time, this project is expected to create approximately 1,000 new direct and indirect jobs, including many green jobs such as energy auditors and efficient-equipment installers.

To boost our clean, local energy supplies and create additional jobs in sustainable industries, we have partnered with National Bank of Arizona to launch Solar Phoenix 2. This is the nation's largest city-sponsored residential solar financing program.

The project enables many Phoenix homeowners — including those with low and moderate incomes — to install electricity-producing solar panels without the obstacle of upfront costs. Success here will build on our goals to develop 15 percent of the city's energy from renewable sources and double the amount of solar power installed on city buildings by the end of 2012.

Strengthening community

We are working to strengthen the fabric of our community. As part of that effort, my sustainability policy adviser is identifying vacant parcels of land that can be redeveloped as community gathering points. These will be transformed into community gardens, art engagement areas, education centers, and entrepreneurial seedbeds that will bring together neighbors and businesses to build social cohesion and a more resilient economic fabric.

This fall, for example, we will renovate a 15-acre parcel of high profile, vacant land into a demonstration area focusing on sustainability — the nation's single largest sustainability-oriented engagement, education, and development space. One idea for the parcel is to invite international refugees to cultivate crops, sell their produce at a farmers market, and share their culture with the surrounding community.

In addition, our city planners have been working closely with ASU faculty and graduate students to engage citizens across the city in understanding and addressing sustainability issues. The sustainability policies that have emerged from this community outreach and education effort are now being incorporated into the city's new draft general plan.

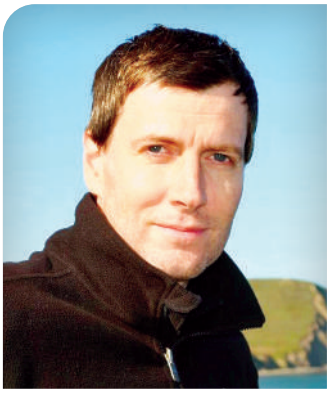
Inspiring sustainability

We are actively engaged in the leadership of the Sustainable Cities Network, an initiative established by the ASU Wrigley Institute, to coordinate sustainability efforts regionally and around the state. This network of more than 40 city, county, and tribal leaders provides a venue for sharing knowledge and best practices about sustainability and allows us to access university knowledge and research that helps us meet frontline sustainability challenges.

Among the sustainability practices we've shared through the Sustainable Cities Network is our Shade Phoenix 2030 plan to expand our city's urban forest. This working model will improve neighborhood livability in the hot seasons and help reduce energy use for cooling.

While we expect great things from these and our other pioneering sustainability initiatives, we must continue to develop and test many more while continuing to coordinate with our neighbors. Unless we get sustainability right in our own backyards, we won't be able to thrive and compete in the world around us.

And that is the central challenge for Phoenix and all cities. We must rise to the occasion, inspire sustainability at an urban scale, and help each other succeed. We must, in other words, begin living like the future matters.



AUTHOR:
Chris Spence

ABOUT THE AUTHOR:

Chris Spence is the director of the Institute at the Golden Gate, a program of the Golden Gate National Parks Conservancy in partnership with the National Park Service that advances environmental stewardship and well-being through parks and public lands.

A native of England, Spence brings more than 20 years of experience working internationally and in the United States on sustainable development, including conservation, climate change, health policy, and protected areas. Prior to joining the Institute at the Golden Gate in 2012, he served in senior management roles for nonprofits in New York, Europe, and New Zealand. He has also consulted for the United Nations and IUCN, the World Conservation Union. Spence is an award-winning writer who has been widely published and has been a guest speaker at many international events.

AUTHOR:
Chris Spence

DATE:
July 24, 2013

TITLE:
Climate Action: Who Will Lead?

THEME AREA:
Leadership and Decision-Making

Do you ever feel like the news on climate change is stuck on repeat? Day after day and year after year, we seem to hear the same dire predictions from climate scientists and activists, the same calls to "act now before it's too late!"

I first started working on climate policy in 1993, which coincidentally is the year the movie "Groundhog Day" first screened. It's about a selfish television weatherman doomed to repeat the same day time and again until he finally learns to change his ways.

Over the past 20 years, I've sometimes felt like I'm stuck in "Groundhog Day." While the science is stronger than ever, working on climate policy can feel like being trapped in a time warp of inaction and paralysis. We all know the problem is real and growing, but serious action on a large scale sometimes seems beyond our grasp.

Who can lead us out of this?

Back in the 1990s, I thought it might be our political leaders. The United Nations (UN) was leading the way through the newly minted Framework Convention on Climate Change and Kyoto Protocol. Having attended more than my share of UN climate negotiations, I can vividly recall the palpable sense of excitement among the thousands of diplomats and other participants who attended some of the early meetings. Freshly inked, the UN agreements had the vocal support of high profile leaders like Al Gore and Tony Blair. What could possibly go wrong?

Fast forward a few years and the mood had shifted. By the early 2000s, the UN process felt like it was losing its way. For several years, I led teams of experts who attended these meetings on behalf of the International Institute for Sustainable Development (IISD). IISD has a marvelous publication—the "Earth Negotiations Bulletin"—which it publishes from UN events. The "Bulletin" provides detailed news and analysis each day on the state of play, including countries' negotiating positions and strategies. It's a non-partisan service providing much-needed transparency—and hopefully some accountability—on why meetings either succeed or fail.

As the years went by, the number of failures began to outweigh the successes. I recall a particularly dismal conference where I went looking to interview one of the prominent European politicians to get their perspective. By chance, I passed two of these VIPs in less than five minutes. First, Britain's Deputy Prime Minister trudged by, head bowed and alone, not an adviser in sight. Moments later, I spied a prominent European environment minister sitting in his office at the conference center, head in his hands. Both looked so downcast, I didn't have the

heart to speak with them.

The power of small, local change

Clearly, the UN process is still struggling. However, I still believe that all countries can work together and I would never give up hope that the UN can lead again. But for now, it's clear we cannot depend on a top-down approach. The same goes for our national leaders; around the globe, there are strong forces aligned against political action. Policy victories from our world's capitals are few and far between.

In spite of the vacuum in global and national leadership, we can take heart from the multitude of local and regional initiatives that have blossomed in recent years. Regional and local governments, individual cities and states, as well as neighborhoods, communities, and schools, are all leading bottom-up movements for change. There are also many nonprofit organizations, think tanks, companies, and entrepreneurs who are genuinely and seriously engaged. We can feel inspired by such energy, and should be finding ways to support and scale up such activities.

Parks pointing the way

An example from my own field illustrates the point. Last year, I joined the Institute at the Golden Gate, a California-based nonprofit committed to making parks and protected areas part of the solution to broader societal challenges. One of our programs is focused on using parks to engage the public on climate change. In our latest report published in May, we identified examples of innovative, effective, and powerful educational programs in 13 parks around the world. During the course of our research, we identified many more parks where the public were being informed about climate change in a compelling, empowering way.

Parks are on the frontline of climate change. Park rangers and other staff members are a trusted and respected source of information. What better place could there be for the public to be informed and inspired on this critical issue? While some visitors are already learning from our parks, an even larger number could benefit. With 283 million visitors to U.S. national parks alone, we believe there's an opportunity to scale up and increase the impact.

If we can learn to champion and replicate local success stories, I believe we can turn that "Groundhog Day" feeling of paralysis and inaction into a thing of the past. We can amend the climate change narrative for good.

AUTHOR:
Patricia Reiter

ABOUT THE AUTHOR:

As the executive director of the Rob and Melani Walton Sustainability Solutions Initiatives, Patricia Reiter is responsible for overseeing the success and impact of eight programs that use evidence-based knowledge to deliver solutions to today's complex sustainability issues.

Before leading the Walton Initiatives, Reiter was the development director of ASU's Julie Ann Wrigley Global Institute of Sustainability. Throughout her career, she has applied business methods to maximize impact of both for-profit and cause-driven enterprises. Her work led her to ASU, where she first joined the ASU Foundation as chief of staff to the ASU Foundation president. Currently, Reiter's interests lie in impact investing, social enterprise models, and performance measurement such as GIOS® 3.0.

AUTHOR:
Patricia Reiter

DATE:
June 25, 2013

TITLE:
Diagnosing the Impact of Sustainable Solutions

THEME AREA:
Leadership and Decision-Making

On occasion, Arizona State University (ASU) President Michael M. Crow draws similarities between the fields of medicine and sustainability. ASU Distinguished Sustainability Scientist and United Nations Champion of the Earth Sander van der Leeuw developed the idea further in a diagram (see next page) that describes the domain of medicine as the health of the individual in relationship to their environment and the domain of sustainability as the health of societies interacting with their environment. This analogy between medicine and sustainability is useful in explaining the intent of the Julie Ann Wrigley Global Institute of Sustainability's Walton Sustainability Solutions Initiatives.

Due to the generosity of Rob and Melani Walton, the ASU Wrigley Institute received a five-year investment from the Walton Family Foundation for eight unique programs to help solve sustainability challenges across the globe. These challenges span environmental, economic, and social sectors that affect us all. The Walton Sustainability Solutions Initiatives are focused on delivering practical, holistic solutions in the same way a general practitioner in a teaching hospital works with real patients to not only heal individuals, but also to test, refine, document, and promote best practices. This in turn offers critical real-world learning opportunities for the next generation of practitioners. Like a teaching hospital, we are focused on improving the public good through direct engagement with the underserved, providing educational outreach, and promoting proven interventions.

Our work has both short- and long-term impact, as we begin to apply systems thinking to complex challenges facing individuals, businesses, and institutions. Our clients and partners often describe their issues as a set of simple symptoms, but when we probe for external and internal causes, we expand their understanding of risks, opportunities, and trade-offs.

Symptoms turn into solutions

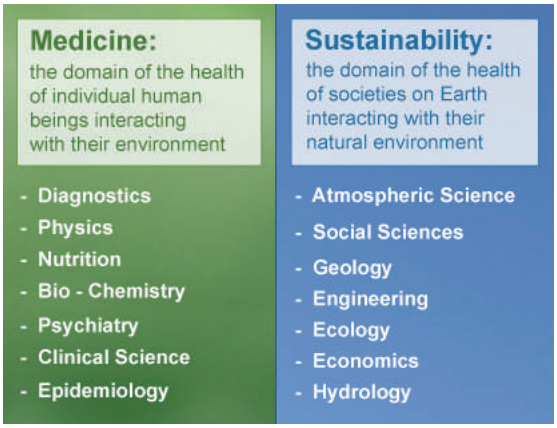
For example, the Sustainability Solutions Extension Service is providing advice to the City of Phoenix on how to best achieve its goal of diverting 40 percent of waste from the City's landfills by 2020. The City's current rate is 13 percent. The Solutions Service's initial analysis indicated that City employees drive over 7 million miles a year picking up and delivering waste to landfills. This represents a great cost in fuel and high carbon emissions. By identifying potential savings and mapping opportunities, we are building an economic case for a regional resource recovery center that will further streamline waste and recycling efforts while reducing greenhouse gas emissions.

Both the Solutions Service and the Center for Integrated Solutions to Climate Challenges are working with the City of Phoenix to update the City's greenhouse gas emissions inventory—the first step leading to a vulnerability assessment and climate action plan. Like a routine doctor checkup, this inventory will allow policymakers and citizens to make informed decisions regarding everyday operations, long-term investments, and personal responsibility.

To better integrate research and practice, the Walton Initiatives' eight programs are designed to leverage the time and talent of faculty specialists while adding to the body of knowledge of sustainability practices. The Solutions Service and the Global Sustainability Solutions Centers are organized to engage faculty in short, focused consultations. The Walton Initiatives team handles the majority of business development, administration, and management. Graduate students with special interests and expertise in project-related topics assist in the implementation and documentation of each engagement. This arrangement is intended to be mutually beneficial to all involved. Clients, public partners, and non-governmental organizations gain access to the broad scope of knowledge from our scientists and scholars; the graduate students gain practical experience to better understand the application of their curriculum; and faculty can continue or expand their line of inquiry, refine their problem sets, or publish results of various activities.

Synergy impacts results

Just like doctors from different medical fields trying to decode a disease, the Walton Sustainability Solutions Initiatives team is a collaborative service and research platform comprised of eight complementary programs that are more than the sum of their parts. For instance, a Walton Fellow, ASU School of Sustainability faculty and students, Walton Initiatives team members, and Walton Family Foundation evaluators organized an Evaluating Impact Workshop to map out sustainability indicators to long-term outcomes for each of the eight programs. The group expanded on the question: "How can we provide evidence that our efforts are leading the transition to a more sustainable future?" We expect several publications to result from this work with the Walton Initiatives.



Another example of collaboration and synergy among faculty and practitioners is the Next-Generation Sustainability Projects that provide seed funding to scientists and scholars working on solutions to "wicked problems"—problems that are complex and resistant to easy solutions. In the first year, we have awarded funds to create a co-Lab that will address issues of sustainable development through collaboration between a developed and an under developed community. This project crosses international borders, disciplines, and institutions.

In addition to direct work on sustainability projects, the Walton Initiatives' outreach aims to educate future leaders at

various levels much like a teaching hospital in underserved communities. We offer study abroad opportunities to ASU School of Sustainability majors and minors through the Global Sustainability Studies Program to provide cross-cultural experiences that expand the global context of their studies. We are creating an Executive Master's for Sustainability Leadership degree for mid-career professionals who may have migrated into sustainability roles from other fields and are in positions to lead their businesses or institutions forward, but may lack the leadership skills to build a business case for change. We are also reaching K-12 students and the broader public through our Sustainability Solutions Festival efforts. Beyond an annual week-long celebration of sustainability solutions, the festival supports key partners through sponsorships that build awareness of the breadth of issues included under the umbrella of sustainability as well as the urgency of finding viable solutions.

Future investing

The analogy of the teaching hospital is useful in another way. Income for the Walton Initiatives depends on a mix of sources. We must identify and tap into additional resources now to continue our work in the future. We have begun and will continue to generate revenue for several of the initiatives. However, by year six, we will no doubt need to develop a mix of earned revenue, philanthropy, and grants to meet our mandate from the Walton Family Foundation to become financially self-sustaining by 2017. In effect, we are building a social enterprise within a university setting. In the meantime, true to the methods of most sophisticated impact investors, we also expect to report progress against specific metrics and ambitious long-term outcomes.

We have a stellar team leading this effort and we are confident that we are advancing the mission of the ASU Wrigley Institute's next phase, GIOS® 3.0, which is to provide evidence of our leadership and accelerate the impact of our solutions.

THEME AREA:

Ecosystem Services

AUTHOR:
Quentin Wheeler

ABOUT THE AUTHOR:

Quentin Wheeler is the current president of the State University of New York College of Environmental Science and Forestry. A former sustainability scientist in the Julie Ann Wrigley Global Institute of Sustainability, Wheeler was also a Virginia M. Ullman Professor of Natural History and the Environment in the School of Life Sciences and School of Sustainability, and founding director of the International Institute for Species Exploration at ASU. From 2007-2011 he was dean of the College of Liberal Arts and Sciences and university vice president. Before joining ASU in 2006, he was a professor of taxonomy at Cornell University, director of the division of environmental biology at the National Science Foundation, and keeper and head of entomology at London's Natural History Museum. He has named more than 100 new species, and has published and lectured extensively on the role of taxonomy in biodiversity exploration and conservation.

AUTHOR:
Quentin Wheeler

DATE:
January 31, 2012

TITLE:
Sustain What? Exploring Species for a Sustainable Future

THEME AREA:
Ecosystem Services

Several centuries of species exploration have taught us that a vast number of Earth's plants and animals are extremely limited in their ecological associations and geographic distributions. When these species lose their specific habitats, it usually means extinction. Yet, because we don't know what or how many species actually exist or where they live, we are unable to detect or measure these quiet changes in biodiversity.

Each unknown loss, however, compromises our ability to understand the origin and history of life on our planet. More importantly, these losses seriously impede our ability to adapt to a rapidly changing environment on Earth.

Since Carl Linnaeus inaugurated the modern age of taxonomy in 1758, nearly two million kinds of plants, animals, and microbes have been discovered, described, named, and classified. This sounds like a lot, but an estimated 10 million species of "higher" organisms remain unknown to science, and the number of unknown microbial species could be even greater. Beyond that, to paraphrase former U.S. Defense Secretary Donald Rumsfeld, we don't yet know what we don't know about the living world around us.

Given all this, the hubris of writing laws and regulations to protect endangered species is laughable. How can we adapt agriculture to climate change or understand complex ecosystems while remaining ignorant of 90 percent of their functional parts? We have lived with this near-complete ignorance of species for so long that we fail to recognize that it need not be so.

What we need to do is invest in a mission to learn all species. We have this capability within our reach. Rather than settling for imprecise estimates of species diversity and untested ecosystem models, we must undertake a comprehensive inventory of every species on Earth. The benefits of completing such a taxonomic inventory would be immediate, profound, and enduring.

First, it would create baseline knowledge of the biosphere against which we could detect, monitor, and potentially respond to increases or decreases in biodiversity. The U.S. currently spends more than $130 billion per year mitigating the impacts of about 6,000 non-native species, but invests only a few million dollars in species exploration. With a more balanced approach, ecology could be empowered to explore the detailed interactions of organisms and detect invasive species before they become established, destructive, and costly.

Second, we would bequeath a legacy of biodiversity knowledge to future generations. Because there is little hope of manned space flights ever reaching a planet with more than a few microbes, our only hope for understanding organic evolution in depth is to gather,

analyze, and preserve evidence of this history on Earth while we can. We will get no second chances.

Third, understanding biodiversity provides our best hope for finding ideas and inspiration to cope with environmental change. Natural selection has worked ceaselessly for 3.8 billion years to adapt species in sustainable ways to the challenges that humans face now. We need to open this vast library of sustainability options by exploring all the ways each species is unique. This effort would reveal the billions of ways in which other species successfully met climate and other challenges. The result could be the basis for a new kind of adaptive entrepreneurship based on time-proven strategies.

Now is the time. Advanced cyberinfrastructure has the potential to overcome every constraint that has held back rapid taxonomic advances in the past. No insurmountable scientific or technological barriers prevent a world species inventory, only political barriers. The enormous scale of the challenge will be dwarfed by the potential benefits to science and society.

Perhaps the greatest challenge will be to transform society's outdated perception of taxonomy. ASU's International Institute for Species Exploration is working to do that. The Institute is facilitating an international effort to accelerate species discovery, inspire the next generation of species explorers, create innovative tools that remove impediments to the growth of knowledge, and increase public awareness of the importance of natural history museums and the science of taxonomy.

AUTHOR:
Tim Beatley

ABOUT THE AUTHOR:

Tim Beatley is a Teresa Heinz Professor of Sustainable Communities and chair in the University of Virginia's Department of Urban and Environmental Planning. Beatley is a foremost expert on biophilic cities and low-impact planning and design. The American Planning Association named one of Beatley's books, "Ethical Land Use," one of the 100 Essential Books in Planning. His *PBS* documentary, "The Nature of Cities," showcases real-life examples of biophilic design. Beatley believes that sustainable and resilient cities represent our best hope for addressing today's environmental challenges.

AUTHOR:
Tim Beatley

DATE:
October 29, 2013

TITLE:
Getting Back to Nature: How Biophilic Cities Can Restore Biodiversity and Enhance Lives

THEME AREA:
Ecosystem Services

Note: *Tim Beatley's 2013 Biophilic Cities Launch exhibit featured student photography and videos from Senior Sustainability Scientist David Pijawka's Sustainable Cities course. The work explored local examples of biophilia in neighborhoods, public parks, and vacant lots.*

When I describe myself as a "biophilic urbanist" as I sometimes do, reactions vary from quizzical looks to knowing smiles. But almost always my title serves to open a conversation about the quality of contemporary life and the important role of nature in our lives.

The concept of biophilia was popularized by Harvard biologist and entomologist E.O. Wilson. To Wilson, biophilia is "the innately emotional affiliation of human beings to other living organisms. Innate means hereditary and hence part of ultimate human nature." We are carrying with us, so the argument goes, our ancient brains, and so no wonder that we are happier, more relaxed and productive in the presence of nature. Living a happy, meaningful life is certainly possible in the absence of nature, but much harder, as we increasingly understand that nature is not optional but essential.

Biophilic design has been well-articulated and convincingly adopted by architects, but relatively less attention has been given to understanding the implications of biophilia for the design and planning of urban neighborhoods, cities, and metropolitan regions, otherwise known as biophilic cities.

The Biophilic Cities project

In 2012 we began in earnest our Biophilic Cities Project, based in the University of Virginia's School of Architecture with significant funding from the Summit Foundation and the George Mitchell Foundation. The project aims to better understand what biophilic cities are; what metrics we might use in defining and monitoring them; and what the current best practice is in supporting and expanding nature in U.S. cities and the world.

Much of this work has happened through our partner cities—cities where we have either developed formal agreements with city government to collaborate or where there are university researchers with whom we are working. Study cities include Singapore; San Francisco, CA; Milwaukee, WI; Vitoria-Gasteiz, Spain; Portland, OR; and Wellington, New Zealand, among others. We have sought to collect basic data and geographical layers about the extent of nature in those cities, and to document the innovative policies, projects, and planning tools utilized, as well as the challenges faced and lessons learned in advancing an agenda of biophilic urbanism.

Each city is different

Each of our study cities is different with different constraints and physical,

ecological, social, cultural, and political settings, as well as different histories and patterns of urbanization with which to contend.

Singapore is impressively pushing vertical greening and showing how high-density, high-rise living can accommodate nature through a variety of tools, from an innovative parks connector network to the use of a mix of subsidies, mandates, and research and development, to ensure that new buildings include nature.

San Francisco is inventing new kinds of small parks ("parklets," created from on-street car parking spaces), while Milwaukee shows the power of neighborhood-based nature centers.

Study cities as diverse as Oslo, Vitoria-Gasteiz, Singapore, and Milwaukee understand the power of daylighting and restoring rivers, streams, and shorelines, and finding ways to connect urban residents to them. Vitoria-Gasteiz and Wellington have a long tradition of successfully developing and expanding greenbelts.

Challenges to biophilic urbanism

How to foster a culture of curiosity about the nature that exists in a city and how to tangibly connect and engage residents remain serious concerns.

The city is home to many of what Wilson has sometimes described as "micro-wildernesses," yet without some help from say, a portable microscope, it may be hard to discover these things. The innovative School of Ants engages school kids in collecting and identifying ants and produced an urban guide to ants.

And it is not just the presence or absence of nature that defines a biophilic city; it is the ways and extent to which residents are directly engaged in nature and are knowledgeable and care about the nature around them. And here, there is much innovation, from citizen science to school-based education, to programs that create opportunities for urbanites to participate in activities such as camping in city parks during the summer months.

The next chapter

While we are already impressed with the variety of efforts in cities around the world, there remain a number of important questions: How much and what kind of nature is needed in cities? What combination of these natural experiences will deliver the greater health and psychological benefits? What is the minimum daily requirement of nature? What urban tools, techniques, and strategies will be most effective at ensuring nature exists in our urban future? Can cities be understood as engines for the conservation of biodiversity, and urban development designed in ways that positively restore and add to global biodiversity?

On October 17 – 20, 2013 we convened our Biophilic Cities Launch event, bringing together representatives from our partner cities to discuss and imagine future initiatives and work, and to form a peer network of biophilic cities—indeed a new model or paradigm of global urbanism that puts nature at the core.

There is more nature in cities than we tend to understand or recognize. From the microorganisms wafting on clouds, to the millions of migratory birds passing through the city, to the diversity of invertebrate life, the biodiversity in our urban midst is immense. Increasingly, we recognize, especially in the face of climate change, that cities can represent essential refugia, places where threatened biodiversity can be nurtured and fostered. A biophilic city is a place that restores.

AUTHOR:
Rick Heffernon

ABOUT THE AUTHOR:

Rick Heffernon retired from ASU where he was a senior writer/editor at the Julie Ann Wrigley Global Institute of Sustainability and lead author of the Morrison Institute for Public Policy's groundbreaking report, "Sustainability for Arizona." For more than 15 years, he has served as a trail steward for the Arizona Trail, a newly finished 800-mile National Scenic Trail from the Mexico border to Utah. He also volunteers as a trail crew leader for the Pine-Strawberry, Ariz. trail-building efforts to develop healthier forests in the region, and he is collaborating on a master trail plan designed to reduce catastrophic wildfires and create a sustainable outdoor recreation destination. In his spare time, he's hiking the entire Arizona Trail.

AUTHOR:
Rick Heffernon

DATE:
July 20, 2014

TITLE:
Trail Magic: Why Trails Are Good for You, Your Economy, and Things that Matter

THEME AREA:
Ecosystem Services

Note: *July is Park and Recreation Month, created in 1985 to celebrate and encourage parks, recreation, and conservation efforts that enhance quality of life for all people. In this essay, Rick Heffernon discusses the quality-of-life benefits of trails like the Arizona Trail, for which he has served as a trail steward for more than 15 years.*

People need trails. Seriously.

Work, home, kids, plans, commitments, life – they're all stressful. Even happy events, like vacations, promotions, marriage, graduation, and success can provide a potent lump of stress. Trails, however, offer a cure.

Healthy Benefits of Trails

Take a quiet energizing walk down a rambling trail lined by majestic trees and nodding flowers and you immediately feel a therapeutic break from the everyday. Trail walks soothe our bodies from head to toe, both physically and mentally. They can pull us back from the brink and reinvigorate our spirits. Plus, trails make us smarter. Stuck on a difficult problem? Just take a long walk and you'll likely find a solution.

Trails also provide a litany of other happy benefits. Among these are improved fitness, access to clean air, reduced traffic congestion, preservation of open space, protection of natural resources, and the simple joy of self-propulsion.

Want better health? In the 4th century, BC physician Hippocrates advised, "Walking is mankind's best medicine." More recently, he has been backed up by dozens of peer reviewed research papers. Two examples: A 2011 study published in *The Journal of the American Medical Association* found that people who walk faster live longer. Another, published in 2005 in *Health Promotion Practice*, calculated that every $1 investment in trails led to almost $3 in direct medical cost-savings.

Trails particularly benefit children. Exercising in a natural environment has been shown to stimulate creativity, problem solving, and self-discipline among students. Studies have also shown that children with Attention-Deficit/Hyperactivity Disorder (ADHD) improve their focus and behavior when they walk or play in natural "green" settings. More broadly, outdoor activities set in nature can help prevent the so-called "Nature-Deficit Disorder." This term, coined by "Last Child in the Woods" author Richard Louv, refers to the noticeably negative effects children suffer when they are alienated from nature.

Economics of Trail Building

From a financial viewpoint, trails provide high return on investment. Numerous studies have concluded that property values typically rise when trails are installed and accessible nearby. In one case, researchers found that homes closer to a new scenic trail were worth an astounding $9,000 more than similar homes only a thousand feet farther away.

Meanwhile, surveyed homebuyers in new

developments overwhelmingly choose trails as their most desired community amenity. This is good for everyone, because natural surface trails are the least expensive to install and maintain among a host of typical amenities such as pool facilities, sports parks, and golf courses. Better yet, natural trail surfaces are easier on the planet.

What I find particularly interesting is the way numerous towns and cities across the U.S., Canada, and Europe have been quietly building well-connected, tourist-friendly trail systems to jump-start sagging economies. In the U.S, these efforts range from East Burke, Vt. to Bend, Ore. But the one that surprises me most is the very small western Colorado town of Fruita. Reports show it bringing in at least $25 million per year from mountain biking revenue.

Back in my neck of the woods — the central highlands of Arizona — $25 million is serious money for local rural budgets. That's why we've been working to emulate Fruita's path, but with a regional twist. Our primary issue isn't maintaining municipal buildings or swimming pools. It is creating healthy forests and reducing fuel loads. So revenue from our hoped-for trail tourism will go primarily to protecting unincorporated towns from catastrophic wildfire. It's about survival.

Urban Girls Wield a Pick

Trails, though, aren't just about health and economics. As a trail crew leader myself, I've been lucky to witness many unusual epiphanies during trail building and maintenance. The most memorable involved a group of 25 inner city pre-teen girls from the Phoenix area, bused to the Arizona high country to beat the summer heat. For unknown reasons, they wanted to learn how to build trails.

The girls showed up wearing cute lavender t-shirts and jeans, and in some cases, sparkling tiaras and tutus not commonly seen on trail work events. But the girls brimmed with spirit, so we quickly broke into small crews and demonstrated the primary tools used in manual trail building — McCleod, loppers, pick mattock, shovel, bucket. Then they tentatively picked up their tools and went to work.

It was awkward going at first. Most of the girls, we learned, lived in small apartments with nary a backyard, garden, or set of work tools. I advised my group, "You don't have to swing a pick very hard; just keep on chipping away at what you're doing, and by the end of the day you'll suddenly see a trail appear."

They looked at me, disbelieving. I wasn't so sure myself. Nevertheless, after a little bit of fooling around and tossing of dirt, the girls gradually got the feel of their tools. Then they began to sense the special satisfaction of swinging a sharp pick into mountain soil. Pretty soon, they didn't want to quit. Even their mothers joined in.

We finally called it a day. Dirty and tired, we walked as a group back to the trailhead, where the girls gave us a few well-rehearsed cheers of thanks. Then we pondered what had just happened. An event we'd expected to be mildly interesting for the girls, but a waste of time in terms of trail building, had totally exceeded all expectations. Not only had the girls conquered a challenge they'd remember the rest of their lives, but a brand new stretch of trail had, indeed, suddenly appeared.

This was clearly a case of "trail magic," as the sage long distance hikers and bikers would say. That's their term for an unexpected trail gift that lifts the spirit and inspires awe. Even if all the health and economic benefits of trails were suddenly to vanish, trail magic would remain — following us home in the tread of our boots. For me, that might be the most powerful reason why trails really matter.

AUTHOR:
M. Sanjayan

ABOUT THE AUTHOR:

M. Sanjayan is a leading ecologist, speaker, writer and Emmy-nominated news contributor focused on the role of conservation in improving human well-being, wildlife and the environment. He serves on Conservation International's senior leadership team as executive vice president and senior scientist, and is the host of the 2015 *PBS* TV series, EARTH – A New Wild.

Sanjayan holds a master's degree from University of Oregon and a doctorate from the University of California, Santa Cruz. His peer-reviewed scientific work has been published in journals including *Science, Nature* and *Conservation Biology* and his expertise has attracted national media coverage in *Outside, Time, Men's Journal, National Geographic, Afar, Grist* and the *New York Times*.

AUTHOR:
M. Sanjayan

DATE:
September 1, 2015

TITLE:
Seeing the Full Picture: Save Nature, Live Better

THEME AREA:
Ecosystem Services

When asked to visualize nature, we tend to picture a rain forest, coral reef or African savannah – a place busy with countless plant and animal species. But there's something missing from that picture, something that profoundly influences every one of those scenes. The missing piece is people.

What does the real picture of nature look like? In my recent PBS project EARTH: A New Wild, we took what was essentially a natural history series and deliberately brought people into the frame. The point was to help show the essential connections between nature and the people who live with it.

For one segment, we traveled to Malawi, home to one of the largest freshwater lakes in the world. Lake Malawi has the highest diversity of freshwater fish on the planet – 800 plus species, half of them unnamed and all belonging to the cichlid family. The people who live around the lake wash in its waters and fish from its shores daily.

In the 1980s, this region of Malawi experienced a startling outbreak of bilharzia – a disease caused by a parasite that burrows through human skin. The parasite breeds in the liver, damaging organs and increasing susceptibility to HIV.

What caused the outbreak was a mystery until university professor Jay Stauffer discovered that the parasites were carried by a freshwater snail that had invaded shallow swimming waters. The invasion occurred after stocks of placodon – a snail-eating cichlid – diminished due to overfishing.

The take-home of this segment is clear: the health of Lake Malawi and that of the people who reside near it are intimately connected.

In recognizing our rightful place in this picture of nature, what can be done to correct the course of degradation and extinction we have initiated?

Efforts to connect a monetary value to nature can be effective in encouraging protection, particularly when it comes to public policy. For far too long, "saving nature" was regarded as something to be done when other human needs were met. Now, experts regard nature's benefits as services to people and determine their value by calculating the cost of replacing, or going without, them.

Another tactic is the landscape approach, which works to maintain the interconnectedness of systems across boundaries. There is little point, for example, in protecting tuna in one area if they can swim to, and be overfished in, another. Conservation International emphasizes this kind landscape-based approach by focusing efforts at scales as large as the Amazon Basin or Pacific Ocean.

To better engage the public in the conservation conversation, it is absolutely critical that the dialogue reflect the

diversity of people affected by proposed policies and outcomes – particularly in regions where our biggest challenges lie. When half the world's population resides in Asia, for example, there should be more than one Asian in the conference room.

If conservation fails to become more inclusive – in terms of both ethnicity and gender – it will remain a niche issue rather than a way of life.

As for what we can do individually, volunteering, leading a campaign and making donations are all valuable endeavors. The most powerful tools we have at hand are our votes and our dollars. What we publicly support, as well as what we buy, matters. And because friends, family and neighbors are greater influencers of opinion than a scientist on a podium, we shouldn't hesitate to engage in social media around issues we care about.

Today, there are few places on the planet that humans have not influenced, yet the idea that we are somehow separate from nature persists. It is easy to lose sight of the fact that we as a species are entirely dependent on nature. It supplies the air we breathe, the water we drink, and plays pivotal roles in food security and climate regulation.

In the words of Conservation International's series Nature is Speaking, "Nature doesn't need people. People need nature." Seeing ourselves in the picture is the first step in creating a mindset where we actively protect what sustains us.

AUTHOR:
Anthony Michaels

ABOUT THE AUTHOR:

Anthony Michaels (Tony) is an internationally known biologist and oceanographer, and a member of the Board of Directors for Sustainability at ASU. Michaels has extensive experience in environmental science, oceanography, sustainable agriculture, food security, aquaculture, bio-energy, zero-waste and energy efficiency. He has held a variety of leadership positions in academia and business, including director of the USC Wrigley Institute for Environmental Studies, chair of the Council of Environmental Deans and Directors (a network of 160 universities), National Council for Science and the Environment, Catalina Island Conservancy and NSF Advisory Committee on Environmental Research and Education. Past business positions include roles as managing director of Proteus Environmental Technologies, chief scientist at Pegasus Capital Advisors, president of MPH Energy and CEO of PhycoSystems. He currently serves as CEO of Midwestern BioAg.

AUTHOR:
Anthony Michaels

DATE:
June 19, 2014

TITLE:
Sustainable Agriculture: The Future is Biological

THEME AREA:
Ecosystem Services

Note: *Anthony Michaels (Tony) is an internationally known environmental scientist who has been a leader in both academia and business. On May 15, 2014, Michaels became CEO of Midwestern BioAg, the industry leader in biological agriculture and one of the pioneers in sustainable food production.*

Can We Feed Nine Billion People While Improving the Environment?

As the world population grows to nine billion people, we face many fundamental questions. How can we improve agricultural production to feed that many people? How can we improve farm economics? How can we reduce climate impacts, minimize the nitrogen runoff that creates dead zones in oceans and reverse soil erosion? How can we create nutrient-rich foods? I believe that a big part of the answer is biological agriculture.

Biological agriculture is an integrated farming system. It combines the best historical practices, honed over centuries, with the strength of the latest scientific discoveries. It promotes natural biological processes to dramatically improve agricultural yields and reduce farm costs.

I first became aware of biological agriculture when I was an advisor to my uncle, Gary Zimmer, who is considered the father of biological agriculture. He founded Midwestern BioAg ("MBA") over 30 years ago. He and his company have taught farmers how to improve the soil life, mineral balance, and the soil structure of agricultural lands. Now biological agriculture is used on thousands of farms on three continents with remarkable results.

The Limits of the Green Revolution and Organic Farming

The "Green Revolution" of the middle of the twentieth century consisted of improvements to crop genetics; biotechnology; expansion of irrigation infrastructure; the widespread use of synthetic fertilizers, herbicides and pesticides; and improvements in farm management practices. These are credited with more than doubling crop yields.

We now realize that these improvements came at a cost. Conventional chemical agriculture now dominates the agricultural landscape in the developed world. It relies too heavily on mono-cropping a few major crops, fossil-fuel-based fertilizers, and intense use of chemicals for crop protection. Not only are these methods, when used in excess, expensive and damaging to the environment, but they also damage microbial soil life – thus limiting long-term soil fertility and the services that biology can provide.

Organic farming is inherently biological, and has been seen as the counter-point to conventional agriculture. However, it also has

its limits. Most organic farming is defined by what it “doesn’t” use – synthetic inputs. With extensive prohibitions on materials beyond the obvious pesticides, herbicides, fungicides and synthetic nutrients, the toolkit is more limited.

A good organic farmer has to be exceptionally well skilled to outperform conventional farming practices with that limited toolkit. It is hard to envision that we can meet the challenge of training that many farmers worldwide to the level necessary to feed nine billion people through organic farming. Furthermore, not all soils and not all cropping systems are suited to organic production. In some farming systems, there are no “natural” responses to the pests, weeds and diseases that attack certain crops.

Biological farming is intermediate between conventional and organic, not as a compromise, but as a thoughtful systems approach. Biological farmers search for ways to have the farm biology and ecosystem provide services for free that the farmer would otherwise pay for through the use of chemistry or farm equipment.

Biological farming has the option of using the full toolkits of biological and chemical farming, but in moderation and with a preference for reduced reliance on chemicals and soluble fertilizers across the whole system. It takes more thought than chemical farming, but with access to the full range of tools, it is a much easier way to realize the full value that biology can bring to a farm.

Biological Agriculture Works with Nature

Our understanding of soil microbiology has increased by leaps and bounds over the past two decades. We now understand that microbial organisms in healthy soils (bacteria, fungi, protists, metazoans) have symbiotic relationships with plants and play a vital role in nutrient uptake that optimizes the health and growth of plants.

How does biological agriculture work? First, biological farmers test and then balance their soil by applying a wide range of minerals, beyond the standard nitrogen, phosphorus, and potassium of traditional fertilizers. Moreover, they use mineral forms and carbon-mineral formulations that are less damaging to soil life and less likely to leach or run off into watersheds.

Next, biological farmers feed microbial soil life by using carbon from compost, green manures, livestock manures and crop residues. They choose crop rotations and cover crops that increase biodiversity and fix atmospheric nitrogen, providing a free alternative to the most carbon-intensive input for chemical agriculture. They apply pesticides and herbicides responsibly and only when necessary; we have found that improvements in trace mineral availability and soil life dramatically reduce or eliminate the need for pesticides and fungicides. Finally, biological farmers use limited tillage practices that preserve healthy soil structure while incorporating carbon from crop residues and cover crops back into the soil.

The end result is a diverse, healthy ecosystem that produces higher yields at lower costs. And, because biological farmers work with nature instead of fighting it, the environmental benefits are enormous: substantial reduction in carbon footprint, increased drought resistance and improved water usage, reduction or elimination of nutrient runoff, and rebuilding of soils to counter-act erosion. The human health benefits are also substantial because fully-mineralized, biologically-grown plants incorporate more nutrients into the crops

and have little or no residues from the crop-protection chemicals.

Anaerobic Digesters Can Reduce the Carbon Footprint of Agriculture

Another elegant innovation is the use of anaerobic digesters that process animal manures, not only to produce clean energy, but also to produce a nutrient-rich, carbon-based fertilizer from the waste. Midwestern BioAg focuses on maximizing the nutrient value of the solids that remain after the digester creates biogas or electricity. These solids are then dried, mixed with specialty minerals and granulated to create high-value biological fertilizers. This approach creates a distributed manufacturing system for biological fertilizers that is closer to the end user, requires little shipping, reduces methane emissions and can be customized for any soil or crop.

Arizona State University's Important Research Focus

Midwestern BioAg is working with ASU on several projects that will advance our understanding of biological farming. Scientists from the Julie Ann Wrigley Global Institute of Sustainability can help understand the full system dynamics as well as determine the carbon life cycle of biological farming compared to conventional or organic farming.

The experts at the Swette Center for Environmental Biotechnology are working to understand the dynamics of soil microbiology and can help tweak the microbes in digesters to maximize the value of the solids as a fertilizer. ASU's interdisciplinary expertise in microbiology, geobiology, and carbon life cycle analysis makes it the perfect partner for these projects.

We Can Feed Nine Billion People and Improve the Environment

With all the recent breakthroughs in soil microbiology, we know we can substantially increase agricultural production through biological farming systems. Biological farms already achieve incredible yields – the U.S. records for corn yield (440-452 bushels/acre) are from farms that use the biological approach. Biological farms are also more profitable, a key requirement for any method that is going to be successful.

I believe that this is the future of farming and food production – in fact, I believe it so much that I have left my previous jobs and dedicated my full efforts to building Midwestern BioAg and ensuring that the value of biological farming spreads widely. Bringing biological farming into the mainstream and changing agriculture as we know it – this is a challenge worthy of all of us.

THEME AREA:

Business and Economics

AUTHOR:
Ralf Wilde

ABOUT THE AUTHOR:

Ralf Wilde is the executive vice president for products and a member of the board of management at TÜV Rheinland AG, a leading independent test provider based in Cologne, Germany. The 140-year old company has 500 locations worldwide in 65 countries, including the Tempe-based TÜV Rheinland Photovoltaic Testing Laboratory. An automation engineer with an MBA and doctoral degree, Wilde previously served as president and CEO of TÜV Rheinland in Japan. There, he was responsible for developing all of the company's business activities in the Asia region.

AUTHOR:
Ralf Wilde

DATE:
May 30, 2012

TITLE:
Practicing Sustainability: From Measurement to Progress

THEME AREA:
Business and Economics

Note: *ASU and TÜV Rheinland in 2009 established a commercial joint venture in Tempe, Arizona – the TÜV Rheinland Photovoltaic Testing Laboratory. It is currently the world's leading provider for PV technology testing.*

Our modern definitions of sustainable development have come a long way from the earliest 18th century German paper about sustainable forestry. Over the last 25 years, however, the concept of sustainability has been stretched considerably to encompass a growing number of issues, ideas, and processes.

Sustainability is now at a point where it may be overladen by too many diverse meanings. At the same time, a number of megatrends are exerting their influence on critical sustainability issues, particularly in the areas of energy landscape, urbanization, and scarcity of resources. This situation has generated calls for a new approach to sustainability that applies rigorous testing and measurement. Implementing such an approach hasn't been easy.

One challenge is the vast socio-economic variability among regions. Disparities in when and how such different regions employ new products and systems will complicate their quantification and comparison.

A second challenge is the lack of global standards for tools that can assess megatrend-size systems and practices. Without these tools, sustainability will take a back seat to local political values and conventional practices.

A third challenge is the current test and certification landscape, which is characterized by a narrow focus on individual products and services. While this is a huge step ahead from decades ago, we need a more holistic approach for the future. Testing needs to uncover the potential for improvement not only for a product or service under investigation, but also for its related systems.

Demand for conceptually new approaches to sustainability measurement will grow as soon as our economic framework recognizes the value of working toward optimum performance – in other words, doing more with less. This notion is embodied by the "Negawatt," which compensates energy consumers for reducing their demand through efficiency measures.

To reach optimum performance, a system needs well-designed combinations of resource saving, efficiency improvement, and reduced material and energy intensity. Designers will be better prepared to achieve this goal when they get reliable input regarding best practices, sustainability policies, and market requirements.

There will certainly be no one-size-fits-all solution. Instead, by using agreed-upon key performance indicators within a given

product or service segment, we can identify the best designs and uses while sharing information that will expedite further improvements.

Such initiatives are underway. One example is the Electrical Energy Efficiency Certification established by the International Electrotechnical Commission for Electrical Equipment. It stands out because of its cross-border applicability – results from this testing certification process are accepted in most industrial countries of the world.

While the Electrical Energy Efficiency Certification does not uncover the overall sustainability impact of a given product (its primary sustainability-related focus being on energy efficiency in use), it does provide a useful model for global certification.

The next step forward will be to create an international test scheme that connects key performance indicators across entire systems to assess the full sustainability impact of a given product or service. Doing this in a standardized manner will produce the ultimate in real comparability. It will enable understanding that goes beyond just technical and economic parameters to include social and environmental impacts as well.

A critical issue is getting the key performance indicators right. With too much specificity, products won't interrelate. With too much generalization or qualitative judgment, results will have little meaning. Most importantly, the selected parameters must be clearly and unambiguously defined to ensure that data can be accepted seamlessly among all participating organizations and countries.

We already see the emergence of these kinds of sustainability assessment and certification programs based on international standards, such as TÜV Rheinland's Green Product Mark for consumer goods. The core value in such assessments is interconnecting data on individual products and services to achieve a systems view with regard to sustainability.

We still have miles to go to resolve all the details, particularly issues over how to balance short-term economic results with long-term environmental and social impacts. Nevertheless, we must continue to push forward. With a standardized systems approach, factual performance information will drive products to continuously improve and become more sustainable than their predecessors.

AUTHOR:
Kasper Rorsted

ABOUT THE AUTHOR:

Kasper Rorsted is the chief executive officer of Henkel, a Fortune Global 500 company based in Düsseldorf, Germany, with leading positions in consumer and industrial businesses. Henkel is regularly ranked as one of the world's most sustainable and ethical companies. Rorsted previously served as managing director Europe of Hewlett Packard and general manager of Compaq in the Europe, Middle East, and Africa region. He studied economics at the International School of Business in Copenhagen and at Harvard Business School.

AUTHOR:
Kasper Rorsted

DATE:
June 27, 2012

TITLE:
Corporate Sustainability:
The Challenge of Achieving More with Less

THEME AREA:
Business and Economics

Note: *ASU and Henkel have a long relationship on issues of sustainability, beginning with ASU's collaboration with the Dial Corporation, now a Henkel company. More recently, Rob Melnick – executive director and chief operating officer of the Julie Ann Wrigley Global Institute of Sustainability and the School of Sustainability – was an advisor to Henkel in the development of the company's current sustainability strategy.*

The Earth's resources are finite – the faster we expand, the faster we use them up. This idea was central to the prescient 1972 study, "Limits to Growth," commissioned by the Club of Rome.

Forty years later, it is now obvious that human consumption is exceeding these limits. Our population of more than seven billion people devours many resources more quickly than they can be renewed.

What will happen in another 40 years when the world's population expands to a predicted nine billion people? Consumption and resource demand could grow faster than ever before. Will the people on this planet willingly forego a higher quality of life and the level of consumption that goes with it? Not likely.

Our approach to sustainability, therefore, must extend beyond the idea of simply reducing emissions, consumption, or living standards. We must find a way to maintain a high quality of life while consuming vastly fewer resources.

Finding smart solutions

What the world needs is an effective strategy for creating more from less. With such a strategy, we can decouple our standard of living and economic performance from the consumption of increasingly scarce resources. For companies, this will mean increasing the value of their products and services while reducing their resource footprint.

Most international companies already recognize the challenge of sustainability and its possible return on investment. Sustainable development can satisfy a duty toward future generations while making good economic sense. Embracing this idea provides a competitive advantage in at least three ways.

First, sustainability serves as an innovation engine. Henkel's industrial and retail customers expect us to develop new products of high quality and low environmental impact. To accomplish this, we must continually find new ways to reduce energy, water use, and waste in the production of our products as well as in their use. These benefit our bottom line as well as those of our customers.

Second, sustainability is an important criterion in the labor market. Top candidates, in particular, tend to choose companies that

show they are both economically successful and responsibly operated regarding the environment and society.

Third, financial markets increasingly consider sustainability a factor in identifying high-performing companies. Sound sustainability plans indicate that a company is thinking long-term and will perform in a consistent, coherent manner.

Alleviating conflicts

Many companies, however, find it difficult to reconcile their business goals and sustainability objectives. They see it as a conflict between making a profit and doing the right thing, but this doesn't have to be the case. What makes attaining these goals possible is a commitment to innovation.

At Henkel, for example, we didn't see a way to meet our sustainability targets without overhauling our production process. This meant we had to step back and invest in redesigning production to work with less input and greater efficiency. The result was we reached our 2012 sustainability targets two years earlier than expected, while simultaneously generating the best earnings results in our corporate history.

Tripling efficiency

To make big improvements, companies need a long-term strategy. In 2011, we drafted a sustainability strategy that sets targets all the way to the year 2030. Our overall goal for this period is to triple the value we generate related to the resource consumption of our products and services. We believe we can achieve this objective of becoming three times more resource-efficient in a variety of ways: by reducing resource consumption and emissions, increasing value, or some combination of the two.

Whatever approach is used, the goal of tripling our company's efficiency by 2030 guides our thinking and planning. We will apply it to all business sectors and functions across our entire value chain. Ultimately, customers, consumers, society, and the environment should all profit from the reduced ecological footprint that results.

Pulling together

To help us achieve our efficiency goals, we have defined three major approaches. These pull together the most important components of our business: our products, our partners, and our people.

The first approach is to develop and manufacture the most efficient and sustainable products. These products are the core of our business, and that is where we can make the highest progress through continued innovation.

The second approach is to involve our many partners – suppliers, craftsmen, industrial users, and consumers. They contribute by reducing their resource consumption all along the value chain. Hence we also focus on helping customers understand how to use our products most sustainably.

The third approach is to tap into the expertise of our people. The company's many employees play a crucial role by contributing their knowledge and ideas to improving our designs and processes. They need to identify and implement the many small changes that can make a big difference.

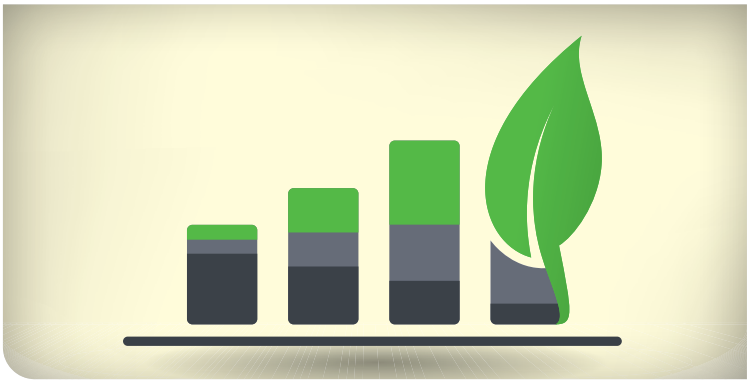
With the effective interplay of innovative products, engaged partners, and committed employees, we feel it is possible to meet our challenge to triple our resource efficiency and achieve more with less. This must be the challenge and goal for every company. It is time to step up and make a difference.

For additional information on Henkel's sustainability strategy, visit: www.henkel.com/sustainability.

AUTHOR:
Hunter Lovins

ABOUT THE AUTHOR:

L. Hunter Lovins is president of Natural Capitalism Solutions and a founder of the new field of sustainable management. Currently a professor at Bard College and the University of Denver, she has consulted for hundreds of industries and governments worldwide, ranging from the Kingdom of Bhutan to most OECD nations. She has consulted for the International Finance Corporation, Royal Dutch Shell, Interface, and Walmart. She was also named millennium *TIME* magazine Hero for the Planet in 2000, and called a "Green Business Icon" by *Newsweek* magazine in 2009. She is a past Wrigley Lecture Series speaker at ASU's Julie Ann Wrigley Global Institute of Sustainability and was a key-note speaker at the inaugural conference of the Association for the Advancement of Sustainability in Higher Education held at ASU in 2006.



AUTHOR:
Hunter Lovins

DATE:
September 27, 2012

TITLE:
Business + University: Tomorrow's Jobs Require Sustainability

THEME AREA:
Business and Economics

Business is probably the only institution on the planet that is nimble and well-managed enough to respond to the global sustainability crises facing humanity. Such challenges as the impacts of climate change, soaring resource prices, poverty, and loss of biodiversity are threats, but are also opportunities. The businesses that successfully respond will be big winners in the marketplace.

Business sustainability leaders already outperform their less sustainable peers. Over 40 studies from all the major management consulting houses, as well as from academic journals such as Harvard Business Review and MIT Sloan Review, show that the companies that are sustainability leaders have higher and faster growing stock value, better financial results, lower risks, and more engaged workforces than other companies.

Despite all this, we're losing. The international Convention on Biological Diversity report, Global Biodiversity Outlook 3, highlights a sobering loss of species and habitats among the world's ecosystems. Threats like the acidification of the oceans could, worst case, end life as we know it on earth. This has happened several times before on our planet with up to 90 percent of species going extinct. Meanwhile, both the International Energy Agency and the Organization for Economic Cooperation and Development warn that unless global leaders implement more sustainable practices immediately we will, perhaps as early as 2017, lock in an unsurvivable amount of global warming.

Next generation sustainability

Universities have an obligation to tip the scales back in humanity's favor by making sure their graduates are educated about sustainability and its practice. This is what businesses want. The global management consultant, Accenture, has noted that over 93 percent of CEO's see sustainability as crucial to business success, with 88 percent stating it will be fully embedded into their strategy and operations within 10 years. It's also what students want. The online career service, MonsterTrak, reports that 92 percent of recent college graduates prefer to work for a company that cares about the environment.

Today's students need to graduate with solid sustainability skills, not only to help save our environment, but also because this is where tomorrow's jobs will be. The market for sustainability consulting is growing at 83 percent each year, with expectations to become a nearly $1 billion market by 2013. Corporate social responsibility reporting is also increasing annually, and the new companies issuing their first CSR reports are in need of employees familiar with integrated reporting. The market for energy and carbon accounting grew 400 percent in 2010 and another 300 percent in 2011. Many other companies need new hires versed in sustainability practices to retrain

their existing employees. Overall, job candidates with a strong knowledge of sustainability are better positioned to not only fill current job openings, but also help lead their companies into the future.

Closing the educational gap

A 2010 study by McKinsey found that many companies understand the need to implement more sustainable practices, but most don't have the knowledge to go forward. While most of the executives surveyed considered sustainability important to their future — agreeing that it was "very" or "extremely" important in a wide range of areas — only 30 percent said their companies actively sought opportunities to invest in sustainability or embed it in their business practices. Respondents admitted to a pervasive lack of understanding about what sustainability is and how to implement it. This educational gap, they said, was inhibiting action.

A survey of business respondents conducted by the W.P. Carey School of Business at ASU found that 65 percent of small-company respondents and 87 percent of large-firm respondents said they would consider a sustainability concentration when making a hiring decision, with 97.5 percent of the large-firm executives saying they would value the concentration. Respondents agreed that sustainability-related topics should be taught to all managers and executives.

Even companies that lack a values commitment to sustainability are recognizing that environmentally and socially responsible practices don't just save them money — they drive employee productivity. American workers are less happy now than at any previous time studied. The Gallop Organization calculates that this is costing American businesses over $300 billion each year. Conversely, companies with an engaged workforce have four times the earnings per share growth rate. Numerous studies show that enabling workers to be a part of implementing sustainability as part of their jobs is one of the best ways to engage them, and increase productivity and worker satisfaction.

Only when a preponderance of companies and communities implement authentic and innovative sustainability practices will many global threats be addressed. It is therefore encouraging that an increasing number of colleges and universities now include sustainability practices as part of their campus management programs and sustainability courses as part of their curriculum. The Association for the Advancement of Sustainability in Higher Education, in its latest review of campus sustainability, reports that 60 percent of all new courses at colleges and universities are now sustainability related.

Are these programs effective and widespread enough to create the next generation of sustainability leaders our world needs? Not yet. But you can help.

Offer sustainability training for your employees. Partner with organizations like ours to bring customized programs to engage your workforce. Join programs such as our Sustainability Leadership and Implementation Certificate now offered through the University of Denver and Bainbridge Graduate Institute. Or work with your local university to create a sustainability training program. Natural Capitalism Solutions has helped establish a variety of such programs and can advise educational institutions in your community.

For more information on Natural Capitalism Solutions and its sustainability program, visit: http://natcapsolutions.org.

AUTHOR:
Kara Hurst

ABOUT THE AUTHOR:

In August of 2012, Kara Hurst was appointed as CEO of The Sustainability Consortium, a joint initiative between Arizona State University and the University of Arkansas that is working to develop science-based tools for measuring and reporting consumer product sustainability. She vacated the position two years later to serve as Amazon's first sustainability executive. Prior to TSC, Kara spent eleven years at BSR (Business for Social Responsibility), where she served as vice president. A skilled practitioner of corporate social responsibility, Hurst's areas of expertise include corporate transparency, responsible supply chain management, management structures, policy assessment, and industry collaboration.

THE SUSTAINABILITY CONSORTIUM

AUTHOR:
Kara Hurst

DATE:
February 27, 2013

TITLE:
Sustainable Consumption:
Creating Standards to Deliver Better Products

THEME AREA:
Business and Economics

By almost any measure, global consumption is growing rapidly. Yet many businesses still struggle to produce sustainable products, and most consumers don't know how to identify and differentiate them. The result is: we continue to waste valuable natural resources, compromise ecosystems, and threaten human health.

Businesses and consumers desperately need a better system for assessing the sustainability of consumer products. To be viable, the system must be one that businesses can trust and consumers can easily apply to make informed decisions.

Such an assessment system must also be rigorously science-based, simple to understand, and fully transparent. And it must earn the buy-in of a vast cross-section of corporations, watchdog organizations, and governments.

Many stakeholders, many products

The Sustainability Consortium has been working to create such a system since its launch in 2009. Conceived as a global multi-stakeholder organization and structured as a joint initiative between Arizona State University and the University of Arkansas, the Consortium has grown to encompass nearly 30 colleagues at four global locations—Arizona, Arkansas, The Netherlands, and most recently China.

The primary goal of the Consortium is to develop science-based tools that advance the measurement and reporting of consumer product sustainability. The research required to meet that goal is comprehensive.

The Consortium currently covers more than 150 product categories across nine consumer product industry sectors, including food, beverages, agriculture, electronics, toys, paper, pulp, forestry, and home and personal care products. The work is made more robust and complete through our partnerships with civil organizations that help us better understand important stakeholder views. In the Consortium, we collaborate with more than 100 member companies and organizations to gather critical information and integrate research findings into business operations and strategies.

Creating the ultimate sustainability index

For these efforts, the Consortium was selected by Scientific American magazine as one of the top ten World Changing Ideas for 2012. The magazine not only described the Consortium's work as the "ultimate sustainability index," but also called it a superior sustainability measurement and reporting system, largely because of its comprehensive nature and cross-sector approach that factors in sensitive data from companies on emissions, waste, labor practices, and water usage, among other factors.

These words from a venerable and highly respected science magazine are high praise.

Nevertheless, there is much more potential impact to be had from a scientific approach to consumer product sustainability. For example, the Consortium has started to identify and address gaps in our research. It has started a commodity mapping effort to provide members with information on probable crop production or threats. By embracing the power of industry collaboration, the Consortium has also begun to examine the effectiveness of electronic product take-back programs and the success of product collection and treatment.

The measure of future success

Even as our research becomes more complex, the Consortium needs to stay focused on growth—both in global reach, such as through our entry into China, and through adding new sectors of consumer products such as clothing, footwear, and textiles. In addition, we are finding ways to scale up the research work, reach new audiences, and attract many more retailers and manufacturers. And it must continue to engage more consumers, regulatory entities, investors and capital market leaders, and civil society organizations with expertise in social and environmental focus areas.

This is no small dream for a young organization standing at the intersection of science and global action. The measure of our future success at TSC—and our progress—will be not just how the research is used and integrated into the global supply chain, but also the positive impacts it generates for people and the planet.

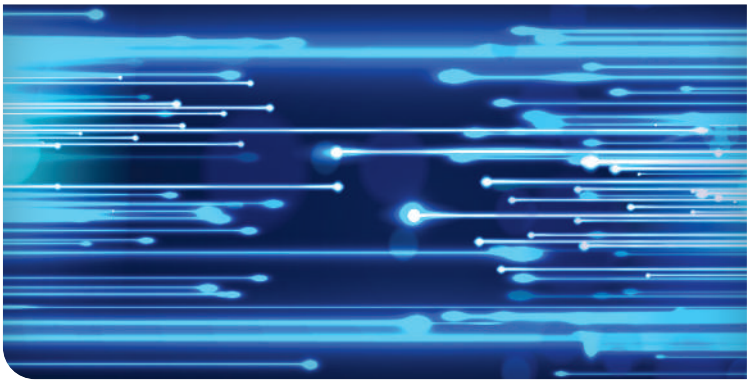
THEME AREA:

Energy, Technology and Security

AUTHOR:
Bruno Sarda

ABOUT THE AUTHOR:

Bruno Sarda is the director of global sustainability operations at Dell, a consultant for the Rob and Melani Walton Sustainability Solutions Initiatives, and a faculty member at the School of Sustainability. In his role at Dell Inc, Sarda is responsible for business integration and strategy, information strategy, measurement and reporting. He also actively supports sustainability advocacy, policy, and objective setting, working with internal and external stakeholders. Recently named one of the ‘most influential sustainability voices in America’ by The Guardian and ranked sixth in GreenBiz’s Sustainability Twitterati index, Sarda actively participates in a variety of cross-industry efforts such as the Global Reporting Initiative and The Sustainability Consortium. He worked with the Walton Initiatives to design and develop the Executive Master’s for Sustainability Leadership, and serves as a coach and mentor through his leadership of the groundbreaking Dell-funded sustainability job training program.



AUTHOR:
Bruno Sarda

DATE:
November 27, 2012

TITLE:
Wicked Problems: How Systems Thinking, Technology, and New Partnerships Can Tackle Sustainability's Challenges

THEME AREA:
Energy, Technology and Security

Our world faces 'wicked' problems.

Wicked problems, as explained by Ann Kinzig, chief research strategist at ASU's Julie Ann Wrigley Global Institute of Sustainability, are challenges that are complex "all the way down." They resist simple solutions.

Wicked problems include how to deal with a rapidly changing and unstable climate. How to feed a projected 9 billion people on this planet while enabling many to rise out of poverty. And how to do all of the above while respecting the physical boundaries and finite resources of our planet. These problems are the key challenge of sustainability.

Sander van der Leeuw, former dean of ASU's School of Sustainability, has advanced the idea that such thorny problems, let alone their potential solution paths, are so complex they exceed the human brain's capacity to fully grasp them. They involve massive data sets and require a level of systems thinking that can only be achieved with the computing power of technology – lots of it.

Delivering such power – the power to make sense of what is unfathomable to the best human minds – requires a new approach. It demands open public-private partnerships, extensive interdisciplinary research teams, and latest-generation technology able to process extraordinary amounts of data.

The world already has corporate-based models of how new kinds of collaboration might make this work. Dell, for example, has partnered with the Translational Genomics Research Institute and others to accelerate personalized treatment for pediatric cancer. The partnership applies Dell cloud technology to help researchers and doctors quickly analyze aggressive tumors in a patient and identify the best treatments to administer.

A number of universities are also stepping up their collaborative projects. The ASU Wrigley Institute was launched specifically to tackle the world's wicked problems by directing talent and resources toward developing solutions-oriented research. The Institute is particularly adept at working in partnership with organizations outside of academia – cities, nonprofits, and businesses – to address complex issues and develop new models for understanding and addressing sustainability challenges.

Nevertheless, researchers and decision-makers around the world need more powerful analysis and greater reach to effectively extract knowledge from enormously complex data sets. How can we fulfill these needs?

One strategy is to establish open collaborations anchored by businesses and universities aimed at developing what are commonly called "community research computing services." One model for this approach is the set of initiatives partnering Dell with ASU, Clemson University, and University of Indiana. These projects support groundbreaking research by providing "big data" research analytics,

open source frameworks, large-data management, and other important services.

But even broader computing partnerships are needed, perhaps more along the lines of the new supercomputer project, Stampede, built by the University of Texas at Austin's Texas Advanced Computing Center. This collaboration partners seven universities — including Texas, Cornell and Ohio State — with Dell, Intel, and the National Science Foundation. When deployed in January 2013, Stampede will rank as the most powerful supercomputer system in the National Science Foundation's eXtreme Digital program, with the ability to support scientists investigating our most challenging scientific and engineering problems related to genomics, climate, environment, nanotechnology, and others.

The October 2012 SXSW (South by Southwest) Eco conference in Austin provided a fitting opportunity for bringing this big collaboration idea into focus. Participants discussed the need to scale up the pace of change for sustainability by beginning to address whole systems. This requires bringing all stakeholders to the table, a potentially tricky endeavor for companies. When businesses join forces with public institutions they often collide with unfamiliar cultures governed by vastly different missions, standards, and disclosure requirements.

To overcome collaboration issues, we must first focus on the most important goals and then be willing to change behaviors to reach them. We must, ultimately, find new ways to share our needed resources and bring all of our intellectual, scientific, and analytical capabilities to the table.

Wicked, indeed, are the big problems we all need to solve. But our future is yet to be made. With a concerted effort to apply whole systems thinking, powerful technology, and inclusive partnerships, we can ensure our researchers and decision-makers always have the best possible resources to guide them. This will unleash a powerful wave of positive change.

AUTHOR:
Ellen B. Stechel

ABOUT THE AUTHOR:

Ellen B. Stechel is the deputy director of ASU's LightWorks and managing director of LightSpeed Solutions, communicating global efforts of leading scientists and researchers working towards sustainable transportation energy based on liquid hydrocarbon fuels from the sun. She is trained in mathematics, chemistry, and physics. Early in her career, she was a technical staff member at Sandia National Laboratories before moving to the Scientific Research Lab and, later, Product Development at Ford Motor Company. While at Ford, her responsibilities included emissions and fuel chemistries, climate change and sustainability, and deployment of new technologies for low emission vehicles. Later in her career, she returned to Sandia National Labs to build and manage research efforts in applied energy, making fuels from the sun and concentrating solar technologies. In addition to her roles at LightWorks and LightSpeed Solutions, Stechel is a professor of practice at ASU's Department of Chemistry and Biochemistry.

AUTHOR:
Ellen B. Stechel

DATE:
April 30, 2013

TITLE:
Low-Carbon Fuels from Sunlight and Waste Carbon Dioxide: It is Possible, is it Practical?

THEME AREA:
Energy, Technology and Security

A network of issues buried beneath the strategic and economic importance of petroleum and the increasing concentration of atmospheric carbon dioxide is complex; however, until addressed, no measure of global sustainability will be obtainable.

If we accept that, any solution to such issues yield lower net carbon emissions by 50-80 percent, then despite obvious advantages, alternative fossil fuel pathways cannot be the ultimate solution for transportation.

The economics of carbon

A stable policy environment to level the playing field and allow time for low-carbon options to develop, deploy, and decrease costs through experience, learning, scale, and innovation is necessary, but insufficient.

Higher carbon fuels from Canadian tar sands; coal or gas-to-liquids projects; and natural gas switching (with modest carbon reductions) rapidly entering the transportation sector may block market penetration of low-carbon innovations, discouraging investment in emerging technologies. Long-lived assets could "lock-in" a high-carbon transportation infrastructure and all but eliminate viable options for transitioning to a low-carbon future.

Innovation policy that enables a balanced portfolio of promising options would stimulate development of viable possibilities by focusing on solving the problem as opposed to choosing a limited set of specified approaches, thereby excluding opportunities for novel solutions, including hybrids, integrated systems, and new concepts.

Is liquid hydrocarbon fuel still a good option?

New low-carbon domestic energy sources and transportation innovation, such as increased fuel economy, biofuels, electrification, and possibly hydrogen, would reduce total demand for petroleum and carbon emissions, but not enough.

Could liquid hydrocarbon-based fuel remain a viable and sustainable option in large quantities? Often overlooked, liquid hydrocarbon fuels are unrivaled in the rate of delivery to on-board, usable energy storage. They are also unsurpassed in having high energy densities accommodating both space and weight requirements. Consequently, there are no credible alternatives for air, heavy-duty, or commercial ocean applications save some penetration of compressed or liquefied natural gas.

Furthermore, it is neither useful nor accurate to think of petroleum as a *primary* energy resource. It is more appropriate and instructive to recognize that conventional fossil fuels are in fact, "stored (ancient) sunlight" in the form of energy dense, sequestered carbon and hydrogen that nature took millions of years to produce and modern civilization is taking only centuries to consume. Carbon dioxide and water are simply the energy-depleted, oxidized form of the

carbon and hydrogen making up the hydrocarbon. Thus, we might consider reframing the problem as a techno-economic challenge to reverse combustion fast enough to match consumption.

Recycling carbon dioxide

This reframing suggests searching for large-scale options that convert, store, and upgrade sunlight to a higher energy value and transportable form as nature did, but faster. An underexplored emerging strategy is to develop solar technologies that recycle—rather than bury—waste carbon dioxide into new supplies of liquid hydrocarbon fuels.

For example, synthetic solar thermochemical fuel processes can convert solar energy, excess carbon dioxide, and low quality water into gasoline, diesel, and aviation fuel—fuels that are compatible with the existing energy infrastructure. This process recycles carbon dioxide back into fuel at rates considerably faster and more efficiently than the biosphere naturally captures and fixes carbon dioxide from the atmosphere.

To achieve societal objectives, such options will need to do so efficiently, affordably, and sustainably. Many challenges are avoided by utilizing existing infrastructure whenever possible and using waste carbon dioxide as a carbon source feedstock initially from concentrated sources, but ultimately directly or indirectly captured from the excess in the atmosphere.

Opportunities and challenges

Large-scale industrial conversion of solar energy that transforms carbon dioxide and water into infrastructure compatible hydrocarbon fuels is an attractive option to facilitate a smooth and continuous transition, affecting the existing vehicle fleet and co-evolving with the future fleet. However, such an option while certainly possible, still has significant resource, economic, and technical challenges before becoming practical, especially if it is going to achieve scale and be sustainable.

A general examination identifies a number of challenges, such as achieving high solar energy-to-fuel system-level efficiency, low material intensity in the solar collectors, high material accessibility, and good material durability; limited and no additional arable land use; and low water consumption. Opportunities to meet each of these challenges are already encouraging.

Using the sunlight to re-energize carbon dioxide both directly and in hybrids (with biomass or fossil feedstocks) can produce net lower and ultimately net neutral carbon-based fuels with most of the carbon in the initial feedstock making it into the fuel product. Researchers in several countries, including the U.S., working on solar-based recycling of carbon dioxide have prototypes and some making it to large-scale demonstrations.

Such innovations could unite solar energy interests with fossil fuel and biofuel interests, and could preserve an option for a low-carbon future and a smooth transition that maximizes the use of installed infrastructure and new investments in natural gas.

A promising energy future

These opportunities offer significant promise for a platform of technologies that store sunlight and sequester carbon above ground as an energy-dense fuel with affordable economics, closing the carbon cycle, and scalable to global demand.

Despite challenges, there are promising advances already happening and opportunities to leverage developments in related industry segments. By working across stovepipes, we can drive sustainable economic growth, create many high-quality jobs, and produce viable and scalable solar alternatives to petroleum.

AUTHOR:
Richard Kidd

ABOUT THE AUTHOR:

Richard Kidd serves as deputy assistant secretary of the U.S. Army (Energy & Sustainability) where he is responsible for overall program direction, policies, strategies, and oversight for implementation of all programs and initiatives related to energy security and sustainability. As the Army's senior energy executive, he also coordinates and integrates both the installation and operation of energy programs and strategies. A 1986 graduate of the United States Military Academy at West Point, Kidd served as an Infantry Officer until 1991. After receiving a master's degree in public and private management from Yale University, he joined the United Nations and served principally in war-affected regions of the world. He served in the U.S. State Department's Bureau of Political Military-Affairs starting in 2001. In July of 2008, he joined the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy where he was responsible for leading the Federal Energy Management Program.

AUTHOR:
Richard Kidd

DATE:
May 1, 2012

TITLE:
Sustainable Army: Creating a Net Zero Bootprint

THEME AREA:
Energy, Technology and Security

Note: *ASU was selected by the Army National Guard to partner in the development and delivery of an online Graduate Certificate in Sustainability Leadership designed exclusively for soldiers and Army-related civilians. Classes are offered through the School of Sustainability.*

Imagine the U.S. Army called to war with no fuel, no supplies, and no training.

You can't. To safeguard against such a scenario, the Army embraces sustainability as a foundation of its global mission, operations, and strategic management. As a matter of preparedness, sustainability is integrated across the Army's four lines of operation – material, military training, personnel, and services and infrastructure.

This is not a fad, but serious business. Army leaders have been working since 2000 to embed sustainability into the Army's culture. Through collaborations with academia, federal agencies, and other organizations, and by emphasizing the key role sustainability plays in enabling operations at home and overseas, the Army has shifted its behavior. A strong culture of sustainability now ensures that the Army of tomorrow has the same access to energy, water, land, and other natural resources as it does today.

Net Zero is one of the Army's signature initiatives in its move toward sustainability. Designed to manage energy and natural resources at Army facilities in an efficient and effective way, this initiative recognizes the value of sustainable approaches. Among the advantages are reduced cost, improved mission capability, healthier quality of life, better relationships with local communities, and increased future options. These are crucial to preserving choice on strategy and installations and to help the Army prepare for future contingencies.

Net Zero works by focusing on three interrelated areas: energy, water, and solid waste. The objective by 2020 is to avoid consuming more energy or water than is sustainably produced and to eliminate solid waste disposal in landfills. Army facilities have begun moving toward this goal. As of April 2012, 17 Army installations differing in size, geography, and mission have been identified as Net Zero pilot projects to test and demonstrate a variety of sustainable practices.

In parallel with Net Zero, the Army has launched the Operational Energy and Contingency Basing initiatives to incorporate sustainability in its contingency operations (actions potentially involving enemy hostilities). The Army clearly recognizes that sustainability on the battlefield is a force multiplier that, when implemented, can increase the combat potential of a military unit and enhance the probability of a successful mission.

The Operational Energy and Contingency Basing initiatives address sustainability in three vital areas: Soldier equipment, forward operating bases, and tactical vehicles. They focus on both increasing energy and water efficiency and also reducing energy and water needs as well as solid waste. By conducting energy-efficient and sustainability-informed operations, the Army reduces vulnerabilities and decreases its logistics tail. It also increases lethality by lightening the Soldier's load and freeing up more Soldiers for mission-oriented, rather than logistical tasks.

Tracking results is also critically important to sustainability, and the Army has been a leader in both measuring and publicly disclosing its progress. Since 2008, the Army has published annual self-assessments using the criteria established by the highly respected Global Reporting Initiative (GRI). The Army was also the first federal organization to link its annual GRI report to the sustainability goals in Executive Order 13514, which requires reductions in greenhouse gas emissions, increases in energy and water efficiency, and continued reductions in the generation of solid waste.

To be relevant to the current and future Army, new concepts must be appropriate to its mission. Sustainability meets that standard. It is now both a way of thinking and a way of doing that improves the Army's efficiency. This gives the Army more choice and flexibility, and that ultimately means greater effectiveness.

This commentary was prepared in collaboration with Marc Kodack, Kristine Kingery, Wanda Johnson, and Natalie Jones, all from the Office of the Assistant Secretary of the Army for Energy and Sustainability.

AUTHOR:
Norman R. Seip

ABOUT THE AUTHOR:

Lt. Gen. Norman R. Seip is former commander, 12th Air Force (Air Forces Southern), Davis-Monthan Air Force Base, Ariz., where he was responsible for the operational readiness of 12th Air Force Active Duty and gained wings of the Air Force Reserve and Air National Guard. He is also a spokesman for the energy security campaign Operation Free, a bi-partisan coalition of veterans from across the country.

AUTHOR:
Norman R. Seip

DATE:
May 12, 2014

TITLE:
Renewable Energy as a Key National Security Interest

THEME AREA:
Energy, Technology and Security

Note: *May 17, 2014, was Armed Forces Day, an annual holiday established in 1949 by President Harry S. Truman as a single day for U.S. citizens to thank all military members for their service. On the occasion of the first Armed Forces Day, Truman recognized the military for progress toward its "goal of readiness for any eventuality," a goal that endures today.*

The Pentagon is leading the charge toward a secure renewable energy future. Senior military and national security leaders agree: a single-source dependence on fossil fuels – primarily oil – endangers our troops in combat zones and threatens our long-term security interests.

Additionally, our continued reliance on these dirty fuels is worsening the impacts of climate change. The effects of shifting weather patterns are already destabilizing vulnerable regions of the world, and international instability could force the military into an ever-rising number of resource-driven conflicts.

While the civilian "debate" on these issues trudges on – hampered largely by politicians beholden to petroleum interests – the Department of Defense has recognized that reducing fossil fuel dependence, investing in clean energy technologies, and incorporating climate change into national security strategies are operational, tactical, and strategic imperatives.

To strengthen our national security and prevent more of our servicemen and women from being sent into conflicts abroad, our civilian leaders would be wise to follow the lead of the military and increase our commitment to employing clean energy and combatting the threat of climate change.

The national security risk of fossil fuel dependency

Energy is the lifeblood of the military, and our armed forces remain heavily reliant upon fossil fuels. In combat zones, everything on a forward-operating base is powered by oil, including the heating and cooling of tents, the powering of vital communications equipment, and the patrol vehicles themselves.

In Iraq and Afghanistan, our servicemen and women were put at great risk in order to protect supply routes for the fuel convoys that provided vital power supplies to remote forward-operating bases. These convoys were quickly recognized as easy targets for the enemy. From 2003-2007, one in twenty-four fuel convoys resulted in a service-member killed or injured, claiming the lives of over 3,000 Americans.

The national security threat of our single-source dependence is not limited to the battlefield. As the largest institutional consumer of fuel in the world, the Department of Defense is extremely vulnerable to price shocks, which puts strain on the military's budget.

And while the day-to-day price of oil is important, there are larger costs to consider. We expend vast resources just to maintain stability in dangerous oil-producing regions of the world, including patrolling global choke-points and keeping international shipping lanes open.

This current energy posture is further exacerbating quite possibly the greatest security challenge facing our military today: climate change. The burning of fossil fuels is driving up carbon emissions to dangerous levels.

The impacts of climate change – including severe droughts, record heat waves, extreme storms, food shortages, mass migration, and rising sea levels – will be felt worldwide. Destabilization in already weak states will exacerbate existing security threats and pose a serious threat to those whose mission it is to protect and serve.

Leadership in action

I am proud to have dedicated my entire life of service to our great nation and protecting our national security. Throughout my 35 years on active duty in the United States Air Force, I gained a thorough understanding of the impact our dependence on fossil fuels has had – and continues to have – on our national security. Our dependence along with climate change and what it portends for our security is why I along with many of my fellow retired general and flag officers are so committed to raising awareness and advocating for solutions to address these two threats facing our military and the nation.

The military instills a culture of winning; this requires a strong will to address even the most daunting national security challenges head-on. To reduce our dependence on oil and address the impacts of climate change will not be easy, but our long-term security depends on it.

I am proud to say the military is rising to the challenge; the Pentagon has already set aggressive policies to tackle and mitigate both security challenges.

A plan for the future

The military is already taking the lead to address these challenges by developing alternative fuels, investing in essential energy productivity technologies, and deploying renewable energy in the field and at home.

Our Marines and Soldiers are now deploying with solar backpacks to charge vital communications equipment, cutting down on the number of dangerous fuel resupply missions. The Navy is powering its ships with hybrid propulsion systems and developing next-generation biofuels to reduce dependence on fossil fuels, extend range, increase endurance, and heighten agility. The Air Force is improving aviation energy efficiency and investing in on-site renewables.

And just last year, the military committed to generating 20 percent of its electricity on installations from renewable sources by 2020. This gives base commanders more energy options and greater flexibility to carry out their missions.

While we pursue strong mitigation policies, the fact remains we have already planned for a certain amount of climate change. The Department is developing climate-based adaptation plans for all institutions, and the military is working with our allies and partners to develop strong humanitarian assistance and disaster response capabilities.

All of these actions will make the military a more capable force, reduce emissions, and address the geopolitical security challenges of this century. American innovation will enable us to forge forward, and I am proud our military leaders are working to remain the greatest fighting force the world has ever seen.

THEME AREA:

Inclusion and Social Justice

AUTHOR:
Rebecca Tsosie

ABOUT THE AUTHOR:

Rebecca Tsosie is a distinguished sustainability scientist, Regents' Professor at the Sandra Day O'Connor College of Law and the vice provost for inclusion and community engagement at Arizona State University. She is also a faculty affiliate for the American Indian Studies Program and the Mary Lou Fulton Teacher's College. Tsosie, who is of Yaqui descent, joined the ASU College of Law faculty in 1994 and served as the executive director of the law school's Indian Legal Program from 1996-2011. She teaches in the areas of Federal Indian law, Constitutional law, Property, Cultural Resources law, Bioethics and Critical Race Theory. Tsosie has written and published widely on doctrinal and theoretical issues related to tribal sovereignty, environmental policy, and cultural rights. Her current research deals with Native rights to genetic resources.

AUTHOR:
Rebecca Tsosie

DATE:
August 25, 2014

TITLE:
Indigenous Peoples and Sustainability Policy: Exploring the Politics and Practice of "Indigenous Sustainability"

THEME AREA:
Inclusion and Social Justice

There are two ways to view the relationship between Indigenous peoples and sustainability policy. One approach places them at the center of sustainability studies, and one relegates them to the periphery. The latter approach became the subject of a recent controversy between experts commenting on the latest draft of the United Nations' new sustainable development policy.

Significance of the term "Indigenous peoples"

Several weeks ago, a panel of experts from the United Nations expressed concern that the latest draft of Sustainable Development Goals had deleted all references to "Indigenous peoples," substituting instead the phrase "Indigenous and local communities." The shift might seem harmless to the uninformed reader. However, as the U.N. experts noted, the effect of the change was to undermine the success that Indigenous peoples have had in claiming their rightful identity as "peoples" with a right to "self-determination," equivalent to that of all other peoples under international law.

The historic recognition of Indigenous peoples' political status emerged in the United Nations Declaration on the Rights of Indigenous Peoples, which was adopted by a majority consensus of the United Nations General Assembly in 2007. Since that time, the term has been used in a wide range of national and international legal and policy documents. The term "peoples" within international law designates autonomous political groups who have the right of self-governance in their domestic affairs and who must be treated with respect and dignity by national governments in their collective capacity.

The U.N. Declaration on the Rights of Indigenous Peoples contains 46 articles that delineate the rights of Indigenous peoples to protect their lands and national environments, to safeguard their cultural heritage (including language, religion and cultural resources) and to maintain their own institutions of self-governance. The declaration also counsels national governments to involve Indigenous peoples in policymaking decisions, and to obtain their "free, prior and informed consent" before taking actions that would jeopardize their fundamental rights.

The decision to omit "Indigenous peoples" from the Sustainable Development Goals represents a "step backwards for Indigenous peoples," said the U.N. experts, particularly because "Indigenous peoples face distinct development challenges, and fare worse in terms of social and economic development than non-indigenous sectors of the population in nearly all of the countries that they live in."

Impacts of climate change on Indigenous peoples

In fact, most Indigenous peoples throughout the world live in areas that are

being heavily impacted by climate change and forms of development (including timber harvesting and mining) that are quite damaging to the natural environment. Indigenous peoples, such as the Inuit people in Alaska, Canada and Greenland, are facing destruction of their homes by flooding and are having difficulty continuing their traditional, subsistence lifeways, given the destruction of sea ice and the impacts upon sea and land mammals in the Arctic.

In addition, Indigenous peoples throughout the world often lack the educational or professional training necessary to transition into an urban economy, and their very survival as distinct, land-based cultures would be jeopardized by such a shift. Inuit leader Sheila Watt-Cloutier made this point quite emphatically. In her 2005 statement in support of the petition filed by the Inuit Circumpolar Conference against the United States in the Inter-American Commission for harms caused by climate change, she stated, "Inuit are an ancient people. Our way of life is dependent upon the natural environment and the animals. Climate change is destroying our environment and eroding our culture. But we refuse to disappear. We will not become a footnote to globalization."

Most experts agree that Indigenous peoples are among the most vulnerable populations in the world to the projected impacts of climate change. The question is how global nation-states should respond. The U.N. experts counseled that "the new Sustainable Development Goals present a unique opportunity to remedy [the] shortcomings [of current policy] and the historical injustices resulting from racism, discrimination and inequalities long suffered by Indigenous peoples across the world." They encouraged states to "affirm that the human rights-based approach to development should be a key framework in achieving sustainable and equitable development."

This advice accords with other current United Nations activities, including the continuing commemoration of an "International Day of the World's Indigenous Peoples" and the conclusion of a second "Decade of the World's Indigenous Peoples." Both are designed to bring continuing recognition to the place of Indigenous peoples within the global politics of cultural and environmental protection.

Sustainability practices of Indigenous peoples

Those lessons are equally applicable to the United States, which maintains a trust relationship with over 560 federally-recognized American Indian and Alaska Native Nations, and recognizes that these Indigenous Nations are separate sovereigns with governance authority over their lands, resources and members. In this respect, federal and state agencies ought to consult with tribal governments as they develop sustainability policies for the future, and there are executive orders and other policy mandates in the United States that require such consultations in many cases.

However, all too often, tribal consultation protocols become a "procedural" requirement, overlooking the substantive value of involving tribal governments in policy design. In fact, the place of Indigenous peoples within the politics and practice of sustainability has a substantive dimension that is deeply rooted within Indigenous cultures. For this reason, Indigenous sustainability might be better positioned at the center of sustainability studies.

Indigenous peoples have survived as separate and distinct nations within often-challenging natural, political and economic environments precisely because they maintain cultural values consistent with sustainability. Indigenous peoples are unique because they

have a long-standing and intergenerational presence upon their traditional territories, and this “ethics of place” is deeply embedded within their cultures and social organization. For most Indigenous peoples, “sustainability” is the result of conscious and intentional strategies designed to secure a balance between human beings and the natural world and to preserve that balance for the benefit of future generations.

Indigenous sustainability is represented by generations of practices, governance structures and complex knowledge systems. These have enabled Indigenous peoples to survive and adapt over many generations, despite the massive shifts in their social and environmental worlds caused by European settlement of Indigenous lands. Resilience, stability and balance are fundamental values within the constellation of Indigenous sustainability practices. Today, Indigenous nations continue to invoke those values and others as they develop and reinvigorate their own survival mechanisms without compromising culture, tradition, or enduring and long-standing lifeways.

Indigenous knowledge is the cornerstone of Indigenous sustainability practices, a fact which has also received global recognition. The United Nations University Institute for the Advanced Study of Sustainability, for example, highlights its “Traditional Knowledge Initiative,” which seeks to study contemporary Indigenous practices and the use of Indigenous knowledge systems as a way to understand how to use resources efficiently, improve waste management and adapt to climate change.

Indigenous peoples at the center of sustainability studies

Today, many scientists are studying Indigenous traditional knowledge as a tool to identify and document climate change, as well as to design adaptation planning strategies. However, it is necessary to realize that “Indigenous traditional knowledge systems” are complex and diverse. They are also holistic in nature and thus, can only be appropriately governed and maintained by each Indigenous group. Indigenous epistemologies represent important sources of information about the people and their natural environment, including systems of Native science and ethics.

However, Indigenous traditional knowledge should not be “mined” for only those bits of information that are perceived to benefit the entire world. This would be exploitative and represent yet another attempt to “appropriate” from Indigenous peoples for the benefit of others, this time focusing on “intangible” cultural resources, rather than Indigenous lands, cultural patrimony or natural resources. Instead of reprising the historic legacy of past policies, the U.N. Declaration on the Rights of Indigenous Peoples directs states to recognize that Indigenous peoples are the owners and custodians of their traditional knowledge, and they must be the ones to set the terms for disclosing or sharing this knowledge with other groups.

Gary Dirks, the director of ASU’s Julie Ann Wrigley Global Institute of Sustainability, has described sustainability as an effort to promote human prosperity and well-being while protecting and enhancing the earth’s support systems. This statement highlights the importance of “Indigenous sustainability.” Indigenous peoples ought to be at the center of sustainability studies because they are key players in the governance of their lands and territories, and because they embody the construct of “cultural sustainability” that is necessary for human survival as “peoples.”

Indigenous peoples are separate social, political and cultural groups who are now subsumed within the political structures

of nation-states, but they also have an internationally recognized right to “self-determination,” which enables them to have a distinctive voice and place within larger governance structures. In the United States, tribal governments have an important role to play in the design of sustainability policy. Indigenous cultures are distinctive and often maintain significant knowledge about the natural world because Indigenous peoples have been part of their territories since “time immemorial.”

There are similarities and differences between Western and Indigenous knowledge systems. Because they often have different metaphysical constructions of the natural world, the agency of human beings and “other than human” peoples, it is necessary to understand the ways in which the two sets of systems complement one another and where they diverge. The dialogue about sustainability must be generated from within Indigenous thought systems, as well as from within Western thought systems, and the interchange must proceed from a platform of respect and mutual engagement. This type of intercultural sharing between and among diverse peoples will open new opportunities to discover our potential as human beings in an ever-changing natural world.

AUTHOR:
David Eisenman

ABOUT THE AUTHOR:

David Eisenman is an associate natural scientist at RAND and an associate professor in the David Geffen School of Medicine at UCLA and the Fielding UCLA School of Public Health, where he directs the Center for Public Health and Disasters. He and his team at UCLA are collaborating with ASU on a research project led by ASU assistant professor Mikhail Chester. They are modeling how variations in the built environment and the provision of energy can reduce deaths and hospitalizations from heat waves.

Eisenman's research focuses on community resilience and he is particularly interested in fielding and evaluating community-based programs to improve resilience. He has served on committees for the National Academies of Science, the Health Protection Agency of the United Kingdom, and the U.S. Center for Disease Control and Prevention, and is on the editorial board of several academic journals.

AUTHOR:
David Eisenman

DATE:
February 17, 2014

TITLE:
Resilience, Sustainability and Social Justice

THEME AREA:
Inclusion and Social Justice

Note: *February 20, 2014, was the United Nations' World Day of Social Justice. The goal of the annual observance is to remove barriers people face due to gender, age, race, ethnicity, religion, culture, or disability. David Eisenman's expertise is in public health and disasters.*

In their book, "Resilience – Why Things Bounce Back," authors Andrew Zolli and Ann Marie Healy argue that it's time for sustainability to move over and make room for resilience.

Suddenly it seems to me that the whole world is talking about sustainability and resilience. In the field of disasters – my field – both are important concepts, complementary to each other and worthy of action and resources.

But frequently missing from the discussion is one of the most important determinants of sustainability and resilience – social justice. Social justice is central to both.

Disasters Discriminate

Disasters typically occur when events exceed the capacity of a community to recover without assistance. Social injustice – or the inequitable access to resources and allocation of risks, benefits, and burdens – accounts for much of the suffering after disasters.

While disasters may seem like they are equal-opportunity destroyers, they are not. Because of inequities in social conditions – education, employment, housing, transportation – the poor and disenfranchised are disproportionately affected by disasters.

Where we locate our homes is strongly correlated with vulnerability to disaster. The most vulnerable often live where they do because of structural discrimination, made worse by poverty and inattention to cultural norms.

Hurricane Katrina brought to the national spotlight the structural discrimination and injustices lived daily in the Lower Ninth Ward. New Orleans neighborhoods that suffered the greatest losses were disproportionately poor, African American, and below sea level.

So when we see newspaper headlines like "Hurricane Leaves Thousands Homeless," we cannot lay the blame on the physical event. It is the socio-environmental factors that caused the event to have disastrous effects.

A Sustainability Approach

While there is a convincing moral argument for addressing social justice and disaster resilience, there is a practical argument too. In a typical disaster, much of the public expenditure of labor, money, and other resources is spent dealing with the marginalized and disenfranchised segments of society, who suffer greatly and lack the personal resources for response and recovery.

Recovery from a disaster can take years. People who are recovering from a disaster are putting their physical, emotional,

intellectual, and economic resources into recovery and rebuilding, rather than into advancing themselves, their families, and their communities.

A sustainability approach recognizes the social, economic, and environmental benefits of planning for, rather than recovering from, a disaster. A community that is resilient to disaster will be better able to provide its residents with the resources that support their ongoing health, jobs, and quality of life.

And if disasters are social – not natural – phenomena, then any sustainable solution to disasters must address the social along with the physical. Plans for sustainable development must consider the social variability, cultural specificity, and resource inequities that are intrinsic to society.

Building Resilience

My work focuses on creating the means for society's marginalized and most vulnerable individuals to be resilient in disasters. To accomplish this, I prioritize community engagement. Within these marginalized groups is vital social capital – local knowledge, skills, trust, and connections – that are resources in building and maintaining resilience.

I work to network community- and faith-based organizations to government agencies, so that trusted relationships are in place when a disaster strikes. I try to identify the resources people use on a daily basis and how they can be used to prepare for and respond to a disaster.

I reduce barriers to available resources, for instance making sure that risk-preparedness communications are available and accessible to low-literacy or non-English speaking adults or teaching them how to stockpile a week's worth of their heart pills despite not having health insurance.

But how do I know that the work I do to build a community's resilience will be sustained after I and my team depart? This falls into the arena of policy and sustainable development.

Resilience and Sustainability

Discussions of sustainability must include plans for resilience. Resilient communities, like resilient individuals, can harness the resources they need to sustain well-being. For community development to be sustainable, it must be able to maintain healthy social, economic, and environmental systems.

As global climate change marches on and the human footprint on the planet increases, it is resilient communities that will sustain. The vogue for resilience is not a passing thing; we need to understand how to wed it with sustainability. Social justice is at the core of both.

AUTHOR:
Vandana Shiva

ABOUT THE AUTHOR:

Vandana Shiva, a world-renowned environmental thinker, activist, physicist, feminist, philosopher of science, writer and science policy advocate, is the director of The Research Foundation for Science, Technology and Natural Resource Policy. She serves as an ecology advisor to several organizations including the Third World Network and the Asia Pacific People's Environment Network.

In 1993, she was the recipient of the Right Livelihood Award, commonly known as the "Alternative Nobel Prize." A contributing editor to People-Centered Development Forum, she has also written several works including, "Staying Alive," "The Violence of the Green Revolution," "Biopiracy: The Plunder of Nature and Knowledge," "Monocultures of the Mind" and "Water Wars: Privatization, Pollution, and Profit," as well as over 300 papers in leading scientific and technical journals.

AUTHOR:
Vandana Shiva

DATE:
March 21, 2014

TITLE:
In Defense of the Earth and Women's Rights:
Four Decades of Evolution of a Philosophy and Activism

THEME AREA:
Inclusion and Social Justice

Note: *March is Women's History Month, a tribute to the generations of women whose commitment to nature and the planet have proved invaluable to society. Vandana Shiva, originally a theoretical physicist, is an environmental activist, author and expert in ecofeminism. She presented a Wrigley Lecture during the Fall 2014 semester.*

Over the last four decades, I have served grassroots ecological movements, beginning in the 1970s with the historic Chipko (Hug the Tree) Movement, in my region of Central Himalaya. In every movement I have participated in, it was women who led the actions, and women who sustained actions to protect the earth and the sources of their sustenance and livelihoods.

Women of Chipko were protecting their forests because deforestation and logging was leading to floods and droughts. It was leading to landslides and disasters. It was leading to scarcity of fuel and fodder. It was leading to the disappearance of springs and streams, forcing women to walk longer and farther for water.

The dominant paradigm of forestry is based on monocultures of commercial species. Forests are seen as timber mines, producing timber, profits and revenue. The women of Chipko taught me and the world that timber, revenue and profits were not the real products of the forest. The real products were soil, water and pure air.

Today, science refers to these as ecological functions of ecosystems. Illiterate women of the Garhwal Himalaya were four decades ahead of the scientists of the world. By 1981, thanks to the actions of these women, the Indian government was compelled to stop logging in the Central Himalaya.

On Earth Day, 22nd April 2002, I was invited by women from a small hamlet called Plachimada in Palghat, Kerala, to join their struggle against Coca Cola, which was mining 1.5 million liters of water a day, and polluting the water that remained. Women were forced to walk 10 kilometers in search for clean drinking water.

Mayilamma, a tribal woman leading the movement, said they would not walk further for water. Coca Cola must stop stealing their water. The women set up a Satyagraha (Struggle for Truth) camp opposite the Coca Cola factory gates. Over the years I joined them in solidarity. In 2004, Coca Cola was forced to shut down.

Why do women lead ecology movements?

I believe it is because, in the sexual division of labor, women have been left to look after sustenance – providing food and water, providing health and care. When it comes to the sustenance economy, women are both the experts and providers.

Even though women's work in providing sustenance is the most vital human activity, a patriarchal economy which defines the economy only as the economy of the marketplace, treats it as non-work. The patriarchal model of the economy is dominated by one figure – the GDP – which is measured on the basis of an artificially created production boundary (if you produce what you consume, you do not produce).

When an ecological crisis created by an ecologically blind economic paradigm leads to the disappearance of forests and water – and the consequent threat to life and survival – it is women who rise to wake up society and to defend the Earth and their lives. Women are leading the paradigm shift to align the economy with ecology. After all, both are rooted in the word "oikos" – our home.

Not only are women experts in the sustenance economy, they are experts in ecological science. The rise of masculinist science with Descartes, Newton and Bacon led to the domination of reductionist, mechanistic science and a subjugation of knowledge systems based on interconnections and relationships. This includes all indigenous knowledge systems, and women's knowledge.

The most violent display of mechanistic science is in the promotion of industrial agriculture, including GMOs as a solution to hunger and malnutrition. Industrial agriculture uses chemicals developed for warfare as inputs. Genetic engineering is based on the idea of genes as "master molecules" giving unidirectional commands to the rest of the organism.

The reality is that living systems are self-organized, interactive, dynamic. The genome is fluid. As these issues move center stage in every society, it is the alternatives women bring through biodiversity and agro-ecology that offer real solutions to the food and nutrition crisis.

As I have learned over 30 years of building the movement Navdanya, biodiversity produces more than monocultures. Small family farms based on women's participation provide 75 percent of the food eaten in the world. Industrial agriculture only produces 25 percent, while using and destroying 75 percent of the Earth's resources.

When it comes to real solutions to real problems faced by the planet and people, it is the subjugated knowledge and work of women which show the way to the future.

AUTHOR:
Ray Jensen

ABOUT THE AUTHOR:

Ray Jensen serves Arizona State University as its associate vice president for integrated business relationships. In this role, he is developing an integrated sponsorship and digital signage program for ASU along with working on affinity related programs through the Enterprise Marketing Hub and assisting the university in other contracting areas. For several years, Ray served ASU as Associate Vice President for University Business Services and its Sustainability Officer for University Operations, promoting sustainable practices in all areas and developing a long-term strategic plan for institutional sustainability. The father of a son with a disability, Jensen is an advocate for disability services, equity and inclusion.

AUTHOR:
Ray Jensen

DATE:
November 19, 2014

TITLE:
Regarding Inclusion – Do We Leave Anyone Behind?

THEME AREA:
Inclusion and Social Justice

Note: *December 2014 marked eight years since the Convention on the Rights of Persons with Disabilities was adopted at the United Nations headquarters in New York. In this essay, Ray Jensen advocates for a new model to address disability issues, with the goal of improving global sustainability through inclusion.*

The romantic biography of theoretical physicist Stephen Hawking, *The Theory of Everything*, was released this month. Its focus is on the relationship of this extraordinary man and Jane Wilde, who weds Hawking and for as long as she is able, embraces the challenges of his life with amyotrophic lateral sclerosis (ALS). From the trailer, it seems that Hawking received, not a death sentence, but a prison sentence when he was a young man, and gradually was translated into a person with a disability. Sometimes it happens that way.

For other people with disabilities, the point of entry is birth, athletic injury, auto accidents or the violence of war. However it arrives, it is usually unexpected, always unwanted, and often the beginning of a journey that can tax the emotional, financial and relational health, not only of the individual with the disability, but of their family and loved ones.

The Larger Picture

December 3, 2014 marks the United Nations' International Day of Persons with Disabilities (UNIDPD). According to UN data, there are currently over one billion people in the world with some form of disability. UN literature describes this population as the world's largest minority group. Taken as a group, persons with disabilities are the least educated, have the highest rate of unemployment and are associated with twenty percent of the world's poverty. In the United States, the divorce rate for parents of children with disabilities exceeds national averages. In many cultures, in particular third world nations, persons with disabilities can be invisible, often hidden by families who experience shame born of ignorance.

The numbers may get larger. A sizable percentage of our aging population will experience some form of disability in their lifetime. The Institute of Medicine projects that by 2030, this growing number of people with disabilities will impact the social and economic resources available for caring for this population.

Relationship to Sustainability

There is a level of consensus that there are three foundational components of sustainability. We must address the environmental, economic and social dimensions that frame our future. For the past quarter century, it seems that our primary focus has been on the existential challenges to the environment. Environmental solutions and programs are rarely separated from their

economic implications, and we are increasingly aware of the destructive nature of economic polarization, even as we wrestle with differences of opinion on how to reverse existing trends. Our 'three-legged sustainability stool' wobbles on a third leg that appears to suffer from a lack of agreement as to the proper noun to follow the word 'social.' Is it social responsibility, social justice, social what?

Clarifying the social agenda is challenging because we can't easily agree on the values that form the foundation of that agenda. Perhaps we can agree on this: our future is not sustainable if the single largest minority group remains marginalized, with limited opportunity participate and contribute in meaningful ways.

The Way Forward

The theme of this year's UNIDPD is Sustainable Development: the Promise of Technology. This captures my attention, as it touches a number of the University's design imperatives, which have framed our mission over more than a decade.

Arizona State University has become a model for the kind of institution that can successfully embrace complex challenges. Its Julie Ann Wrigley Global Institute of Sustainability integrates transdisciplinary education, solutions-focused research, global outreach and day-to-day operations – a truly comprehensive approach to the challenge of global sustainability.

In my somewhat biased opinion, the ASU Wrigley Institute makes an ideal prototype for comprehensively embracing the subject of disability. An initiative modeled after the institute could include:

- **Education** – The subject of disability can be applied to virtually any topic and would ideally be integrated across the spectrum of an institution's educational offerings.
- **Research** – Comprehensive disability research would include a broad range of projects and programs for the purpose of forming collaborative networks for shared funding and resources.
- **Outreach** – With over 100 nations as signatories to the UN Convention on the Rights of Persons with Disabilities, there is a worldwide opportunity to engage individuals, companies and countries in advancing solutions.
- **Operations** – An institution should be responsive to the needs of its constituents with disabilities, providing opportunities for learning and growth to both able-bodied and disabled affiliates, while in the process improving outcomes for the institution itself.

Going forward, we must all raise our level of engagement to improve the quality of life and opportunities for persons with disabilities. It may be the most significant civil rights issue of the first half of this century. It is certainly integral to a sustainable future.

THEME AREA:

Urbanization and Sustainable Development

AUTHOR:
Sunita Narain

ABOUT THE AUTHOR:

Since 1982, Sunita Narain has worked with the Centre for Science and Environment. She is a prominent environmentalist and writer, publishing *Down to Earth* magazine and authoring the 7th State of India's Environment Reports. In 2005, 2008, and 2009, she was voted one of the world's 100 public intellectuals by the U.S. journal, *Foreign Policy*. Narain's work has ranged from rainwater harvesting to tiger conservation, and from air pollution to climate change. She gave a Wrigley Lecture Series presentation on March 27, 2013, at Arizona State University.

AUTHOR:
Sunita Narain

DATE:
March 20, 2013

TITLE:
Growing in the Context of Climate Change

THEME AREA:
Urbanization and Sustainable Development

We all know the threat of climate change is urgent. We also know combating this threat will require deep and drastic cuts in greenhouse gas emissions. This is when, already, the poor of the world—who are more vulnerable and less able to cope—are feeling the pain of a changing and more variable climate.

The question is: Why has the world been desperately seeking every excuse not to act, even as science has repeatedly confirmed that climate change is real? Climate change, though related to carbon dioxide and other emissions, is also related to economic growth and wealth in the world. Climate change is man-made. It can also devastate the world as we know it.

Shared solutions

The issues are clear, but the answers are lost in avoidance. The reason is simple: climate change is related to economic growth. It is the "market's biggest failure." In spite of protracted negotiations and targets set under the Kyoto Protocol, no country dismisses the correlation between economic growth and increasing emissions. No country has shown how to build a low carbon economy, either.

The solution involves redistributing the responsibility for growth between nations and people. There is a stock of greenhouse gases in the atmosphere, built-up over centuries in the process of creating nations' wealth. This has already made the climate unstable. Poorer nations will now add to this stock through their drive for economic growth. But that is not an excuse for the rich world to not take on tough and deep-binding emission reduction targets. The rich world must reduce so that we can grow. We must also find low-carbon growth strategies for emerging countries, without compromising their right to develop.

This can be done.

Efficiency first

It is clear that countries like India and China provide the world the opportunity to avoid additional emissions. These countries are just beginning to build new energy and industrial infrastructure; they can make investments in leapfrog technologies first, rather than later. Like them, other nations can build their cities on public transport; their energy security on local and distributed systems like biofuels; their industries on energy-efficient technologies.

India and China know it is not in their interest to first pollute then clean up; or first to be inefficient then save energy. But existing technologies are costly. It is not as if China and India are bent on first investing in dirty and inefficient technologies. They invest as the rich world has done: first increase emissions; make money; then invest in efficiency. The global climate agreement must

recognize this fact and provide technology and funds to make the world transition to “efficient first” development.

Reinventing for sufficiency

There is another inconvenient truth: cutting emissions at the scale that is needed will require the world to seriously reinvent the way to growth. The agenda then is to reinvent growth without pollution.

For the past 20 years of climate negotiations–from Rio to Copenhagen–the world has looked for small answers to this big problem. We believed the magic bullet was to plant crops that could fuel the world. We learned quickly that there was a trade-off in the biofuel business when cost of food skyrocketed. The next quick fix was to improve the fuel economy of each vehicle until we found that even as cars became more efficient, people consumed and drove more. The end result was the same: emissions increased. Now we are banking on hybrids. We refuse to learn that the scale of transition will need more than just an efficiency revolution. The transition will need a sufficiency goal.

A new growth model

The options for serious emission reduction are limited in the industrial model we belong to or want to inherit. The world has to look for new ways to cut emissions. There are win-win options, but only if we consider that in all current scenarios, the planet is losing.

This new growth model will need changes in behavior and lifestyle to cut emissions. It will need new drivers to stimulate quick and aggressive technology innovation; changes to take the world beyond the known and the ordinary. This change will not come cheap.

Behavior and lifestyle change is the most inconvenient of all truths. And this is precisely why the already rich world wants to spin a deal weak on commitment and action. This is not good for climate change. This is not good for all of us.

AUTHOR:
Mick Dalrymple

ABOUT THE AUTHOR:

Mick Dalrymple is the practice lead for the Walton Initiatives' Global Sustainability Solutions Services and a senior sustainability scientist. He is a LEED-accredited professional and co-founder of the Arizona Chapter of the U.S. Green Building Council. He was the ASU program manager of Energize Phoenix, an initiative that aimed to save energy, create jobs, and improve local neighborhoods along a 10-mile stretch of Phoenix's light rail. Dalrymple was also instrumental in promoting the Julie Ann Wrigley Global Institute of Sustainability's 2013 Energy Efficiency Idea Guide for Arizona. In addition to his work in sustainability, Dalrymple is also a film producer having developed various green building documentaries and educational videos. He has served as director on the U.S. Green Building Council's National Board; co-founded the Scottsdale-based a.k.a. Green Environmental Building Center; and founded the Scottsdale Green Drinks community. Dalrymple continues to remodel his 1975 home to improve its waste, water, and energy efficiency.

AUTHOR:
Mick Dalrymple

DATE:
May 29, 2013

TITLE:
One Degree: Icing the Heat Island Effect

THEME AREA:
Urbanization and Sustainable Development

Imagine what would happen if an array of stakeholders made a concerted effort to cool the overnight low temperature of downtown Phoenix by one degree. For starters, more people would spend their evenings outdoors, increased economic activity would boost local businesses and tourism dollars, and roughly 21 million kilowatt hours (nearly $2.1 million) of energy would be saved per year.

But most importantly, Phoenix would become a real example to the world that we all can work together to positively change our climate.

Such is the power of One Degree, a simple concept that describes a tremendously complex and ambitious (but doable) challenge to create concerted change that improves community sustainability.

The problem

Phoenix, the sixth largest city in the U.S., is hot and getting hotter. Most climate models predict that Arizona will become drier and experience higher temperatures as climate change sets in. In downtown Phoenix, heat is absorbed and retained in our built environment, only to be re-radiated slowly at night, causing what scientists call an "urban heat island."

The general measure of the urban heat island effect is an increase in the overnight low temperature. A 2002 Arizona State University (ASU) study found that the overnight low temperature at Sky Harbor airport was 17-23 degrees Fahrenheit hotter than surrounding rural areas. This creates negative impacts on energy use, comfort, health, plants, animals, water use, equipment wear and tear, and even social justice, as elderly, poor, Hispanic, and homeless populations are disproportionately impacted.

We can improve the situation by modifying the design of our built environment, creating a counter force to the hotter temperatures.

The goal

By applying ASU's urban heat island and sustainability research, One Degree can galvanize efforts led by the local government, non-governmental organizations, and utilities to create a more livable and resilient local community in Phoenix. The broader, psychological goal is to set an example to the community and to the world that tackling climate change is possible.

We can mitigate urban heat island causes with a portfolio of known actions to physically reduce the annual average overnight low temperature, setting an initial goal of one degree within a time period of five years—enough time to develop a plan, change policies, and implement actions.

Looking to other cities, Chicago has become the "Green Roof Capital" of the United States and has at least 359 now in place. New York City is currently experiencing significant demand and operations shifts in its real

estate market through the city's Greener, Greater Cities Plan that mandates public disclosure of building energy performance. Boston is the latest city to implement a similar mandate, joining Philadelphia, Seattle, San Francisco, Austin, and Washington, D.C. And since 2003, Sacramento has required that 50 percent of parking lots must be shaded by trees. Phoenix can develop key policies to create physical and behavioral change at such scale.

Possible strategies include cool roof ordinances, incentives to use the existing Green Construction Code, and promoting local sourcing and financing. There are many plans and programs already established that could be leveraged through One Degree: Phoenix Tree and Shade Master Plan, utility tree-planting programs, MyPlan Phoenix, Reinvent Phoenix, the Downtown Urban Form Project, and the Sustainable Communities Collaborative.

There are several physical strategies that could be implemented in City of Phoenix operations and promoted in the private sector. To reflect daytime heat, streets and parking lots can be refinished with heat-reflective coatings. Native and low-water trees can shade hard surfaces and cool the surrounding air. Man-made structures can do double duty as shade and solar electricity generators. Vertical parking structures can replace vast expanses of heat-absorbing parking lots. With ASU's assistance and by engaging the private sector and community groups, the possibilities abound.

The outcomes

One Degree is, from an implementation standpoint, an incredibly complex proposition. It involves coordinating many departments within city government, collaborating with many partners with often-divergent goals and management structures, identifying new funding mechanisms, and concerted change.

However, examples and many of the necessary elements exist. City of Phoenix, APS, and ASU successfully structured a complex partnership to create Energize Phoenix. The downtown Phoenix grassroots community is very active and has pulled together many successful wins including Feast on the Street, the arts scene, bicycling improvements, and the burgeoning food truck and local food movements. These examples show that with a common goal, we can come together to organize and implement change.

Even if One Degree's ultimate temperature goal is not reached, the steps taken to get there will still positively impact the livability of the city, reduce energy bills, and provide institutions additional experience with large-scale partnerships to tackle sustainability challenges. Just think of the possibilities if the One Degree goal is a serious *underestimate* of what is actually achievable. Phoenix owes itself the leadership opportunity to find out.

AUTHOR:
Christopher Boone

ABOUT THE AUTHOR:

ASU School of Sustainability Dean Christopher Boone is particularly interested in how social and ecological systems interact in urban environments and how to use this knowledge to plan for sustainable futures. As a professor in the School of Sustainability and School of Human Evolution and Social Change, Boone teaches courses on urban environments, sustainable urbanism, environmental health, and environmental justice. He also serves on the executive committee of the Julie Ann Wrigley Global Institute of Sustainability's Central Arizona-Phoenix Long-Term Ecological Research, a National Science Foundation project that studies urban ecosystems. He is a co-editor of the Cambridge University Press book series, "New Directions in Sustainability and Society."

AUTHOR:
Christopher Boone

DATE:
September 25, 2013

TITLE:
Transitioning to a Sustainable Urban Future

THEME AREA:
Urbanization and Sustainable Development

Note: *Christopher Boone became the dean of Arizona State University's School of Sustainability in July, 2013. He continues to teach in the School of Sustainability and the School of Human Evolution and Social Change. Boone co-edited the book, "Urbanization and Sustainability: Linking urban ecology, environmental justice and global environmental change."*

History shows that significant transitions are possible, and these radical changes can have far-reaching impacts on human beings and the environment. In a span of just three human lifespans—roughly 200 years—we have experienced demographic, energy, and economic transitions that have altered the human condition and our relationship with the planet. In the United States in 1800, birth rates were high, but life could be miserably short; people depended on animals, falling water, and wood for energy; and the economy was based on agriculture and resource extraction.

Today in the U.S., families are not large enough to replace the current generation, but people can expect to enjoy long lives; we are utterly dependent on fossil fuels for energy; and the economy is based mainly on services. The implications of these transitions are multi-faceted and complex, but they have contributed to, among other concerns, rising energy and material demands, global climate change, biodiversity loss, and increasing disparities of human well-being.

Today's transition: urbanism

We are now undergoing another transition, the shift to an urban world. Although cities have existed for at least 10,000 years, not until quite recently could a majority of people live in urban centers. England became the first urban country in 1851, meaning more than half of its population lived in cities. The U.S. did not reach the urban threshold until 1920.

Now that half of humanity lives in cities and nearly all of the projected 3 billion in population growth by 2050 is expected to occur in urban environments, it is critically important—as the transition is underway—to think about sustainable pathways forward. This is no easy goal, especially since many of the current sustainability challenges are the result of living in highly urbanized societies. Cities now consume 65 percent of the world's energy and generate 70 percent of global greenhouse gas emissions. In China, people who move from the countryside to its burgeoning cities double their energy consumption and carbon emissions. Higher incomes in cities mean greater demand for resources and higher production of wastes,

both of which threaten the health of the world's ecosystems.

The twentieth-century model of urbanization cannot be sustained. Instead we need to promote and guide the best assets of urban life—innovation, opportunities for collaboration and exchange, an educated and healthy citizenry, diversity of people and opportunities, concentration of financial, human, and social capital—to build a desirable, sustainable future. Urbanization is going to happen, and happen on a grand scale. It would be unwise to simply stand on the sidelines and watch it unfold; sustainability depends on the ability and willingness to "bend the curve" rather than hope or wait for the system to correct itself.

Bending the curve

A fundamental principle of sustainability is that action and intervention is necessary in order to avoid potentially catastrophic change. Scarcity of fossil fuels, for instance, may eventually force a transition to a renewable energy portfolio, but the danger in waiting for price signals is the environmental damage and human suffering that will occur as a result of increased and persistent carbon dioxide in the atmosphere. Sea level rise is already underway, and many of the world's cities located in low coastal elevation zones are especially vulnerable to damage from rising oceans, storm surges, and an inability or unwillingness to plan for climate change hazards. If municipalities pay heed to early warning signals, careful planning can save human lives, property, and resources. Rather than waiting for crises such as Hurricane Sandy or the devastating European heat wave of 2003, cities can "bend the curve" or accelerate a transition to a new, more desirable, and resilient state.

Leapfrogging into healthy pathways

In most rich, industrial countries, urban populations have reached what appears to be an upper plateau of approximately 80 percent of total population. Many of the challenges of sustainable urbanization in these regions will focus on how to retrofit what is already in place. Most new urban growth over the next 50 years will be in Asia and Africa, not in the megacities that attract most attention, but in cities of less than 500,000 in population. Before these cities dot the landscape, there is a huge opportunity to rethink what cities should be, how they should function, and how they can support rather than hinder global sustainability.

Urban centers created in this century do not have to—and indeed should not—follow the models of cities created in the industrial era of the last century. New York, London, and Tokyo invested billions of dollars in concrete, asphalt, steel, and cables to make the industrial city function. The sunk costs of hard or gray infrastructure make it difficult to try new ways to service the city. New cities built around the idea of green infrastructure using ecosystem services to make cities livable and healthy, is a way to "leapfrog" the traditional pathway.

For instance, foresting watersheds can be a more cost-effective way to maintain water quality than an energy intensive water treatment plant. A forested watershed has other co-benefits, such as recreation space, wildlife habitat, and flood control that make a green infrastructure strategy an attractive proposition.

Many cities built in the twentieth century are now struggling to retrofit their transportation infrastructure that was built to make car use as easy as possible, and

to change it to support public transit and walkability.

New cities can get ahead of this painful and expensive process by designing from the outset with an emphasis on walkable, transit-oriented urban living. The smart money will be invested in urban design that elevates human well-being and ecological integrity.

Let’s not forget equity

An imperative of sustainability is to consider the well-being of future and present generations. Sustainability actions taken by one city could have the effect of undermining well-being elsewhere or for future generations of city dwellers. Well-intentioned recycling programs for electronics, for example, can mean hazardous living conditions for workers in developing cities.

Cities around the world are “teleconnected” to one another, meaning that an action at one place can have a rapid impact on other cities even at great distances. For a sustainable urban transition, we need to take into account the teleconnected systems of cities that function on a global scale. Sustainability at the gross expense of others is inequitable and unjust and could ultimately undermine the ability of the world to function as an urban earth.

AUTHOR:
William McDonough

ABOUT THE AUTHOR:

William McDonough is a globally recognized designer in sustainable development, thought leader, author, sustainable growth pioneer and a member of the Board of Directors for Sustainability at ASU. Trained as an architect, McDonough's interests and influence range widely, and he works at all scales. McDonough has written and lectured extensively on design as the first signal of human intention. He speaks around the country and the world on these issues, and has spoken at ASU's Wrigley Lecture Series and the ASU Sustainability Series.

McDonough is the architect of Delta Development's Park 20|20, which the Arizona State University Global Sustainability Solutions Center at Haarlemmermeer is analyzing to evaluate the connection between productivity and a sustainable, optimized working environment. The goal is for Park 20|20 to utilize the findings of the project to continue to revolutionize and optimize the working environment for its clients.

AUTHOR:
William McDonough

DATE:
April 22, 2014

TITLE:
Building Cities that Celebrate Life

THEME AREA:
Urbanization and Sustainable Development

Living in the age of cities

We live in the age of cities, in the midst of the most dramatic transformation of urban life and the urban landscape the world has ever seen. Cities have always been engines of growth, innovation and opportunity, drawing people from afar since the ancient settlements of Mesopotamia, Egypt, the Indus, and the Yellow River gave urban form to "a certain energized crowding" along their alluvial plains.

But urbanization on a global scale has happened in a heartbeat. It took more than 5,000 years of human development for the world's urban population to approach one billion, in the early 1960s, but in the short half-century since it has more than tripled, reaching 3.5 billion in 2010. By 2030, according to the latest United Nations estimates, five billion people will live in cities, nearly half of them making their lives in homes, schools, workplaces and parks that do not yet exist.

To be sure, the global urban boom, "the big build-out," presents formidable challenges, but it also offers extraordinary opportunities for regenerative urban growth—growth that supports healthy communities, thriving ecosystems and productive, vigorous economies in cities old and new.

Good design supports sustainable growth

One fast-growing city in which I'm very excited to be working is the Municipality of Haarlemmermeer, in the Netherlands. Amsterdam's nearby neighbor, the relatively new city of Haarlemmermeer has an international reputation as a supportive, innovative place to establish a sustainable business, and William McDonough + Partners had the privilege of designing the master plan for a new development there.

Working closely with Haarlemmermeer and Delta Development, we designed the first large-scale Cradle to Cradle®-inspired urban development in the Netherlands, Park 20|20. Designed as a dynamic environmental system, the 28-acre site now supports a vibrant, sustainable business community, home to Bosch Siemens Hausgerate, Fox Vakanties and FIFPro, among others. It is a healthy, delightful, productive place, a beacon of good urban growth.

Park 20|20 supports sustainable growth by enhancing the positive, productive effects of good design. Rather than seeking to simply minimize the negative environmental impacts of real estate development, it celebrates the use and re-use of safe, healthy materials; the generation and harvesting of renewable energy, food, clean water and oxygen-rich air; the restoration of ecological health and biodiversity. In other words, it celebrates life. As the marble cutters in Italy like to say when looking at a beautiful piece of stone, "God never has a bad day."

Natural systems as a model for urban design

Cradle to Cradle generates life-enhancing growth by recognizing healthy, productive natural systems as the model for human designs. From an urban planning perspective, that means seeing each site as a unique ecological system; responding creatively to its natural and cultural landscapes; and enhancing the natural flows of nutrients, water, and clean energy that support life and regenerative growth. It means creating a community of integrated buildings and systems that perform like natural nutrient cycles, an organism or metabolism of viable size and density to serve as urban-scale infrastructure.

Park 20|20 can be seen as an "essay of clues" in Cradle to Cradle-inspired urban design, its network of gardens, green roofs and living buildings making regenerative growth part of the development landscape. Greenhouses grow food and supply Park 20/20 restaurants, where the meals could not be fresher. Green roofs provide habitat for butterflies and birds, while green walls produce oxygen for human inhabitants. Landscape connectivity links the community to a regional system of parks, wetlands and greenways, strengthening an emerging foundation of biodiversity.

Preparing for the future through Cradle to Cradle strategies

Park 20|20's buildings employ many Cradle to Cradle-inspired strategies, wherever possible, from orientation to the daily and seasonal path of the sun to maximize exposure to natural light, to photosynthetic optimization of surfaces. Photovoltaic arrays and green roofs serve as the buildings' "leaves and roots," harvesting clean renewable energy, absorbing and filtering water, and providing habitats.

Wastewater is collected through a district loop and treated in a solar aquatic system on site. Bio-gas from water treatment powers turbines for electricity. Heat generated in that process produces hot water for the hotel. As many Cradle to Cradle Certified™ Products as possible have been used throughout. Their coherent use turns buildings into material banks, storage sites of valuable commodities for future generations.

A city designed to celebrate life

These elements underpin the productivity of Park 20|20, and people who come here to spend their day are finding that it is a wonderful place to be. Fresh air, sunlight, and water are plentiful. The environment, indoors and out, is beautiful, comfortable and safe. People have easy access to gardens, parks, waterways and transit, as well as new ideas, knowledge and a creative, innovative community.

There are markets and theaters, athletic fields and restaurants. And more. That's the bounty cities can offer when they're designed to celebrate life. And when they are, cities can perform the essential service of 21st century urbanism: creating regenerative buildings and landscapes that produce more good for more people rather than places that are merely less bad. More clean energy, more fresh water, more fertile soil, more food, more productivity, more biodiversity—more health and well-being for all.

AUTHOR:
John Trujillo

ABOUT THE AUTHOR:

John Trujillo is the director of Public Works at the City of Phoenix and heads the City's Reimagine Phoenix initiative. In January 2014, the Phoenix City Council approved funding for $2 million to initiate the Resource Innovation and Solutions Network, which is managed and operated by the Global Sustainability Solutions Services, a program within the Walton Sustainability Solutions Initiatives at ASU.

AUTHOR:
John Trujillo

DATE:
July 31, 2015

TITLE:
Reimagining Phoenix by Pitching Waste

THEME AREA:
Urbanization and Sustainable Development

The current world population of 7.2 billion is projected to increase by almost another billion by 2025 – reaching 9.6 billion by 2050. A report by McKinsey & Company states that three billion people from developing countries will rise into the middle class by 2030. This population growth will create an unprecedented demand for our planet's already limited resources, thereby increasing commodity prices and the cost of future manufacturing and reducing our natural resources.

Currently, we work in a linear economy society that extracts resources to make products for consumers to use. The vast majority of these products are then disposed of in landfills where we manage and maintain environmental controls for decades. The City of Phoenix wants to change that concept by creating a circular economy in which we divert waste from landfills and keep resources in use for as long as possible, extracting the maximum value from them while in use and then recovering and regenerating products and materials at the end.

To create that transition from a linear economy to a circular economy requires a departure from the large-scale industrial status quo – along with extensive engagement of corporate, cultural and civic leaders – to be successful. Additionally, research on and development of new processing methods will be essential to transform our waste into new products and resources. A successful transition to a circular model would enable vast amounts of innovation and collaboration across a variety of industries, both private and public, resulting in truly exciting economic and sustainability developments.

The main driver of economic benefits in the circular model is derived from the ability to restore materials that would normally be disposed of in a linear production model. The restoration of these materials leads to multiple cycles of product use. The process of product reuse, repair, remanufacture or recycle is more energy- and cost-efficient than producing from scratch.

Reimagine Phoenix was developed to create a cultural and behavioral shift among Phoenix residents and businesses in order to achieve the city's waste diversion goal of 40 percent by the year 2020. The campaign centers its main message on repositioning trash as a valuable resource rather than a material to be thrown away. Reimagine Phoenix deploys a comprehensive strategy to gain public buy-in and achieve measurable results through programmatic changes to existing solid waste programs, an inclusive communications plan designed to reach multiple target audiences, and partnerships with regional and private sector organizations.

To accomplish this established goal, the city is working to invest in infrastructure for mixed waste and/or other solid waste diversion technologies that will help divert additional recoverable material in the municipal solid waste stream from the landfill and create a

circular system focused on job creation, new revenue for the City of Phoenix and innovative development.

The City of Phoenix demonstrated its commitment and investment in innovation development by establishing a partnership with Arizona State University's Walton Sustainability Solutions Initiatives as part of the city's Reimagine Phoenix initiative. Together, the city and ASU created the Resource Innovation and Solutions Network (RISN), a global network of public and private partners who share the goal of creating economic value and driving a sustainable circular economy. RISN encompasses partnerships that cultivate cutting-edge research and development opportunities to advance the diversion of waste while generating economic value through the creation and advancement of new technologies.

The city is fostering public and private partnerships through the development of the Resource Innovation Campus, occupying the area from 27th Avenue to 35th Avenue, and from Lower Buckeye Road south to Rio Salado. RISN, which will be headquartered at the Resource Innovation Campus in Phoenix, will manage the on-site Technology Solutions Incubator space for innovators developing emerging products and technologies from the city's waste resources. The vision of the Resource Innovation Campus is to be a world-leading, vibrant innovation hub, demonstrating the values of Reimagine Phoenix and the principles and benefits of a circular economy in action.

This campus is an example of the City of Phoenix's commitment to innovation and has led to the creation of international RISN hubs in Guatemala and Lagos, Nigeria – making RISN a truly global network. We are privileged to have ASU's Walton Sustainability Solutions Initiatives as a partner in this important endeavor.

THEME AREA:

Climate Change and Resilience

AUTHOR:
Lawrence M. Krauss

ABOUT THE AUTHOR:

Lawrence M. Krauss is Foundation Professor in the School of Earth and Space Exploration and director of the Origins Project at ASU. Well known internationally for his work in theoretical physics, he is the only physicist to have received major awards from all three U.S. physics societies: the American Physical Society, the American Institute of Physics, and the American Association of Physics Teachers. He is the author of more than three hundred scientific publications and nine books, including best sellers such as "The Physics of Star Trek" and, most recently, "A Universe from Nothing." Krauss is a commentator and essayist for newspapers such as the *New York Times* and the *Wall Street Journal*, has written regular columns for *New Scientist* and *Scientific American* magazines, and appears frequently on radio and television. He serves as co-chair of the Board of Sponsors of the Bulletin of the Atomic Scientists and on the Board of Directors of the Federation of American Scientists.

AUTHOR:
Lawrence M. Krauss

DATE:
March 29, 2012

TITLE:
Sustainability Waits: Doomsday Clock Ticks Forward

THEME AREA:
Climate Change and Resilience

Shortly after the end of World War II, Albert Einstein uttered his now famous warning about the new global danger of nuclear weapons: “Everything has changed, save the way we think.”

In the intervening sixty-odd years, the world has continued to change and become even more dangerous. And still, there is no great evidence that our way of thinking about global catastrophes has evolved to meet the challenges.

I am currently honored to be co-chair of the Board of Sponsors of the Bulletin of the Atomic Scientists – a body created by Albert Einstein and Robert Oppenheimer in 1946 to help warn the public about the dangers of nuclear war.

Perhaps the most visible face of the Bulletin is the “Doomsday Clock,” which was created in 1947 to graphically reflect how close we might be to human-induced apocalypse. The idea of the clock is to display the “number of minutes to midnight,” a point at which we reach apocalypse and time itself no longer matters.

Over the intervening 65 years the clock has been adjusted 20 times, moving as close to two minutes to midnight in 1953 after both the U.S. and Soviet Union first tested thermonuclear devices, and as far as 17 minutes to midnight in 1991 after the U.S. and Soviet Union signed the Strategic Arms Reduction Treaty.

In 2007, however, we at the Bulletin recognized that nuclear war was no longer the only significant global threat facing humanity. The emerging possibility of biologically induced weapons, particularly biological terrorism, led us to consider the possible global dangers associated with these new technologies. Fortunately, our findings on their probability have been mildly encouraging.

While the dangers associated with creating new lethal viruses are significant, the technological sophistication required and the difficulties of wide dispersal reduce the likelihood that these weapons might have a global impact. For the moment, at least, bioterrorism is a subdominant threat.

At the same time, a new global threat has clearly arisen – climate change. While its impact might be less immediate than that of a nuclear conflagration and its harmful effects difficult to quantify at present, human-induced climate change has emerged as one of the greatest global challenges confronting humanity’s outmoded mindset. Nevertheless, attempts to address this challenge have not been encouraging.

Two factors play significant roles. First is the issue of national self-interest. Due to historic rivalries and local economic pressures, most nations are not eager to make sacrifices that may largely benefit those outside their borders. Even countries wanting to limit greenhouse gas emissions face the reality

that acting now, while other industrialized countries do not, could put them at a competitive disadvantage in the near term. We are a long way from developing a political framework that allows countries to play well together globally.

Second, at least in the U.S., is the issue of money and its influence on policy. During the 2008 presidential election, climate change was a hot political issue. During the 2012 campaign it has all but disappeared from view. Instead, opponents of climate change policies have followed a strategy of strict denial.

How the campaign to discredit climate change was won in the U.S. over the past four years will no doubt be the subject of many future studies, but one thing is obvious. Money for disinformation altered the national debate. Significantly, this disinformation effort was bankrolled by wealthy conservatives and lobby groups working for industries that are responsible for much of our carbon emissions.

The hard result is that the amount spent each year in this country to discredit climate change science exceeds the entire budget of the Intergovernmental Panel on Climate Change – the scientific body established to address its effects. Faced with such a daunting financial disparity, it is not hard to see why science is losing out.

Taking note of these new challenges as well as exacerbations of existing ones, with nuclear weapons still representing the most urgent pressing danger facing humanity, the Bulletin in January 2012 decided to turn the Doomsday Clock forward one minute. It now stands at five minutes to midnight. The actual value, however, may not be as important as the trend toward increasing danger. From what we observe, new global thinking to address new global challenges remains absent at the highest levels of international governance.

As a cosmologist who thinks about the truly long term future of the universe, I am fond of saying that the universe is the way it is, whether we like it or not. But when it comes to our own future in the next century on this planet, we have more choice. At this moment, it appears we are choosing to live, not in the best of all worlds, but in one where nuclear tensions and climate change continue unabated.

AUTHOR:
John Sabo

ABOUT THE AUTHOR:

John Sabo is a senior sustainability scientist, professor in the School of Life Sciences and an affiliated faculty member in the Center for Biodiversity Outcomes. He is also the Julie Ann Wrigley Global Institute of Sustainability's former director of research development. In this role, he led a grant proposal team that, since 2008, brought in over $44 million in expenditures. Sabo also collaborates with scientists across the U.S., investigating the impacts of water shortages on the sustainability of human and natural systems. All of his work is geared toward understanding the sustainable management of water resources for humans and biodiversity.

AUTHOR:
John Sabo

DATE:
August 27, 2013

TITLE:
The Second Moment of Climate Change:
Fire, Flood and Drought

THEME AREA:
Climate Change and Resilience

The year 2013 will be remembered in the U.S. as a year of extremes: The effects of Hurricane Sandy continue to cripple New York City. Droughts across the Corn Belt are causing massive crop failure. Devastating fires destroyed hundreds of homes in Colorado for a second year in a row. Flash floods have claimed lives and businesses from coast to coast, including communities experiencing recent drought and fire. This year was exceptional. Or was it?

When most people think of climate change, they think of global warming—the trend of rising air temperatures that causes a shift in expected or long-term average climate conditions. There are valid exceptions to the trend of course. Many people observe their cities occasionally cooling, and therefore think global warming is not happening. Local observations that differ from the global average from time to time are an example of a second aspect of climate change that is equally, if not more important, than the global trend: climate change exacerbates regional differences in climate as well as the swing between years of famine and years of plenty.

In statistical terminology, the climate change trend and increasing trend departures are explained as changes in the "moments" of our long-term climate record. Translation: think of the bell curve from a large college class. The peak of the bell curve is the most common test score (e.g., a "C"). This peak is the first "moment" (also called the average), and climate scientists predict this moment will move to the right during warmer temperatures.

Now back to test scores. The width of the bell curve represents the variation in all test scores. A wider bell curve means less Cs and more As and Fs among college classmates, or in the case of climate, extremely high temperatures and extremely low temperatures. The width of the bell curve is the second "moment" (also called the variance), and is also predicted to increase during climate change.

Both predictions have been observed in our current climate record; the first moment (peak of bell curve) and second moment (width of bell curve) have both increased. The increase in the second moment is best exemplified by year 2013: our exceptional year of extremes.

Recent impact of climate change

A few examples illustrate this point:

This year, the state of New York is recovering from the largest Atlantic hurricane on record causing an estimated $65 billion in damage. The ensuing summer, a July heat wave pushed temperatures in downtown Manhattan to record levels. During the same summer, the fourth 100-year flood in ten years destroyed houses and claimed lives in the Mohawk and Hudson valleys.

In Phoenix, June temperatures skimmed 120 degrees Fahrenheit, among the hottest in 100 years. Mile-high dust storms uprooted trees and damaged houses for the third consecutive year, and to add insult to injury, flash floods followed the dust storms. In this same year, forest fires claimed the lives of 19 fire fighters in the small town of Yarnell, 60 miles outside of Phoenix.

Finally, in Colorado Springs, after over a decade of drought statewide, the Waldo Canyon (2012) and the Black Forest (2013) fires burned a combined 51 square-miles, destroyed 857 houses, and were the second and first most destructive fires on record in the state. More recently, the town of Manitou experienced mud slides and flash floods that moved cars and homes after heavy rains fell on the Waldo Canyon burn site.

Cutting the cost of climate change

As we continue to experience climate change, adaptation to new climates will require us to embrace the second moment of extremes. Increased hurricane strength and higher storm surges characterize the second moment of climate change, from Lady Liberty to the Gulf Stream waters. The drought-fire-flood syndrome is the new norm from “amber waves of grain through purple mountain majesty,” all the way to the redwood forest. How do we mitigate risk in a world where the second moment of climate change is increasing?

Embracing the second moment has great consequences for our economy and public policy. The second moment of climate change is and will continue to stress federal insurance programs for fire, floods, and crop failure, likely shifting the burden of reinsurance from the public to the private sector. This means it will be more expensive to rebuild in riskier fire- and flood-prone areas. The insurance premiums may rival crop revenue or the property value for a house in the woods; or these assets may simply not be insurable.

Coastal cities are no longer rebuilding over and over again, but incentivizing relocating out of the path of hurricanes. In New York, Governor Cuomo offered to pay citizens not to rebuild parts of Staten Island neighborhoods most devastated by Hurricane Sandy. A one-time adjustment with a no-rebuild stipulation prevents future claims and costs.

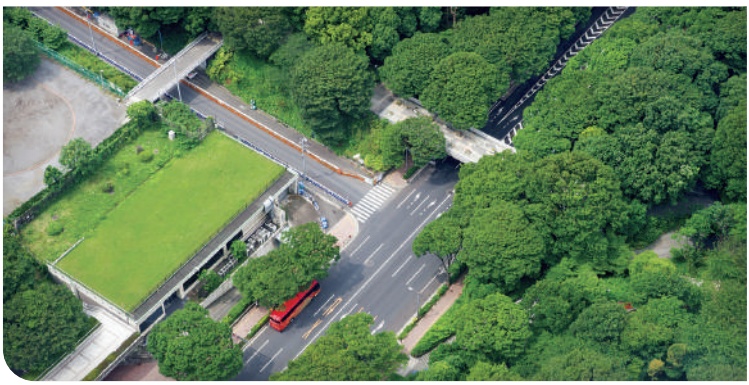
In other parts of the U.S. where the drought-fire-flood syndrome prevails, we should adopt similar forward-thinking. We should be giving bigger settlements to farmers who choose not to replant a series of failed crops and to homeowners who choose to move to the proverbial higher ground. A higher one-time payment with a no-rebuild or no-replant clause could incentivize and expedite the transition from high- to low-risk housing and farming.

Doing this, we can increase our resilience to the second moment of climate change.

AUTHOR:
Nancy Grimm

ABOUT THE AUTHOR:

Nancy Grimm is a senior sustainability scientist, professor in the School of Life Sciences and director of the ASU Wrigley Institute's NSF-funded Central Arizona-Phoenix Long-Term Ecological Research (CAP LTER) project since its inception in 1997. As the director of CAP LTER, Grimm collaborates with hydrologists, engineers, geologists, chemists, sociologists, and others to study the complex urban social-technological-ecological system of metro Phoenix. Her own research focuses on climate variability impacts on biogeochemical processes in urban, desert, and stream ecosystems. She received her doctoral and master's degrees in zoology from Arizona State University and her bachelor's degree in natural science from Hampshire College.



AUTHOR:
Nancy Grimm

DATE:
December 18, 2013

TITLE:
The Anthropocene: Humanity's Age of Change

THEME AREA:
Climate Change and Resilience

In 2014, the United States will release its third National Climate Assessment (NCA) based on the efforts of hundreds of scientists and practitioners over a three-year period. During 2011-2012, I served as a senior scientist for the NCA in Washington, DC. I worked with teams who assessed the current and future impacts of human-caused climate change on biogeochemical cycles, ecosystems, and urban systems. These topics are highly interrelated and solutions to climate and global challenges must recognize their interdependence. A sustainable future depends on rethinking the extraction and recycling of Earth's mineral resources, reducing impacts on ecosystems, and investing in building sustainable cities.

Why climate is changing: biogeochemical cycles

Human activities, especially since the Industrial Revolution, have changed our world so much that some scientists believe we are living in a new geologic era: the Anthropocene. Accelerating changes in all kinds of human activities—such as automobile use, fast food restaurants, direct foreign investments, and paper or wood consumption—are mirrored by ever-changing environmental conditions like increasing surface temperature, deforestation, and ozone depletion.

Among these environmental changes, the rise of carbon dioxide in the atmosphere, a direct consequence of our accelerating fossil fuel burning, is the most important driver of changes that we are already seeing in our climate system. Thus, it is essentially a major, human-caused disruption in the carbon cycle that has created one of our greatest challenges for sustainability.

Now in the Anthropocene, we also are mobilizing more nitrogen, phosphorus, and metals from the Earth's crust and atmosphere, contributing not only to climate change but to other problems such as air, water, and soil pollution and excess fertilization of some land- and sea-based ecosystems. Alteration of these biogeochemical cycles feeds back to climate and paradoxically, can result in shortages through inequitable extraction and distributions of these nutrient and mineral resources worldwide.

Reduce impacts on ecosystems; reduce impacts on us

Ecosystems capture and transform energy and cycle materials. They provide the "stage" for individual plants, animals, and microorganisms to interact and go through their life stages. Some of the energy capture, material cycling, or life processes of individual species end up benefiting people, although that is not their so-called purpose. We call these benefits ecosystem services. The growth of commercially important fish is one example; water purification by rivers is another.

Major impacts on species from climate change and other stressors of the Anthropocene—including changes in the timing of major

life events like flowering, insect emergence, shifts in ranges, and even extinctions—have already begun and are expected to continue unabated unless we reduce greenhouse gas emissions. When species' loss and shifts are accompanied by physical changes in climate and increased extreme events, dramatic consequences in ecosystem services such as crop or forest products provisions, pollutant removal, and storm surge protection can occur.

Shifts and changes in species and ecosystems have obvious consequences for people, and experience is showing that promoting ecosystem integrity can reduce those impacts. Avoiding economic losses or food shortages as a result of reduced agricultural productivity and fisheries decline will require society to be nimble in management practices. The human and financial costs associated with the impacts of extreme weather events are well documented. Superstorm Sandy reminded us how intact oyster reefs and sand dunes provide ecosystem protection and reduced property loss.

Of course, causes are not always clearly assignable to climate change. In the Anthropocene, multiple interacting stressors are affecting people and ecosystems. One is of our own making: the massive human migration to cities that transformed the more developed world in the past century and that is now transforming the developing world even more rapidly.

Why cities?

How cities will be affected by and respond to a changing climate are questions of primary importance to society. But cities also are important *drivers* of environmental changes locally, nationally, and globally. As concentrated centers of human lives and activity, cities draw upon the non-urban world for resources to build infrastructure, support consumption, and drive production. Cities collectively influence global-scale climate trends by contributing up to 70 percent of annual global greenhouse gas emissions. So it is logical to suggest that we need a better understanding of how urban ecosystems interact with the carbon cycle in order to develop strategies that reduce emissions.

As the global population shifts to urban living, society's ability to provide for basic human needs is an issue of utmost importance. When compounded with climate change, the urgent need to find solutions comes into greater focus.

For example, increasing frequency and severity of extreme events are an especially high risk for cities where housing, transportation, energy generation, and other sectors are often concentrated. Even the location of many cities—on coasts, along large rivers, and in the drought-prone interior U.S. West—increases their vulnerability. But so far, we have mostly relied on historical data to evaluate risk and a "hard" engineered infrastructure (like a levee or a sea wall) to "protect" us from climate-related extremes. In the changing conditions of the Anthropocene, a "new normal" demands a new approach.

City governments are keenly aware of these issues. Indeed, climate-change mitigation and adaptation actions, or at least planning, are taking place to a greater extent at this level of government than at state or national levels. After all, cities are places where people are concentrated, and with them, a great potential for innovation and solutions.

In my view, we need to stop thinking of our inventions and our built environment as a replacement for nature's benefits or as a way to push nature out of our lives. Instead, when we design our cities, we must develop complementary ecological and engineered infrastructure that will not draw excessively on other ecosystems nor degrade the environment of downstream ecosystems or future generations.

In the Anthropocene, the new city for the new normal will be a flexible, resilient, diverse nesting place for humanity.

AUTHOR:
Hallie Eakin

ABOUT THE AUTHOR:

Hallie Eakin is an associate professor in the School of Sustainability, where she teaches courses on sustainable worlds. Her recent research investigated economic globalization, agricultural change, and rural vulnerability to climate in the context of comparative international projects involving case studies in Mexico, Argentina, Guatemala, and Honduras. She is currently exploring coffee farmers' adaptive strategies in Mexico and Central America. Eakin has consulted with the World Bank, the United States Agency for International Development, and the United States Environmental Protection Agency on projects in agricultural development, the use of seasonal forecasting in drought risk mitigation, and adaptation to anticipated climate-change impacts on urban water availability.

AUTHOR:
Hallie Eakin

DATE:
January 21, 2014

TITLE:
Climate Adaptation: Lessons from Family Farming

THEME AREA:
Climate Change and Resilience

Note: *2014 was the United Nations' International Year of Family Farming. The goal of the observance was to call attention to the role of family farming in achieving sustainable development. Senior Sustainability Scientist Hallie Eakin is an expert in agrarian change, vulnerability, and adaptation. Her work was featured on Arizona PBS's Horizon program.*

The International Year of Family Farming (IYFF) focuses on the role of the family farm in meeting our most pressing sustainability challenges: food security, poverty alleviation, and environmental integrity. That family farms are now seen as significant in solving these challenges, rather than causing them, marks a revolution in international thinking.

Many people envision small-scale farms as unfortunate features of the developing world: impoverished, lacking basic services, and suffering from economic insecurity and, ironically, hunger. Associating poverty and hunger with smallholder communities is not unfounded, but does family farming cause poverty or food insecurity? My work in Latin America, and that of many other scientists elsewhere, clearly answers, "No."

Our collective evidence demonstrates that small-scale farms can play significant roles in feeding the world. They can both support and enhance biodiversity and also promote regional economic growth and technological and entrepreneurial innovation.

For most smallholders, agriculture is more than a living; it is what makes living meaningful. The family farmers that I have studied in Mexico, Central America, and even here in central Arizona are among the more resourceful on the planet: their livelihoods are founded on family labor, social ties, risk sharing, technological innovation and, perhaps most important, vocation – a real commitment and love for the difficult work entailed.

Maize and Multifunctionality

Besides IYFF, 2014 is also the 20th anniversary of the North American Free Trade Agreement (NAFTA). Since NAFTA's signing, I have collaborated with researchers in Mexico to document the changes in the rural sector – particularly to the production of maize, the basic staple and iconic ingredient of Mexican cuisine. NAFTA was widely expected to transform Mexico's agriculture by moving small-scale producers off the farm into more lucrative economic activities and by concentrating production in more efficient, irrigated, and large-scale farms. Public policy certainly supported this shift: resources were diverted to large farms to support production for export and investment in smallholders declined rapidly.

Nevertheless, the small-scale campesino farmer has persisted, despite increasing drought and flood events, lack of economic incentives, and increasing urban opportunities. Today there are still approximately 2.8 million

maize farmers in Mexico, the majority producing on small land parcels under almost every ecological condition possible. Land area in maize has declined, but the primary change has been economic: without a supportive policy environment smallholders are not selling in formal markets.

The situation in Mexico suggests first that maize has significance beyond its value as an economic commodity. It remains the most important source of sustenance for Mexicans. While small-scale farmers may not be selling it in formal markets, they are actively trading and sharing maize in their communities. In doing so, they are maintaining agro-biodiversity, supporting community food security, and building strong social ties that are fundamental for sustainable development.

Second, rather than symbolizing poverty, maize provides insurance against the uncertainty of urban employment. Economic conditions have significantly improved across Mexico, and rural households now have access to opportunities off-farm. Formal employment, however, continues to be unstable or inaccessible in many areas. Maize – despite pests and climatic losses – provides a basis for livelihood security.

Third, maize remains the key ingredient for the traditional cuisine still highly valued by the rising Mexican middle class. Some households continue to grow maize even when they adopt urban lifestyles. Some peri-urban households are now establishing small-scale businesses, selling homemade tortillas, pozole, atole, and other traditional dishes to urban consumers who no longer have land to farm.

Finally, maize farming still occupies over half the agricultural land in Mexico, and the associated resources – soil, water, biodiversity – are managed by small-scale family farmers. These farmers are essential to solving the environmental challenges of the coming decades.

Learning from Smallholders about Risk

Climate change is one of the biggest threats to food production in the coming decades. Family farming is an incredibly risky activity, and small-scale producers are the most vulnerable. Imagine betting your yearly income and food security on the vagaries of weather, soils, pests, and markets! These conditions, however, have enabled farmers around the world to develop innovative and robust ways of managing risk: they diversify their crops, they find alternative sources of income, they collaborate with neighbors to share technology, knowledge, and seeds, and they join cooperatives to develop collective means of marketing their products.

As we face a warming world with limited understanding about how crop pests will behave, how farming will be affected, and how markets will respond, we need to take a second look at the strategies and knowledge of family farmers. Making agriculture more robust during climate change requires learning to live with risk and surprise; smallholder farming can teach us a great deal.

Small-scale producers will need support in return: they cannot meet the world’s food needs alone. Truly collaborative research among scientists and smallholders, combined with innovative policies that recognize the potential of family farming for sustainable development is necessary. As consumers, we need to support these efforts and in doing so, celebrate the multiple values and meanings associated with farming and food.

May 2014 be a year in which smallholders thrive, to all of our benefit!

THEME AREA:

Art, Design and Communications

AUTHOR:
Peter Byck

ABOUT THE AUTHOR:

Documentary filmmaker Peter Byck joined the School of Sustainability as a professor of practice in Fall 2013. His position is jointly shared with the Walter Cronkite School of Journalism and Mass Communication, where he teaches students how to create their own clean energy documentaries.

Byck has spent nearly three decades in the film business, working for studios and directing and editing his own documentaries, “Garbage” and “Carbon Nation.” He is collaborating with ASU to develop a series of short films for Carbon Nation 2.0. Byck’s work and teachings focus on real-world solutions to today’s energy and land-use opportunities. He received his B.F.A. in Film/Video from the California Institute of the Arts in 1986.

AUTHOR:
Peter Byck

DATE:
November 25, 2013

TITLE:
Everyone Likes a Good, Low-Carbon Story

THEME AREA:
Art, Design and Communications

Can good storytelling lead us to a low-carbon economy? And can I help students become good storytellers? These questions have led me to Arizona State University to become a joint professor of practice for the School of Sustainability and the Walter Cronkite School of Journalism and Mass Communication.

The Greeks had an expression that I will roughly paraphrase: "The storyteller rules society." So the power of good storytelling is clearly not a new idea; but, storytelling has been a tough nut to crack for the folks who aspire to guide us to a low-carbon economy. I think the reason is simple enough: The scientists, engineers, and thought-leaders focused on sustainability are good at what they do; they just are not trained in storytelling. That's why Carl Sagan became so well-known – a brilliant scientist and a fantastic story-teller – a powerful combination.

For me, documentaries are an excellent way to get a story told. Films aren't the only storytelling game in town, to be sure, but they are incredibly accessible and easily disseminated now with the World Wide Web. And great documentaries actually change society. The Thin Blue Line proved that by using DNA, many people on death row were actually innocent. Super Size Me literally showed that too much fast food is, indeed, bad for one's health; at least it was damaging for the filmmaker and his liver.

I continue to teach students from the School of Sustainability and the Walter Cronkite School of Journalism and Mass Communication what it takes to make a quality documentary in my new course, Sustainability Storytelling. That being said, I'll be happiest if they learn the craft and disciplines inherent in filmmaking so they can continue making films well after the class is complete. The students are challenged with making a short, 5-minute documentary profiling a clean energy story. This first semester is focused on Arizona's place as a national leader in solar power and whether solar power will continue to grow.

The story of rooftop solar and gas taxes

Arizona has just taken the lead nationally for rooftop installations per capita. This success has put a serious issue onto the front pages of the state's newspapers. The same issue has been brewing for a few years in San Diego, which Arizona just displaced with the most residential solar. When the utilities charge their customers for electricity, they incorporate a fee for transmission line maintenance into the monthly statement. It's not a separate charge; it's blended in. Now, when someone has rooftop solar, they're buying much less electricity from the utility thus the utility is collecting less money to repair the lines. The homeowner is still tethered to the grid for when they need more utility power (cloudy days, night-

time) and, importantly, so they can sell all excess power back to the utility at a retail rate. Many policy questions could be changed this fall: Will the utility be able to separate a transmission line fee from an electricity fee? Will they be able to do it at a charge that doesn't completely undermine homeowners continuing to install solar in the first place? And will the utilities still to be required to buy back residential solar at a retail rate?

Let me give you another clean energy conundrum coming down the pike – literally. State and federal road repairs are funded with gasoline taxes. Imagine a day when a good chunk of peoples' cars are electric – we're not there yet, but this could change quickly in the next decade (think about how many people had cell phones in 1989). So, all those electric cars won't be filling up, and big piles of gas tax revenue will disappear. Or will it? Will the taxes be torn from their tie to gas sales, and will they then be tied to miles driven? How will tax collectors figure out how many miles I'll drive next year in my new Tesla Model S Sedan (I don't own a Tesla… yet). And what about my rights to privacy – can the revenue folks figure out how many miles I drive without tracking which miles exactly that I'm driving?

Our power source

We can now actually see a near future where solar could be powering a serious slice of our homes and cars. Which leads me back to solar and utilities: Thomas Edison can be credited with helping to invent the very utility industry that's now in such flux. He had something very prophetic to say about future energy use: "We are like tenant farmers chopping down the fence around our house for fuel when we should be using Nature's inexhaustible sources of energy – sun, wind, and tide. I'd put my money on the sun and solar energy. What a source of power! I hope we don't have to wait until oil and coal run out before we tackle that."

Now in my first class at ASU, I look forward to the students' take on these complex and intriguing solar issues in Arizona. I look forward to their mouths dropping when they learn how much work goes into a 5-minute film. And I really look forward to the premiere of their work this coming December.

AUTHOR:
Heather Lineberry

ABOUT THE AUTHOR:

Heather Sealy Lineberry is senior curator and associate director of the Arizona State University Art Museum and a senior sustainability scholar at the Julie Ann Wrigley Global Institute of Sustainability. Collaborating with artists, faculty and students across disciplines and with community members, her curatorial work explores how new art practices can impact decision making and change entrenched behaviors and systems. The textbook she mentions in this essay is forthcoming in 2016: “Sustainability Science – An Introduction,” edited by Heinrichs, Martens, Michelsen & Wiek, and published by Springer, Berlin and New York.

For more information on social practice projects at the ASU Art Museum, visit http://asuartmuseum.org/social-studies-projects.php.

AUTHOR:
Heather Lineberry

DATE:
October 24, 2014

TITLE:
What Can Art Bring to Sustainability?

THEME AREA:
Art, Design and Communications

Note: *The ASU Art Museum hosted "Trout Fishing in America and Other stories," an exhibition by artists Bryndis Snæbjörnsdóttir and Mark Wilson, from October 2014 through January 2015. The project was supported by a research grant from the Julie Ann Wrigley Global Institute of Sustainability.*

Over the past four decades, solutions to the persistent and complex challenges of sustainability have typically been developed through scientific analysis. There has been an assumption that knowledge will lead to appropriate action. Recently the accuracy of this one-dimensional assumption has been in question, and many have begun to seek more effective ways of developing robust solutions.

About a year ago, Arnim Wiek from the School of Sustainability asked me to co-author a chapter for an introductory textbook on sustainability. This might seem an odd request for a contemporary art curator and art historian, but much of my research and curatorial work has explored the ways that artists have engaged with our challenges in living sustainably. I've found that art can facilitate deep collaboration across disciplines and social groups to challenge existing models and propose new ones.

A new perspective on the status quo

Art has the ability to engage us—mind and body, emotion and cognition, individual and community—with complex ideas, vivid representations and experiences. It occupies an intellectual and imaginative space that is open-ended, somewhat outside of existing behavioral patterns, and sometimes subversive, allowing for surprising and promising perspectives and outcomes.

Since the 1990s, there has been a surge in interest among artists, curators and theorists in collaborative art, called by a variety of names, including social practice. Artists or artist collectives engage directly with specific audiences and with pressing issues to produce works that vary widely in their intent. Some works encourage reflection, conversation and learning, while others develop concrete solutions by means of new objects, services and practices.

Social practice projects are social and cultural experiments that strive to build connections and dialog, and open up new, previously unforeseen pathways. They usually begin with a central question or problem, which morphs through the participatory process and is influenced by the project's location and context.

Charged and committed

One of my favorite examples of a social practice project is *It's not just black and white*, created in 2011 by artist and ASU School of Art faculty member Gregory Sale. During the three-month residency exhibition at the ASU Art Museum, the project explored the criminal justice system in Arizona and

the United States. Close to 7 million people are in prison, on probation or on parole, and we spend $80 billion annually to keep them there. In collaboration with inmates, Sale created an installation that was a charged but safe and welcoming place. Here, crime victims, their families, corrections and law enforcement officers, activists, academics and the general public gathered to examine the underlying cycles of poverty, racism and politics in incarceration. The exhibition attracted nearly 20,000 visitors.

It's not just black and white developed out of extensive work—over 50 events—with these diverse communities and stakeholders, who became deeply committed to participating in the dialog and in finding solutions.

Conservation and cultural change

In our current exhibition at the ASU Art Museum, artists Bryndis Snæbjörnsdóttir (Iceland) and Mark Wilson (England) explore the networks and ripple effects of scientific conservation initiatives in Arizona. Their exhibition of photographs, videos and site-specific installations, *Trout Fishing in America and Other stories*, takes a kind of vertical slice of the Grand Canyon.

The artists focus on the reintroduction of two endangered species: the Humpback Chub, native to the Colorado River, and the California Condor, whose zones of flight extend from the Canyon to the Vermilion Cliffs and into Utah. Working with co-curator Ron Broglio (ASU Department of English and Sustainability Scholar) over a two-year period, they interviewed and labored alongside research scientists running conservation programs for the endangered species.

The exhibition provokes wonder about human-animal interactions through strategies of humor, contradiction, absurdity, surprise and lateral (rather than direct) representation. Snæbjörnsdóttir and Wilson broaden our perspective by considering the scientific data within cultural and social contexts, compelling us to recognize how ecologies can change radically as a result of tiny individual initiatives by human or other agents.

Demarcation or collaboration

There is much to debate about these projects, and the questions are only amplified when viewed from sustainability fields. When does the project become social service, political activism or scientific documentation as opposed to art? Is it more effective or appropriate for art to visualize and occupy problems, or to propose practical solutions? How can we measure the success of these projects and based on what criteria (aesthetics, awareness, social change)?

Finally, the sciences often view artists as communicators, illustrating complex ideas for a broad public, rather than bringing new knowledge and creative strategies to the research process. What is necessary for true collaboration between artists and sustainability scientists?

Unlike conventional forms of problem-solving, social practice engages a broad range of stakeholders to experiment with alternative approaches to sustaining the viability and integrity of our societies and natural environments. Our museum's director Gordon Knox often says, "Science and technology will be key components of any approaches to global challenges, but any long-term and real solutions will be cultural."

These art projects create spaces for potent experiences that truly challenge conventions, habits and the preference for the status quo. My colleagues and I are less concerned with the definitions and demarcations of our fields, and more concerned with forging real progress towards sustainability.

AUTHOR:
Prasad Boradkar

ABOUT THE AUTHOR:

Senior Sustainability Scholar Prasad Boradkar is co-director of the Biomimicry Center, an organization dedicated to the exploration of biologically-inspired solutions to problems of sustainability. He is also director of InnovationSpace, teaching students how to develop products that create market value while serving real societal needs and minimizing impacts on the environment. Boradkar is a professor in The Design School, Herberger Institute for Design and the Arts, at ASU.

AUTHOR:
Prasad Boradkar

DATE:
February 23, 2015

TITLE:
Biomimicry: Mining Nature for Ideas

THEME AREA:
Art, Design and Communications

Note: *March 3, 2015, marked the launch of ASU's new Biomimicry Center, established in partnership with Montana-based Biomimicry 3.8, and co-directed by Prasad Boradkar. In this essay, Boradkar describes how biomimicry can help us create solutions to address our problems in sustainable ways.*

A short five-minute walk takes me from my suburban home in south Phoenix to the Sonoran Desert, from the highly standardized and manufactured human-made world into the somewhat wild and undomesticated natural world.

Satellite views show stark differences between the two landscapes: rectilinear, hard lines divide the land inhabited by people, while meandering, unrestrained territories mark the land inhabited by all other creatures. We have, by design, created in contrast to the natural world, an artificial world of products, buildings and cities.

Philosopher Richard Buchanan describes design as "conception and planning of the artificial." Using these processes of planning, we have created everything from tiny paperclips to enormous jet aircraft, from the smallest dwellings to the largest metropolises. And though these things are made of such materials of human creation as chrome-plated steel, aluminum and reinforced concrete, they are all ultimately extracted from the natural world. From the natural emerges the artificial.

But what if we were to extract from the natural world, not ore and minerals, but innovative ideas and creative solutions? Enter biomimicry. Described as "the conscious emulation of nature's genius" by Janine Benyus, author of the seminal book on the topic, biomimicry does exactly that. It is an emerging discipline dedicated to mimicking strategies and principles of the natural world to develop sustainable solutions to human problems.

Evolution as a design process

One of the most cited examples of biomimicry is Velcro. Invented by Swiss scientist Georges de Mestral, this system of attachment was inspired by the burdock seed that uses its hooks to attach itself to the coats of roaming animals as a means of travel. This natural Velcro is the burdock plant's design strategy and mechanism of seed dispersal.

Plants and animals adapt to the conditions in which they live through unique and local strategies that have been perfected over millions if not billions of years. Processes of evolution can be seen as processes of design—iterative, based upon trial and error, and often ingenious.

As I walk into the Sonoran Desert, I am surrounded by organisms that have adapted to the arid conditions of the ecosystem in which they live. The saguaro cactus, for example, has numerous strategies that it deploys, not to combat the extreme heat, relentless sunshine

and limited water supply, but to work with these conditions. Its pleated body expands to absorb moisture, and contracts as it uses up this precious resource.

For added benefit, these pleats also offer shade. And because it is impossible to have too much shade in the desert, the spines perform a similar function by creating a lattice of shadows on its surface while also protecting the cactus from predators. Its sap-green body uses every square inch of that surface for photosynthesis. Lying hidden just under the ground is its network of roots, eager and ready to start absorbing moisture when it rains.

The cycle of life

According to the National Park Service, the average life of a saguaro cactus is 150-175 years, and at times, some might live 200 years. However, the artificial things that design creates often live extremely short lives. The Environmental Protection Agency estimates the average life of a mobile phone in the U.S. to be approximately 18 months.

In 2005, writes Giles Slade, more than 100 million mobile phones were disposed in the U.S. In addition, a report from Nokia revealed that only 3 percent of users recycle their phones. What happens to the ones that end up in the landfill? Lead, cadmium, mercury, lithium and a host of other substances that are toxic to the soil, ground water and human health are likely to leak out of the devices.

What happens to a saguaro cactus when it has lived its life? Under the forces of photo- and biodegradation it slowly starts to disintegrate. All the water stored in its tissues oozes out, as an offering to other desert creatures. In its death, it supports other life. Over time, the saguaro disappears from the landscape, leaving little trace of its existence. The components from a cell phone – circuit boards, screens, plastics – may take multiple human lifetimes before they start degrading. What if our products are made from materials and technologies that, like the saguaro, vanish when their useful lives are over?

Learning from nature

Maybe we can learn about waste management from nature, where one organism’s refuse serves as another organism’s raw material. An ecosystem does not need landfills for animal droppings, decaying fruit or dead creatures. It has dung beetles, microbes and vultures that will gladly take care of it all.

Biomimicry can help us in carefully observing and learning from organisms and ecosystems so that we may create more sustainable solutions to address our most complex problems. Biomimicry can serve as the bridge that links our natural and artificial worlds.

Let us mine nature for ideas, not materials.

AUTHOR:
Ed Finn

ABOUT THE AUTHOR:

Ed Finn is the founding director of the Center for Science and the Imagination at Arizona State University, where he is an assistant professor with a joint appointment in the School of Arts, Media and Engineering and the Department of English. His research and teaching explore digital narratives, contemporary culture and the intersection of the humanities, arts and sciences. He is the co-editor of "Hieroglyph: Stories and Visions for a Better Future" (William Morrow, September 2014) and is currently working on a book about the changing nature of reading and writing in the age of algorithms.

AUTHOR:
Ed Finn

DATE:
March 25, 2015

TITLE:
Happily Ever After: Storytelling and the Long View

THEME AREA:
Art, Design and Communications

The story goes that when beetles were discovered in the eaves of the great hall at New College in Oxford, everyone began wondering where they could possibly find replacements for the gigantic timbers that had held up the roof for hundreds of years. They needed oak trees almost as old as the building itself. As it turned out the founders of the college had planted oaks expressly for the purpose of repairing structures, with university foresters protecting them over generations. The great hall was completed in the late 1300s, and they were building something that they intended to last functionally forever.

Today it seems like the expected lifespan of a building is getting shorter, not longer. More alarmingly, our perception of time seems to be narrowing—we forget our history just as readily as we ignore the future.

The long view

I see this as the central challenge of sustainability: changing our frame of reference to include what some people call "deep time." For me, this problem is rooted in the stories we tell. Not stories about environmentalism, or efficiency, or entrepreneurship, but the really fundamental narratives: the ones that carry us through life. Once enough people believe a narrative, it starts to come true—thousands of little decisions, course corrections and implicit assumptions end up steering the actions of millions of people. We inherit stories from our parents, from our communities, from books, from film and television. Yet the most powerful stories are often the ones we reflect upon the least.

What are the stories of happiness and success that we absorb from our elders, our myths, our media? For too many of us, "happily ever after" is an unexamined inheritance: expensive consumer products, a huge mortgage and a car of one's own. Bad enough when that was just the American dream—now it's the dream of billions across the world, and who are we in the industrialized West to say it's wrong? Critiquing these unexamined narratives is a mug's game—to really inspire change, you need to come up with different stories.

I direct ASU's Center for Science and the Imagination, which helped sponsor an installation piece at the ASU Art Museum by artist Jonathan Keats. He created a millennium camera, a pinhole device that would slowly expose an image on a treated copper plate over the course of a thousand years. As Keats pointed out, the camera is really on loan—his heirs will expect it back from the museum in 3015—though the museum gets to keep the photograph. The project literally asks what the "long view" looks like. It also raises questions about what permanence means for a culture where it seems impossible to think beyond the next election cycle or even the next social media status update. Imagining

that camera sitting there, slowly absorbing photons, puts a very different frame on your day and your ambitions.

A world like ours, but different

Just the words “millennium camera” might be enough to spark that moment of disorientation, of stepping outside everyday reality to see things in a different light. Keats’ project illustrates one of our center’s central missions: to use creative inquiry to develop new stories about the future, to push for new vocabulary and new ideas. These are the kinds of questions we grapple with—in classrooms, in books and in public conversations with projects like the Imagination and Climate Futures Initiative. We use tools like science fiction and exploratory design to invite people to imagine new experiences in a personal, visceral way. Imagine your life, your commute, twenty years from now. What will you touch? Who will you see? What objects will be familiar, and what new things do we need to invent?

Scholars of science fiction call this experience “cognitive estrangement.” This is the moment when a story suddenly reveals its otherness: the *Star Trek* transporter beaming up Captain Kirk or the factory producing test tube babies in Aldous Huxley’s *Brave New World*. The reason these stories work is not because of their wild ideas but because they are mostly familiar to us, just like Keats took the idea of the camera and changed one important thing about it. In science fiction, human characters struggle through conflicts, overcoming obstacles in a world that pretty much looks like ours, with a few crucial differences.

Seeing ourselves in an alternative future

I believe that what the sustainability movement needs right now is more of that creative dissonance, that sense that other worlds are possible. Technical solutions to environmental problems are vital, but they will never succeed without the right stories—narratives that billions of people can believe in. As parents, citizens and stewards of the future, we are already responsible for what’s going to happen next, even when we try to pretend that future is being invented somewhere else. We need stories that are inviting, playful, exciting, hopeful and expansive: stories we see ourselves in that can change the world.

Arizona State University has made an institutional commitment to lead by example. One example is printing this booklet on recycled papers that are manufactured using 100% renewable energy. Another example is printing a limited number of booklets, being selective with who receives printed copies and posting the booklet online as a PDF download: ***sustainability.asu.edu/thought-leader-book***

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JULIE ANN WRIGLEY GLOBAL INSTITUTE of SUSTAINABILITY
ARIZONA STATE UNIVERSITY

ADDRESS:
Julie Ann Wrigley Global Institute
of Sustainability
Arizona State University
PO Box 875402 | Tempe, AZ 85287-5402

WEBSITE:
sustainability.asu.edu

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