

momentum

Institute on the Environment • University of Minnesota • Fall 2012



BIG CHALLENGES PROMISING SOLUTIONS

+ New hope for hydropower

Q&A: Looking ahead with **Jamais Cascio**

Food waste, migration, hip-hop, corporations with benefits *and more*

Push Here

WE ARE SUPPOSED TO BE in the business of changing the world. The question is: Are we?

Countless people are seeking to solve some of the most vexing problems of the 21st century: climate change, food insecurity, biodiversity loss, emerging diseases and more. Dedicated scientists, designers, policy makers, health experts, business leaders, philanthropists, journalists and activists are working tirelessly to develop a more secure and sustainable future for the world. But, sadly, our efforts often seem unequal to the task at hand. The problems are still getting bigger and bigger, and our efforts struggle to keep up.

Why are we falling behind? It's certainly not from a lack of effort. Maybe we're not being strategic enough. And maybe we're focusing too much on symbolic fights and not enough on those that can yield sizable, tangible outcomes.

Take climate change. Some people are passionately focused on stopping the Keystone XL pipeline, saying that this single pipeline would be "game over" for climate change—yet the pipeline itself would only represent a

Likewise, with respect to food security and the environment, we focus a lot of attention on ideologically charged issues, while largely ignoring bigger, more pragmatic ones. Organic or conventional? GMO or no? We fiercely debate these two systems, even though both are small players in the global food system: Certified organic farms produce less than 1 percent of the world's food calories, and GMOs are only used on 10 percent of the world's agricultural land. Yet research shows that many agricultural solutions—such as improving soil and water management, addressing food waste, or shifting diets—may provide significant food security to the world without getting sidetracked by ideological debates. Let's put our sustainable-agriculture efforts where they matter most.

How can we focus on the bigger issues and make truly transformative change? Maybe we can take our lead from Archimedes, who once said that, given a lever long enough and a fulcrum on which to place it, he could move the Earth. Let's try to find some of these "planet levers."



PHOTO BY JOE TRELIVEN

Finding these kinds of planet levers will require that we look at pivotal ideas, pivotal solutions and pivotal places that can truly change the world. In this issue of *Momentum* we showcase seven projects that are doing just that in the domains of ocean fisheries, climate change, rain forests, urban expansion, population growth, sustainable agriculture and freshwater.

Let me be clear: I don't want to dismiss the efforts focused on the Keystone XL pipeline, debates over organic versus GMO agriculture and other hot-button issues. These are still important, and they should continue to receive attention. But looking forward, let's be careful to not get too caught up in these ideologically charged, highly symbolic efforts. Let's make sure we reserve enough time, energy and other resources to attend to the key planetary leverage points. Moving the Earth toward a sustainable future demands nothing less.

JONATHAN FOLEY

**Director
Institute on the Environment**
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"Finding these kinds of planet levers will require that we look at pivotal ideas, pivotal solutions and pivotal places that CAN TRULY CHANGE THE WORLD."

minuscule fraction of our national energy use. While stopping this pipeline would certainly be helpful to climate change mitigation, *far* bigger reductions in greenhouse gas emissions are possible (and already underway) through improving America's automotive efficiency standards, retrofitting buildings and factories, deploying more solar and wind power, and shifting away from coal. Why not attend more to these larger parts of the American energy system, where we're able to make much more progress on CO₂ emissions? Why not also focus on non-CO₂ greenhouse gas emissions such as methane, nitrous oxide and soot—much of which come from a small number of countries and economic sectors, and may be far easier to change quickly than the whole fossil fuel economy?

An effective planet lever has three key characteristics. First, it needs to be a *long lever*, able to amplify small forces into larger actions. Such leverage can sometimes be gained through media, political change or social movements. Often it happens through technology and the marketplace.

Second, the lever needs to be *positioned in the right place, moving the planet in the right direction*. This means avoiding the largely symbolic efforts, where change is small and possibly in the wrong direction, and focusing instead on big wins in the right direction.

Third, it helps if there *aren't strong, opposing forces* pulling the lever in the other direction. Finding potential allies—and minimizing the potential of facing ardent foes—makes the job a lot easier.

momentum

FALL 2012 • 4.2

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printing MODERN PRESS

Thanks to the **Aspen Environment Forum**, presented by the Aspen Institute and National Geographic, for providing the opportunity to gather ideas that enriched “The Future Teller,” “Plastic: Take Two,” “At Home on the Range” and “A Measure of Well-Being” in this issue.

Momentum is published three times per year by the University of Minnesota’s Institute on the Environment. To subscribe, change your address or request an alternative format, email momentum@umn.edu. Sign up for an e-alert when the new issue is available online: environment.umn.edu/connect.

IonE is committed to sustainability. This magazine is printed on environmentally friendly paper with an average of 100% recycled fiber and 30% postconsumer waste.

The opinions expressed in *Momentum* are those of the authors and not necessarily of the Institute on the Environment/University of Minnesota.

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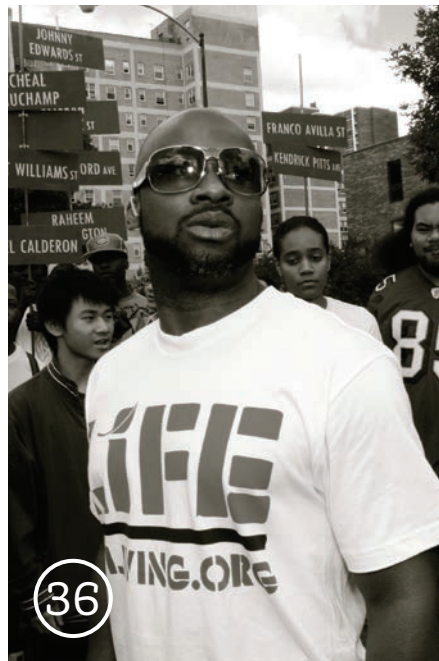
on the cover
Santa Monica designer and matte painter **ANDREW BURDIN** has provided creative services to 20th Century Fox, WB, Disney, Lionsgate, Paramount and more. View his portfolio at andrewburdin.com.

DEPARTMENTS

- 2 **Standout**
Q&A with futurist
Jamais Cascio
- 4 **In Focus**
Women face climate change
- 6 **Noteworthy**
- 36 **Snapshot**
Hip-hop meets green
- 38 **Connections**
The heat is on for Iceland
and Kenya
- 40 **Viewpoints**
Game over for GDP?

FEATURES

- 8 **Seven Wonders of a Hopeful World**
Promising projects around the globe take on grand environmental challenges.
by HILLARY ROSNER
- 20 **New Spin on Hydropower**
Small turbines offer big opportunities for renewable energy. by FRANK JOSSI
- 26 **B Is for Better**
Making room for sustainability in the bottom line.
by ANNE FIELD
- 30 **Spoiled**
One-third of the food we produce never makes it to our mouths. by TODD REUBOLD
- 32 **On the Move**
Why migrations matter—and what we can do to protect them. by JEREMY LEON HANCE



36



8



30

The Future Teller

Interview by **TODD REUBOLD** | photo by Bart Nagel

From the Aspen Environment Forum to TED, futurist JAMAIS CASCIO is one of the most sought-after speakers in the world today. And with good reason. His talks and writings on the future of the planet allow us to peer into the crystal ball and experience a world that “might be” in the decades ahead. *Momentum* caught up with Cascio recently to get his thoughts on our changing planet, the future of energy and, yes, jet packs. »

≡CASCIO AT A GLANCE≡

Home base: San Francisco, California

Wears the hats of: Author and Futurist

Good to know: Co-founded Worldchanging.com

One hope for the future: That we get it right

WHAT DOES IT MEAN TO BE A FUTURIST? It means I'm an easily distracted generalist.

YOU'VE WRITTEN ABOUT “LEGACY FUTURES.” WHAT ARE THEY, AND WHERE DID THE IDEA COME FROM?

I realized we have all of these ideas about

the future that emerged 20, 30, 40 years ago that remain stuck in our heads as the default vision of the future, such as jet packs or flying cars. When I introduce myself as a futurist, these are often the first things I get asked—you know, “Where’s my jet pack?” We have in our heads these legacy futures, these old visions of tomorrow that really no

longer apply and yet still shape our beliefs and expectations about what’s around the corner. More recently we have things like singularity, a concept embedded in a 1990s vision of computing technology. The way it was described 20 years ago still remains the core description of the concept even if and even when our relationship with technology

has evolved considerably. When I think about and write about legacy futures, what I'm really saying is, we need to move away from these reflexive visions.

AT THIS YEAR'S ASPEN ENVIRONMENT FORUM YOU SAID, "THE CONDITIONS WE FACE TODAY DON'T DEFINE THE CONDITIONS WE'LL FACE 15 TO 20 YEARS FROM NOW." DOESN'T THAT MAKE IT CHALLENGING TO PLAN THINGS SUCH AS ENERGY SYSTEMS OR URBAN INFRASTRUCTURE THAT WILL BE AROUND FOR DECADES? Yes, it does. And so part

of the process I use when I do foresight work is to avoid making single-line predictions. Actually, anyone who gives you a single prediction about the future is probably trying to sell you something. People who do foresight work professionally these days tend to use scenarios—that is, a set of divergent, possible and plausible future narratives.

HAVE YOU GIVEN UP ALL HOPE IN POLITICS AND POLITICIANS WHEN IT COMES TO SOLVING GRAND ENVIRONMENTAL CHALLENGES? There's certainly a role for governments and government institutions. They are ultimately the ones who make policy into laws, and there has to be buy-in at that level for anything to be able to move forward because they can really get in the way.

But more importantly, they're one of the handful of institutions that have the potential to have a longer term perspective, an institutional memory that lasts longer than any one person. Religions are one example; universities are another and governments are yet another. So there's definitely a role.

Now, that doesn't mean governments are the perfect source. And it certainly doesn't mean they can't become problematic. I think we're at a particularly pathological era in American government, but that doesn't have to last. It can't last.

ALONG THESE SAME LINES, IS IT A CHALLENGE FOR THE BUSINESS SECTOR THAT COMPANIES ARE OFTEN LOOKING QUARTERLY OR

SHORT TERM? Very much so. The way the rules for public companies are structured, they almost have to look at the short-term view in order to remain viable. That's because we have rules around fiduciary responsibility, etc., that tend to force companies to appeal to the near-term interest of shareholders rather than looking out in the long term.

You have a handful of companies breaking the mold: for example, Google in its initial public offerings, and Facebook. They both had a similar kind of statement saying, "Anyone who invests in this company be aware that we're going to make some

long-term decisions from a long-term perspective that won't have immediate returns, so you've got to be ready for that." Even so, there's still an enormous pressure on these companies to try to meet the quarterly expectations of Wall Street.

OIL IS STILL RELATIVELY ABUNDANT AND ACCESSIBLE. WILL THIS MAKE IT DIFFICULT TO MOVE TO RENEWABLE ENERGY IN THE COMING DECADES?

I don't think the oil age is going to end because we've run out of oil. The notion that we're going to keep using petroleum or keep using natural gas until it runs out is kind of silly. And yet when I've spoken to energy industry executives, quite a few of them had this notion that we're going to keep using oil as our primary source for transportation fuel throughout the century.

That's ridiculous. Not just because of any peak oil issues and not really even because of carbon or global warming issues, but simply because that's an assumption that we're going to remain stuck in a particular paradigm of technology. That just doesn't hold true.

WHERE DO YOU DRAW HOPE FROM WHEN IT COMES TO THE FUTURE? A realization that the world changes. I sometimes say to people that I'm a short-term

pessimist and a long-term optimist. I look around and I see all sorts of reasons to be frustrated with the way world looks today. But, as I said in Aspen, the way the world looks tomorrow isn't based solely on the way it looks today.

DO YOU EVER WONDER WHAT THE IMPACT OF YOUR WRITING OR TALKS WILL BE? Yeah, I do. It's actually one of the ways I rationalize my enormous carbon footprint from traveling around the world. What I hope is my writing and the talks that I give allow people to step back and reconsider, basically look at the world from

"The future is not something that happens to us.

THE FUTURE IS SOMETHING WE CREATE WITH EVERY CHOICE."

a perspective they haven't thought of before, and hopefully make better choices, have a better vision of what they can do with their lives and with their companies and countries.

ANY FINAL WORDS OF WISDOM? One of the things I try to talk about in many of the talks I give is this recognition that the future is not something that happens to us; the future is something we create with every choice. If we start thinking that the future is going to happen to us regardless and there's nothing we can do, it makes it easy to give up. But if we recognize that the future is our creation, that like it or not we have a responsibility, then at least there's a chance that the people who hear this will step back and think more constructively, in a more sophisticated way, about the impacts of what they choose. **Q&A**

FORWARD-LOOKING:

To read more of Jamais Cascio's thoughts on the environment, politics, geoengineering, transformative futures and more, visit openthefuture.com.



Forces of Nature

Ripple Effect Images, a collective of photojournalists, emphasizes the strength and perseverance of women and girls facing climate change and the programs that are helping them thrive.

(1) A mother mourns the loss of her son, who drowned in the Brahmaputra River in Bangladesh. Any rise in ocean levels represents a grave danger to the country, which is home to the massive estuary delta of the Ganges, Brahmaputra and Meghna rivers. *Photo by Ami Vitale* (2) Three billion people use inefficient cook stoves to prepare their meals. Fueled by wood, coal or dung, such stoves and open fires produce smoke that causes 1.9 million deaths each year. *Photo by Ami Vitale* (3) Barefoot College in Rajasthan, India, helps train women to build and repair solar panels. This former student runs a solar desalination plant that brings fresh water to her village. *Photo by Annie Griffiths* (4) A Kenyan girl helps plant seedlings outside her school as part of the International Small Group Tree Planting Program, which led to the growth of millions of trees. The project helped her learn that trees are valuable, not just for firewood and home building, but also for purifying the air, conserving soil and building community. *Photo by Lynn Johnson* (5) Cement-splattered hands show the dedication of the people of Ilalambyu Village. More than 170 villagers came together to build a dam and restore a water supply altered by climate change. *Photo by Lynn Johnson* (6) A Cambodian woman grins with joy after receiving food assistance from Church World Service following the devastating flood of 2011. *Photo by Annie Griffiths*

LEARN MORE: rippleeffectimages.org



Solutions in Action

Plastic: Take Two

Lorna Rutto looked around her childhood neighborhood in Nairobi, Kenya, and saw three big problems: plastic litter, disappearing trees and jobless workers. Instead of despairing, she created



a company that makes fence posts and lumber from discarded bags. Eco-Post has salvaged more than 1 million kilograms of plastic waste for wood-replacement products since it began in 2009.



One Stop Eco-Shop

Looking for solutions to sustainability challenges in your community, region or country? The Sustainia 100 catalog could be just the thing. Launched in June, the catalog showcases innovations around the world, from a transparent fashion label that tells how and from what materials clothing items are made,

to a screen saver that lets humanitarian organizations use your computer power when you're not using it yourself. Check it out—and share your own ideas—at z.umn.edu/sustainia.



Thank Plankton

Need another reason to care about the state of the world's oceans? Phytoplankton, microscopic organisms that drift in the water, produce nearly half of the oxygen in Earth's atmosphere.



Walk on Watts

Power to change our planet may soon be as close as your own two feet. UK-based Pavegen produces pavers that use the energy of footsteps to generate electricity. Good for high traffic areas, the pavers took a step toward a more sustainable world as part of an installation near London's Olympic Village. Learn more at pavegen.com.



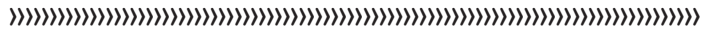
PHOTO COURTESY OF PAVEGEN



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ENCYCLOPEDIA OF LIFE

The species we encounter on a typical day make up only the tiniest fraction of what's out there. To make it easier to learn about living things and share that knowledge, the Encyclopedia of Life is working to bring info on every known species together from all over the world. So far contributors have created more than 1.1 million pages. Check out your favorites and learn how you can help at eol.org.



The More You Know

Policy makers looking to improve environmental and human health have a valuable new tool: The World Health Organization's Health and Environment Linkages Initiative. This Web-based resource provides easy access to tools and information related to environmental health hazards. Learn more at z.umn.edu/heli.



Momentous Change

Global challenges and efforts to solve them have both evolved since we first published *Momentum* magazine in the fall of 2008. We're on it! January 2013 will bring big changes to *Momentum* as well. We're redesigning the print magazine to retain your favorite features while adding more and better content, and launching a daring new website with fresh articles, commentaries, multimedia and more every week. Stay tuned!

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Minnesota's Institute on the Environment and Seoul National University. Greenhouse gas emissions from a socially networked

Spreadable Solar

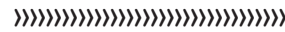
As the components of solar collectors get smaller, ideas about how to apply them grow. Notre Dame scientist Prashant Kamat and colleagues recently developed a liquid suspension of sunlight-capturing nanoparticles that can be applied to a surface to create a thin layer that transforms energy from the sun into electricity. Called "Sunbelievable," the coating still needs perfecting to become practical, with efficiencies currently in the range of 1 percent. But the proof of concept takes the idea of painting the town with solar closer to reality.



Friend a Package

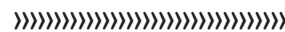
What if your cell phone and social network could help deliver packages to you? This may be easier and more beneficial to the environment than you think, according to researchers at the University of

delivery system were projected to be 45–98 percent less than those from typical home delivery. Read more about the study at z.umn.edu/pkg.



Recycled Reaction

Among efforts underway to make nuclear energy safer and more efficient is a technology being developed by Transatomic Power, a company launched in 2011 by two MIT grads. Transatomic takes radioactive wastes from conventional nuclear reactors, places them in molten salt and uses them to produce electricity. If all goes as hoped, the reactor could produce enough power from existing nuclear waste to meet global electricity demand through 2083. Watch the TEDx talk at z.umn.edu/tap.



World of Discovery

A night-blooming orchid, a nematode that lives in gold mines and a wasp that lays its eggs inside ants are among the newly discovered species included in the International Institute for Species Exploration's Top 10 for 2012. Nominate your favorite find for next year's list at species.asu.edu/Top10.



PHOTO COURTESY OF HOUSEHOLD ENERGY, INC.

HOT STUFF

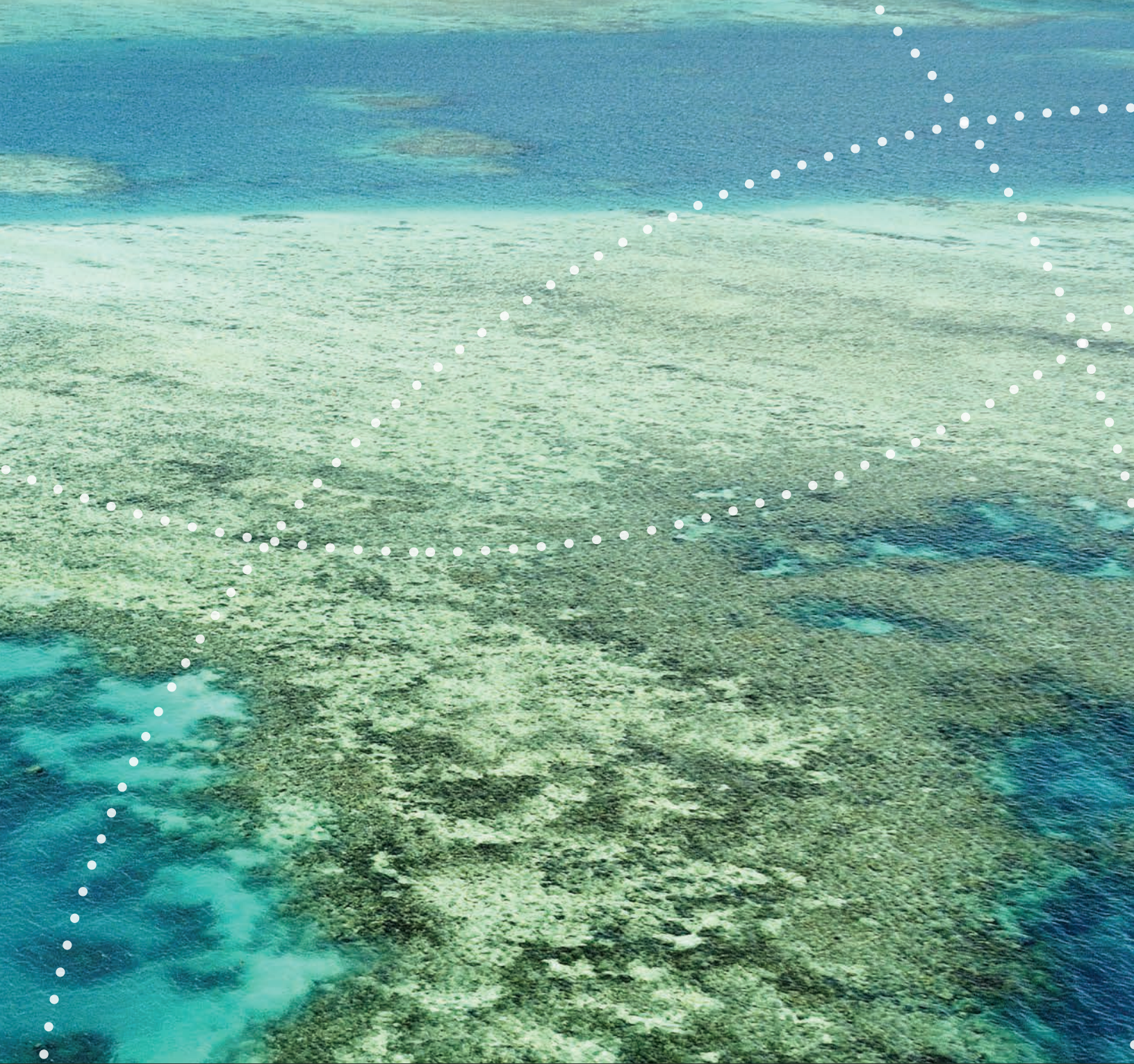
Desperate for fuel to power their wood-fired cook stoves, residents of Tilorì, a rural village in Haiti, were harvesting trees faster than they could regrow. Convinced food and forest don't have to be an either-or proposition, The Nature Conservancy and Solar Household Energy, Inc., began working several years ago with government and other nonprofit organizations to find a better option. Along with a tree-planting project, the team brought 30 solar ovens to the community. Tilorì women now use the ovens regularly to cook meals, helping the forest heal and reducing health-harming pollutants from conventional cooking.

An aerial photograph of a vibrant coral reef, showing various shades of blue and green. A large, dark teal graphic element, resembling a stylized letter 'Z' or a large arrow, is overlaid on the image, pointing downwards and to the right. The background is a high-resolution aerial view of a coral reef, with intricate patterns of coral and clear, shallow water. The overall color palette is dominated by blues and greens, with the teal graphic providing a strong contrast.

WONDERS OF A HOPEFUL WORLD

The environmental challenges we face today are daunting, no question.
But opportunities for overcoming them abound.

by HILLARY ROSNER



SEVEN BILLION PEOPLE and growing. A quarter of them living in poverty. Unsustainable—and unequal—resource use. Landscapes vanishing, along with their nonhuman inhabitants. Global warming upending natural systems. These are tough times on planet Earth.

But while sustainability remains far from a global edict, hopeful signs of progress are poking up around the world. In some places, in some cases, we are doing things right, taking steady steps toward a smarter future.

Here we offer seven of them—seven concrete answers to seven of the most pressing and vexing environmental dilemmas of the 21st century. None is perfect. But each elegant effort attests to the fact that effective and relatively simple solutions are already within our reach. The main missing ingredient is one that's seemingly scarce but in fact unlimited, and which we'll need to gather and harness in order to change course and stay that way: resolve.

PHOTO BY MARTIN FROYDA

Across the planet's oceans, more than 70 percent of fish species are either over-harvested or at the very brink of what their populations can tolerate. A groundbreaking 2006 study painted a grim picture: At current rates, every seafood fishery on the planet will collapse by mid-century. We are drastically altering ocean ecosystems—and at the same time threatening the food security of 200 million people.

of scientists who recommended expanding the Great Barrier Reef Marine Park's no-take areas. Today, fishing is banned in one-third of the park. And evidence of success is rolling in.

The thriving Great Barrier Reef, with its sightseers, snorkelers, divers and fishers, now generates nearly 54,000 full-time jobs and \$5.4 billion per year, with tourism providing roughly 36 times more revenue than commercial

Around the world, no-take reserves are showing similar results. Off the Mediterranean coast of Spain, a no-take area just 1 square kilometer in area has created 200 full-time jobs and generates €10 million per year in tourism revenue—20 times the revenue from fishing. Elsewhere in Spain, in an area famous for its giant lobsters, the no-take zone of the Columbretes marine reserve is enabling lobsters to grow even bigger.

CHALLENGE: Ocean fisheries collapse OPPORTUNITY: Marine protected areas



The benefits of no-take reserves range from economic gains due to tourism to more sustainable seafood populations beyond reserve borders. PHOTO BY DEBRA JAMES

One solution is proving successful everywhere it's employed: the no-take reserve, whose biggest story comes from Australia.

The Great Barrier Reef is home to an almost incomprehensible number of species. There are 1,500 types of fish, 400 kinds of coral, 5,000 varieties of mollusk and 500 different species of seaweed. But despite the fact that the area—all 214,000 square miles of it—has been a designated marine park since the 1970s, its biodiversity was under threat until not long ago. The marine park is a multiuse area, with activities ranging from diving to commercial fishing permitted in some parts. In fact, until 2010, fishing was totally banned in less than 5 percent of the park.

Recognizing that more needed to be done, the Australian government convened a panel

fishing. Having fish alive in the water, it turns out, is highly profitable.

What's more, research published just last May shows that the benefits of no-take areas spill beyond their invisible borders. Using genetic techniques, scientists studied the origins of coral trout and stripey snapper, two species

of commercial fish in a 1,000-square-kilometer area around the Great Barrier Reef. Twenty-eight percent of the area was protected in no-take zones, but half of all the fish were hatched in those reserves.

Each year lobsters migrate out of the no-take area to nearby fishing grounds, where the local fishermen are now catching larger lobsters that command a greater price. In Kenya and the Solomon Islands, the income of locals fishing the areas surrounding no-take reserves is twice that of fishermen elsewhere.

Given all this, you'd expect no-take reserves to be sprouting up everywhere. Yet just 1 percent of the ocean is within the boundaries of a marine protected area, and only a fraction of those areas are no-take reserves. The reasons are twofold, says Enric Sala, a marine ecologist and explorer-in-residence at the National Geographic Society in Washington, D.C.

The first is lack of awareness. "Most people don't know what the benefits are," Sala says. "The first reaction from fishermen is, you want to kick us out of the sea and prohibit fishing everywhere. But once the reserves are created and they work, fishermen tend to like them a lot."

The second is a stifling policy structure that in many countries allows only governments to create—and fund—reserves. "If local communities in coastal areas were empowered to create their own reserves and manage them," says Sala, "then we'd be able to scale up for sure."

Sala is working to create the first privately

HAVING FISH ALIVE IN THE WATER, IT TURNS OUT, IS HIGHLY PROFITABLE.

funded marine reserves, investment opportunities that will both create jobs and generate profits. Projects in the Philippines, Turkey and Timor-Leste begin next year.

Germany leads Europe in wind energy, with more than 30,000 megawatts of installed capacity. PHOTO ©VVO/SHUTTERSTOCK.COM

GERMANY'S ENERGIEWENDE

CHALLENGE: Greenhouse gas emissions
OPPORTUNITY: Boosting renewables

Perhaps no environmental problem is more complex, fraught and fundamental than how to drastically decrease greenhouse gas emissions. If we can't solve this dilemma, all the others may well turn out to be moot. But international progress is maddeningly slow—and here in the U.S., change still feels decades away.

Not so in Germany. The world's fourth-largest economy and Europe's stern nanny during the continent's unfolding economic crisis, Germany is poised to show us all how to switch to renewables. Having vowed to shut down its nuclear power plants by 2022, the country has a decade in which to demonstrate how it will generate 35 percent of its electricity (18 percent of its total energy) from renewables.

This being Germany, there's a word for all of that: *Energiewende*, or energy transition. "It's an enormous opportunity, a catalyst moment," says Arne Jungjohann, program director for the

environment at the Heinrich Böll Foundation, a think tank affiliated with the Green Party. "It means that Germany has been serious and has a broad consensus to go to renewables."

Despite that consensus, the central government has yet to issue a road map. ("There is no such thing as a master plan in some drawer in Merkel's desk," is how one German journalist recently put it.) So for now, the public is stepping up—something that's possible in part thanks to the certainty of *Energiewende*, as well as years of demonstrated commitment to renewables in the form of feed-in tariffs.

"Today, you see windmills across the country, blue shining solar arrays on rooftops and town halls," says Jungjohann. "More than 100 villages and communities have set targets to go completely renewable." Through energy cooperatives in which the buy-in is as low as a few hundred euros, whole villages can invest in a wind park

or an anaerobic digester (which makes natural gas from organic waste).

One striking difference between Germany and the U.S. is just who invests in clean energy technology. In the United States it's mostly banks, corporations and hedge funds—outside investors that find ideal locations for wind or solar, try to convince the local community and end up with a NIMBY problem. To wit: Only about 2 percent of all U.S. installed wind capacity is community owned. But in Germany, half of all wind projects are community owned, by small-scale investors and farmers—people, says Jungjohann, who "invest their money in a wind park instead of in the bank." Thanks to a combination of tax policy and guaranteed grid access—investors don't have to negotiate to deliver their power to the grid, unlike in the U.S.—renewables can be a solid investment, at least on paper.



3

BRAZILIAN RAIN FORESTS

Brazil, home to one-third of the world's rain forests, has established extensive reserves to prevent agriculture from encroaching. Deforestation has dropped in recent years. PHOTO BY DIRK ERCKEN



CHALLENGE: Rain forest loss OPPORTUNITY: Policy and pressure

Each year, we burn and bulldoze approximately 50,000 square miles of rain forest—disrupting ecosystems, pushing wildlife toward extinction and sending vast stores of carbon dioxide into the air.

In Brazil, though, a decade of smart governance has slowed the rate of Amazon deforestation by 67 percent below its average from 1996 to 2005 through a combination of good policies, beefed-up enforcement and a little help from the market.

Previously, ranchers and farmers looking to expand their holdings would move into the forest illegally, occupy the land and eventually manage to legalize their claim (and often sell it off). But from

agrees. The expansion of protected areas, he says, “knocked the wind out of the land speculation market, which is a very important driving force behind deforestation.”

The Brazilian government also began calling out communities with the highest deforestation rates, cutting them off from government credit until they reformed. And it stepped up enforcement of land use laws, jailing hundreds of people for illegal logging and confiscating their machinery and timber.

Government actions alone don’t account for all of the slowdown in forest destruction. A drop in commodity prices—for both soy and beef—during the mid-2000s helped. And pressure from

FOR A RANCHER, IT'S NOT WORTH THE INVESTMENT TO START CUTTING DOWN THE FOREST.

2003 until 2009, state and federal governments in Brazil created more than 270,000 square miles of new reserves near agricultural frontiers—an area larger than France. By designating new protected areas at the edges of farmland—rather than deep in the forest—the government all but abolished the allure of encroachment.

For a rancher, it’s not worth the investment to start cutting down the forest, says Steve Schwartzman, director of tropical forest policy at the Environmental Defense Fund, “because your likelihood of ever getting title to the land has gone way down.”

Daniel Nepstad, executive director of IPAM, the Amazon Environmental Research Institute,

environmental groups, particularly Greenpeace, created a market rejection of deforestation in the form of an international backlash against Amazon soy and beef. Consumers “sent a message to farmers, saying, ‘If you’re clearing forests, we may not want your product,’” Nepstad says.

Today, however, the story is changing. A long and convoluted battle to change the country’s forest code—propelled by strong beef and soy lobbies—has put the future fate of Brazil’s forests at risk. The law, which contains hundreds of complicated amendments, may ultimately bog the country down in unclear and unenforceable rules that undermine the country’s decade of rain forest progress.

● CHALLENGE: Unsustainable urban expansion OPPORTUNITY: Comprehensive planning ●

More than half the world's population currently lives in cities; by the middle of this century, that figure could hit 75 percent. Cities are responsible for two-thirds of human energy use and 70 percent of our greenhouse gas emissions, consume vast quantities of water, and produce enormous amounts of waste—all on just 2 percent of the world's surface area.

How we design, build and live in our cities will have an outsized impact on the planet's future. But many cities appear blind to this, lumbering forward on outdated building codes, leaking infrastructure and archaic, car-centered layouts.

And then there's Vancouver. Through its Greenest City 2020 initiative, the Canadian metropolis has developed a 10-point plan to tackle everything from jobs and investment

emitted from sewage pipes, and at first the city's engineer balked. "I said, 'Here's the business card of an engineer in Switzerland, where they've been doing this for years,'" Cadman recalls. "So he called the guy." The technology, which involves wrapping sewage pipe with a coil that collects the heat, debuted at the Olympics and now supplies 70 percent of the annual energy demand in Southeast False Creek, the neighborhood that encompasses the village. The program, known as a Neighborhood Energy Utility, has already lowered local greenhouse emissions from buildings by 74 percent (surpassing expectations of a 62 percent average annual reduction).

Elsewhere in the city, sustainable development is taking shape. Vancouver updated its mass transit to accommodate bicycles and built urban bike lanes that are physically separate from

HOW WE DESIGN, BUILD AND LIVE IN OUR CITIES WILL HAVE AN OUTSIZED IMPACT ON THE PLANET'S FUTURE.

to buildings, transportation, waste and even food—all to emerge as the world's most sustainable city.

A decade ago Vancouver vowed to meet Kyoto Protocol greenhouse gas emission standards city-wide, and to exceed them by 20 percent within the government. Later, city leaders decided to reduce emissions 80 percent by 2050. And then they asked a radical question: "If we want to be the greenest city in the world, what do we need to do?" recalls David Cadman, a former Vancouver city council member who helped conceive the green blueprint and is now president of ICLEI Local Governments for Sustainability.

Borrowing ideas and technology from cities the world over, Vancouver began designing itself a smart future. Cadman proposed heating the Vancouver Olympic Village by tapping waste heat

the streets. Today, residents make 40 percent of their trips in the city on foot, bike or public transportation (the goal is two-thirds of all trips by 2040). To help conserve water, the city now requires water meters on all new residential water services. And Vancouver has adopted the greenest building code in North America.

Every city is unique, of course, and not everything that works in Vancouver makes sense elsewhere. As a city already lauded for its quality of life, Vancouver could afford to set strict policies for developers. But the central ideas behind Greenest City are replicable in a broad sense: The way forward is a combination of creativity, smart policy and will. Vancouver's efforts show that cities can thrive (the greater region of 2.3 million people is growing at 5 percent per year) while using fewer, not more, resources.





4 CITY OF VANCOUVER

Extensive bikeways and a bike-share program are among the initiatives helping Vancouver move toward its goal of reducing greenhouse gas emissions 80 percent by 2050. PHOTO BY STEVE ROSSET

● CHALLENGE: Population growth
● OPPORTUNITY: Improving education for girls



BRIDGES & BICYCLES IN INDIA

Organizations such as the Foundation to Educate Girls Globally work with communities to identify and overcome barriers to girls' education—some as basic as a lack of appropriate restrooms. PHOTO BY KIM SEIDL

As world population careens toward 9 billion, all the planet's systems will be strained. Lowering fertility rates is a complex endeavor, and no one path leads directly there. Poverty, access to contraception, education, job prospects, cultural mores—all of these influence family size. So addressing any of them, or a combination, can help. Solutions abound, at least on a relatively small scale, such as conservation programs that include family planning components.

But the most promising opportunities may lie in promoting girls' education. Study after study throughout the years has found the same thing: Across every culture, women with higher levels of education have, on average, fewer children. (Girls' education is also correlated with higher individual and national income levels.) One recent analysis by the International Institute for Population Sciences in Mumbai, India, found

that the relationship between education and fertility is mutual. Increased education is followed by decreased fertility—but women who have fewer children are also more likely to receive more education.

India is home to several innovative efforts. In Uttar Pradesh and Orissa, two states with massive gaps in gender inequality, CARE India runs “bridge” schools, residential programs that give girls who have had little or no schooling a chance to catch up. In one district where the literacy rate for girls was near zero, the non-governmental organization started its first Udaan (which means “flight”) 12 years ago. The school took in 100 students for 11 months in a round-the-clock program that not only taught them basic elementary school coursework but also focused on life skills—everything from leadership to cycling.

Gradually but steadily, the age at which the girls married increased, says Suman Sachdeva,

technical director for education at CARE India, “so you now rarely see these girls get married before 18.”

CARE currently operates four Udaan schools in India, and the concept is spreading to other NGOs and even the government. A recent “right to education” law makes education a fundamental right for children age 6 to 14, who are now entitled to free schooling.

But what happens to those kids—many of them female—who are suddenly eligible for school but are now years behind? Sachdeva hopes the bridge school idea will help solve the problem and ensure that more girls can pursue an education.

Elsewhere in India, in 2007 the chief minister of Bihar state began giving schoolgirls vouchers to buy bicycles. Preliminary research shows the program has significantly increased the number of girls staying in school.

Farming in Africa's drylands was tough enough before climate change and skyrocketing populations piled on extra problems. Today, smallholder farmers across Africa, but particularly in the Sahel, face pressure to feed their families on land with depleted soils, erratic rainfall and encroaching sand. In years to come, these farmers will need to produce more food on existing land, even as weather conditions grow more precarious.

Chris Reij has spent more than three decades working on sustainable agriculture in Africa, and his years of experience point to a solution that's so low-tech and inexpensive it's been overlooked by large aid agencies. Reij, sustainable land management specialist at the Centre for International Cooperation, oversees an effort called Africa Re-greening Initiatives. Re-greening means allowing native trees to grow back on farmland, and then tending, pruning and managing them for maximum return.

Trees provide an almost unbelievable number of benefits: They block wind, lower microclimate temperatures, reduce evaporation, fix nitrogen, provide livestock fodder and increase organic nutrients in the soil. They also generate edible fruits and leaves and produce firewood. Twenty years ago, says Reij, women in parts of Niger spent two-and-a-half hours each day collecting firewood; now they spend half an hour.

"It's not the silver bullet, but it is at least a big piece of shrapnel," Reij says.

Agroforestry isn't new; African farmers grew crops alongside trees for centuries. But a severe drought in the 1970s forced farmers in Niger to cultivate extra land to offset declining crop yields. To

trees to regrow from seeds stored in the soil. Reij's initiative helps spread the message and the knowledge from village to village. Today he

There is no one solution to the problem of sustainable food production across the vast and varied continent of Africa. (The Polish journalist

TREES PROVIDE AN ALMOST UNBELIEVABLE NUMBER OF BENEFITS: THEY BLOCK WIND, LOWER MICROCLIMATE TEMPERATURES, REDUCE EVAPORATION, FIX NITROGEN, PROVIDE LIVESTOCK FODDER AND INCREASE ORGANIC NUTRIENTS IN THE SOIL.

estimates that 5 million hectares in Niger have been re-greened. The effort has also spread to Mali, Burkina Faso, Ethiopia and elsewhere across the continent.

Although Niger, which was hard hit by drought and pests last year, has an overall deficit

Ryszard Kapuscinski once wrote, "Only with the greatest simplification, for the sake of convenience, can we say 'Africa.'" But Reij's farmer-managed re-greening does suggest some broad lessons: "Barefoot" science can be as important as the latest science. People are most likely to



CHALLENGE: Unsustainable agriculture
OPPORTUNITY: Regenerating native trees

expand they cut down trees, which only made things worse.

Starting in the 1980s, though—spurred on by a missionary—some farmers began encouraging


of cereal crops (up to 600,000 tons), one study found that in a district with a high incidence of on-farm trees, there was a cereal surplus of 14,000 tons.

stick with an innovation if it yields rapid results. And low-tech, low-cost solutions can spur other changes in the ongoing search for solutions to Earth's greatest environmental challenges.



7 WATER FUNDS IN LATIN AMERICA

Among the best ways to ensure abundant supplies of fresh, clean water for human use is to protect ecosystems upstream.
PHOTO BY JASON HOUSTON



CHALLENGE: Freshwater depletion/deterioration
OPPORTUNITY: Payments for ecosystem services

We may live on the blue planet, but 97 percent of that liquid is of the salted variety. And of the planet's freshwater, just 1 percent is "readily accessible for direct human uses," according to the Stockholm International Water Institute. Clean water is an increasingly scarce commodity, particularly in the developing world—where 90 percent of the additional 3 billion people who will inhabit the Earth by midcentury will live.

Water scarcity has many causes, from drought to inefficient infrastructure to poor (or no) sanita-

development from central Mexico to central Chile, and another 13 under consideration.

The idea is fairly simple: Water users—a hydroelectric power provider, an urban water utility, a brewery—pay into a fund and then spend that money to improve the watershed. Funds may pay farmers to change agricultural practices (reduce fertilizer use, fence cattle) pay guards to prevent ranchers from encroaching onto reserves or simply pay landowners to restore or preserve vegetation. Funds can focus on improving water supplies or water quality, or reducing risk from

IN THEORY, THE FUNDS BOTH PROTECT VITAL WATER RESOURCES AND ALSO USE THE VALUE OF CLEAN WATER TO BANKROLL CONSERVATION.

tion to politics. Often the root of the problem is ecological: destruction of forests that help preserve clean water at its source, or farming practices that wash toxins into rivers and streams.

"I've seen places where cows are walking down steep sandy banks, causing local landslides," says Heather Tallis, lead scientist at the Stanford University-based Natural Capital Project. "So just keeping cows out of the river can make a difference."

One way to keep cows out of rivers—and to protect the ecosystems that protect freshwater supplies—is to value clean water as a resource and pay to safeguard its source. New York City did this when it bought and conserved land in the Catskills, where its drinking water originates. But buying up land isn't the only option: Water users can pay upstream landowners to change how they use the land. For more than a decade, The Nature Conservancy has been attempting this by creating water funds across Latin America. Today, there are 35 funds either operating or in

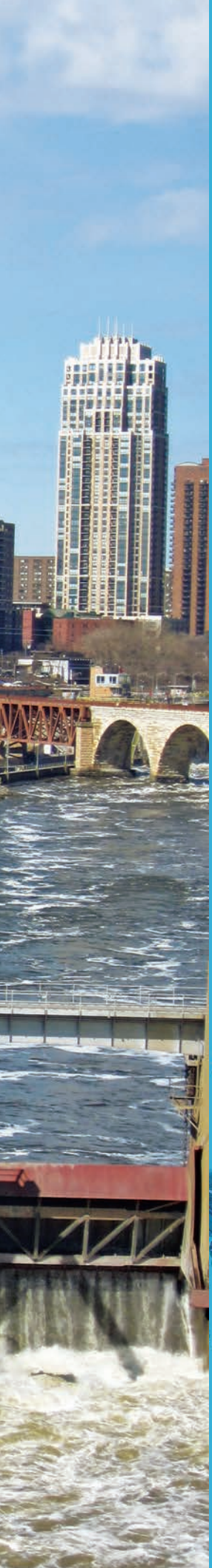
floods or landslides. In theory, the funds both protect vital water resources and also use the value of clean water to bankroll conservation.

The first fund, in Quito, Ecuador, was established 11 years ago. Little analysis has been done to monitor the effectiveness of the funds launched since then. Yet anecdotal evidence has been strong enough to entice a coalition of partners, including the World Bank, the Inter-American Development Bank and a Coca-Cola bottler, to join forces with TNC in the Latin America Water Funds Partnership, which will standardize the funds and introduce scientific monitoring. The idea is also spreading beyond the Americas: Kenya and Mongolia may be next in line.

HILLARY ROSNER is a fellow of the Alicia Patterson Foundation. She writes about science and the environment for many publications, including the *New York Times*, *Wired*, *Popular Science*, *Scientific American* and *High Country News*.



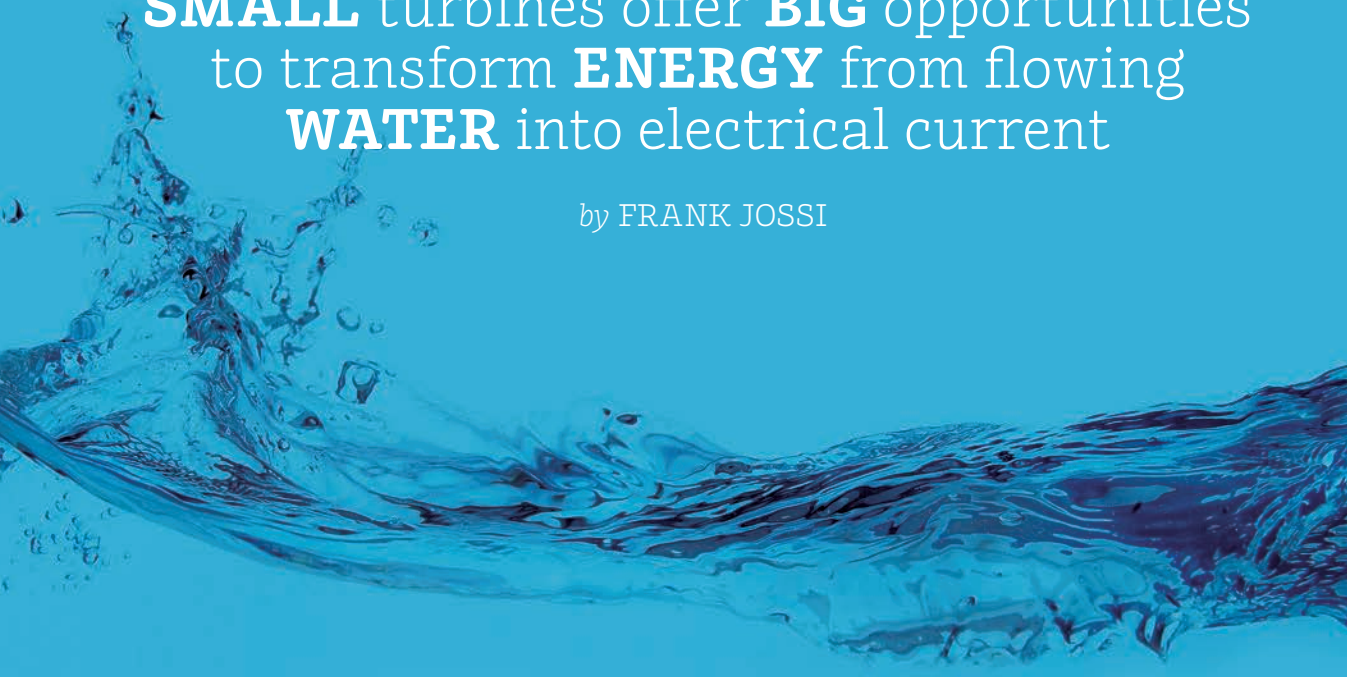
A low-head hydropower facility recently installed on an existing dam in Minneapolis turns the power of the Mississippi River into electricity. PHOTO COURTESY OF BROOKFIELD RENEWABLE ENERGY PARTNERS L.P.



New Spin on
**HYDRO-
POWER**

SMALL turbines offer **BIG** opportunities
to transform **ENERGY** from flowing
WATER into electrical current

by FRANK JOSSI



On a fast-moving stretch of the Mississippi River in downtown Minneapolis, a new 9.2-megawatt hydroelectric dam generates enough electricity to power 7,500 homes.

Built by Brookfield Renewable Energy Group and Nelson Energy, the Lower St. Anthony Hydroelectric Project sits in a lock of an existing U.S. Army Corps of Engineers dam.

The Lower St. Anthony is the first major new hydroelectric project on the upper Mississippi in decades. It represents a budding movement to begin tapping into perhaps the world's most overlooked yet reliable power source—moving water. Although most of the rivers best suited for large hydropower plants already have seen the installation of massive dams and turbines that use the power of trapped water gradually let loose to generate electricity, what's left is still a pretty rich trove of potential. Energy developers are now eyeing large and small river systems, tidal basins and even big western irrigation ditches as sources of a less common but very promising approach to tapping the power of water: small hydro.

Developers have focused on two broad types of small-hydro proposals: placing low-head hydro on existing locks and dams in rivers, and installing hydrokinetic turbines, which capture the energy of currents while being tethered to beds of rivers and tidal areas.

“We have a chance to squeeze some new energy out of little spots,” says Matthew Nocella, spokesman for the Washington, D.C.–based National Hydropower Association. “Folks working in this market say there is a lot of interest right now on the small hydro side.”

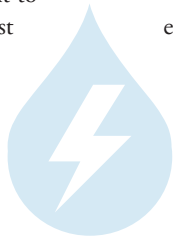
It's a global trend. In collaboration with the United Nations, China created the International Center on Small Hydropower to gather data and promote small hydro, and is seen as a global leader in its development. The center's February 2012 newsletter highlighted

low-head projects in Peru, South Korea, Uganda, China, Scotland, Switzerland and Tanzania.

Like big hydropower, small hydro offers utilities the rarest of attributes among renewables: a steady stream of power day and night, unlike intermittent sources such as solar and wind. That trait is one of the reasons hydro supplies more than 90 percent of all electricity produced by renewable power sources, according to the World Energy Council.

Small hydro systems have additional advantages. They are seen as less disruptive and more widely applicable than conventional hydropower facilities because water dropping less than 30 feet can turn their turbines, and installation does not dramatically change a river's flow or create pools of water.

“The idea is to create more distributed generation,” says Trey Taylor, co-founder of the hydrokinetic firm Verdant Power. “When you



Workers prepare to lower a hydrokinetic turbine generator into the Mississippi River. PHOTO COURTESY OF FREE FLOW POWER CORPORATION

think about it, most people live near water, in some form or another.”

And there's power in that water.

Lock and Dam Hydro

Only 2,500 or so of the existing dams in the U.S. use the energy in flowing water to turn turbines that create electricity, leaving at least 54,000 (some suggest the number may be 80,000) unpowered, according to an April 2012 report by the NHA and the U.S. Department of Energy. The vast majority of dams, in fact, are used for navigation, irrigation, municipal water supplies and flood control. The Army Corps' National Inventory of Dams of 2007 shows half of those nonproducing dams are at least 25 feet tall. By simply adding a smaller version of conventional turbines to the dams with the greatest potential, as much as 12 gigawatts of capacity could be installed, an amount equivalent to roughly 10 to 12 nuclear plants, according to the NHA's report. The International Energy Agency, meanwhile, reports only 19 percent of hydro's potential

The agency even created an exemption from several aspects of the usual regulatory process for hydro of less than 5 MW. Jeff Wright, FERC's energy projects office director, urged Congress earlier this year to increase the exemption to 10 MW and to allow for a two-year, rather than three-year, application process.

“We need licensing requirements that are better coordinated and have a more predictable process,” says Jeanne Hilsinger, executive chairman and development director for the Czech Republic-based firm Mavel, a.s., and president of Mavel Americas, Inc., its Boston-based subsidiary. “It's a very difficult process now, more difficult than it needs to be to protect the things [hydro opponents] want to protect.”

In fact, the environmental group Hydro Reform Coalition, which has fought to remove dams, sees little problem with the majority of proposals on locks. National coordinator Rupak Thapaliya says U.S. Army Corps locks “aren't going anywhere” and seem good candidates for the addition of hydro. He says he hopes devel-

ONLY 2,500 OR SO OF THE EXISTING DAMS IN THE U.S. USE THE ENERGY IN FLOWING WATER TO TURN TURBINES THAT CREATE ELECTRICITY, LEAVING AT LEAST 54,000 (SOME SUGGEST THE NUMBER MAY BE 80,000) UNPOWERED.

has been tapped, much of which can only be unlocked with low-head hydro.

Low-head hydro operations have been around for decades, but the field is seeing a mild resurgence as improved technology makes capturing the power of moving water all that easier, as tax credits create opportunity and as interest in green energy grows. Filings from the Federal Energy Regulatory Commission, which vets all U.S. hydro projects, reveal that nearly every Army Corps lock and dam in the country has a hydro project proposed on it, ranging from 5 MW to more than 100 MW. FERC has issued more than 1,000 licenses for new hydro projects since 2007, and several hundred sit in the pre-filing-phase queue. Applying and getting a license is just one step toward building a plant, but the numbers seem to indicate a renewed interest in hydro.

opers work to allow fish to safely pass through the dams, don't damage water quality and stop filing proposals for hydro on unsafe dams, an issue he's seen in some New England projects.

A 2010 Congressional Research Service report on small and low-head hydro suggests the environmental impact is minimal. Still, the report notes that “low-head hydropower development also has the potential to affect environmental components such as water quality, soils, and groundwater, as well as terrestrial and aquatic habitats and associated animals and plants, with the construction and operation phases of a project potentially affecting the local environment.”

Low-Head Turbines

Low-head hydro developers install either vertical or horizontal turbines to capture waterpower.

By the NUMBERS

3,145
billion kwh of hydropower produced worldwide in 2009

252
billion kwh/year wave energy potential off U.S. coasts

63
percent of all U.S. renewable energy supplied by hydropower in 2011

29.4
percent growth in global hydropower consumption, 2001-2010

5.3
percent growth in global hydropower consumption, 2009-2010

150
approximate number of countries with hydropower facilities

UNDAM IT

by LAUREN
WERNER-FOLEY

Water wheels have turned the energy of flowing water into mechanical energy for human use since ancient times. With the construction of the first hydroelectric power plant in the late 1800s, water became a source of electricity as well. Soon after, the U.S. Army Corps of Engineers began overseeing the construction of dams to trap water and channel its energy to generate electricity. Today thousands of hydropower dams have been built around the world.

But dams have downsides, too. They can pose safety hazards, alter land use, violate environmental and tribal protection mandates, present targets for terrorism, demand expensive restoration, disrupt ecosystems and prevent native fish from reaching spawning grounds. As a result, some communities have begun removing dams.

Just like dam construction, dam removal changes ecosystems and economies. Such changes can include release of nonnative fish and toxic industrial chemicals and loss of shoreline from the reservoirs the dams create. To protect people, infrastructure and nature, dam removal demands careful planning and post-removal monitoring.

A dam's removal cannot fully restore the pre-dam conditions. However, ecosystems and economies have ways of adapting over time; removing a dam puts at least part of the natural river system back.

A vertical system brings water down into a turbine from above, similar to what happens in higher dams except that the height—the head—is much lower, as little as a showerhead in some circumstances. A horizontal system employs turbines located within a dam or lock that capture the moving water's energy as it passes through. Spent water is discharged from the turbines through tailraces back into the river.

The Kaplan turbine, the most popular low-head option, is manufactured mainly in Europe and uses axial flow technology. It has been around for decades. The \$35 million Lower St. Anthony project represents a similar approach developed by Andritz, an Austrian manufacturer. Using the Andritz StrafloMatrix system, Brookfield installed 16 turbines stacked in eight modules in a gate adjacent to a lock. Energy is captured as water flows horizontally from the river through the turbines.

Although St. Anthony is among the first in the U.S. to use this Andritz low-head application, it is hardly new in other parts of the world.

"Europe is 10 years ahead of the U.S. on low-head power, probably 20 years," Hilsinger says. "There's so many low-head hydro sites in Europe that it's seen as standard."

Mavel is involved in five projects in the U.S., with two 10 MW dams on locks in Illinois and Des Plaines rivers near Joliet nearly complete. Developed by Northern Illinois Hydropower LLC, the installations will use Kaplan pit tur-



locations of only a few feet that may not need a great deal of power. In Kyoto, Japan, a Mavel microturbine produces 4.5 kilowatts of power, enough to light up a historic bridge and offer a green symbol in the city where the world's leading climate accord was signed.

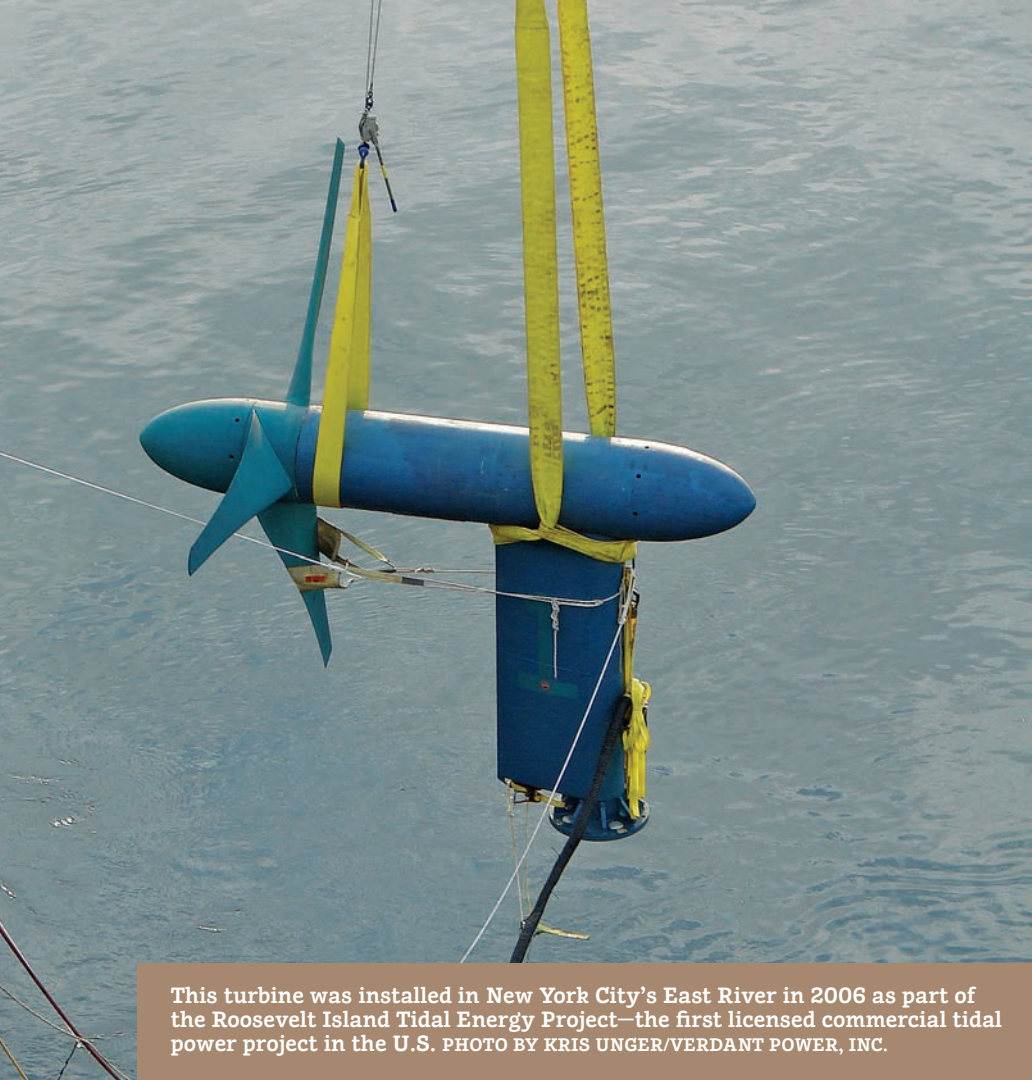
"IT'S LIKE CAPTURING WIND, EXCEPT WATER IS 840 TIMES DENSER THAN AIR, SO THERE'S MORE ENERGY IN WATER."

TREY TAYLOR, CO-FOUNDER VERDANT POWER

bines that look like airplane propellers. While the projects are important to building Mavel's brand, North America represents just 3 percent of the company's business, far less than Europe, South America and Asia, notes Hilsinger.

Beyond these turbines is the growing field of microturbines. These produce less than 1 MW per turbine—a level that hardly seemed worth the effort in the past—while offering a way to generate electricity in extremely low-head

The Alameda, Calif.-based Natel Energy's hydroEngine turbine produces energy with as little as 5 feet of drop, says Gia Schneider, the company's founder. The hydroEngine can produce as much as half a megawatt and—like all microturbines—be installed in multiples to produce more power. For now, Natel has had an installation producing nearly 1 MW in an Arizona irrigation canal and another underway in an irrigation canal in Oregon.



This turbine was installed in New York City's East River in 2006 as part of the Roosevelt Island Tidal Energy Project—the first licensed commercial tidal power project in the U.S. PHOTO BY KRIS UNGER/VERDANT POWER, INC.

Underwater Wonders

The bottom of rivers and tidal areas are the next frontier for small hydro. Verdant's hydrokinetic turbine employs underwater windmill-like turbines in arrays optimally configured to absorb the power of New York's East River.

"It's like capturing wind, except water is 840 times denser than air, so there's more energy in water," says Taylor. "The other beauty of water and water currents is reliability and predictability. It's not intermittent, like wind—you don't know when the wind will blow. Water, even the tides, is predictable."

As of August 2012, FERC had issued 113 "preliminary" marine and hydrokinetic permits. Another 62 projects were in the "prefiling" license phase, many involving proposals on the Mississippi and other midwestern rivers filed by Free Flow Power and other energy companies.

Near Roosevelt Island in New York City, Verdant's project is the first to receive a commercial license from FERC to produce power from the energy of tides. The turbines stand on pier-post-like structures drilled into bedrock in the east channel—the west channel handles all

the shipping traffic. Located 6 to 8 feet below the river's surface, the turbines turn at 35 revolutions per minute and change direction, like a weather vane, as the tide turns. Eventually the project will produce 1 MW of power, says Taylor, but the real opportunity "is 1,000 MW, for the Hudson River, Long Island Sound and upstate using this type of resource."

A different sort of hydrokinetic turbine is being tested in the Mississippi by Free Flow Power, which has proposed 65 hydrokinetic projects totaling 4 gigawatts. Free Flow's innovation, which looks like a jet turbine and is at least 6 feet tall, captures energy as current flows through it at a nominal pace of 32 rpm, says Jon Guidroz, Free Flow's project development director.

That requires the river to flow 7.2 feet per second, a speed capable of allowing the turbines to produce 40 kW, much less than traditional dam turbines. The idea, says Guidroz, is to install 5 to 10 MW of turbines per mile using a configuration of six turbines set up on pilings. Sets of turbines at 90-foot intervals could be put into place, ideally, in the southern section of the Mississippi where the river reaches a mile wide

and more than 100 feet deep. Before long, various stretches of the river would have the equivalent of an underwater wind farm, he suggests.

Last year Free Flow tested a hydrokinetic turbine attached to a dock on the Mississippi in Louisiana owned by Dow Chemical Company. Engineers studied energy generation and ability of the turbine to withstand the rigors of a river often filled by branches and other debris.

"We saw it perform in a real river environment and it was successful. We're pleased with the power generation it produces," Guidroz says.

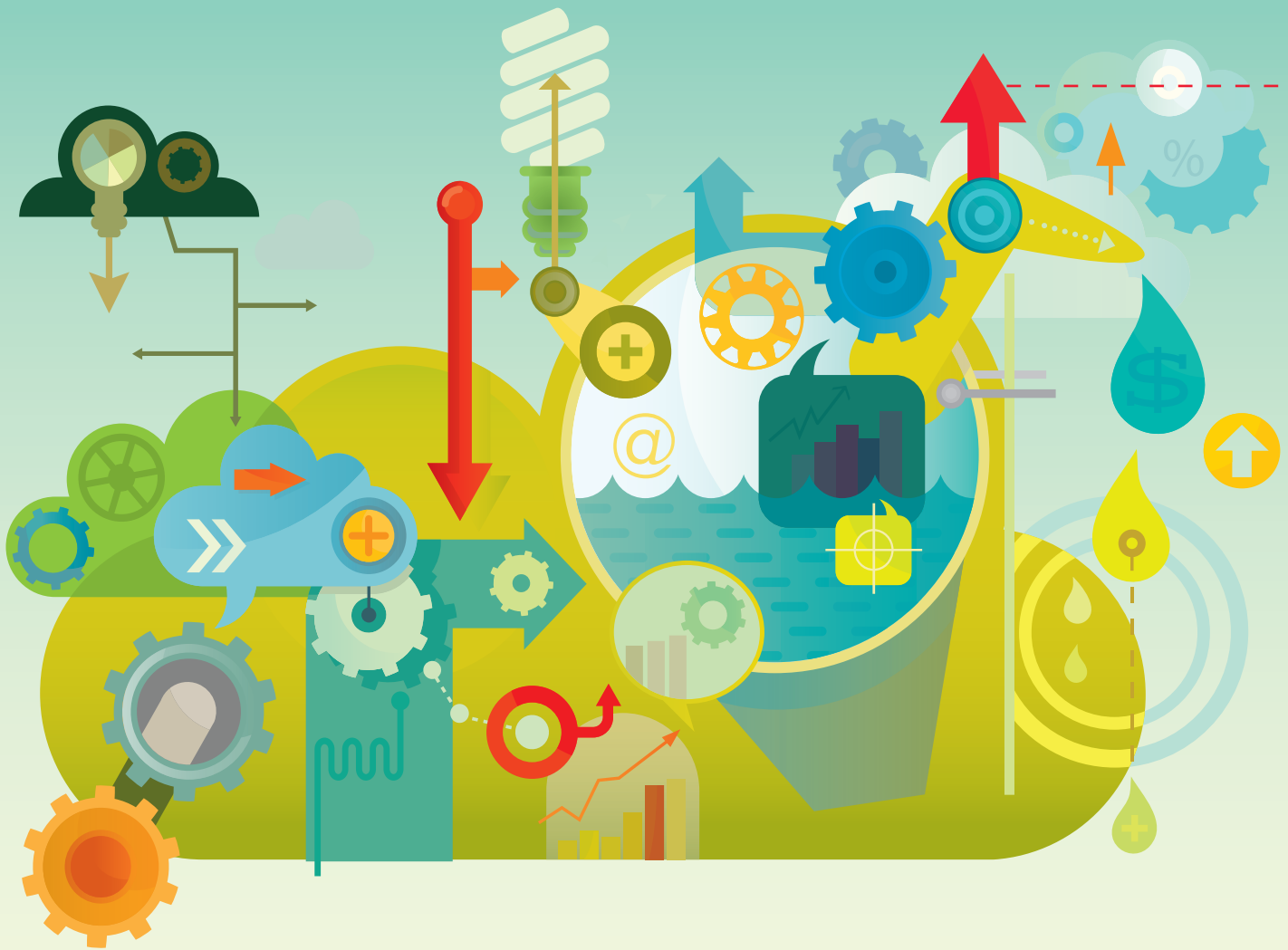
Hydrokinetic experiments, however, have not always worked. HGE started testing a hydrokinetic turbine at Hastings, Minn., in 2009. Mark Stover, vice president of corporate affairs, says it created power but wasn't ready for prime time, forcing HGE to focus on a modular "plug and play" turbine it developed for locks and dams. That turbine can be installed next to a dam or downstream from it using an approach requiring less construction than a typical project.

"We were able to take the technology and development approach [at Hastings] and plug that into our low-head technology," Stover says. "I'm not sure if we had not done Hastings that we would have seen the light on low head. There is a ton of potential low-head hydro in the United States that has not been developed for 20 or 30 years, and we're going to go after it."

A self-described "optimistic curmudgeon," Nelson Energy manager Bob Larson sees hydro as beneficial not only to energy balances but also to the economy as a whole. He notes that Minneapolis became a vibrant metropolis thanks to St. Anthony Falls, which was diverted in the 1800s to run sawmills and flour mills that produced the city's original wealth.

"We've been a growing community for a long time because of hydro," he says. "When I think of hydro I think about community development. Anywhere in the world where you install hydro you will be building a community."

FRANK JOSSI is an award-winning journalist who writes about energy, the environment and public policy for a variety of publications. His work has appeared in *Wired*, *Renewable Energy World*, the Federal Reserve Bank's *Fedgazette*, *Midwest Energy News*, the *Star Tribune* and more than 60 other publications.



B *is for* **BETTER**

An innovative legal structure helps corporations make sustainability their true bottom line.

by ANNE FIELD

Since he founded Solar Works in 1986, John Parry has focused on a lot more than profits. Through the Sebastopol, Calif.-based business, which installs solar energy systems in residential and commercial buildings, Parry aims to help address what he sees as an urgent environmental emergency facing the planet. “From my point of view we are in a major crisis here on Earth, and taking action is necessary if we want to have any chance of surviving,” says Parry.

In early January, Parry found himself at the office of California’s secretary of state, near the head of a line of 40 like-minded companies waiting to hand in their documents and become B corporations. “This is a corporate structure completely aligned with my way of thinking,” he says.

Solar Works is typical of more than 120 businesses that have signed on to become B corporations over the past year and a half or so

However, their ability to do so has been hindered by a legal stumbling block. Traditional corporations must, by law, consider first and foremost the financial interests of shareholders. Profit, in other words, before anything else.

That leaves triple-bottom-line companies, as they’re called, in a bind. If they want to take an action that helps achieve their environmental mission—say, buy from a supplier with a low carbon footprint—it could hurt their profits. The vendor, after all, might charge higher prices than a less environmentally friendly competitor. But if they were to choose that less profitable path, it would mean they had violated their fiduciary responsibilities to their shareholders. At the same time, it’s hard for investors and consumers to tell whether a company that claims to be triple bottom line is the real thing.

B corporation legislation aims to address that quandary by baking into articles of incorporation some important requirements. Companies have to create what’s called a “general purpose benefit,” defined as a “material positive impact on society and the environment.” In most states, B corporation directors must consider the effects of their activities on employees, customers, the



Solar Works founder and president John Parry (left, with spouse and Solar Works vice president Laura Goldman) jumped on board the B corporation bandwagon the day California began accepting applications. The innovative corporate structure is “completely aligned with my way of thinking,” he says.
PHOTO COURTESY OF SOLAR WORKS

So last year, when Parry heard from a friend and colleague about a new corporate form recently passed into law in California, he immediately knew it was a structure he needed to adopt. Called the benefit corporation, it targeted companies just like Parry’s—for-profit firms that consider environmental and social missions as important as their money-making goals. Commonly known as B corporations, businesses incorporated under this structure are required to consider how their decisions affect not just shareholders, but the environment, society and employees as well.

in the 11 states that have adopted such legislation. The companies range from well-established household names like Patagonia to fledgling start-ups. They function as a type of hybrid—for-profit businesses with altruistic missions at their core.

Bottom-Line Bind

The desire to do good while doing well is not an unheard-of trait among businesses: Perhaps 50,000 enterprises with that goal exist in the U.S. today, according to B Lab, the Berwyn, Pa., nonprofit that has been the prime force encouraging states to adopt B corporation legislation.

B CERTIFIED

Benefit corporations can pursue certification from B Lab, the organization behind the passage of B corporation legislation, that they’re bona fide triple-bottom-line companies. Nationwide, there are more than 500 certified B Corps. Ratings cover five areas related to sustainability, with 130 to 180 individual factors depending on company size and industry. Each year, about 10 percent of certified companies receive an unannounced audit.

community and the environment in addition to shareholders. And if the corporation takes an action that can harm its mission, shareholders

can sue to hold the business accountable. In addition, to prove their bona fides, companies have to produce an annual report detailing their social and environmental performance using a third-party standard. “Our belief is the strongest protection for these companies is to have a statute ensuring their right to consider things other than maximizing profit,” says Erik Trojian, director of policy at B Lab.

Definite Draw

Most company owners, like Parry, seek to become B corporations to align their corporate structure with their principles. But there’s also a financial motivation—the belief that the seal of approval will help them raise money from impact investors interested in financing businesses that are trying to create substantive societal change. According

to some studies, there’s as much as \$3 trillion worldwide in such money available. In addition, because a B corporation’s triple-bottom-line mission is protected by law, investors would have to respect those priorities later on.

Gary Gerber, CEO and co-founder of Berkeley, Calif.-based Sun Light & Power, which does solar power installations, registered to be a B corporation in January. He says he’s seen the competition heat up significantly over the past two years or so as more venture capital-backed players have entered the market. To compete, he figures he needs to raise outside money. But he doesn’t want to do business with investors who might want him to make compromises in areas such as quality of service or benefits for his 70 employees. That’s one reason why he jumped at the chance to become a B corporation. “There’s the possibility now of finding money to help us grow while protecting the triple-bottom-line nature of the business,” he says.

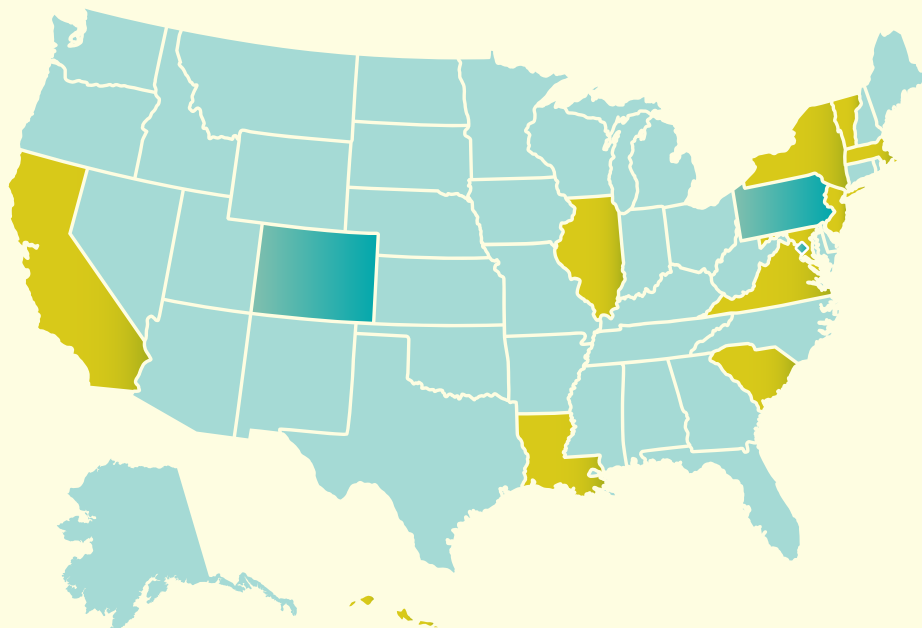
“There’s the possibility now of finding money to help us grow while protecting the triple-bottom-line nature of the business.”

films such as “Fresh,” a documentary about the local food movement, and “A Chemical Reaction,” about a community in Canada that worked to ban the use of pesticides for lawn care.

“Becoming a B [corporation] fit us like a glove,” she says. “It was an appropriate way to formally state

we’re concerned with people, planet and profit.”

But, like Gerber, Jones-Napier also signed on as a B corporation to help the company raise money. By registering under the new corporate form, she was able to attract several like-minded investors who were impressed by the move and provided low-cost loans. “I would say we would not have been able to open the store were it not



STATE-BY-STATE

As of this writing, 11 states—California, Hawaii, Illinois, Louisiana, Maryland, Massachusetts, New Jersey, New York, South Carolina, Vermont and Virginia—have passed legislation enabling businesses to incorporate as benefit corporations. Colorado, Pennsylvania and Washington, D.C., are among those formally considering such legislation. To learn more, go to z.umn.edu/benefitcorp.

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Gary Gerber, CEO and co-founder of Berkeley, Calif.-based Sun Light & Power, which

Or take Pennye Jones-Napier, whose company in 2010 became the first in Maryland—and in the nation—to incorporate as a B corporation. Jones-Napier and her partner run The Big Bad Woof, a franchise and store that sells eco-friendly pet food and supplies. They also hold regular events for the community—for example, showing

for angels who said they believed in what we were doing,” she says.

For Jones-Napier, there’s also been a marketing benefit. The Big Bad Woof’s website touts the company’s standing as the first registered B corporation in Maryland, and she and her partner tend to talk it up with customers. They

also speak frequently at events in the area about the corporate form. While she can't say whether customers patronize her store because of the B corporation status, she has found they often bring the topic up in conversation. What's more,

B corporation requires them to incorporate—a change that can have tax implications for company partners under certain circumstances. That's why Maryland created a benefit LLC designation in 2011.



The B corporation structure fits her pet supply company's business philosophy "like a glove," says Big Bad Wool co-owner Pennyne Jones-Napier, shown here with her dog Yaya-Zen at the company's Hyattsville, Md., store. PHOTO COURTESY OF THE BIG BAD WOOF

it has been a definite draw for prospective employees "who want to work for a company that believes in following the three Ps," she says.

Way to Go

Still, the new structure has a way to go before it becomes standard operating procedure. "A lot of firms just don't know about it," says Andrea Chen, executive director of Propeller: A Force for Social Innovation, a startup incubator in New Orleans that helped several fledgling companies become B corporations when the Louisiana law went into effect in August. She's held three workshops recently for companies interested in finding out about the law, featuring lawyers who discussed the legislation. The most recent one attracted about 40 attendees.

Then there's the LLC problem. Many triple-bottom-line companies are privately held limited liability companies (LLCs). Registering as a

But proponents of the legislation say it's only a matter of time before a critical mass of states adopt the statute—and triple-bottom-line companies register by droves. It's been not even two years since the first state adopted the legislation, they point out.

Says Stefan Doering, managing partner of Shift Group, a New York City-based training firm for triple-bottom-line companies and a consultant specializing in that area, "This will help lend further legitimacy to the triple-bottom-line movement, help attract more investment and boost the development of more social enterprises."

ANNE FIELD is an award-winning journalist specializing in social enterprise, small business and entrepreneurship. Her work has appeared in the *New York Times*, *Bloomberg Businessweek*, *Forbes* and *Crain's New York Business*, among other places.

BEYOND B

The benefit corporation isn't the only option for mission-driven for-profit companies. The following two choices are also possibilities:

L3Cs. Nine states and two Native American tribes recognize this form, which is more formally known as a low-profit limited liability company. There are about 600 such businesses, which must have a charitable or educational purpose. L3Cs were created to be treated as program-related investments. In the U.S., foundations are legally obligated to devote 5 percent of their assets every year to charitable purposes. They can do that through a PRI as long as the organization has a charitable or educational goal as its primary objective. The jury is still out, however, as to whether many foundations will be willing to treat L3Cs as a PRI investment.

Flexible Purpose Corporations.

Companies that adopt this corporate form, which has been passed only in California, don't have to meet general public benefits. Instead, the law allows these corporations to include in their bylaws one or more "special purpose" activities, which may (but does not have to) include charitable and public-purpose activities. The structure protects directors from claims that they violated their fiduciary duties by considering nonfinancial goals. While they don't have to produce annual assessments based on third-party standards, these corporations are required to deliver annual reports that include a discussion of their special purpose activities.

SPOILED

DIGGING INTO FOOD LOSS AND WASTE AROUND THE GLOBE | BY TODD REUBOLD

What if someone came to your house and threw every third meal—breakfast, lunch or dinner—in the trash before you had a chance to take a bite? You'd probably be pretty upset. Yet every day around the world that's essentially what we're doing. We're throwing away nearly one-third of the food produced globally. Below we take a look at where we lose or waste food as it travels from farm to fork—and offer a few ideas for getting the most out of the food we produce with increasingly scarce land and water resources.

FOOD LOSS, FOOD WASTE

FOOD LOSS refers to disposal of edible parts of food during the growing/catch, postharvest/slaughter and processing stages of the food supply chain. **FOOD WASTE** typically occurs during the distribution, sale

and consumption phases. In the developing world, food loss is significant and food waste is minimal. In the developed world, with both more efficient production and more wasteful consumption, both are a big concern.

290 KG/YR

Average per capita food loss in Europe and North America

145 KG/YR

Average per capita food loss in sub-Saharan Africa and South/Southeast Asia

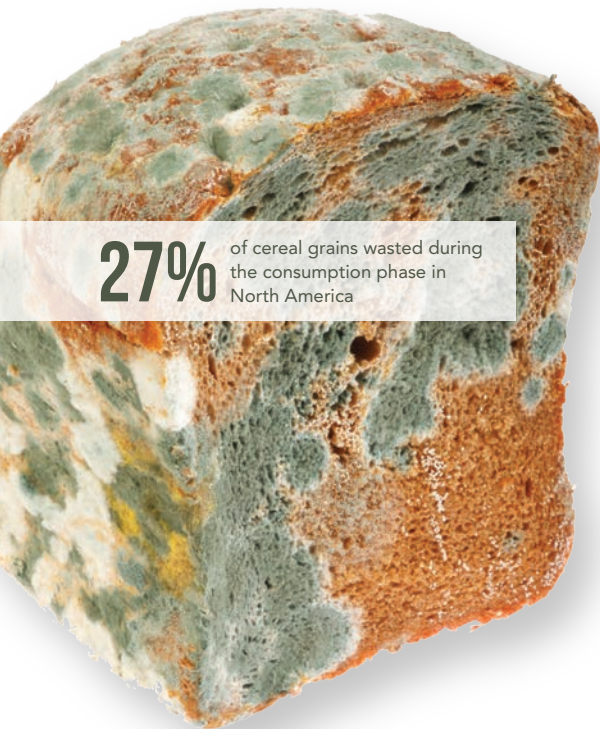
105 KG/YR

Average per capita food waste by consumers in Europe and North America

8.5 KG/YR

Average per capita food waste by consumers in sub-Saharan Africa and South/Southeast Asia

BY THE NUMBERS



27% of cereal grains wasted during the consumption phase in North America



15% of oilseeds and legumes lost during the growing phase in North Africa and the Middle East



15% of fish and seafood lost during the catch stage in East Asia



19% of roots and tubers lost during postharvest in South and Southeast Asia



25% of fruits and vegetables lost during processing in sub-Saharan Africa



8% of dairy products wasted during distribution in Latin America



11% of meat wasted during the consumption stage in Europe

1,300,000,000

Tonnes of food—nearly one-third of total global production—are lost or wasted on average each year.

GLOBAL LOSS AND WASTE FOR FISH AND SEAFOOD



Europe, Russia
(35.9%)*



Australia, Canada,
New Zealand, U.S.
(50.5%)



China, Japan,
South Korea
(42.0%)



Sub-Saharan
Africa
(37.7%)



North Africa,
Middle East
(34.6%)



South and
Southeast Asia
(40.2%)



Latin America
(33.7%)

Fishing/Fisheries
 Post Catch/Storage
 Processing
 Distribution
 Consumption
 * % of total edible catch lost or wasted, including bycatch

EXPLORING SOLUTIONS

How can we best reduce food loss and waste?

That depends on the circumstances. In developing countries, the greatest opportunities lie in diversifying production; investing in infrastructure, transportation, food and packaging industries; and improving technical and managerial skills of people in charge of food handling and storage. It's important to note that large-scale investment in infrastructure—roads, storage facilities, etc.—alone has been shown to fail where markets and local investment are absent.

In developed countries, the most effective strategies include improving communication between producers and retailers to avoid overproduction; increasing awareness of food waste's economic and environmental impacts; better labeling of perishable items; and finding ways to salvage safe, edible food that is currently thrown out.

As the planet moves toward 9 billion people, feeding the world while protecting the environment is one of the greatest challenges we face. Reducing food waste and loss is a big step in the right direction.

SOURCES: Swedish Institute for Food and Biotechnology, Food and Agriculture Organization of the United Nations

PHOTOS: © SHUTTERSTOCK.COM: (From left) ra3rn, Peter Zijlstra, bogdan ionescu, nikkytok, Tijana, LockStockBob, thumb and holbox

On the move

Saving nature's greatest spectacle from extinction

Excerpted from *Life Is Good: Conservation in an Age of Mass Extinction*, published in 2011 by Mongabay and available at amazon.com in paperback and Kindle versions.

written by JEREMY LEON HANCE // illustrated by SAMUEL CASTAÑO

If we could turn back the clock 200 years, we could watch as millions of whales took to their migration routes. Around 150 years ago, we could witness bison filling the vast America prairie or a billion passenger pigeons blotting out the sky for days. Only a few decades

back, and more than a million saiga antelope could be seen crossing the plains of Central Asia. Fast-forward to today: the humpback whale (*Megaptera novaeangliae*) population is only 5 percent of its estimated historic population. Based on DNA data, the species has fallen from up

to 1.5 million behemoths to perhaps 80,000. Around 30,000 American bison (*Bison bison*) are left out of a population that may have reached 100 million; the percentage remaining is not even a whole number. The saiga antelope (*Saiga tatarica*) has dropped 95 percent in 20 years, from a million individuals to 50,000. But the passenger pigeon (*Ectopistes migratorius*) proves the most drastic, going from one of the world's most populous birds to extinct in a few decades.

Such examples illustrate a common occurrence: the phenomenon of mass migration going

the way of the passenger pigeon. From whales to sea turtles and insects to songbirds, from hoofed mammals to the predators that track them, massive migrations are declining worldwide, and in a number of cases simply vanishing altogether.

In a paper in *PLoS Biology*, David S. Wilcove and Martin Wikelski, both with the Department of Ecology and Evolutionary Biology at Princeton, discuss the ramifications of such losses in abundance and the importance of putting new conservation attention on beleaguered migrants.





Wilcove and Wikelski point to four major reasons why massive migrations are gravely threatened: human-created barriers like dams, fences and roads; habitat destruction; climate change; and overexploitation of a species, particularly important in the case of oceanic and freshwater migrants. All of these reasons are anthropogenic (human-related), but Wilcove and Wikelski believe that those who caused the demise of the great migrations could also save them, arguing that the world's great migrations deserve suitably large-scale conservation initiatives. In fact, they state that mass migrations should be protected much like endangered species. But unlike endangered species, massive populations of the migrating species must be preserved to warrant success, while researchers often consider a few hundred healthy breeding pairs enough for the recovery of an endangered animal.

Although no one knows exactly how each migration affects its environment, the authors believe diminishing migrations drastically alter the productivity of an ecosystem, challenging its ability to provide essential services. For example, the authors illustrate that salmon “by migrating upstream, spawning and dying ... transfer nutrients from the ocean to the rivers. A portion of the nutrients is delivered in the form of feces, sperm and eggs from the living fish; much more comes from the decaying carcasses of the adults.

Phosphorus and nitrogen from salmon carcasses enhance the growth of phytoplankton and zooplankton in the rivers, which provide food for smaller fish, including young salmon.” However, the northwestern rivers of America receive only about 6–7 percent of the nutrients they once did due to a drastic decline in the migratory population of salmon. Fewer nutrients ultimately lead to fewer salmon in the next generation and less biomass altogether.

Such drops in population are also bound to have drastic impact on ecosystems; for example, migratory birds help control insect populations. Fewer birds may mean a population explosion of insects, some of which could be detrimental to forests or nearby farmland.

It is not just one-species migrations, such as salmon and saiga that suffer from decline.

“Birdwatchers in North America and Europe, for example, complain that fewer songbirds are returning each spring from their winter quarters in Latin America and Africa, respectively,” the authors write, citing a recent study of Europe’s birds, which show migratory birds have suffered greater declines in population than stationary species. Such drops in population are also bound to

have drastic impact on ecosystems; for example, migratory birds help control insect populations. Fewer birds may mean a population explosion of insects, some of which could be detrimental to forests or nearby farmland.

A 2005 study of the passenger pigeon’s extinction argued that the bird’s demise caused the current prevalence of Lyme disease. Deer ticks (*Ixodes scapularis*) only spread Lyme disease after feeding on an infected host, often mice. But mice,

researchers theorized, are more abundant now since the extinction of the passenger pigeons. Why? Passenger pigeons used to compete with mice for the same food source, acorns. Thereby, the loss of passenger pigeons may have caused an incomprehensible rise in the deer tick population due to more mice.

Of course, when migratory species diminish, predator numbers also decline as their food sources dry up. In addition, plant diversity and

AT HOME ON THE RANGE

by JEREMY LEON HANCE

Is it possible to restore a lost ecosystem and, maybe one day, even a vanished migration? The American Prairie Reserve is attempting to do just that with one of the boldest rewilding projects in the world: returning a Connecticut-sized plot of land in the American West to wild prairie, complete with what could become the world's largest herd of wild bison.

By buying up land in sparsely populated northeastern Montana, APR is working to connect parks and cooperating Indian reservations into one large ecosystem which, the group says, will be “reminiscent of that seen by Lewis and Clark.”

APR now manages several hundred bison on 14,000 acres within the larger reserve, which is open to the public. Although bison are naturally long-distance migrants—following food south in the winter—APR's herd is not allowed to migrate due to laws that treat them as livestock.

“The one way in which this might change is if the state of Montana changed the classification of bison from livestock to wildlife,” explains Alison Fox, director of marketing with APR. “If they did this, we have made it clear to the state that we hope to turn our bison over to them to be managed as wildlife on the reserve.”

Fox says the economic benefits of the project are beginning to be felt: APR, which is funded by contributions from private foundations and individuals, has contributed some \$19 million to the local economy through jobs and purchases of land, equipment and supplies.

The project has not been without controversy, however. Some local ranchers criticize APR for buying up private land. Others fear wild bison could transmit disease to cattle.

“The community response has been mixed,” says Fox. “As is the case with any new idea and one that proposes change to land use, there has been some initial opposition to our goals and skepticism about our approach.”

If APR succeeds in turning even a corner of the vast American West back into wild prairie and bison country, it could have profound implications for biodiversity and ecological health because bison are massive ecological engineers, underpinning the now largely vanished American prairie. The project may also spur other bold conservation projects worldwide.

In the 19th century the U.S. broke new ground by creating the world's first national park. In the 20th century it drafted the Endangered Species Act, the first comprehensive legislation to save vanishing species. So perhaps it's not a pipe dream to think America's 21st century could see a large-scale return of a once-lost ecosystem.

populations change when thousands of herbivorous mammals fail to make their seasonal appearances.

Illustrating just how imperiled global migrations are, a 2009 study in *Endangered Species Research* surveyed two dozen large ungulate species (hoofed animals) known for their migratory patterns, including some well-known species, such as caribou (*Rangifer tarandus*), American bison, elk (*Cervus elaphus*), Burchell's zebra (*Equus burchellii*), blue wildebeest (*Connochaetes taurinus*), Tibetan antelope (*Pantholops hodgsonii*) and saiga.

Shockingly, almost all 24 focal species lost migration routes and suffered population declines. Six of the focal species either no longer migrated at all or, in a couple of cases, no longer survived in the wild: the springbok (*Antidorcas marsupialis*) used to form some of the world's largest migrations; the black wildebeest (*Connochaetes gnou*) was nearly exterminated and has relied on reintroduction efforts; the blesbok (*Damaliscus dorcas*) is not endangered but no longer migrates; the dwindling population of wild ass or kulan (*Equus hemionus*) of central Asia was cut in half in just 16 years; the scimitar horned oryx (*Oryx dammah*) is extinct in the wild, but there are plans for reintroduction; and the quagga (*Equus quagga*) from southern Africa is simply gone.

Part of the problem has simply been a lack of awareness: Researchers found that many of these migrations have been little studied. Although Africa includes the most large-scale migrations, the authors discovered that three migrating species had no publications on their population status at all. In Eurasia half of the migratory species have been largely ignored by science.

Preserving migrations, however, has proven even more difficult than identifying the causes in their decline.

“If we are going to conserve migrations and species, we need to identify what needs to be done: where migrations remain, how far animals move, their habitat needs and location, threats, and the knowledge gaps that needed to be filled,” says Joel Berger with the Wildlife Conservation Society and the University of Montana. “For some of these species, such as the wildebeest and eland in Botswana, threats were identified decades ago. We as a society have made little progress at figuring out how to save migrations.”

Grant Harris of the American Museum of Natural History says that “a large part of this is an awareness issue. People don’t realize what we have and are losing.”

But preserving thousands to millions of individuals will be far from easy. Wilcove and Wikelski write that saving these migrations will pose “unique scientific and social challenges.” How does one approach preserving abundance,

How does one approach preserving abundance, rather than settling for simple existence?

rather than settling for simple existence? The writers believe that protecting migrations will require action on the local, national and global level. Those in power will have to change their mind-set and protect a species before its population declines.

However, to date the importance of migrations has not penetrated the policy sphere. Even the world’s most well-known migration—the wildebeest in the Serengeti—is facing an existential threat from a road that could potentially cut off the movement of wildebeest, essentially stalling one of the greatest natural spectacles on Earth. Warnings from the tourism sector, environmental

groups and international governments have to date failed to stop the Tanzanian government from proceeding on the road.

“If we are successful,” Wilcove and Wikelski write, “it will be because governments and individuals have learned to act proactively and cooperatively to address environmental problems, and because we have created an international network of protected areas that is capable of

sustaining much of the planet’s natural diversity.”

The authors believe it would be well worth the energy and sacrifices required, considering the ecological services provided by these massive movements, the scientific importance of studying the mechanisms behind such migrations, and the perfect wonder of such spectacles. Migrations are a kind of culmination of nature’s potential—once so prevalent across the world, now only surviving in a few aberrant places.

Some great migrations do remain. Although in decline, monarch butterflies still cross international boundaries in astounding numbers. At least for now, some 2 million wildebeest, zebra and Thomson’s gazelles travel across the African

plains, providing food for many of Africa’s large predators, from lions to hyenas to crocodiles. Caribou still migrate in the thousands across the Arctic tundra. And as recently as 2007 a previously unknown migration was observed in the southern Sudan, with over a million antelopes, including the white-eared kob (*Kobus kob*), the tiang (*Damaliscus lunatus*) and the mongalla gazelle (*Eudorcas albonotata*).

Conservationist and adventurer Michael Fay said of the discovery: “This could represent the biggest migration of large mammals on Earth. I have never seen wildlife in such numbers, not even when flying over the mass migrations of the Serengeti.”

Although on the wane, great migrations still exist: The discovery of a new migration containing a million individuals buoys that point. Now, with proactive attention, great energy and global cooperation, such migrations could not only survive, but thrive. In the future—as in the past—millions of whales, saiga antelopes and even bison could move along migratory routes, completing their ecological role.

JEREMY LEON HANCE is a senior writer for the environmental and conservation website mongabay.com and has also written for *Yale Environment 360* and *Conservation Magazine*. His new book is called *Life is Good: Conservation in an Age of Mass Extinction*.



Power to the People

Marc Bamuthi Joseph draws on hip-hop and spoken word to recast the green movement as a means of sustaining humanity as well as the planet.

by **STEPHANIE XENOS** | photo by Bethanie Hines

NATIONAL POETRY SLAM CHAMPION. Rockefeller fellow in the performing arts. One of *Smithsonian* magazine's Top Young Innovators in the Arts and Sciences. Director of performing arts for the Yerba Buena Arts Center in San Francisco. Marc Bamuthi Joseph has serious artistic credentials. He also is a powerful voice for an urban green movement that pushes conversations about sustainability to include activities that support healthy living, particularly in communities plagued with urban crises such as gang violence and high dropout rates.

"I grew up in New York. I knew buildings, urban sprawl, trains and grids," says Joseph, who now lives in the Bay Area. "I didn't really get the preciousness of the planet until I was able to see it."

When he made the move to the West Coast, Joseph moved into Bayview Hunters Point, a predominantly poor African-American neighborhood. The area is dotted with rundown housing projects and grapples with the legacy of pollutants from an old naval shipyard. Crossing the Golden Gate Bridge on his way to work, Joseph was struck by the juxtaposition of the natural beauty of the region and the pervasive toxicity in his own neighborhood; the disconnect between marginalized, under-resourced communities where life itself isn't even always a shared value and the environmental movement at large.

Joseph argues that both the language and the spirit of the environmental movement need to be more expansive and more accessible. He considers the work of people such as Paul Hawken and Majora Carter foundational.

"I think [Majora Carter] is probably the most visible among those of us contemplating urban environment not as an oxymoron, but actually looking at people as part of the environmental discourse," Joseph says. He points out that you don't need to know your carbon footprint or even what a carbon footprint is to be part of the green movement. "We need to make the discussion available to an expanded public," says Joseph. "It's about language and who gets to speak."

Joseph starts that conversation with a simple question: What sustains life in your community? Answers to that inform a mix of activities that weave together hip-hop-infused performance and community engagement: Life Is Living, a series of urban eco-festivals that bring together under-resourced communities with green-action agencies to create dialogue around living healthier lives; the Living Word Project, through which Joseph develops performances that draw on the stories he collects; and Youth Speaks, a program that uses spoken word as a vehicle for expressing views on the environment.

The latter propelled Joseph from awareness to activism. Under his direction, Youth Speaks traveled around the globe giving performances in partnership with Robert Redford's Sundance Institute. Yet, despite the warm embrace by eco movers and shakers, the experience left Joseph feeling ambivalent.

"When you are dealing with people of a certain level, you are not in the transformation business but in the affirmation business," says Joseph. The young performers were, he observed, simply providing "spoken word codas" for a largely homogeneous green movement. He realized that what he really wanted to do was engage marginalized communities, and he chose hip-hop, a culture that amplifies the experiences and concerns of the marginalized, as the foundation on which to build. "I wanted to make hip-hop a fulcrum if not a focal point of the creative process," he says.

Joseph's multimedia performance called *red, black & GREEN: a blues*, which he has staged at a number of major arts institutions, is a vivid demonstration of the skillful way the artist weaves together message and medium. He pulls stories, history and poetry together into a visceral investigation of what Yerba Buena Center for Arts, where the performance premiered, describes as "emerging definitions of environmentalism in [urban] communities." As with everything Joseph does, the product is a by-product of the process—a process predicated on inclusion.

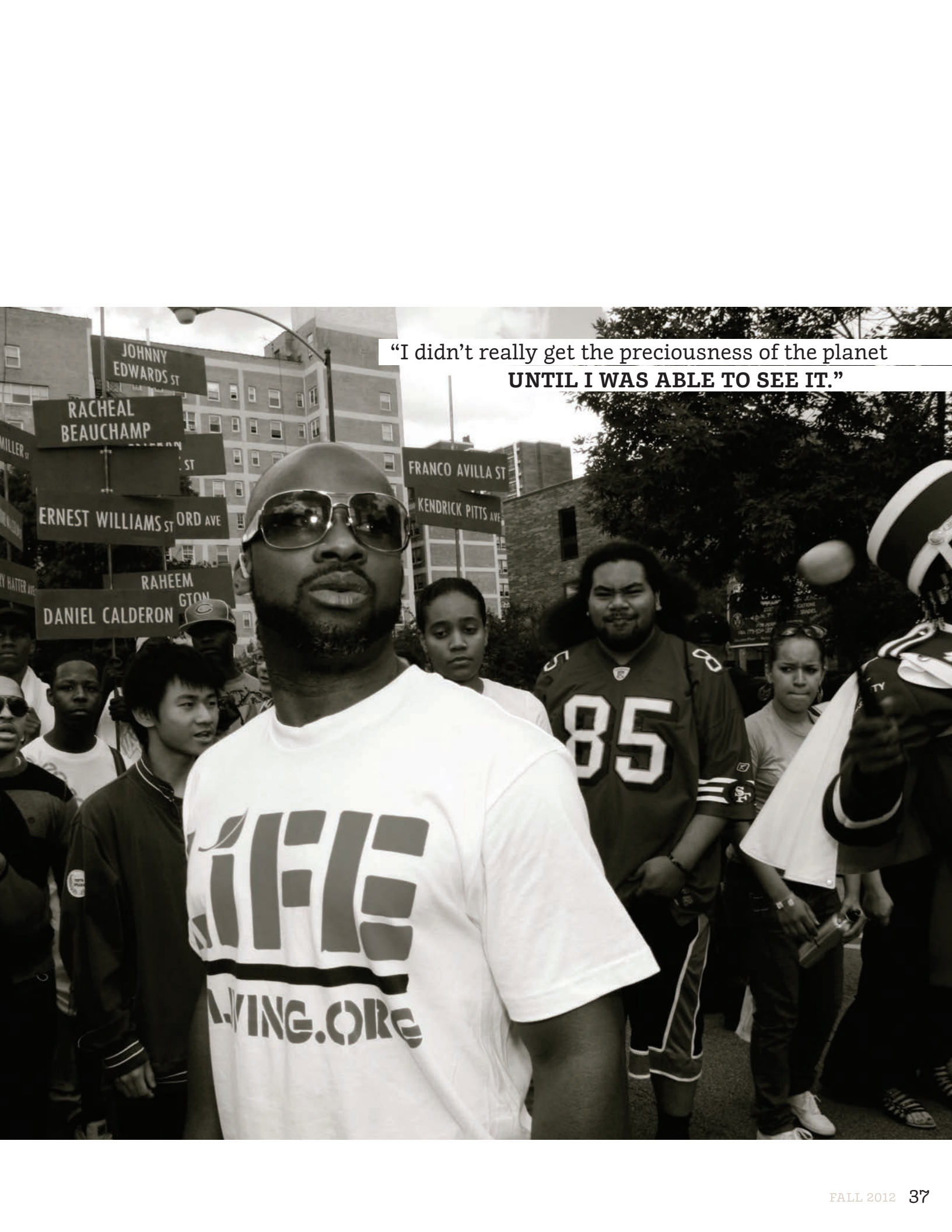
"Everything about our world is winner-take-all zero sum," says Joseph. "Everything is yours or mine. It can't be ours." Achieving sustainability in the broadest sense will require a radical change in that equation.

"Nature tells us homogeneity is the wrong approach," Joseph says. "Instead of siloing the conversation where it has already happened [among scientists and scholars], we need to move the discussion to places and ways available to an expanded public."

STEPHANIE XENOS writes about the arts for *Mpls.St.Paul Magazine* and other publications.

VIEW A TRAILER OF
red, black & GREEN: a blues:
vimeo.com/42851726





“I didn’t really get the preciousness of the planet
UNTIL I WAS ABLE TO SEE IT.”

Steam Team

Iceland’s geothermal expertise helps Kenya meet growing energy needs.

by JEANNIE HANSON

“**DRILL, BABY, DRILL?**” Well, yes, if it’s geothermal energy you need. Two quite different countries—Iceland and Kenya—are circulating their expertise to do so.

It may seem a truly odd connection. But the two countries are cousins under the skin, geologically speaking. Both experience active splits, or “rifts,” of the Earth’s crust, probably caused by “hot spot” tectonic forces below the crust in our planet’s mantle.

Kenya is underlain by the East African Rift. The rift’s two separated sides slice the country roughly north to south. To make these fissure walls, the Earth’s crust cracked, basaltic magma flooded out to pile up,

and the expanded area between stretched and flattened. The rifting is still a work in progress, and today a dozen or so active or semiactive volcanoes keep the crust warmed. Kenya has become the first African country to exploit the energy potential of its geology, through two national companies actively drilling to release steam that can be used to create electricity.

Iceland lies atop a rift, too: the vast Mid-Atlantic Rift. If the Earth were a baseball, this rift would be the stitching from the Arctic to Antarctica. Stretching at the stitched seams has created the Atlantic Ocean—and the island of Iceland itself, as basaltic rock flowing out of



The Svartsengi Geothermal Power Plant in southwestern Iceland produces heat and electricity for local residents. Ninety percent of Iceland’s space heat and 26 percent of its electrical power come from geothermal sources. PHOTO BY INGÓLFUR BJARGMUNDSSON

the fissure piled up to break the ocean's surface. Rifting is still active here, too, and the high rate of volcanic activity feeds the areas where five major geothermal plants pump up hot water.

"Iceland has had 40 confirmed eruptions in the last 19 years, more than is usually known," says Páll Einarsson, professor of geophysics at the University of Iceland. The country gets about 26 percent of its electricity from geothermal heat created by the formation of the Earth and the radioactive decay of its minerals. Earth's warmth is used mainly as hot water for heating, with some of the heat used to turn turbines that produce electricity.

Iceland's long-time expertise with geothermal energy and drilling—the wells here are 1 to 2 kilometers or so deep—is being tapped by the United Nations. The United Nations University started a geothermal training program in Iceland in 1979. To date, 515 postgraduate scientists and engineers from 50 developing countries have come for six months of specialized geothermal energy training. The program includes background on geological exploration, borehole geology, the chemistry of thermal liquids and drilling technology. The training is managed by a "Geothermal Cluster" of about 80 institutions that mapped the country's geothermal resources, keep its development focused and export its expertise.

Among those trained in Iceland was Pacifica Ogola from Nairobi. An environmental scientist with KenGen, Kenya's major power company, Ogola sent a picture home of herself in a parka, grinning, amid plumes of geothermal steam. It was taken in 2009, when she returned to Iceland after her initial training to pursue a Ph.D. in geothermal technology. The sharing goes both ways: In March 2013, Iceland will host a geothermal conference (see box at right) at which Kenyans will be among the speakers.

Kenya's goal is to get 5,000 megawatts of electricity—about one-third of its needs—from 566 geothermal wells by 2031. The country has used hydropower effectively, but persistent drought has necessitated power rationing. According to Ludvik Georgsson, deputy director of

the UN program in Iceland, Kenya has almost 100 geothermal wells producing more than 200 MW of geothermal power.

Geothermal development in the broader Rift Valley of Africa (about six countries) is boosted by funds from the African Development Bank, World Bank, U.S. government, European Investment Bank, French Development Agency and Kenya's own funds. In Iceland, private companies such as Reykjavik Geothermal and Gekon, as well as the public organization ISOR, are important players. ISOR has had many geothermal projects in East Africa, as well as around the world.

As Kenya develops its geothermal energy resource with Iceland's help, the downside of geothermal is receiving attention, too. The steam contains some carbon dioxide and hydrogen sulfide. So far, Kenya is able to use some of the sulfurs to tan hides and some carbon dioxide to boost flower production. Iceland has plans for a methanol fuel plant to use the carbon dioxide from one of its wells and to pump carbon dioxide

into Iceland's porous basalt rock, where the resulting seltzer will make solid limestone.

Though Iceland and Kenya are more than 5,400 miles apart, their connection reflects "one field where Icelanders have expertise and can be useful to others," says Einarsson.

JEANNIE HANSON is a science writer who has authored natural history books for HarperCollins, Viking, Simon & Schuster and other publishers. Her writing has appeared in *Harvard Magazine*, *Lake Superior Magazine*, the *New York Times*, *Los Angeles Times* and other newspapers.

EXPLORATION, REALIZATION & UTILIZATION

The Iceland Geothermal Initiative will host an international geothermal energy conference in Reykjavik in March 2013.

Learn more at geothermalconference.is.



Fellows participating in the 2011 United Nations University geothermal training program tour the Svartsengi plant. From left: Jeremiah Kipng'ok (Kenya), Janet Suwai (Kenya), Anna Mwangi (Kenya), Convine Omondi (Kenya), Urbanus Mbithi (Kenya), Lúdvik S. Georgsson (program deputy director, Iceland) and Isa Lugaizi (Uganda). PHOTO BY INGIMAR G. HARALDSSON

A Measure of Well-Being

by MARY HOFF

Around the world, nations define their well-being in terms of gross domestic product—the value of the goods and services they produce. However, GDP is a far-from-perfect proxy because it does not take into account the value of the ecosystems that sustain us. But what could we use instead? The Inclusive Wealth Index, which factors in the value of goods and services generated by nature as well as by humans, has bubbled to the surface as a promising alternative. But IWI is problematic, too, because nature's worth is difficult to quantify. Partha Dasgupta, one of the developers of IWI, and Gernot Wagner, Environmental Defense Fund economist and author of *But Will the Planet Notice? How Smart Economics Can Save the World*, offer two views on the dilemma. »

“THE LITERATURE ON ECONOMIC DEVELOPMENT has suffered from a persistent weakness. The indices used to judge the progress and regress of nations are all ad hoc; they aren't derived from any reasonable conception of intergenerational well-being. For example, GDP doesn't account for the depreciation of capital assets, such as natural capital. That means GDP doesn't take the well-being of future generations into account. The Human Development Index (HDI) suffers from the same weakness.

If an index is to serve economic evaluation meaningfully, it must meet two conditions. First, it should reflect intergenerational well-being—meaning that the index records an improvement if and only if intergenerational well-being increases. Second, the index should be linear in economic quantities to ease measurement problems for the economic statistician.

An inclusive measure of *wealth* satisfies both conditions. By *wealth* I mean the social worth of an economy's entire stock of capital: manufactured, human and natural. Wealth connects any conception of intergenerational well-being to the economy's capital assets via a system of shadow prices. Some shadow prices would be expected to equal market prices (at least approximately), but many others would have to be estimated. That's hard work, because shadow prices depend not only on the conception of intergenerational well-being we adopt for the purpose of economic evaluation, but also on the extent to which goods and services can be substituted for one another in consumption and production. The intellectual trick that's required is to devise useful shortcuts for estimating shadow prices.

That is not a weakness unique to wealth, of course. Shortcuts are necessary in any exercise in economic evaluation. The estimation of GDP, for example, is full of shortcuts. That wealth proves to be difficult to measure isn't an argument for not estimating it. Our research and the International Human Dimensions Programme on Global Environmental Change's Inclusive Wealth Report 2012 constitute a first step in what will prove to be a lengthy but necessary project. ”

Sir Partha Dasgupta

Frank Ramsey Professor Emeritus of Economics
University of Cambridge

“GDP IS BROKEN. Robert F. Kennedy said as much in his first major presidential campaign speech. Simon Kuznets, the father of GDP, acknowledged its shortcomings. GDP is an imperfect indicator of human well-being at best, and outright misleading at worst.

Still, we shouldn't scrap GDP and start over.

Up to a point, GDP does tell us important facts about people's lives, livelihoods and aspirations. Living on a dollar a day is miserable no matter how you look at it.

Choking on economic growth, of course, is equally bad. There are a few simple, well-established steps we ought to take to bring GDP closer to where we should be. That, by the way, isn't 'Green GDP' or 'green accounting.' It's honest accounting.

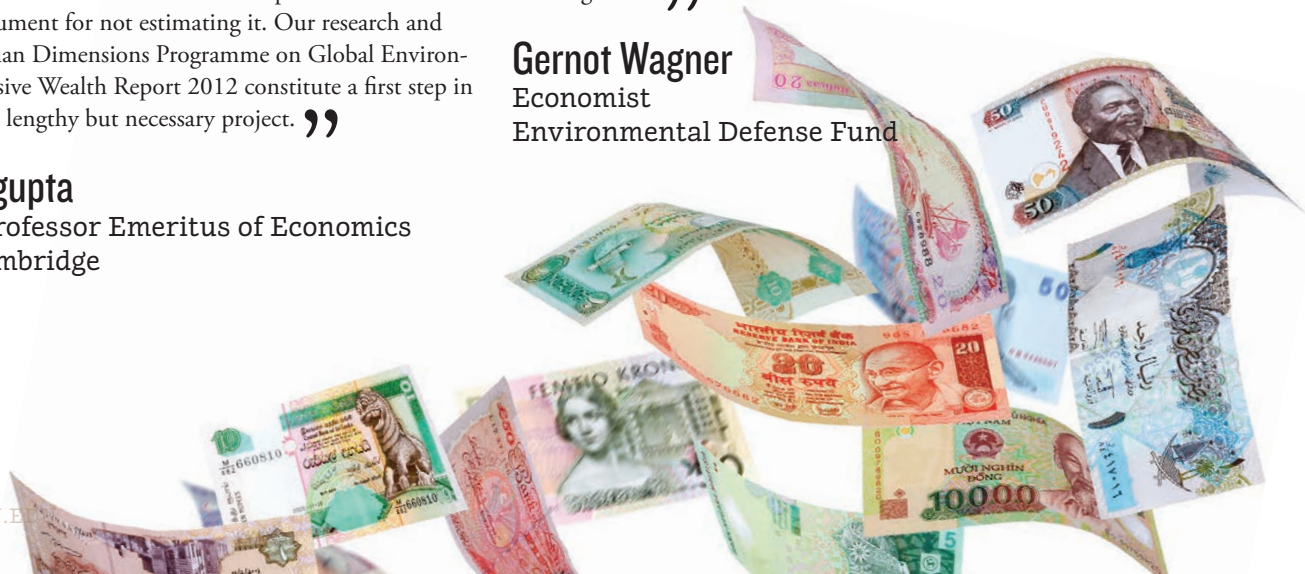
Start with accounting for the true value of natural assets still in the ground. We don't 'produce' coal. We extract it. And the fact that the ton of coal extracted today is no longer there for the taking tomorrow should show up in our national income accounts. A ton of West Virginian coal adds about \$30 to GDP. Honest bookkeeping would decrease that amount to \$15. The same holds for oil, trees, water and all the other valuable natural assets that fuel our economy but are largely treated as free in our GDP accounting.

Then quickly move on to pollution. Every ton of coal, every barrel of oil causes more in external damages than it adds value to GDP. Properly measured GDP ought to reflect that fact.

In the end, policy makers should expand their horizon and look at a dashboard of indicators to get a fuller picture of the true state of the economy, society and the planet. Yet when it comes to GDP itself, the name of the game is fixing it rather than scrapping it. We know how to do that. The U.S. Bureau of Economic Analysis is at the ready. Let's have a go at it. ”

Gernot Wagner

Economist
Environmental Defense Fund



“When people were able to **CONNECT WITH THE ARTWORK** in person,
when they witnessed the process,
they were more likely to care about what happened in the end.
This is very similar to our relationship with our **NATURAL ENVIRONMENT**.
When we spend time in our surroundings, observing the processes,
we **START TO UNDERSTAND** how our actions affect those surroundings.”
—Gregory Euclide



The **LAI D DOWN & WIPED AWAY** series documents temporary paintings by Gregory Euclide using sumi ink on dry-erase board. Euclide teaches high school in Minnesota and, during his 25-minute lunch period, began creating and then erasing paintings as a demonstration to his students and a challenge to himself.


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“Everything in nature is connected.
IT’S THE ULTIMATE SOCIAL NETWORK.”

M. Sanjayan, lead conservation biologist for The Nature Conservancy and a contributor to CBS News, held his Momentum 2012 audience in rapt attention last spring in Minneapolis. View a video of Sanjayan’s urgent and inspiring talk, “Awakening the Environmental Movement,” at z.umn.edu/sanjayan.