

momentum

Institute on the Environment • University of Minnesota



EMERALD CITIES

Green development
in the developing world

KAMPALA

turning garbage
into gold

BAHÍA DE CARÁQUEZ

a forest in the ruins

MEDELLÍN

from slums to
social justice

Plus... Telling river stories

PLUG-AND-PLAY SOLAR

Q&A A NEW HOPE
with Alan Weisman

Urban Legends

Where, exactly, is the “environment”? It depends when you ask. In the transition from 1970s feel-good environmentalism to today’s pragmatic efforts, the notion of where we focus our environmental attention has fundamentally shifted.

We no longer think of the environment as being “out there” only in pristine locations. Instead, we now include the spaces around us, including our cities and towns—from our worst slums to our toniest suburbs. These built environments are just as important as the most pristine rainforest or coral reef. In fact, they may be *more* important to the future of our planet.

As cities take center stage in our thinking of a sustainable future, they also represent an important paradox.

On one hand, cities are tiny—at least in the planetary scheme of things. While we typically think of vast cities expanding into the countryside, gobbling up countless acres of farmland, this is something of a myth.

Across the Midwestern United States, for example, the total amount of farmland has remained largely unchanged in the past 50 years, even with increasing suburban sprawl. While suburbs *are* replacing some farms, including some very productive acres, the amount of farmland is still far greater than the total area of our cities, suburbs and roads. This may seem strange, especially when we see regular evidence of this sprawl in our daily commutes, but it’s true.

At the global scale, current satellite estimates show that our cities occupy just 650,000 square kilometers. That’s less than 1 percent of the world’s land area. In comparison, croplands cover 15 million square kilometers, while pastures cover 28 million square kilometers, together occupying roughly 35 percent of the world’s ice-free land surface.

So, cities are extremely small compared to the extent of global forests, grasslands, croplands, pastures and deserts. There’s a notion that urban sprawl has wiped out a large fraction of the world’s agricultural lands and natural ecosystems. But the numbers don’t add up.

Here’s the paradox: Even though they cover a tiny fraction of the world’s surface, cities have become the nexus of human activity on the planet, and are central to determining our relationship with the environment.

For the first time in human history, cities hold more than 50 percent of the world’s population. *Homo sapiens* is now an urban species—no longer completely tied to agricultural and rural landscapes—which represents a fundamental shift in our relationship to the environment. And this trend will continue. More than 90 percent of the world’s population growth will occur in cities across the developing world during the next 20 to 30 years.



Cities are also the focal points of global trade and industry, where 70 to 90 percent of our economic transactions take place, as well as global resource consumption.

In addition, cities have distinct environmental characteristics, ranging from urban heat islands and air quality issues to impervious surfaces that cause flash flooding. Not only do these factors challenge human health, they also exacerbate the vulnerability of urban populations to climate change and natural disasters.

But it’s not all bad news. Cities are also centers of creative energy, cultural innovation and entrepreneurship—the very things that will ultimately solve our sustainability crises.

Increasingly, cities around the world are pioneering new solutions to environmental, economic and social challenges. Not just the rich cities and ecotourism villages, but poor cities in some of the most challenged parts of the world. In this issue, Emily Gertz highlights several inspiring examples of innovative urban solutions, drawn mostly from war- and poverty-torn countries.

If they can do it, why can’t we? That’s the central question *Momentum* intends to address. We know there are solutions out there, so why not learn from them, adapt them to new situations and dramatically expand their impact?

Instead of creating more urban legends, we all need to roll up our sleeves and make even more legendary urban centers for the world.

“FOR THE FIRST TIME IN HUMAN HISTORY, CITIES HOLD MORE THAN 50 PERCENT OF THE WORLD’S POPULATION.”

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momentum

SPRING/SUMMER 09 – 1.3

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printing SHAPCO PRINTING, INC.

The Institute on the Environment is committed to sustainability. This magazine is printed on FSC-certified paper with a 20 percent soy-based ink.

Momentum is published three times per year by the University of Minnesota's Institute on the Environment. To change your address or to request an alternative format, contact Eve Daniels, momentum@umn.edu, 612-626-2670.

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

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Want to weigh in on something you read in *Momentum*? E-mail your thoughts to momentum@umn.edu for potential publication in the next issue. Here's one recent reaction from a careful reader:



THE OIL WE'LL HAVE TO LIVE WITH

I was intrigued by *Momentum's* cover line "Life after Oil," but after reading the cover story ("Out With the Old, In With the New," winter 2009), I was disappointed that there was little mention of fuels and chemicals—the major sources and sinks of energy in society.

The title conveyed an implicit message that petroleum-type hydrocarbons will not be relevant in the future. I strongly disagree, as do significant numbers of venture capitalists, major international corporations and academic researchers.

It will be economically impossible to dismantle the petroleum infrastructure and start over. Petroleum refineries and the ancillary pipelines and infrastructure represent an enormous investment in time and money. Funding in the current economic stimulus package would not come close to replacing this infrastructure. Retrofitting the automobile industry to use a completely different fuel would require remaking Ford, General Motors and Chrysler simultaneously...

Lawrence P. Wackett
Distinguished McKnight Professor
Biochemistry and BioTechnology
Institute, University of Minnesota

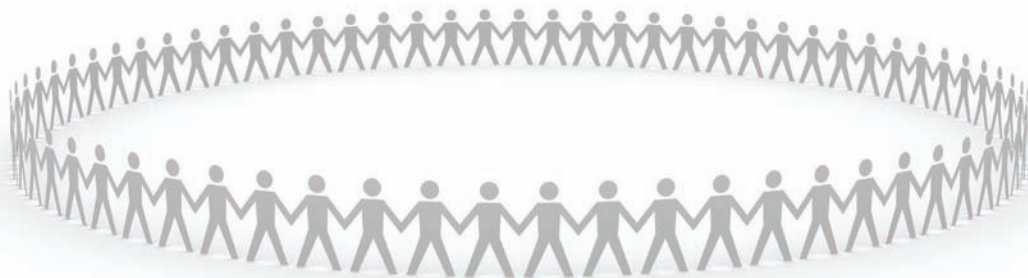
Visit the **INBOX** page at environment.umn.edu/momentum to read Wackett's letter in full.

Meet and Greet

LINKEDIN Join the Institute on the Environment's professional network to take part in polls and discussions on the most critical issues of the day.

FACEBOOK Become a fan of the lonE to enjoy comment-and-win contests and quirky eco-quizzes.

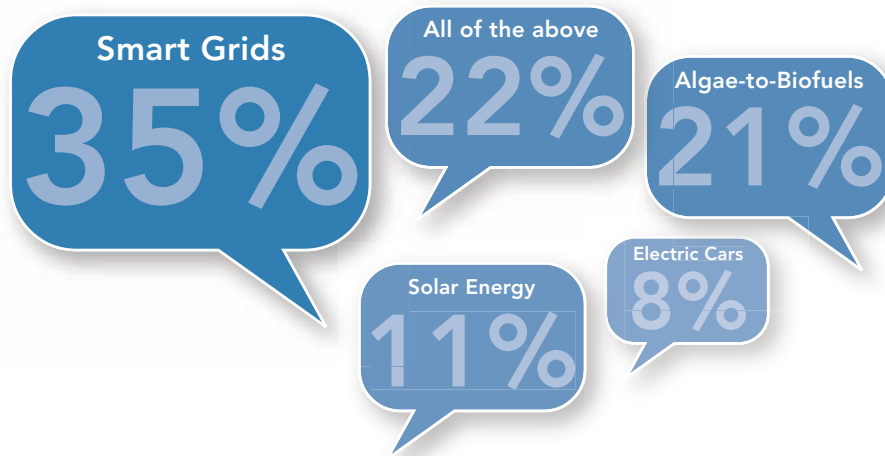
TWITTER Follow the lonE for daily tweets on our latest news and research, along with ongoing event updates.



★ **BE SOCIAL AND WIN!** On July 7, we'll enter all of our LinkedIn members, Facebook fans and Twitter followers into a drawing for cool prizes, including the complete *Planet Earth* DVD set and four passes to the Science Museum of Minnesota's omnitheater and exhibits. Visit the **NETWORK** page at environment.umn.edu/momentum for your chance to win.

RENEWABLE ENERGY 2010

We asked the lonE's LinkedIn audience to look into a crystal ball and predict what the most buzzed about energy technology will be a year from now. And the people's choice is...



"Smart grid technologies will rise to the forefront due to the integration with solar and electric cars." **DAVID GALEA**, Melbourne, Australia



Watch for this symbol throughout the magazine, and visit us online for special features.

Smart Money

The Initiative for Renewable Energy and the Environment, a signature program of the Institute on the Environment, recently awarded nearly \$5.6 million to 19 worthy endeavors. The 2009 **large grants** program will support major steps toward a sustainable future—funding “Thermochemical Fuels: Solar at Night,” “Sustainable Polymers: Tomorrow’s Advanced Materials,” and five other pioneering projects. Rounding out IREE’s research portfolio, this year’s **seed grants** will help launch a dozen projects in the early stages of development; focus areas range from energy production for large wind turbines to dye-sensitized solar cells. “We’re convinced these investments will position the University of Minnesota, the state and the broader region as a world leader in sustainable energy systems,” says Dick Hemmingsen, IREE director. Link to the press releases at environment.umn.edu/iree

Coal and Carbon



Coal presents a range of local environmental problems, including mountaintop removal and the risks associated with storing coal ash. But the larger problem involves the carbon dioxide emitted from burning this fossil fuel. In Georgia, a state that gets 60 percent of its electricity from coal, residents are connecting the dots among coal, carbon emissions and climate change. Some Georgians are exploring “clean coal,” or carbon capture and sequestration, a technology that could capture as much as 90 percent of the carbon emissions from coal-fired power plants. But will it work? Learn more from a **new report** produced by *The NewsHour with Jim Lehrer* and Climate Central—an IonE partner—as experts from all sides of the clean-coal controversy weigh in. climatecentral.org

Biofuels Done Right

While biofuels may help to solve energy and climate change issues, current studies show their widespread production could disrupt global food security, biodiversity and water

quality. To weigh the pros and cons precisely, the **Great Lakes Bioenergy Research Center** has joined forces with the IonE. Sponsored by the Department of Energy, the partners will produce the first geographically-detailed assessments of land availability for bioenergy production. The experts will measure feedstock yields from croplands, pastures and forests using satellite- and census-based data, as well as new statistical fusion techniques. They’ll also look at the pressures on food supply and natural ecosystems. “Already, the center is doing state-of-the-art work in assessing the trade-offs of bioenergy systems in the Great Lakes region,” says Jonathan Foley, director of the IonE and a lead scientist on the project. “Together, we’ll expand this work to reach the rest of the world.”

Team Players

Single-minded, ivory-tower research is so last century. Solving today’s major problems requires major teamwork—a fact that our new **interdisciplinary graduate fellows** have fully embraced. Supported by the University of Minnesota’s graduate school and the IonE, these star students will pursue environmental studies that transcend any one discipline. In the coming year, the four graduate fellows will work closely with IonE faculty and staff on research, outreach and leadership training.

David Bael (applied economics) will look at regime shifts in coastal ecosystems, as well as the role of reserve site selection in conserving biodiversity; **Vamsi Ganti** (civil engineering) will propose new models of environmental transport for eco-hydrology and integrated

Noteworthy continues on page 4...

Oscar-nominated actor Pete Postlethwaite interacts with the futuristic interface designed for the film by Taiyo Nagano.



MUST-SEE

“It’s strange, watching these film fragments. It’s like looking through binoculars observing people on a far-off beach. Running around in circles, fixated on the small area of sand beneath their feet, as a tsunami races toward them.” Actor Pete Postlethwaite’s character, the Archivist, utters these harrowing words in the new film **The Age of Stupid**. From writer/director Franny Armstrong, the film stars Postlethwaite as a man living alone in the devastated world of 2055, where he spends his days looking at footage from 2008 and asking: Why didn’t we stop climate change when we had the chance? The *Guardian* newspaper went so far as to call it “the first successful dramatization of climate change to hit the big screen.” Wonder what Mr. Gore would make of that. Check out movie trailers and more at ageofstupid.net



NOTEWORTHY

Continued from page 3...

watershed management; **Julia Haltiwanger** (mechanical engineering and public policy) will explore the technical, economic and political feasibility of a cutting-edge approach to harvesting and storing solar energy; and **Emily Peters** (ecology, evolution and behavior) will work to quantify the impact of trees on carbon and water budgets in urban areas.

Bold EnterprISE

Minnesota was made for environmental problem-solving—and not just because of our 10,000 lakes. No other place in the world has the geographic advantage of a top-ranked research university, a diverse natural landscape *and* a thriving business community. This state lays claim to nearly 20 Fortune 500 companies and many other major players in the global economy. Now more than ever, it's time to combine these advantages and make things happen.

The **Initiative for Sustainable Enterprise (iSE)**, a new program of the IonE, promotes collaboration among business, academic,

government and nongovernmental sectors to bring vital social and environmental change. Working together across industries and disciplines, the iSE experts will develop high-demand, high-impact and timely approaches to sustainability. As one of the University of Minnesota's key investments, iSE will

facilitate the stakeholder-driven research and private-sector participation needed to tackle the world's most pressing challenges.

"Rather than reinventing the wheel, we're building on our previous efforts with the U of M's Center for Sustainable Enterprise Development," explains Tim Smith,

THE BIG GREEN APPLE

Researchers at the University of Minnesota's St. Anthony Falls Laboratory recently scored \$400,000 to help produce clean energy for New York City. Fotis Sotiropoulos, director of SAFL, will lead a team of researchers in developing computational models for optimizing underwater turbines to generate power from tidal, river and ocean currents. The effort is funded, in part, by IREE. www.safl.umn.edu



SPARKLERS »

This month, 20 of the University of Minnesota's best and brightest start their three-year fellowships with the IonE. Our **resident fellows** were selected for their brains, their creativity and, just as importantly, their sparkle factor. We'll post everyone's bio online this fall, but here's the master list—complete with a few fun facts.

Favorite book: Annie Dillard's *Pilgrim at Tinker Creek*



Hobby: Dog-sledded more than 4,500 miles throughout the Russian, Canadian, Alaskan and Fennoscandian Arctic

Hobby: Won four blue ribbons at the Minnesota State Fair for his organic plums

Hobby: Former beach volleyball competitor



JEANNINE CAVENDER-BARES
Ecology, Evolution and Behavior

AARON DOERING (see back cover)
Curriculum and Instruction

EFI FOUFOULA-GEORGIOU
Civil Engineering

PAT HAMILTON (see page 26)
Science Museum of Minnesota

JASON HILL
Applied Economics

VOLKAN ISLER
Computer Science

JENNIFER KUZMA
Science, Technology and Public Policy

director of iSE. “By sharing our expertise and resources, we hope to export Minnesota solutions to the globe while creating new opportunities here at home.”

On Location

This summer, the IonE’s multimedia producer, Beth Anderson, will travel to Uganda with the **Engineers Without Borders**, University of Minnesota chapter. With funding from the IonE and IREE, the student-led organization will implement a solar-powered water supply system for Hope Integrated Academy—a vocational college, high school and community resource center in rural Mulobere. Upon completion, the system will provide the entire school and more than 500 villagers with clean drinking water. The project also incorporates a sanitation building design and health education focused on malaria prevention. Anderson will rough it alongside the volunteers and capture footage for a short documentary, slated for release in spring 2010. Watch for a trailer at environment.umn.edu/multimedia this fall.

The IonE and IREE recently awarded \$50,000 to Engineers Without Borders for several projects. The money will help the student organization to advance its mission: To improve the quality of life for disadvantaged communities through economically sustainable and environmentally friendly engineering projects.



PHOTO: ALI HAUPT



Milestone: New father of twins—a boy and a girl

Heroine: Sigurd Olson and others who fought to preserve the Boundary Waters Canoe Area Wilderness

Favorite book: Ken Kesey’s *Sometimes a Great Notion*

Milestone: Spent a year of college traveling the country by bus with the Audubon Expedition Institute

Hobby: Strives to go sailing whenever the wind calls

CLARENCE LEHMAN
Ecology, Evolution and Behavior

STEVE MANSON
Geography

JULIAN MARSHALL
Civil Engineering

KRIS MCNEILL
Chemistry

MARK PEDELY
Journalism and Mass Communication

KATEY PELICAN (see page 24)
Veterinary Population Medicine

STEVE POLASKY
Applied Economics

JENNIFER POWERS
Ecology, Evolution and Behavior

PETER REICH
Forest Ecology

CARISSA SHIVELY SLOTTBACK
Urban and Regional Planning

RANDALL SINGER
Veterinary and Biomedical Sciences

TIM SMITH (see iSE highlight on page 4)
Bioproducts and Biosystems Engineering

DAVID TILMAN
Ecology, Evolution and Behavior

Shifting Gears by JIM MOTAVALLI

Public transit in the United States has been starved for funding for nearly a decade. But President Obama's stimulus plan will put nearly \$48 billion into transportation programs. As a country, it's incredibly important that we use that funding strategically, not just for highways (the traditional cash magnet) but also for pedestrians, cyclists and straphangers. The road to a better transportation infrastructure is long, but we're heading in the right direction. Here's a snapshot of progress to date from *The New York Times* "Wheels" columnist.

ROAD WEARY

Without question, Americans are driving less—Minnesotans included. "We saw close to a 4 percent drop in vehicle miles traveled in Minnesota last year, and it's been going down for something like 14 months straight," says Lynne Bly, transportation connections director at Fresh Energy.

Minnesota mirrors the nation as a whole, which has also experienced a 14-month VMT decline. It's not hard to understand why VMT started to recede: The National Household Travel Survey found that the average cost of fuel for Minnesota families alone doubled between 2001 and 2006. So motorists were already suffering by the time \$4 a gallon gas arrived in summer 2008, which propelled people out of cars, says Bly.

One might have expected the miles traveled to go back up when fuel prices dropped again, but they didn't. Most likely because the recession took over from expensive gas as the major motivator, says Doug Hecox, a spokesman for the Federal Highway Administration. The loss of millions of jobs also got a lot of commuters off the roads (and caused not a decline in transit use, but a decline in its rate of growth).

BACK ON THE RAILS

In April, President Obama released a strategic plan to jump-start rail lines across the country with an allocated \$8 billion. "This is not some fanciful, pie-in-the-sky vision of the future. It's happening now. The problem is, it's happening elsewhere," Obama said, citing superior high-speed rail travel in countries like Japan, China, France and Spain.

Right now, the Amtrak station in St. Paul, Minn., offers access to the Empire Builder, a passenger train that plies the route between Seattle and Chicago. The prices are sometimes roughly compatible with air travel, but long train rides lead most people to fly.

The Chicago-St. Paul line would even things up. Part of the Chicago Hub Network, the line is one of 10 corridors designated to receive funding in the plan. Best-case scenario, passenger trains traveling at 110 miles per hour could run to and from St. Paul, Chicago, Milwaukee, St. Louis and several other cities within about four years.

Excitement over the national rail network is palpable, and with good reason: Building a mile of high-speed rail would cost \$1 billion, compared to \$41 million for a mile of interstate. And one rail car takes 50 cars off the road.

THE RECKONING

The fact that people are driving less has reduced carbon emissions to an extent that no government policy—including the Kyoto treaty—has yet been able to accomplish. But the number of vehicle miles traveled is likely to go up again when the recession eases. According to a new study by a team of University of Minnesota transportation and public policy researchers, actions to meet the state's goal of reducing greenhouse gas emissions by 15 percent in 2015 have to start now if they're going to succeed.

The team's report says a combination of increasing fuel efficiency, reducing the carbon content of fuel, and cutting consumption could result in a 30 percent reduction by 2025. "The emission reduction goal is achievable if action starts today," says Robert Johns, director of the U of M's Center for Transportation Studies.

"The technology to make this happen exists, it is just a matter of using it," says David Kittelson, a professor of mechanical engineering who worked on the study. Among the revelations of the report: Biofuels could contribute 27 percent of Minnesota's climate goals by 2015, and heavy trucks simply slowing down and using low rolling-resistance tires could add another 13 percent.



The economic stimulus package also includes \$25 billion to boost American production of electric cars and battery packs. The funding has set off an intense competition to break ground, with many of the applications coming not from the Big Three, but from ambitious startup companies—many of them based in or looking at the Midwest.

An example is Indiana-based Bright Automotive, a carmaker spin-off of the nonprofit Rocky Mountain Institute, which announced its new four-wheel drive, plug-in hybrid utility truck in mid-April. John Waters, the company's president and chief executive officer, developed the battery pack for General Motors' first production electric vehicle, the EV1. Waters aims to develop a car factory to build environmentally friendly plug-in hybrid vans somewhere in the Rust Belt, where available skilled labor and proximity to Detroit are big pluses.

Tomorrow's auto industry is likely to be decentralized, with dozens of automakers spread out all over the United States. Could clean cars roll out of Minnesota factories in 2012 and beyond? You betcha.

JIM MOTAVALLI is a journalist, professional blogger, author and radio personality who lives in Fairfield, Conn. He's a regular contributor to *The New York Times* and has a weekly syndicated "Wheels" column. He has written several books with environmental themes, including *Forward Drive: The Race to Build "Clean Cars" for the Future*.

MINNEAPOLIS BY METRO



Taken Metro Transit lately? The transportation division of the Twin Cities Metropolitan Council operates the 14th largest transit system (based on ridership) in the nation, with 268,000 rides on an average weekday.

The local bus service has already made sustainable strides with 67 diesel-electric hybrid buses and 10 percent biodiesel content in its fuel. Metro Transit uses 10 million gallons of diesel annually, so it's good to hear that it was the first transit operator in Minnesota to use low-sulfur fuel since it provided an incredible 68.7 million local bus rides in 2008, up 4.8 percent from 2007.

Metro Transit also operates the Hiawatha light rail corridor, which has enjoyed steady ridership growth. In 2008, there was a 12.3 percent ridership increase and more than 10 million individual rides. In fact, every Metro service other than dial-a-rides was up last year.

Further expansion includes the central corridor light rail line, which will connect the downtowns of Minneapolis and St. Paul and pass through the University of Minnesota campus. And the Northstar Commuter Rail Line will soon parallel Highway 10 from Big Lake to Minneapolis, where it will connect to the Hiawatha Line.

Rejoice transit fans. Ridership on all modes is at a 40-year high and shows no signs of being derailed.

A New Hope Interview by TODD REUBOLD

Author ALAN WEISMAN has a knack for the dramatic. In *The World Without Us*, subways are flooded, bridges crumble into the sea and wildlife reigns supreme once the world is relieved of pesky humans. His earlier best seller—*Gaviotas: A Village to Reinvent the World*—chronicled efforts to establish an eco-community in an area of Colombia considered by many to be uninhabitable. • Despite the massive environmental destruction he's witnessed firsthand, Weisman remains hopeful. *Momentum* caught up with the globetrotting writer in Arizona to talk over his seminal books, the importance of sustainable cities and the folly of converting wetlands to playgrounds.

WHY WRITE A BOOK ABOUT A WORLD WITHOUT HUMANS? I

wasn't writing a book that just made people feel depressed or frightened or guilty. I wanted to leave people feeling, "there's still a way we can do this." I don't want to kill hope. I did not write *The World Without Us* because I think the world will be better without us. I wrote *The World Without Us* so people would see how fabulous the world could be.

DO YOU GENERALLY CONSIDER YOURSELF AN OPTIMIST OR A PESSIMIST?

I came out of that book much more hopeful about Earth than when I went into it because I realized by the end of my research that the planet is going to be fine. The planet has gone through unbelievable destruction in the past. Huge species lost and it always bounces back.

ARE HUMANS A LOST CAUSE, THEN?

I would not have written this book if I thought we were a lost cause. I would have just gotten drunk. I mean, the book was a lot of work. I really believe that humans deserve to be here on this planet as much as anything else. It's taken a lot of hard work to evolve to this point. Yes, we've done some very destructive things. But we've also done some very beautiful things.

Having said that, it's also clear that any species that outstrips its resource base suffers a big crash. Sometimes it's a fatal crash. All the signs are absolutely there in the ecosystem and the economic system that we have grown beyond realistic size. We are no longer

sustainable. You know, every four days there are a million more people on the planet; and we are trying to provide more goods and services and energy. And it just doesn't work. I'm optimistic that there is still a chance for us, but we're going to have to make some big changes. Nature will not let anything stay at an unsustainable level for long.

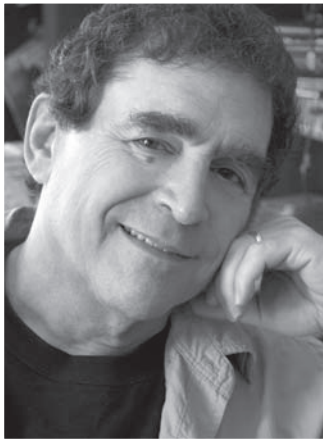


PHOTO: RONN SPENCER

IN THE WORLD WITHOUT US, YOU WROTE ABOUT THE UNINTENDED CONSEQUENCES OF PLASTIC. IS THERE A COMPARABLE EXAMPLE THAT'S EMERGING TODAY? Yeah, nanotechnology. There are all these tiny little particles. Just by the very nature of how small they are, they are very hard to control. They can get into the ecosystem, and a lot of these things are built to replicate themselves. It's sort of like Kurt Vonnegut's *Cat's Cradle*, where this thing that converted water into a solid called ice-nine suddenly went rampant. So there's concern that nanotechnology

could have some really unintended consequences.

DID YOUR CHILDHOOD IN MINNESOTA IMPACT YOUR ENVIRONMENTAL VIEWS?

I lived on one of those countless wetlands in Minneapolis, or just outside of it, and I could see incredible birds. And I go back there now and there's just far fewer of them. And that wetland, which was my playground and the playground for all the kids I grew up with, they filled it in and they built a playground. I never see kids using [the playground]. It's just the dumbest thing.

WHAT SHOULD WE BE DOING IN THE MIDWEST TO MAKE OUR CITIES MORE SUSTAINABLE?

I've been in towns in Germany that are of a higher latitude than Minneapolis and they've been giving terrific tax or purchase advantages for solar-generated electricity for anybody who puts solar collectors or panels on their houses. They've been doing that since the early '90s in some towns. So, our rooftops should be slathered with implements for catching the sun. From now on when we build buildings, we should be building them to be producers of energy as well as consumers of energy.

YOU'VE DONE A LOT OF INTERVIEWS OVER THE YEARS. ANY COMMENT IN PARTICULAR THAT STANDS OUT?

Years ago, I was doing an article and I was interviewing a composer. He said the most intelligent thing to me. He said, "When anyone talks about how beautiful a city is, they are always talking about the trees." **Q&A**

Skywalker

To call TOMÁS SARACENO a visionary is a bit of an understatement. When he looks at the sky, he sees an infinite canvas—one that stretches beyond the usual notions of nationality, property and the built environment. The Argentina-born artist and architect draws on scientific principles to create bold new models for sustainable living and thinking. His first large-scale U.S. exhibition, *Lighter than Air* (on view at the Walker Art Center through Aug. 30), draws on the ecological theories of Fritjof Capra; the Austrian-American physicist asserts that, “throughout the living world, we find systems nesting within other systems. ... These may be social systems—a family, a school, a village—or ecosystems.” In his latest exhibition, Saraceno brings these ideas to life, literally, with images of floating cities and a self-sustaining web of installations powered by the sun, the wind and each other. Essentially, he’s captured his mind’s own biosphere: a future skyline where the built and the natural gracefully coexist.

*Tomás Saraceno, “The Endless Photo,” 2006;
C-print mounted on aluminum behind Plexiglas; edition 5 of 5;
courtesy of the artist and Tanya Bonakdar Gallery, New York*

ON THE
EDGE OF

BY EMILY GERTZ

THE FUTURE

*What are some of the world's poorest cities getting right,
and what can they teach us?*

This is the era of the Urban Majority: the first time in human history when most of us live in cities.

In some ways it's a troubling moment. With the world's population headed for 9 billion-plus by 2050, many cities in the global North are trying to confront decades of neglecting basic infrastructure. The United States alone could spend \$2.2 trillion in the next five years on existing urban water, sewage and transportation systems, and would achieve only a basic level of repair.

Meanwhile, billions of people in the cities of the global South have never had clean drinking water and effective sanitation.

It's also a hopeful, exciting moment thanks to a growing recognition that the metropolis doesn't have to be nature's enemy. Energy-efficient city living is crucial to curbing global warming. Increased urban density will help preserve open spaces, wilderness and wildlife, while making the most of limited resources like timber, clean water and farmland.

In the current global economic reckoning, the cities of the North could learn from the "disadvantaged" cities of the South—that it's possible to do a lot of social, economic and environmental good with very, very little.



For six straight months, from December 1997 to June 1998, intense El Niño rains drenched Bahía de Caráquez, Ecuador. The steep hills overlooking the Pacific coast city melted into devastating mudslides. Houses were crushed, roads buried and bridges destroyed. The city was cut off from the rest of the country for weeks, and some 5,000 of its 25,000 residents were left homeless.

Then, that August, a magnitude 7.2 earthquake shook more than 200 buildings into rubble.

The dual disasters prompted the resort town to reconsider its relationship to the surrounding environment. In 1999, Bahía de Caráquez declared itself an "eco-city," vowing to rebuild according to principles of bioregionalism and sustainable development.

That year the city's mayor invited Peter Berg, founder of the San Francisco-based Planet Drum Foundation, to advise and educate the community on the eco-city plan. In 2000, Planet Drum partnered with the local Eco-Bahía Learning Center to work with the city's different communities. The foundation has had a presence there ever since.

"We decided that the longest-term project was to revegetate hillsides that were severely eroded [in the mudslides]," says Berg, "to control erosion and recreate food sources, native plants, fruits, cattle fodder, habitat for wild species, and to start recreating natural systems."

El Niño washed the hillsides of the María Auxiliadora barrio clean—right down to the clay subsoil (16 people died in one such landslide). On the "if it will work here, it will work anywhere" theory, Berg and his colleagues decided this was the place to start replanting trees.

These efforts have relied heavily on volunteer energy. On the first day of tree planting in María Auxiliadora, in January 2001, around 20 men and a passel of children from the barrio showed up. Together with Planet Drum and Eco-Bahía staff, they planted

six-odd acres of barren hillside with 500 seedlings indigenous to Ecuador's dry, neotropical forests.

Eight years later, the area is known as the "forest in the midst of the ruins."

"Today the trees are 65 feet tall. You can't tell it was replanted," says Berg. The patch of urban forest has become self-propagating, reproducing amazing habitat. "You're seeing animals previously declared extinct in the region."

The barrio residents continue to maintain the wild park. In recent years, they've sought to improve its potential as an educational and tourist enterprise.

And Bahía de Caráquez has developed plans for green projects ranging from renewable energy systems to artificial wetlands for sewage filtration.

The Planet Drum Foundation remains involved in pursuing the city's vision for ecologically sound renewal. The revegetation project appears to be its most successful effort to date: Approximately 50 areas have been replanted with 300 to 500 seedlings each.

Unfortunately, many of the city's ambitions have been stymied by Ecuador's struggling economy and endemic poverty, says Berg. "The bloom went off the rose about five years into the eco-city movement, when people felt they weren't going to get any return on the labor they were putting into it. ... Job creation is an absolute necessity."

Berg hopes to recruit more volunteers to Bahía de Caráquez, particularly students interested in bioregional development and reforestation. "[We're] making models for carrying out erosion prevention in different kinds of sites. But it's a drop in the bucket compared to what's needed in the region."

The patch of urban forest has become self-propagating, reproducing amazing habitat.





Just 10 years ago, Medellín was known as one of the world's most dangerous cities. Today, bold civic policies are transforming Colombia's second-largest city into a striking story of urban renewal.

In the early 1990s, the murder rate in Medellín numbered in the thousands each year. Armed drug cartels fought for control of the region's lucrative narco-trafficking trade, and the city became a battleground between nationalist paramilitaries and revolutionary guerrillas. In 1991, the city saw 381 murders per 100,000 residents, or just above 6,300 for the year.

The situation began to improve in 2002, when the newly elected president of Colombia, Álvaro Uribe, directed federal resources toward quelling the violence and demobilizing the paramilitaries.

The following year, the city elected a new mayor, Sergio Fajardo. He ran on the platform that change was possible, even in violence-torn Medellín. Backed by fellow professionals and civic leaders, the mathematician-turned-politician had a formula for improving the city: Immediately complement every reduction in violence with tangible community improvements.

The son of an architect, Fajardo grasped how important good design can be in creating a more optimistic, sustainable, socially-just city. In keeping with the mantra "to the poorest people, the most beautiful buildings," some of the city's most impoverished and brutalized neighborhoods became homes to top-notch new schools and housing (as well as new police stations). New social programs and micro-lending to support new businesses rounded out the design upgrades.

Under Fajardo's leadership, Medellín also built several "library parks" in the city's worst neighborhoods. The parks have become world-renowned symbols of the city's changing fortune. They merge accessible, attractive and safe community spaces with educational and cultural resources.

Parque Biblioteca España, for instance, was built in the Santo Domingo Savio barrio—a notorious slum that, nine years ago, was considered one of the most violent neighborhoods in all of Latin America. Colombian architect Giancarlo Mazzanti's striking design

The parks have become world-renowned symbols of the city's changing fortune.

perches three linked buildings atop a hillside like enormous boulders, studded with clusters of gleaming windows and surrounded by the low stucco and brick buildings of the barrio.

This award-winning library park has "helped catalyze a challenged community," notes a recent issue of *Architectural Record*, "especially

its children, who flood the computer stations and play and socialize on the deck." The library has created "a pride of place ... quite a change from the feared neighborhood of the recent past."

Halfway through his first term, Fajardo also oversaw the creation of a now-iconic aerial tramway. The Metrocable connects one of Medellín's most isolated slums to the city's established transit system, breaking real and psychological barriers to overcoming poverty and despair.

Medellín has taken daring, sometimes counter-intuitive steps to wrest itself away from anarchy, and toward greater stability and social progress. By the time Fajardo left office in 2008, the city's murder rate had plummeted to 26 per 100,000 residents, nearly 90 percent lower than the previous decade's highs.



Since the early days of the Industrial Revolution, the path out of urban poverty has been traveled via factory jobs and service-oriented small businesses. But in Kampala, Uganda, where about 40 percent of the city's 1.2 million residents live in abject poverty, the road toward better health and greater prosperity is lined with plots of maize, stands of fruit trees, gaggles of chickens, and the occasional goat or cow.

The Uganda capital city's urban farmers no longer have to worry that they're breaking the law: In 2005, Kampala became the first city in sub-Saharan Africa to legalize urban agriculture. Since urban farming produces about 40 percent of the city's food supply—including poultry products and vegetables—the move essentially made a virtue of necessity.

Still, legalization allowed the Kampala city government to begin regulating the safety of food grown and raised in the city, however unevenly.

It has also enabled international development groups to fund programs that assist Kampala neighborhoods like Kasubi and Kawaala. The valley-bottom parishes' crowded, low-slung buildings are home to roughly 70,000 of Kampala's poorest residents.

During the city's frequent downpours, storm water rushes down from the steep hillside neighborhoods around the Kasubi-Kawaala district. The deluge picks up plastic trash, kitchen garbage and sewage on its way down slope. The solid wastes block drainage channels and local roads become impassable. Afterward, standing water and poor sanitation combine to cause disease outbreaks.

The slums have been the focus of several pilot projects, under the umbrella "Sustainable Neighborhoods in Focus." When SNF

launched in 2006, the staff planned to focus on developing sustainable urban agriculture and related micro-enterprises. But the community's first priority was finding ways to deal with the floods.

"Instead of agro-business being the main focus, it became part of the solution to flooding," says Jean D'Aragon, a program officer with the Ottawa, Canada-based International Development Research Centre, which is funding SNF.

Along with turning trash into gold, these projects demonstrate how even a desperately poor community can take control of its own welfare.

D'Aragon's team observed what people in Kasubi and Kawaala were already doing with what they had available. For instance, he says, "a guy was making briquettes out of compressed organic matter from the garbage." So SNF began looking for ways to improve the briquettes and turn them into an income-generating business.

"Add charcoal dust to the mixture and it becomes an energy source—fuel for cooking stoves," says D'Aragon. "We looked at this as a potential solution to the garbage problem, instead of [the organic waste] ending up in the channels. Plus, energy sources are valuable."

Another man was drying banana peels for chicken feed. SNF determined that peel feed was just as nourishing as the more expensive maize feed, while also getting banana peels out of the drainage canals. "They seem to grow normally," D'Aragon says of the chickens. "So it might be a solution for the garbage, for income generating and for cost saving."

There's a peer-to-peer educational effect as well. "If their neighbor is doing a business with banana peels, they're suddenly sensitized to the possibility of giving peels to their neighbor rather than throwing them in the channel," says D'Aragon.

SNF has helped set up two waste sorting and composting stations in the neighborhood, employing local residents in the process. The stations sell 20-kilogram bags of compost for \$3 each to local residents, for use on their gardens. And growers from outside the city come to load up on larger quantities.

Another SNF project is under way to gather up and crush the plastic trash that collects in the valley during flooding, and then sell it to recyclers.

Along with turning trash into gold, these projects demonstrate how even a desperately poor community can take control of its own welfare, creating tangible improvements within just a couple of years.

"Today the channels are not as full of garbage. They're much cleaner," says D'Aragon. "People see the impact of what they're doing. [It's] completely different from just building a road or something like direct aid."

The SNF project team is currently investigating other flood-prevention techniques. One involves "infiltration ponds," wherein soil soaks up the storm water. Another would create reservoir-like

retention ponds to cache rain runoff. The water could be stored for later uses like irrigation or fish farming.

The team is encouraging uphill residents to leave the grounds around their homes unpaved, and to plant more mangos, jackfruits and other fruit trees. The trees help absorb and secure storm water runoff in the soil, while providing a source of fresh food for households to eat or sell.

The pilot projects in Kasubi and Kawaala will inform sustainable development, urban agriculture and environmental remediation projects in other African cities. But D'Aragon believes even a Western city like Ottawa can learn a few things.

"Ottawa outlawed scavenging in an attempt to deal with the noise and nuisance problem of people going through the garbage," he says. (The people were looking for deposit-and-return bottles and other valuable materials in curbside bins.) But the underlying problems of poverty and homelessness haven't been solved.

"[Ottawa] could decide to train people to do it differently," says D'Aragon, just as Kampala residents are learning to set banana peels and mango skins aside for compost. "Maybe if we allow [scavenging], but help organize it in a way so side effects aren't as bad, we'll all gain."



What Afghanistan's north-central Panjshir Valley lacks in civil infrastructure, it makes up for in relative peace and solidarity. The province held off the Soviets in the 1980s and the Taliban in the 1990s. And it lays claim to abundant natural resources, including wind, sun and flowing water.

So it's not surprising that development efforts in this region have emphasized reliable green power. For example, in November, the Panjshir Provincial Reconstruction Team finished repairs on a micro-hydropower station—damaged by flash flooding in 2007—in the Rokha district.

PRTs are quasi-military units led by NATO nations involved in the Afghan conflict. The teams combine military personnel with civilian experts. State department employees head the Panjshir PRT, which also includes U.S. Air Force and Department of Agriculture personnel, as well as members from the U.S. Agency for International Development.

The repaired station's two generators supply 60 kilowatts of power to about 400 households in and near the village of Abdawa, along with civic buildings like the local community center and mosque.

Sixty kilowatts is not much juice—just enough to power about 60 average American homes. Yet, it's an ample supply for Abdawa's

current needs, which include compact fluorescent lights, a lot of cell phone chargers and a few television and satellite dishes.

“Power is the biggest thing that a lot of these small communities want,” says Air Force Capt. Patrick Kolesiak, a civil engineer with the Panjshir PRT. “Luckily, the province has a lot of rivers and side valleys, which gives us the opportunity to develop hydropower on a small scale.”

In considering sustainable development in Afghanistan, it’s impossible to overlook the country’s precarious peace, or to understate the controversial, ongoing presence of NATO forces. Still, the green power projects are remarkable for how they interweave building capacity for local governance with forward-thinking environmental and security concerns.

The reconstruction team coordinated its work with a local community development council. These councils are elected by the local villagers as part of Afghanistan’s National Solidarity Program, which promotes grassroots-run development efforts in the country’s many rural villages.

In line with the program, local development councils control funding and decision-making. This allows them to work directly with resources such as PRTs, eliminating many of the money-consuming layers of contracting in traditional top-down aid programs.

The community development councils are elected by a secret ballot, and manage their projects and expenditures transparently. The idea is to establish democracy, public participation and accountability as normal components of village governance.

The projects are remarkable for how they interweave building capacity for local governance with forward-thinking environmental and security concerns.

Air Force 1st Lt. Dustin R. Koslowsky, another civil engineer assigned to Panjshir, says the PRT’s practices help build the local capacity for good governance. “By getting them involved ... and bringing in their own engineers to assure the quality and learn construction practices, we help teach them to manage contracts and requirements.”

Koslowsky says the biggest challenges the Afghan people are facing include things taken for granted in the United States. “Developing a budget, prioritizing requirements, figuring out what people want—that’s all happening here for first time.”

Afghanistan needs to develop sustainable power that doesn’t require diesel to run before it can move past subsistence agriculture and into economic development, says Koslowsky. “Once we bring that sustainable power, the country can stand on its own feet and can become an ally of the U.S. and the Western world.”

Local participation in the Abdawa micro-hydro repair was crucial to coordinating a successful project, according to both officers. “They have to take a vested interest in the program,” says Kolesiak. “Where they don’t, it’s difficult if not impossible for us to undertake a project.”

Koslowsky describes his encounter with the micro-hydropower station operator. “He’s very passionate about his work.” During one of the final inspections of the installation, “[he] took us down to the canal and pointed out an area where he knew problems were going to be in the future.”

The encounter left Koslowsky hopeful about the local commitment to clean energy development. “His having that familiarity with over a kilometer of canal—he’s already taking the first steps toward preventative maintenance on his power plant. It’s a level of ownership that we appreciate very much.”



Clearly, the shortcomings of the 20th century’s command-and-control development models are being answered with a global wave of grassroots programs.

And the extremes of displacement, violence and poverty in places like Kampala are less alien to the American experience than it may be comfortable to admit.

The failure of the New Orleans levees in 2005 was an unnatural disaster comparable to the 1998 mudslides on the deforested slopes of Bahía de Caráquez. The city’s rebuilding efforts have been equally halting at times, due to patchy (or absent) aid and funding. The New Orleans murder rate—in 2008, 209 murders in a population of about 300,000—is on a par with Medellín’s worst years.

At the same time, industrialized countries can use the solutions created in the developing world.

In some places, like the gritty, low-income East New York section of Brooklyn, it’s already happening. As part of the East New York Farms collaborative project, local farmers produce and sell more than 10,000 pounds of produce a year in the neighborhood.

Or in East Biloxi, Miss., where the Biloxi Model Home Program has been helping low-income residents rebuild their homes since Hurricane Katrina leveled them in 2005. The community-based design and build project shares its architectural plans online for free at the Open Architecture Network.

By marrying community organizing to technical support, the world’s growing cities can create their own best solutions for improving health and prosperity, from the barrios of Medellín to the boroughs of New York.

EMILY GERTZ is a journalist, editor and professional blogger who lives and works in Brooklyn, N.Y. She has covered environment, technology and science issues for *Dwell*, *Scientific American*, *Popular Mechanics*, *Grist*, *Worldchanging* and more.

FOR RICHER OR POORER

Now that we've heard some stories from less-developed communities, what about those with relative wealth? Are they doing any better? Here, we highlight a few sustainability successes—and failures—in four of the world's industrialized cities.

WASHINGTON, D.C., has culled around 360 vehicles from its fleet of 1,600, which sit unused in parking lots much of the time, and replaced them with a mere 58 cars. Zipcar—the world's largest car-sharing company—equips and manages the vehicles so that city employees can reserve them online and open their doors with a keycard. The District expects to save \$6.6 million over five years with its pioneering, municipal car-share fleet. In April, Zipcar CEO Scott Griffith told *The Washington Post* that 12 to 15 other cities are interested in the government program, officially dubbed "FastFleet."

The Beddington Zero Energy Development, a 100-home complex in the Sutton area of South **LONDON**, was designed for extreme sustainability and energy efficiency. But by 2007, five years after opening, two of its most cutting-edge systems had failed: The Living Machine, which used reed beds to filter sewage water for toilet and garden use, proved financially inviable, and the wood chip-fired, combined heat and power plant had failed. BedZED now gets electricity from the grid and hot water from high-efficiency, gas-condensing boilers. According to a 2007 analysis, the homes used half as much electricity as the average Sutton household, 81 percent less heat, and 50 percent less municipal water. Still aiming for full carbon neutrality, the developers expect to shift the complex to a green electricity purchasing plan, and may replace the cogeneration plant with a biomass boiler.

Hoping to score the 2016 Olympics, **CHICAGO** unveiled its first solar-powered electric vehicle charging station during a recent tour of the city by the International Olympic Committee. "[It was] important to show our commitment to renewable energy and preventing global warming, [to being] part of the future," says Scott Emalfarb of Carbon Day Automotive, the Midwest distributor for Coulomb Technologies, which developed the 2.4-kilowatt battery system. The station features a plug-in charger shaded by a broad photovoltaic canopy. The charger is backed up by a connection to the grid, but can channel excess energy back into the grid as well. So, although the solar system costs more up-front than grid-only charging points, it presumably can make back the extra investment.

In early 2008, **ABU DHABI** trumpeted plans for Masdar City. The enclave on the city's outskirts could become the world's first car-free, zero-carbon, zero-waste city: powered primarily by solar energy, watered via desalination systems, with an eventual 50,000 residents whisked about in personal "podcars." And today? "Most of it is desert right now, and some brush," says Jesse Fox, a Tel Aviv-based urban planner and writer who toured Masdar in February. But ground has been broken for a new research institute and personal rapid transit system. By way of a photovoltaic farm, which is generating 10 megawatts of power, the city planners are testing two dozen different PV panels to determine which will work best on the Masdar site. As for why a petro power wants to build a hub for clean technology innovation: "My opinion is that the people who run the country recognize that this is the future of business," says Fox, "and they can make a lot of money off it."



IMAGES: ZIPCAR IN D.C., MARIO ROBERTO DURAN ORTIZ; BEDZED ROOFTOP, PAUL MILLER; CHICAGO'S ELECTRIC CAR CHARGING STATION, CARBON DAY AUTOMOTIVE; MASDAR CITY RENDERING, FOSTER + PARTNERS



THE RIVER'S RETURN

BY GREG BREINING

TURNS OUT, CITIES CAN PROTECT AND PROFIT FROM THEIR RIVERS AT THE SAME TIME. TWIN CITIES PLANNERS SHARE A FEW SUCCESS STORIES.

If you want to understand Minneapolis, stand on the bridge James J. Hill built over the Mississippi in 1883. The stone arch landmark once carried up to 80 trains a day to lumber and flour mills, which tapped the might of St. Anthony Falls. The power of the river thundering over the drop—that's why Minneapolis is here.

And if you want to understand a continental transportation network, visit the river landing at Lowertown in downtown St. Paul. This notch in the bluff was the farthest upstream horses and wagons could meet docking riverboats to unload cargo. Upstream lay 15 miles of unnavigable rapids and swift water culminating in St. Anthony Falls. So this is where St. Paul grew, first as a river town, and then as a hub for railroads.

Other large cities tell similar river stories, though few are more compelling than those of Minneapolis and St. Paul.

"Is there anything more American than the Mississippi River?" asks Steve Johnson, chief of resource stewardship for the Mississippi National River and Recreation Area.

"When Congress set out to designate some portion of the Mississippi River to celebrate the river and its role in American culture, they chose this place and not any other. And why was that? Here you have kind of a unique confluence of geology, natural history and cultural history. You've got features you find nowhere else on this big river."

Even so, the Twin Cities, like cities elsewhere, neglected their founding rivers as railroads replaced riverboats and waterways became increasingly polluted. "We had our backs turned to the river for a long time," says Pat Nunnally, the Institute on the Environment's River Life coordinator.

It's a sentiment you hear over and over. But in recent decades cities have reclaimed their riverfronts, not only Minneapolis and St. Paul, but also St. Louis, the Quad Cities, Chicago, New Orleans, Cincinnati and others.

Whether they approach it as urban planning on a river or river planning in a city, land managers and city planners are pursuing two sometimes conflicting goals in the name of "sustainable" river development.

First, to protect the ecological integrity of the river—its water quality, plants and wildlife, and the ebb and flow of current that sustains life, shapes the river's channel and renews its floodplains.



And second, to exploit the river in the city's midst as scenery, for recreation and for continued economic gain.

They must, says Nunnally, "design as if the river really does matter."

1. SERVE AND PROTECT

Riverfront planning begins with protecting or restoring the river itself. Mike Davis unreels a capsule history to explain why.

Davis is a Mississippi River ecologist for the Minnesota Department of Natural Resources. In researching freshwater mussels, he discovered that "by 1900, all the mussels in the river from Minneapolis to Hastings had been killed by the pollution. That was sewage from the Twin Cities. It wiped out the whole river."

Skip to the 1920s. River surveys showed that sewage decomposition had consumed all dissolved oxygen. "They found three fish between Minneapolis and Red Wing," Davis says. "It was pretty much nuked."

The cities began primary sewage treatment in 1938, but a mid-1960s fisheries survey turned up more condoms than fish. Ten years later, a survey discovered only seven species of mussels.

More than a decade after the federal Clean Water Act of 1972, the river turned a bend. The Twin Cities upgraded sewage treatment

and began separating antiquated septic and storm sewers—meaning far less raw sewage in the river.

In 2000, Davis and crew, scuba diving in the dark swift currents, found 26 species of mussels, including two state endangered species. Nowadays, game fish are plentiful and large throughout the Twin Cities.

Sewage clean-up "made the river usable by humans again," Davis says. "Before, it was such a vile place to go, no one would go there. Now you go down to Hidden Falls Park or somewhere, it's beautiful."

2. MAKE THE MOST OF IT

The most intractable barrier between river town residents and the Mississippi? "Probably perception," says Tim Griffin, director of the Saint Paul on the Mississippi Design Center. "Until 10 years ago it was still an industrial riverfront. The city had really turned its back on the river."

Sound familiar? Old habits are hard to break. So is old infrastructure that made the riverfront friendly to industry and inhospitable to visitors. Changing both habits and habitat has been a challenge for communities across the Twin Cities.

St. Paul's revival of 17 miles of riverfront (more than any other

city between Lake Itasca and New Orleans) began in the early 1990s. West Publishing, a major employer on the riverfront, had just left downtown. “It was pretty grim,” says Griffin.

But then-Mayor Norm Coleman, together with various urban planners and community leaders, began devising ways to reconnect the city and the river.

In 1997, the city published its *Saint Paul on the Mississippi Development Framework* to guide riverfront land-use decisions; the river planning apparatus soon evolved into the Saint Paul on the Mississippi Design Center.

This framework has encouraged planners to surmount the 100 feet of elevation that separates downtown from the Mississippi in some creative ways—among them, relocating the Science Museum of Minnesota along the riverfront.

Across the river, new facilities at Harriet Island have brought more than 1 million people a year to a site with a stupendous view of the downtown. New housing at Upper Landing created a community along the river. Interconnecting bike and walking trails join the entire Twin Cities riverfront. And jealously guarded sight lines allow people views of the Mississippi despite new development.

“All the time,” says Griffin, “we’ve been operating under this mantra of more urban, more natural and more connected.” That is, restore natural areas so they’re even wilder. Concentrate development in areas that are already urban. And find ways to get residents to the river.

3. EMPOWER THE PEOPLE

Enlisting volunteers to work on river restoration pays two dividends, says Deborah Karasov, executive director of Great River Greening.

Most obviously, you get the work done. In the case of Greening, work involves the hard labor of tearing out unwanted invasive species, replanting erosion-prone slopes, and replanting native plants, shrubs and trees in semi-natural areas that are more fallow than wild.

But just as important as the work is the attitude. “The idea that you could have people coming down to the river, helping to improve it—literally plant trees on the riverfront—that was part of changing a decades-old perception of what the riverfront was,” says Karasov.

Launched in St. Paul in 1995, Greening now works in 17 counties. “You have to continue to involve people,” says Karasov. “It’s not enough for an agency to do it. You have to have people invested in natural resources. That personal investment needs to be nurtured.”

The riverfront isn’t just a line, Karasov explains, but a swath that covers floodplains and rises to the bluffs. To stem erosion and restore native habitat “you need to work with private landowners. In terms of ecological resources, you can’t just deal with public land.”

Accordingly, Greening is working with refining company Flint Hill Resources to improve prairies and oak savanna habitat on several hundred acres bordering the river and Pine Bend Bluffs Scientific and Natural Area.

The organization also organized volunteers in rehabilitating the steep hillside and bluff at the southeast end of the High Bridge.

Says Karasov, “They see it as a mark of a sense of place in their neighborhood.”

4. JOIN FORCES

The Mississippi National River and Recreation Area runs from Dayton, Minn., to south of Prescott, Wis., some 72 miles.

Managed by the National Park Service since 1988, the area is a “quasi new breed of partnership parks,” says resource chief Steve Johnson. It has a mission to “protect, preserve and enhance” the river’s natural, historical, recreational and cultural qualities, despite little federal land (other than several islands) or regulatory authority.

But the Park Service has the power of the purse. It has provided money for bike trails, park improvements and wildlife studies. “That’s the kind of thing we do when we can,” says Johnson.

The Park Service also brings a nationwide network of experts to the table. For four years, agency scientists with the Great Lakes Inventory and Monitoring Network have climbed into all 22 bald eagle nests along the national river to take blood and feather samples from nestlings.

The scientists have been tracing emerging contaminants such as perfluorooctane compounds. “We are finding very high levels in some of these bald eagles,” says Johnson. The Minnesota Pollution Control Agency plans to fund this research in the future.

“Scattered around the country we have people who have some very specialized expertise,” Johnson says. “We can bring those folks in and help local governments figure some things out.”

Another strength: telling stories. “There are a lot of interesting stories to tell,” says Johnson, “and the Park Service is probably better at telling ... stories of American history and how history is related to place than any other agency in the world.”

Case in point, the agency has helped rediscover the old Meeker Island Lock and Dam. The first on the Mississippi, the facility is now mostly submerged just upstream from the Lake Street bridge. Along with developing and signing a trail to the dam, the Park Service provided money for a theater at the Mill City Museum in Minneapolis and for exhibits in the Science Museum’s Mississippi River Visitor Center.

The river’s stories beg being told, says Johnson. “We’re chipping away at the local consciousness of the importance of the Mississippi River and the fact that it’s no longer a sewer,” he says. “This is one of the major rivers in the world. It’s an enormously important natural resource.”

GREG BREINING is a St. Paul, Minn.-based travel, science and nature writer. His articles have appeared in *The New York Times*, *Audubon*, *National Geographic Traveler*, *Minnesota Conservation Volunteer* and many other publications. He’s also the author of several books on travel and the environment, including his latest, *A Hard-Water World: Ice Fishing and Why We Do It*.

MICHAEL BIRAWER brings a new look to the face of urban neighborhoods through his unique style of painting—a combination of graffiti, cartoon, illustration and heavy textures. He was born, raised and currently resides in the Twin Cities.

TELLING RIVER STORIES

Several years ago, the University of Minnesota found itself surrounded by talk of river revitalization. The Minneapolis campus straddles the Mississippi, after all. Both Twin Cities had undertaken vigorous efforts to reclaim their riverfronts. In 1988, the federal government designated the 72 miles of river through the metro area as the Mississippi National River and Recreation Area. State and federal natural resource agencies had a stake in restoring or protecting the river's natural features, from bald eagles to freshwater mussels.

"Off campus there was a lot of attention paid to the Mississippi, not only in Minneapolis–St. Paul but from Bemidji to New Orleans—in revitalizing the river, in revitalizing community relations with the river," recalls Pat Nunnally, a program coordinator with the Institute on the Environment.

U of M planners and designers decided to bring some of that attention to campus. Students might learn from the urban design going on around them and contribute to people living and working on the river.

Thus was born the multi-collegiate project River Life. Initially part of the College of Design, River Life is now part of the IonE.

As River Life coordinator, Nunnally acts as go-between for the university and various planning, resource and recreation agencies along the river as he looks for opportunities for joint research and education projects.

For example, he says, design students will confront a site such as B.F. Nelson Park in Northeast Minneapolis where a succession of sawmills, paper mills and a factory operated. Students must design a plan that will link the river with existing streets.

One River Life project now under way is the Telling River Stories Web site. In time, Nunnally says, the site will guide visitors along a comprehensive map of the Mississippi, where they can click to read site-specific stories.

"We're trying to get away from sort of a grand march of history," and instead concentrate on "things you need to know to understand the river at that place." Examples: The Fort Snelling connection to the rights of slaves before the Civil War. Or the Dakota Indian concept of homeland at *Bdote*, the confluence of the Mississippi and Minnesota.

Rounding out River Life's educational focus, Nunnally teaches a class called Making the Mississippi that examines how people have settled and shaped the river for 200 years.

"We help the students understand that the Mississippi River is a cultural landscape. We really try to think about urban planning and design from the river out rather than the land in."

environment.umn.edu/riverlife and www.riverstories.umn.edu



environment.umn.edu/momentum

VIDEO

The Mississippi River runs through the heart of the University of Minnesota's Twin Cities campus. In a new video clip at *Momentum* online, Nunnally discusses the relationship between the river and the U of M.

WEB EXCLUSIVE

That same river is cleaner, more enjoyable and more productive of fish and wildlife than a generation ago. But there's plenty of work ahead. Visit us online for a "Big River To-Do List" from Mike Davis, a river ecologist with the Minnesota DNR.



LIVING WITH THE GRID

FROM THE WEST WING TO WEST ST. PAUL,
SOLAR AND ITS CLEAN ENERGY COUNTERPARTS
AREN'T JUST FOR "OFF-GRIDDERS" ANYMORE.

BY JOSEPH HART

Hike around the West Side of St. Paul, Minn., and you'd hardly think you were among energy pioneers. The quiet neighborhood is a far cry from sci-fi. Yet, the home of Elizabeth Dickinson and Christopher Childs may well be the home of the future, at least in terms of electricity.

Dickinson and Childs are one of a growing number of U.S. households turning to solar energy to meet their electricity requirements. With a 3-kilowatt photovoltaic system powering their house, their electricity is, on average, entirely generated by the sun—with a little left over. Carbon footprint? Zero.

Only a few decades ago, photovoltaic solar was considered an exotic technology. Today, Jay Leno uses solar to fuel his larger-than-life garage, and George W. Bush—not exactly a wild-eyed environmentalist—installed photovoltaics to help power the White House and heat its pool.

It seems safe to say that solar energy has come of age.

“There’s a growing awareness,” explains Doug Shoemaker, a retired fleet manager at Xcel Energy who joined the board of directors of the Minnesota Renewable Energy Society in 2004.

“When I started, we’d get maybe one or two calls a year inviting us to an event. Now I’m getting one or two calls a day,” says Shoemaker. “I used to leave the capital after lobbying and I would feel discouraged. Now I have legislators who come to *me* for information about solar.”

There are many reasons for the surge in interest, including concerns about climate change and energy independence. But these factors alone would be for naught without a simple, but profound, shift in the technological approach to solar.

Early pioneers of the technology were, for the most part, homesteaders in search of an energy source independent of the electrical grid. Solar fits the bill, but you can make hay only when the sun shines. Moreover, storing electricity is notoriously difficult. For at least 40 years, then, the primary focus of the solar industry has been on building a better battery.

Enter net metering. In a typical grid-powered house, your meter calculates how much energy you suck out of the grid. With net metering, you can add a solar panel (or, for that matter, any electricity generator) and your meter will actually spin backward during the time periods that you’re generating more electricity than you’re using.

In Minnesota, state laws require the utility to purchase this excess power for the same price that you would pay on your electricity bill. And according to Shawn Bagley, an engineer in charge of Xcel Energy’s net metering program, the typical household system requires literally no modifications to the grid. “For the large majority of residential systems, all we have to do is replace the meter with one that can read both ways,” he says.

As a result of this technology, says Childs, he decided to skip battery storage altogether. “The grid has gone down maybe three times in the 10 years I’ve lived here,” he says. “So I figured, why not save the five to 10 grand that a battery would have cost.”

Childs, a writer, and his partner, a nonprofit lobbyist, have spent a lot of time working for progressive causes, including alternative energy. Childs put in a stint for Greenpeace demonstrating the power of solar photovoltaics, while Dickinson ran for mayor recently as a Green Party candidate.

But, Childs says, “I would hardly qualify as a hippie,” and solar was not their first priority when they bought their “farmhouse in the city” 10 years ago. “We wanted a lovely older home, so our first investment in time and money was in restoring the character of the house and making it an attractive place to live.”

During their years of renovating, they also kept energy efficiency in mind. They swapped out light bulbs to compact fluorescents and LEDs and bought an Energy Star fridge. Judging by energy bills, they’ve cut their usage by at least a third to a half. While he was sanding

birch floors and choosing paint, the memory of the Greenpeace solar tour stayed with Childs, and eventually he and Dickinson took out a mortgage to pay the roughly \$20,000 it took to put up a 3-kilowatt system to power their home.

Will the system pay for itself? Sort of. The couple considers the \$20,000 a capital investment; like a new roof, the price should balance out when they

sell the home. Plus, they pay for no electricity, and generate enough that they actually earn a little bit each year.

And then there are the intangible benefits.

“When I was 21, I bought a used Porsche,” Childs explains. “I never asked what the payback was on that. The payback came when I got behind the wheel and drove the car. Today, if I wake up on a sunny morning, I feel like I’m driving a solar-powered Porsche.”



ABOVE: Dickinson and Childs, modern “energy pioneers.”
LEFT: Now that a photovoltaic array powers their home in St. Paul, the couple uses this small, 30-watt Solarex panel—the first they ever owned—for demonstration purposes.

JOSEPH HART is a freelance writer and editor, an author, and a contributing editor to the *Utne Reader*, where he covers a range of topics including alternative energy and green issues. He lives and works in Viroqua, Wis.

Our Fracture-Critical World

In our quest for hyper-efficiency, the modern world has lost most of its resilience. by THOMAS FISHER

The collapses we have all witnessed in recent years, from falling bridges to failing banks, could be avoided in the future if we gained a better understanding of how ecosystems work.

Consider the August 2007 collapse of the I-35W bridge in Minneapolis. Completed in the early 1960s, that bridge had what engineers call a “fracture-critical” design—with so little redundancy in its highly efficient and interconnected steel trusses that the entire structure fell after one gusset plate cracked due to overloading.

An ecosystem can collapse in the same way. Its elements can become so interconnected and efficient that the ecosystem can lose its resilience and rapidly decline. Ecosystems go through adaptive cycles, as the ecologist C.S. Holling has argued, but they return, like the replacement I-35W bridge, in a more resilient, less efficient and less interconnected form.

The parallel between ecosystems and the systems that we design should come as no surprise. We create our world in terms of how we see the world around us, and we have tended to focus, until relatively recently, on the efficiency and interconnectedness of nature. If the process of evolution can eliminate waste, we figured, why can't we? This has led us to overlook another aspect of nature—its healthy

redundancy and resilience—and to drive those qualities out of the world we design for ourselves, to our great misfortune.

This almost-obsessive focus on efficiency might not matter much if it only resulted in the occasional bridge collapse. But it has come to pervade most of the systems and structures upon which we depend, and we find ourselves in the midst of fracture-critical failures at a scale never seen before in human history.

Take our financial system, for example. Just as one gusset plate brought the I-35W bridge down, so too did the failure of a couple of investment banks—first Bear Stearns and then Lehman Brothers—set off a chain-reaction collapse of the credit and stock markets around the world.

We shouldn't have been surprised by this meltdown. The global economy had become so interconnected and efficient that it had no more resilience than the trusses of the bridge. Regulators ignored signs of stress in the banks just as inspectors did the bridge's bending gusset plates, while investors piled huge amounts of debt onto the financial system, like the added weight of paving equipment that contractors placed on the bridge before it fell. Our financial system will emerge from this crisis, but, like a recovering ecosystem, it will be less connected, less efficient and more resilient than before.

Adding to the urgency, we also have a fracture-critical food system, in which the failure of any one of the three dominant plants—rice, wheat and corn—could cause widespread starvation. We have a fracture-critical electrical grid, in which failures in a few places at once can bring down large sections of the grid and disrupt electrical service for extended periods of time.

Closer to home for many of us, we have a fracture-critical housing system, in which enough foreclosures, especially in economically



homogeneous neighborhoods, can send the value of all the other nearly identical houses underwater, with homeowners paying more for their mortgages than their houses are worth, leading to further foreclosures.

We don't have to look far to envision a more resilient future for ourselves. Humans have long lived this way: husbanding finite resources to ensure that future generations have enough. Cultivating renewable resources to maintain their quantity and diversity. Allocating desirable resources in ways that prevent overconsumption. And encouraging the enjoyment of infinite resources such as community, creativity and empathy.

This future will bring a new appreciation of ecosystems, not only as valuable in their own right, but also as a model for human systems. We'll apply our knowledge of the natural environment to design more sustainable and secure human environments, less vulnerable to the catastrophic collapses that have come to characterize our current situation.

We will someday emerge from this adaptive cycle, hopefully with less hubris and with a newfound humility and renewed respect for nature.

This article is an abbreviation of a chapter in a forthcoming book on the I-35W bridge collapse, to be published by the University of Minnesota Press in spring 2010.

THOMAS FISHER is a professor and dean of the College of Design at the University of Minnesota. He has written extensively about design and sustainability, and his most recent book, *Architectural Design and Ethics* (Architectural Press, 2008), looks at the ethical aspects of leading more sustainable lives.

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Whole Village, Whole Planet

Just as challenges to human and ecosystem well-being are interconnected, so are solutions.

by MARY HOFF

The images weave together like the warp and woof of a brightly colored Tanzanian *khanga*: Masai villagers carrying their crops and chickens on bicycles down pebble-pocked roads. A fly-covered boy sleeping on the dusty ground. Bony cattle corralled by thorn fences. Wildlife struggling to survive in the face of human-wrought change.

For Craig Packer and Katey Pelican, recipients of the Institute on the Environment Discovery Grants, the picture that emerges when the diverse strands of rural Tanzania intertwine is one of both challenge and hope. The University of Minnesota researchers aim to turn the tide on poverty and environmental destruction through a village-based, evaluation-grounded effort known as the Whole Village Project.

The project is the brainchild of Packer, a professor of ecology, evolution and behavior who has spent the past three decades studying lions in Tanzania. He and Pelican are working to preserve natural resources by educating and empowering the people who literally eat, breathe and live them every day.

Home not only to wild places like the Serengeti and Mount Kilimanjaro—but also to 38 million people who face alarmingly high rates of population growth, malnutrition, infant mortality and infectious disease—the East African nation is as economically impoverished as it is natural resources-rich.

With habitat increasingly threatened by human impacts, Packer has decided to extend his work, in his words, “to address the fundamental cause of environmental degradation ... overpopulation and poverty.”

As a scientist, Packer appreciates the importance of evaluation in any attempt to make a change. Although aid programs abound in Tanzania, he says, nobody really knows what impacts they have.

His strategy: Measure health, prosperity, education and natural resource practices in 240 villages; empower villagers to make improvements; check back every two years to document changes; then share the results with local people so they can sustain any improvements.



Funding from the IonE grant, which was awarded earlier this year, will help Packer map land-use patterns to create a baseline against which to measure progress. “It will fill an important metric that we really have to have,” he says.

For Pelican, a veterinarian whose passion is conservation, the road to the Whole Village Project started, interestingly, with another kind of cat. After working for 10 years with the Smithsonian Institution helping Asian clouded leopards thrive, she realized that focusing on the animals alone was not going to do the job.

“I can save clouded leopards, but that doesn’t save the ecosystem,” she says. “If we want to save cute fuzzies, we have to feed people in a sustainable way.”

Now an assistant professor of veterinary population medicine, Pelican traveled to Tanzania with a study group last year. When she returned, she struck a plan to connect the rich and diverse human health, animal health and ecosystem health resources of the U of M with the needs of Tanzanians.

Her part of the project: Build an extension program at Tanzania’s Sokoine University of Agriculture, empower extension workers to promote sustainable agriculture and health at 50 Whole Village Project communities, and establish 10 to 15 of them as demonstration sites for healthy, prosperous and environmentally sound living.

Through the Whole Village Project, Packer, Pelican and their colleagues intend to create a proven model robust enough to move from whole villages to the whole world.

“[IonE was] asking us to address a grand challenge in the environment. Sub-Saharan Africa is one of the big challenges,” Pelican says. “If we can provide sustainable food and water and maintain a healthy environment in a place like Tanzania where there is such a high poverty rate, then we can do it anywhere.”

MARY HOFF is a science writer specializing in natural resources, the environment, health and sustainability. A regular contributor to *Minnesota Conservation Volunteer*, she also has published in *Science World* and *National Geographic Explorer*, and has written numerous books for children on natural history and environmental topics.

PHOTOS: KATEY PELICAN AND CHRISTOPHER POLYDOROFF



The Whole Village Project aims to provide an in-depth understanding of the health, prosperity, education and natural resource consumption of rural Tanzanians. This information serves as a common language that allows communities to more easily collaborate and share best practices.

“Our challenge is to help people understand that this is going to be a human-determined future.”

Seeing is Believing

After 25 years with the Science Museum of Minnesota, Pat Hamilton has all but mastered the art of global show-and-tell. by EVE DANIELS

A young mother shoves her double stroller, which holds cranky twins, through the glass doors. In the lobby, a nervous tour guide talks up the city of St. Paul to some weary conventioners. At the ticket counter, a grade-school teacher rounds up a mob of restless tweens who would rather giggle, talk, text-message... anything but, *ugh*, learn.

A typical day at the Science Museum of Minnesota. And this is just a taste of Pat Hamilton's not-so-typical audience. As director of environmental and Earth-systems science programs, Hamilton looks for what the often-preoccupied public needs to see. Then he helps them to see it.

This job can come at the risk of stating the obvious, at least to scientists. For example, a few years ago, Hamilton had a notion. Maybe he had osmosis to thank, but the idea that *humans are the dominant agent of change on the planet* entered his mind like an "aha" moment.

Not long after, during a retreat with the National Center for Earth-surface Dynamics, he stood up and asked a room full of very smart people what they thought of his notion. The majority response was "Sure, we've known that for years."

"That's where the science museum needs to be," says Hamilton. "We need to be between what scientists know and what the public doesn't know."

And that's where projects like *Future Earth* fit in. The 6.7 billion people roaming the earth today are leaving one serious footprint. Our collective impact rivals any natural process in the planet's history. Right now, Hamilton is working with six research centers across America to develop an interactive exhibit that drives this idea home.

"Our challenge is to help people understand that this is going to be a human-determined future," he says.

That's a tall task, and one that calls for advanced technology to do it right. So, when he's writing grant proposals (and he writes

a lot of them), Hamilton isn't shy about asking for high-tech equipment.

High-tech *and* heavy-duty, like Science on a Sphere, a global display system developed by the National Oceanic and Atmospheric Administration. This past March, a captive crowd gathered around the 68-inch, suspended globe to marvel at "The Blue Planet," a standout component of the science museum's recent *Water* exhibit.



As a new fellow of the Institute on the Environment, Hamilton is collaborating with IonE researchers to develop programs for Science on a Sphere and other displays. Pictured here, he demonstrates the Rain Table, an interactive exhibit developed by the Electronic Visualization Laboratory, the U of M's department of geology and the Science Museum of Minnesota.

It's one thing to read how "less than 1 percent of Earth's water supports all life outside of the oceans." It's another thing to see global water shortages pinpointed in dynamic detail around this state-of-the-art sphere—a technology that Hamilton first discovered at a conference in 2003 and promptly secured a grant for.

Evidently, Hamilton has always had a fascination with the blue planet. Back in junior high, when most boys his age were playing sports and chasing girls, he was paging through satellite images of the world.

"NASA had published this book of

Landsat pictures of the earth's surface," he recalls, his eyes lighting up. "For like 12 bucks, you could have NASA send you this cool book."

Following a brief stint as a biology major at Minnesota State University in Moorhead, Hamilton learned he was a lot keener on Earth-as-a-whole than its separate organisms. He transferred to the University of Minnesota, Duluth, graduating in 1980 with a geography degree. Two years later, he earned his master's degree in the same field at the Twin Cities campus.

Then, in 1984, he landed his dream job at the science museum.

"I was hired to help the director of the geography department produce an exhibit about Minnesota. I didn't have any exhibit experience, but it was exactly what I wanted to do. So I really poured myself into making the best case possible for why I should work here."

A quarter-century and a few promotions later, Hamilton is still making the case. He's played a lead role in creating the museum's outdoor science park, the zero-emissions Science House, the long-standing Mississippi River Gallery and a host of other exhibits.

Granted, he's not working on his own. The Science Museum of Minnesota boasts the largest in-house production facility of any museum in the country, with a 12,000-square-foot fabrication shop and 100-plus staffers in the exhibits division alone.

So, Hamilton is one small part—albeit an important part—of a well-oiled machine. "I get the funding and get the ball rolling. Then my involvement tapers off as I look at what the next big opportunity is."

Money is tight these days, but Hamilton feels bullish.

"The environment is going to be the story of the 21st century. How we survive and thrive on this planet is a narrative we'll be working on for a long, long time."

Building Blocks by AMANDA OBERG

Developed by the U.S. Green Building Council in 1998, the LEED (Leadership in Energy and Environmental Design) rating system has planners, builders and everyone in between going the extra mile in the name of green construction. Today, office towers, hotels, schools and government centers far and wide tout access to public transit and reduced light pollution like past generations touted parking ramps and flood lamps. While the LEED standards are high, some say the process is too expensive and bureaucratic, or that it fails to address lifetime energy consumption. Here, two sustainable building buffs look at the issue from different angles.

“I think the greatest benefit of using the certification system is being able to prove a claim about performance. It’s very easy to say, ‘I design buildings like this all the time. I don’t need to go through LEED. My building is already green.’ But it’s another thing to prove it.

Some people struggle to get their buildings LEED-certified because they aren’t really changing the way they design something. They are simply applying a checklist to something that’s business as usual. LEED should fundamentally change the way people start designing. And everybody on the design team ... needs to share information so that [it’s] an interdisciplinary approach.

Achieving LEED certification at the most basic level shouldn’t cost more in terms of construction dollars. It’s when you get into gold and platinum—then you’re doing things that aren’t typical. You may be doing solar panels on the roof or geothermal systems ... and that’s going to be an additional first cost. But if you’re already starting with quality construction, getting to the basic LEED certification shouldn’t cost you more than if you aren’t doing it.

Building codes are changing so much that I think they’re almost going to replace the need for LEED. From an energy point of view, as new national codes are developed and put in place, they are going to require essentially what LEED does now. So LEED is already changing the marketplace. It’s beginning to change policy and the lowest rung of achievement, the building code.

As LEED continues to grow, it will become even more effective. It’s not a perfect tool yet, but I think it’s the best one we have. It’s a really important step in changing the way all of us think about the built environment.”

KEVIN FLYNN

President, U.S. Green Building Council
Mississippi Headwaters Chapter

“LEED is a good first step to get everybody engaged in doing a green building, but the next step is to make sure it ensures performance. Whether we’re using LEED or not, we have to go back and monitor what’s going on in buildings after they’ve been built. You can have a very well-designed, sustainable building, but if it’s operated poorly it will still use a lot of energy.

The U.S. Green Building Council chapter in Minnesota is very strong. I expect that will only grow, and I totally support that. I would just say, let’s do ‘LEED-plus.’ I think the future is going to focus on real performance metrics and outcomes, not just on best practices. LEED is evolving in that direction, but there will always be competitors. And it’s good that there’s not just one dominant system and that these higher standards will come in different ways.

One example is Sustainable Building 2030, which was passed by the Minnesota Legislature last year and is based on a national program called Architecture 2030. Essentially, it says we have to get to net-zero carbon or net-zero energy buildings by 2030. The beauty is that it’s performance-based. Our research center is leading a team to develop that program in Minnesota ... and all state buildings will have to meet this new higher standard. Utility programs will be designed to provide incentives for these standards as well.

We are in such an important time in history, and we’re going to experience a great transformation. So we need to be very clear about what the real measurable performance targets are, and give people the tools and information they need to reach them. Then we need to track that performance and make it public. This way, everybody keeps learning from everybody else’s mistakes, because nobody has all the answers.”

JOHN CARMODY

Director, Center for Sustainable Building Research
University of Minnesota

UPCOMING EVENTS

JUNE 21-26
Goldschmidt 2009: Challenges to Our Volatile Planet
Davos, Switzerland
www.goldschmidt2009.org



JUNE 23-24
Renewable Energy Finance Forum: Wall Street
New York, N.Y.
www.reffwallstreet.com

JUNE 23-25
Energy and Sustainability
Bologna, Italy
www.wessex.ac.uk



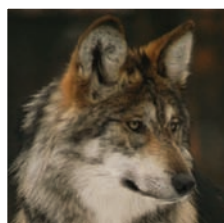
JUNE 28-30
Cities and Climate Change: Responding to an Urgent Agenda
Marseille, France
www.urs2009.net

JULY 6-10
International Conference on the Environment and Sustainable Development
Havana, Cuba
www.cubambiente.com

JULY 21-24
TEDGlobal: The Substance of Things Not Seen
Oxford, England
www.ted.com

THROUGH AUG. 23
Wolves and Wild Lands in the 21st Century

Bell Museum of Natural History, Minneapolis
 Through real wolf displays, artwork and photography, this provocative exhibit examines conservation issues facing wolves from the Arctic to the southeastern United States.



AUG. 24-28
Global Energy and Water Cycle Conference
Melbourne, Australia
www.ihdp.unu.edu/article/647

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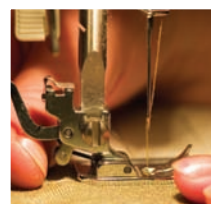
VoTech Building, St. Paul
 This weekly series will feature seminars by Institute on the Environment faculty and staff, along with visiting speakers. Scholarly and general audiences will enjoy dynamic talks on a range of environmental hot topics—minus the PowerPoint overload. Stay tuned to the IonE Web site for the complete schedule.

SEPT. 13-17
International Conference on Transportation and Ecology
Duluth Entertainment Convention Center

Leading experts address the challenges of adapting to climate change, shifts in transportation demand and patterns, and evolving environmental and transportation policy.

THROUGH SEPT. 16
Climate Change Works by the Fiber Artists' Study Group
Coffman Art Gallery, Minneapolis

This textile art exhibit reflects diverse environmental, social and psychological perspectives on climate change. The exhibit includes quilting, sculptural fiber and figurative art.



SEPT. 16-18
World Bioenergy: Clean Vehicles and Fuels
Stockholm, Sweden
www.elmia.se/en/wbcvf

NOV. 17
E3 2009: The Midwest's Premier Energy, Economic and Environmental Conference
Saint Paul RiverCentre
 Save the date! This annual IREE conference focuses on the intersection among innovative technologies, visionary policies, environmental benefits and emerging market opportunities in renewable energy. www.iree.umn.edu/e3

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