

# ensia

SUMMER 2014 | ENVIRONMENTAL SOLUTIONS IN ACTION

## MEET THE NEW MEAT

CUTTING THE ENVIRONMENTAL  
COSTS OF CARNIVORY



**PLUS:**

**CITIES IN 2050**, living in a **ZERO WASTE WORLD**,  
water funds, beyond sustainability, deltas & more

# RESPECT THE UNEXPECTED

THERE WAS AN ANT in the avgolemono.

I hadn't thought to dust out the pot before I started cooking, and while stirring the sauce discovered that the uninvited guest had dropped in for dinner.

Clearly this was a dilemma. Should I surreptitiously scoop the critter out and serve something that had touched insect feet to my mother-in-law? Or forget my concern about wasting food, toss the sauce and start over?

After reading this issue's cover story — "Has Meat Met Its Match?" — I now recognize there was a third alternative. Perhaps the ant was not an unexpected problem, but an unexpected *opportunity* — to dish up a little extra protein with the meal.

Which got me thinking: How often do the problems we face have an underlining of possibility we neglect to see because we're so fixated on our woes?

This is not to make light of the truly daunting dilemmas we face. We know meat consumption is a can of worms. We under-

*How much might we gain by looking for and capitalizing on the up side of our downs?*

stand that the world won't suddenly switch to vegetarian diets; that alternative protein sources have problems, too; and that there is no magic recipe for feeding the 9-billion-plus people expected to inhabit the planet by mid-century. Undoubtedly it will take all of the ingenuity, will and conviction we can muster to tackle this and other challenges. But the mindset with which we do so could make all the difference. The dividing line between problems and opportunities is a fine one. How much might we gain by looking for and capitalizing on the up side of our downs?

Plenty, if the other articles in this issue are any indication. In "Zero-Waste World," writer Marc Gunther describes how companies that see trash as treasure — rather than trouble — are boosting their bottom lines by retrieving used goods from customers. In "The Future of Cities," urban innovators imagine a world in which strategic design



moves us beyond the disadvantages of crowding to take advantage of the chances increased density offers to become more energy efficient and socially connected. And New York restaurateur Ryan Chadwick puts a new twist on the idea of making lemonade from lemons in "Snapshot" by making dinner from invasive lionfish at his Lower East Side eatery.

Disrupted deltas. Threatened water supplies. Environmental injustices. Do we see problems as unalloyed adversity? Or can we be open-minded enough to ask what the ancillary opportunities might be?

What happened to the ant and the avgolemono I'll leave to your imagination. As I will the notion of turning unexpected difficulties into launchpads for efforts to build a better world.

What troubles will come your way today? And what will you do with them? 

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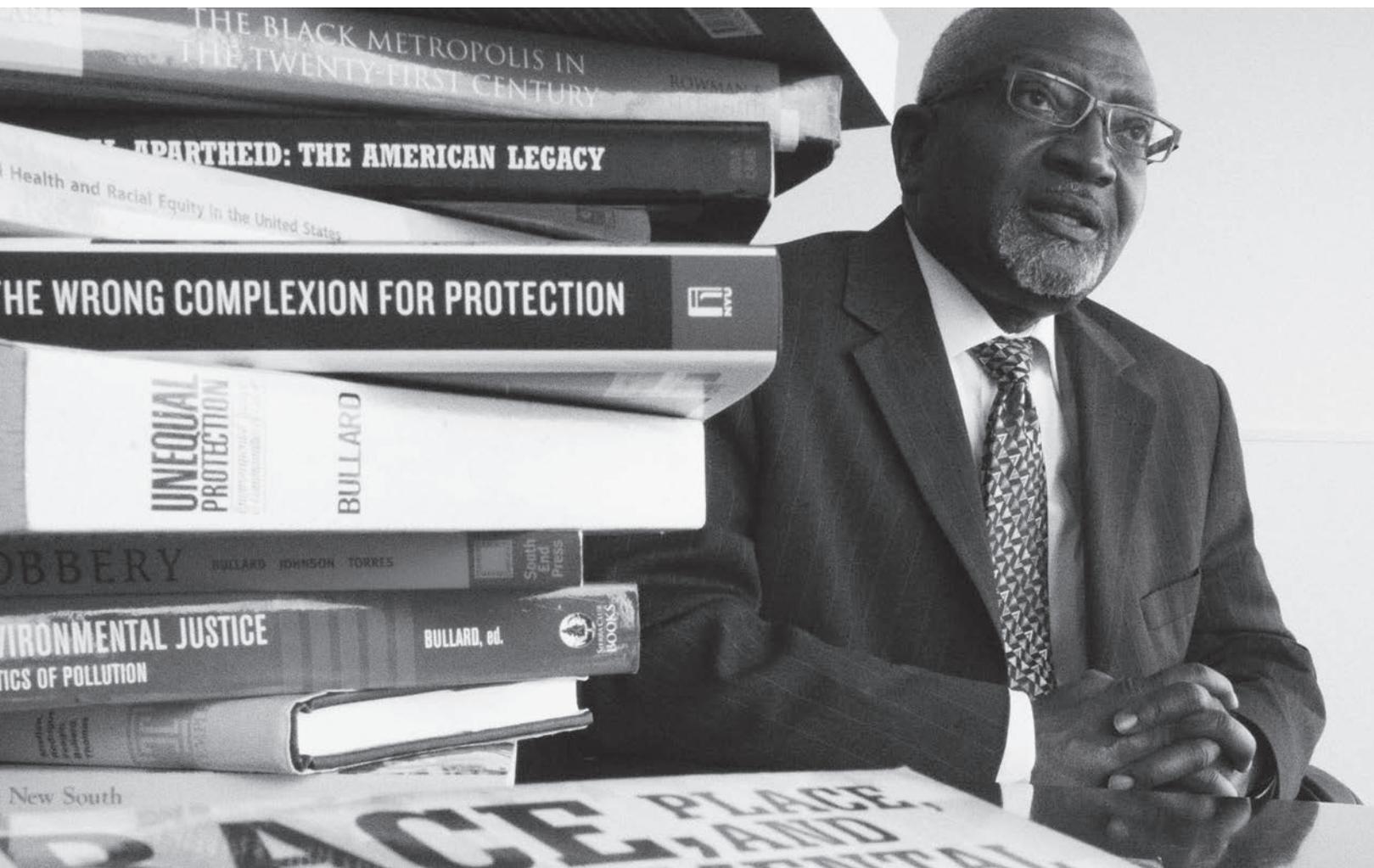


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## JUST CAUSE

As a sociologist in the 1970s, **Robert Bullard** made a dismaying discovery: Houston landfills and incinerators were far more likely to be located in communities of color than in white neighborhoods, even though blacks made up just one-fourth of the city's population. That realization launched a lifetime of environmental justice work, including leadership in convening the First National People of Color Environmental Leadership Summit and framing the landmark 17 Principles of Environmental Justice in 1991, bringing environmental justice to the fore at the 1992 Earth Summit in Rio de Janeiro, and catalyzing creation of the U.S. Environmental Protection Agency's Office of Environmental Justice. 📖 Now dean of the Barbara Jordan–Mickey Leland School of Public Affairs at Texas Southern University, Bullard is widely considered the father of the environmental justice movement. He shared his reflections with Ensia in the wake of the 20th anniversary of Executive Order 12898, which instructed federal agencies to address environmental justice in their activities.

INTERVIEW BY MARY HOFF | PHOTO BY PATRIC SCHNEIDER



**WHAT IS ENVIRONMENTAL JUSTICE?** Environmental justice embraces the principle that all people and communities are entitled to equal protection of our environmental laws. It means fair treatment, and it means all people — regardless of race, color or national origin — are involved when it comes to implementing and enforcing environmental laws, regulations and policies.

**WHAT ARE THE BIG POINTS OF PROGRESS IN THE PAST TWO DECADES?**

One of the most important is the codification and integration of environmental justice into our language and our understanding of basic civil rights and human rights. Today we have every state at least acknowledging that environmental justice is a framework that needs to be codified in law or some type of legislative order.

The other is that environmental justice is now being recognized as a legitimate subject for study. At least 22 legal clinics and dozens of university-based centers and programs have environmental justice as their central focus.

And, I think, also the fact that environmental justice now is getting recognition as worthy of national and international prestigious awards, such as Goldman prizes and Heinz Awards and MacArthur prizes — and even the Nobel Prize, with Wangari Maathai winning the Nobel Prize for her work around environmental justice in Kenya.

Finally, I think it's important to note that environmental justice has springboarded from a United States domestic issue to become a global movement. The environmental justice movement has grown, matured and taken root across the globe.

**WHEN YOU LOOK FORWARD, WHAT ARE THE BIG CHALLENGES YOU WANT TO ADDRESS?**

Climate change for me is probably the number one environmental justice issue of the 21st century, because the people who are impacted first, worst and longest are the same environmental justice communities we have been working with, trying to address environmental inequities,

sustainability and environmental degradation of pollution. It's important that we get more people who are on the front lines, and who are most impacted, who are vulnerable, to talk about their experiences and what's happening to them right now. I think that has a lot of potential to change minds and to put a human face on the issue of climate change and build community resiliency.

We have to be more aggressive about coming up with alternatives when it comes to energy production and having more clean, efficient, green, public transportation, because a lot of our people don't have cars. I think we have to talk about how we're going to redevelop and redesign our cities so they are walkable and greener and more sustainable and livable. Also, our cities have to become more just when it comes to the distribution of amenities and access to quality neighborhoods and green space.

**IS THE MAINSTREAM ENVIRONMENTAL MOVEMENT PART OF THE PROBLEM OR PART OF THE SOLUTION?**

The fact is that the mainstream environmental conservation movement is pretty much white and middle class, [although] there has been some diversification within those organizations. What we have said all along is that the environmental movement and the conservation movement is reflective of our society, in that it becomes very difficult for these organizations to deal with race and class and social inequality. That's why the environmental justice movement emerged, out of saying, "If these groups don't do it, then we will do it."

Where there's overlap in terms of issues and agendas and strategies for getting things done as a collective, we're seeing groups come together. Many of the organizations have environmental justice programs. Many have people of color, and representatives from low-income impacted communities on their boards. But for the most part these groups are pretty much the same as they were 20 years ago.

The other thing: These groups still get the lion's share of funding from the private foundations. [When] we did the People

of Color Environmental Groups Directory in 1991, we identified 300 people of color and environmental justice groups. Today, that number is more than tenfold, but the funding has not grown at the level of the organization. That's a problem. That's a big problem.

As we change demographically, it only makes sense that we not wait until 2042 when this country becomes the majority of people of color, but that we start right now developing the leadership from those communities of color. I think the face of our movement will need to reflect that change.

**THIS SOUNDS LIKE A WAKE-UP CALL TO MAINSTREAM ENVIRONMENTAL ORGANIZATIONS.**

I think it is a wake-up call. These are very smart people, and I'm sure they understand the way that complex organizations work: If you are membership based, you grow or you die. And if you look at the demographics, where is the potential growth for these organizations? If you look at the trends, the growth will most likely come from people of color. So it will make a whole lot of sense that we start to be an inclusive movement, or we have inclusive movements, and that inclusion also takes into account resource inclusion — money.

**WHAT GIVES YOU HOPE?** The fact that we have more and more young people, and more and more students involved in the environmental justice movement around issues of sustainability, around walkable communities and smart growth, transportation and climate change. This generation, they're weaning themselves off of cars, and more of them are wanting to access public transportation, and access parks and green space. They want to live in cities. This is hope.

And, I think young people in many cases don't carry those baggages of discrimination and prejudice and fear of "the other" — they have less of that baggage than my generation. We are now in an era where young people are more willing to live and let live. I think this is the kind of new movement that young people want to own as their movement. For me that's very good. 

# ENDANGERED DELTAS

BY JOHN SISSER | PHOTO BY J.A. KRAULIS

From its source at Great Slave Lake in Canada's Northwest Territories, the Mackenzie River flows more than 1,000 miles through wilderness before forming one of the world's largest deltas at the Beaufort Sea. Thousands of channels, islands and lakes create a vast network of wetland ecosystems spanning nearly 5,000 square miles. While small towns dot the landscape, the Mackenzie River delta is dominated by wildlife, including grizzly bears, musk oxen, beluga whales and over 100 species of migratory birds.

Like others, the Mackenzie River delta is endangered. From Bangladesh to British Columbia, scientists, governments and nonprofits are working to protect natural processes in these ecosystem services-rich landscapes even as rising sea levels, shifts in precipitation and human manipulation threaten to permanently alter them.

+ SEE MORE IMAGES OF DELTAS  
AROUND THE WORLD: [ENSIA.US/DELTA](https://www.ensia.us/deltas)S





**FISH-FRIENDLY DAMS**

Modifying the design of turbines at hydropower dams to minimize dramatic shifts in pressure could save millions of fish by protecting them from *barotrauma* — a sudden and potentially deadly expansion of the swim bladder. Learn more at [ensia.us/fish](http://ensia.us/fish).

**65** percent of people surveyed said the world would be better if we shared more and owned less. —*Havas Worldwide*

**MODEL BEHAVIOR**

To help companies think outside the business-as-usual box, the sustainable enterprise organization SustainAbility identified 87 innovative business models, dissected and analyzed them to see what makes them tick, then categorized them into 20 types others can use as inspiration for building their own sustainable business. Learn more at [ensia.us/big](http://ensia.us/big).

**167** MPH  
top speed of new Spark-Renault SRT\_01E electric race car

—*Formula E CEO Alejandro Agag*

**CONNECTING THE DOTS**

Part of a growing global focus on bringing big data to bear on solving human problems, the University of Exeter and partners have launched the Medical and Environmental Data Mashup Infrastructure project, a three-year initiative to bring together databases for climate, environment and human health; build compatibility among them; and make them accessible through a single Web portal. With the help of sophisticated statistics and GIS technology, MEDMI will provide data resources that allow researchers, public health practitioners and others to, for instance, explore correlations between climate and infectious disease or issue health alerts based on weather forecasts. Learn more at [ensia.us/medmi](http://ensia.us/medmi).

**COUNTER-CAR CULTURE**

Call them the Public Transportation Generation. A recent Rockefeller Foundation survey found that 66 percent of U.S. urban Millennials surveyed said access to public transportation is one of their top three criteria for choosing where to live. Learn more at [ensia.us/transit](http://ensia.us/transit).

**OUR PLACE ON EARTH**

How are people around the world responding to climate change? Researcher Nuin-Tara Key and filmmaker Tom Miller hope to answer that question with *Our Place on Earth*, a project that will take them from the Caribbean to Finland in late summer and fall 2014. Key and Miller plan to produce a documentary about community-based responses to climate change, create a tool kit for replicating local solutions and teach video workshops to help communities share their climate adaptation stories. Watch for updates at [ensia.com](http://ensia.com).

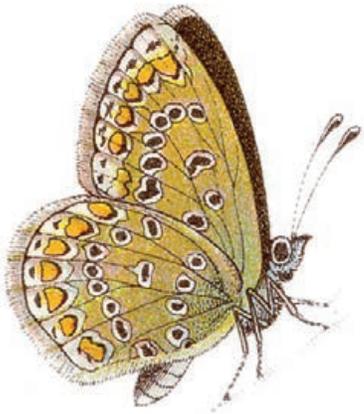


**44** percent of new power-generating capacity installed in 2013 was from renewable sources (excluding large hydro).

—Global Trends in Renewable Energy Investment 2014

#### NUMBERS GAME

How many hectares of forest have been destroyed worldwide this year? How many bicycles have been built? How many days until the world runs out of oil? You can find (literally) up-to-the-minute estimates for these and dozens of other environment, health and related statistics at [worldometers.info](http://worldometers.info). Users can view the latest statistics on the website for free, or license counters for embedding on a Web page or exhibiting at an event.



#### BETTER FOR BIODIVERSITY

Gathering results of 94 previous studies of farmland biodiversity into one giant meta-analysis, researchers from the U.K., Sweden and Switzerland found that biodiversity was an average of 34 percent higher on organic farms than on conventional ones. Plants, insects, birds and microorganisms showed the biggest boost.



## MANTA RAYS OF HOPE

Indonesia has designated nearly 6 million square kilometers of ocean as a protected area for oceanic and reef manta rays. Mantas are killed by fisherman for their gill plates — a purported medicinal tonic in Southeast Asia. A recent study published in PLOS ONE reported that the tourism value of mantas globally is nearly \$140 million per year.

#### 12-STEP PLAN

Twelve straightforward strategies could slash food-related greenhouse gas emissions 50 to 90 percent, according to a report published earlier this year by Climate Focus and California Environmental Associates. Specific recommendations range from improving catering portion control in China to changing the feed regimen for beef cattle in Brazil. Learn more at [ensia.us/food](http://ensia.us/food).



**80,000**  
acres of coastal wetlands lost in the U.S. each year

—U.S. Fish & Wildlife Service and National Oceanic and Atmospheric Administration

**126,000**  
number of described species that rely on freshwater habitats

—International Union for Conservation of Nature



# HAS MEAT MET ITS MATCH?

Sensitized to the environmental costs of livestock, a new generation eyes options for kicking our carnivorous ways.

BY ROWAN JACOBSEN | ILLUSTRATION BY JERICÓ SANTANDER

# THE FUTURE OF FOOD ARRIVED

at Waitsfield Elementary School — a tiny brick throwback in Vermont’s pastoral Mad River Valley — just after lunch on May 15, 2014, in a handmade straw basket on the shoulder of Rachael Young. The cafeteria was still full of kids, so Young slipped into the kitchen as surreptitiously as possible. **“Let’s see if we can do this on the sly,”** she said to me. **“I don’t want them to see anything ahead of time.”**

We unpacked in a far corner of the kitchen, shooing away the occasional set of prying eyes. While I spread a ramp-knotweed pesto onto tortillas and cut them into eighths, Young found a pan, fired up the stove and dry-fried the main ingredient. “You may get a really weird smell in a moment,” she apologized. “It has something to do with the chitin when it’s heated. But it still tastes great!”

Young is the 34-year-old founder of Eat Yummy Bugs, a Vermont-based enterprise that encourages people to do just that, and a partner in World Entomophagy, the premier supplier of “Recipe-Ready” crickets and mealworms for human consumption.

Like fedoras and Mickey Rourke, entomophagy (bug-eating) has experienced periodic but short-lived flares in popularity over the years. But this time it seems to have legs. You can snack on fried grasshoppers in New York and D.C., wrap your chopsticks around cricket sushi in Portland, Ore., and chow down on mealworm tacos from the Don Bugito food cart in San Francisco. Edible insect festivals are no longer news, and a variety of cricket-flour energy bars are dueling for retail shelf space.

What adds timeliness to the trend is the U.N. Food and Agriculture Organization’s recent report *Edible Insects: Future Prospects for Food and Feed Security*, which points out that 2 billion people already eat bugs and the rest of us had better get on it, because by 2050 the world population will have swelled from

the current 7 billion to 9 billion or more. If the growth in demand for animal protein continues on its current trajectory, cows, pigs and chickens may need some help meeting it.

## The Protein Problem

To feed those 9 billion or so people, a coterie of non-governmental organizations, government agencies and agriculture representatives tells us, we will need to *double* crop production by 2050. To do so, they say, we will need a massive initiative to improve yields through hi-tech farming, genetically modified crops and other such solutions.

But that’s not the whole story. In reality, we already produce enough potentially edible calories to feed 13 billion people three square meals a day. One-third of it, however, doesn’t get eaten by humans, but instead is fed to livestock, which turn it into protein we consume in the form of meat and dairy products. And that’s bad news for the environment for several reasons.

For one, the FAO named the livestock industry one of the biggest producers of greenhouse gases, topping even transportation. Worldwatch Institute scientists attribute about half of the problem to livestock. Beef cattle are notorious, generating 41 percent of the livestock industry’s GHG emissions, while pigs produce 9 percent and chickens, 8 percent. The reason? Cows are methane factories, and methane traps heat 40 times more effectively than CO<sub>2</sub>.

Meat production also requires massive amounts of water. It takes 500 gallons of water or more to produce a hamburger, mostly to grow alfalfa and other feed crops. Ironically, even as it is mired in the midst of one of its worst droughts ever recorded, according to James McWilliams, author of *The Politics of Pasture*, California is shipping 100 billion gallons of prime water per year to Asia in the form of alfalfa so Japan and China can feed their cattle. A third of the Colorado River, the faltering lifeline of Southwest U.S. cities, is used to grow forage crops.

Livestock are also tough on rainforests. Most Amazon land that has been cleared is now in ranching and feed crops. Worldwide, animal production is also a major cause of deforestation.

All of this would be bad enough if livestock were actually good producers of protein, but they aren’t. Livestock are quite inefficient at transforming vegetable calories into meat and dairy calories, so much of agriculture’s output is lost by turning plants into protein. It takes about 2.5 pounds of feed to make one pound of live chicken, 5 pounds of feed to make one pound of live pig and 10 pounds of feed for



a pound of cow on the hoof. And even after all that converting, only 40–55 percent of the animal is edible. That's a lot of grain, and it explains why 70 percent of our existing agricultural land is devoted to livestock.

In other words, we don't have a food problem. We have a protein problem. And it's just going to get worse, pundits predict, because not only will 2.5 billion new people be added between now and 2050, but rising incomes and changing dietary preferences are expected to increase per-capita meat demand as well.

It's time to move beyond meat animals, suggest an increasing number of environmentalists, entrepreneurs and out-of-the-box thinkers. Sure, this is an argument as old as vegetarianism itself, but this new generation of advocates isn't suggesting we all endure a lifetime of Tofu

me. "Try one," she said. I popped a cricket into my mouth and chewed fast. It was crisp and crunchy, with a unique pistachio funk. Not bad at all. I could tell when I hit the head, which had a dense chewiness to it, like a dried blueberry. Pokey bits got stuck in the corners of my mouth, but no worse than your average tortilla chip.

Young tossed a second pan of sautéed mealworms with salt and cayenne. They were as crisp and insubstantial as a can of french-fried onions. While I placed three crickets on each tortilla wedge and sprinkled sprouts over the top, Young went into Eat Yummy Bugs mode for the 50 fifth and sixth graders gathered in the cafeteria. Firing up her PowerPoint presentation, she showed a photo of a cricket farm in Thailand. She told them how people all over the world have always eaten bugs. Then she rattled the

## *It's time to move beyond meat animals, suggest an increasing number of environmentalists, entrepreneurs and out-of-the-box thinkers.*

Pups and bland black-bean soup. Instead, they are hacking meat itself. If most people crave meat (and a look at our species' evolutionary history suggests we have every reason to) then let them eat it — in alternative forms that don't stress the environment as much but are still delicious enough to make us all forget our mammoth-hunting glory years.

### **Gourmet vs. Gross**

"So why not insects?" Young likes to ask. Insects don't burn up lots of calories keeping themselves warm, and they thrive on food scraps. While it takes 27 pounds of feed to make 1 pound of hamburger, just 1.7 pounds of feed will get you a pound of ground cricket. Yet they are not without their issues, as Young admitted as we cooked. "I hate raising crickets. It sucks. They're nocturnal, and they're so noisy. If you have them in your closet, you just lie awake at night thinking, 'Shut up!'"

As we talked, Young poured her pan of fried crickets into a metal bowl and handed them to

students with a disturbing close-up of the head of a slaughtered pig. She talked about meat's links to climate change and water pollution and world hunger. She played the shrimp card. "Who here likes shrimp?" Most hands went up. "What's the difference between a shrimp and a cricket? Why is one gourmet and one gross? If you can eat a shrimp, you can eat a bug."

I asked the teacher standing next to me to predict the rejection rate. He surveyed the group, then said, "30/70. Thirty percent will be pushing forward, and the other 70 percent will be stampeding the other way."

I hoped for better, because embracing creepy-crawlies could be an environmental boon. Raising a pound of mealworms produces a far lower carbon footprint than raising a pound of beef, and uses less land and water, too. It's not a sustainability slam dunk — farming and processing insects has its own set of impacts, from producing large-scale amounts of feed to climate control and grinding, milling or preserving the final product — but a growing body of evidence suggests that pound for

## **WHY DIET MATTERS**

Recent studies have estimated that crop production will need to double by 2050 in order to meet growing food demands. If global population (currently at 7 billion) is expected to increase by 2 or 3 billion by 2050 — a 30 to 40 percent increase — why would crop yields need to *double*? Where is the extra demand coming from?

The main culprit is increasing meat consumption. As people move out of poverty and get wealthier, they consume more meat and dairy. Because meat-heavy diets require substantially more crops to produce than plant-based diets (on average, of every 100 calories we feed to animals we only get about 12 back in the form of meat and dairy), growing global wealth has surpassed population growth as the bigger reason for increased crop demand.

How many people could we feed with those calories? Globally, 36 percent of all calories produced on croplands never become food for human consumption, but are instead used for animal feed. Differences by country are stark: In India less than 10 percent of crop calories are fed to animals; in China, it's one-third; and in the U.S., 67 percent. If we used U.S. croplands to grow only crops for direct human consumption, we could feed more than 1.5 billion people. That means the U.S. alone could feed a staggering 1 billion more people on the calories that do not end up in the food system.

— BY EMILY CASSIDY

Read more at [ensia.us/diet](http://ensia.us/diet)

pound, producing insect protein is far friendlier when it comes to the environment than is producing protein from conventional livestock.

## Vat Burger

Last year in London, Mark Post, a cell-culture expert at Maastricht University, cooked the world's first "test-tube" burger and served it straight-up to two underwhelmed taste-testers in a live press conference. The burger — which

took \$325,000 of funding from Google's Sergey Brin, who explained that he considers the current system of factory farming unworkable from both environmental and ethical standpoints — was made of 20,000 tiny strips of bovine muscle tissue, each grown in petri dishes and then combined with saffron, beet juice, bread crumbs and "a binder." The saffron and beet juice were necessary to turn the bloodless burger a pleasing pink. The burger was fried in butter. The verdict was mixed.

"It's close to meat," said Hanni Rützler, a nutrition scientist, looking cornered. "It's not that juicy. But the consistency is perfect."

"It has a mouthfeel like meat," agreed Josh Schonwald, author of *The Taste of Tomorrow*. "The absence is the fat." Apparently all that butter wasn't enough.

So what if it isn't as dazzling as a T-bone? Many common foods taste downright strange if you stop and pay attention to them. I recently drove to my nearest McDonald's, ordered a



### « GOT CULTURE?

Maastricht University professor Mark Post (left) and food technician Peter Verstrate used cow muscle, beet juice and a few other ingredients to make the world's first "test-tube" burger last spring.

PHOTOS BY DAVID PARRY / PA WIRE

### MAKE-BELIEVE MEAT »

Southwest Style Chicken-Free Strips are one of several Beyond Meat products earning kudos from culinary critics.

PHOTO COURTESY OF BEYOND MEAT

burger with nothing on it, removed it from its bun, and ate it like a cookie. Stripped of all the ketchup and pickles and cheese, it was weirdness itself. It had the texture of oatmeal. I have no doubts that in-vitro meat will soon pass the fast-food test.

But does it pass the environmentally benign test? Obviously, this early beta stage doesn't even come close, but a much-cited 2011 article by Oxford researchers estimated that switching to cultured meat could reduce meat-production land use by 99 percent and greenhouse gas emissions and water use by up to 96 percent each. Yet barring a major technological breakthrough, cultured meats will never be commercially viable. The problem lies in the scalability and the raw materials. As synthetic biologist Christina Agapakis blogged at *Discover*, "Cell culture is one of the most expensive and resource-intensive techniques in modern biology. Keeping the cells warm, healthy, well-fed and free of contamination takes incredible labor and energy, even when scaled to the 10,000-liter vats that biotech companies use." When you start to grasp the

electricity, heat, antibiotics and sterilization involved, you start to appreciate the self-heating, self-healing cow. One U.K. study estimated that, even when done on a commercial scale, cultured meat would still be twice as expensive as conventional chicken meat.

And the cells, of course, don't grow out of thin air. They get their raw materials from the medium they grow in, a broth of sugars and amino acids that began as traditional feed crops before being "digested" in a factory somewhere — a process that is neither cheap nor efficient. In addition, they require fetal calf serum, which is collected from unborn cows in slaughterhouses. With no viable serum substitute on the horizon, and no legitimate claim to being any more "real" or tasty than the meat substitutes that have been around for years, it's hard to see in-vitro meat's path to viability.

That goes double for the other contender in the lab-meat field: 3-D printed meat. Modern Meadow makes the stuff by squirting a yellow slurry of vat-grown cow cells out of a nozzle into little strips. The cells self-adhere and, in theory, form a muscle-like texture. It makes a

great headline or TED talk ("Printed Meat!"), but Modern Meadow has barely begun to address such quibbles as flavor, color and cost, and is wisely banking more on printing leather than meat.

## Killer App

What's the big deal about meat, anyway? These lab-meat ventures do us a favor by begging the question. The issue is not ontological status. I eat meat not because I have a desire to dance atop the food pyramid, but because I adore its savory succulence, something I can't quite find in the tofus and tempehs of the world. The fact that the bloodless vat burger was made out of cells that share their DNA with a cow does nothing for me, and I suspect that most consumers who are willing to think outside the box on meat consumption are probably just as happy to step all the way out of the box — so long as they can take that meaty flavor and texture with them.

Recently, I tore open my first package of Beyond Meat Chicken-Free Strips and sau-



téed the ivory-colored slabs with broccoli and onions. They made an undeniably delicious stir-fry — chewed like chicken and tasted, well, about as much like chicken as any of the actual pre-cooked chicken strips do. Beyond Meat is the brainchild of environmentalist and vegan Ethan Brown, who started his company to address livestock’s planetary impact, as well as animal-welfare issues. Its backers include Bill Gates and Twitter co-founders Biz Stone and Evan Williams. Its converts include food author and journalist Mark Bittman and chef Alton Brown. Its killer app is a trade secret that involves using steam, pressure and cold water to induce soy and pea proteins to hook up, Velcro-like, as do muscle proteins, and transform into white, fleshlike strips that chew and tear like chicken. That’s what sets it apart from the Boca Burgers of the world, which always tasted fine but chewed like the starchy lump of veggie mush that they were. Beyond Meat has now added a ground-beef impersonator. My teenage son pounded three “beef” tacos in three minutes and headed out the door, none the wiser. A burger is due later this year.

Beyond Meat might have the numbers we need. According to the company, while it takes 192 square meters of land to produce one kilogram of protein from cattle and 64 square

meters to produce a kilogram of protein from chickens, a kilogram of Beyond Meat protein has just 3.5 square meters of land backing it up. The dry feed demand differential is similarly

but it doesn’t have to. The low-hanging fruit is the burritos and burgers of the world, the daily disposable meals quickly eaten and just as quickly forgotten. I can easily see a near

**No plant-based meat substitute will ever perfectly replace a good steak or roast chicken, but it doesn't have to. The low-hanging fruit is the burritos and burgers of the world...**

striking: Beyond Meat uses just 4.8 kilograms of feed to produce a kilogram of protein, while chickens need 24.5 kilograms to do the job and beef, a hefty 69.4.

At \$5.29 for 12 ounces, Beyond Meat is not going to cure China — or even Chipotle — of its flesh addiction quite yet, but Brown assured me that one more round of scaling up and “our ability to dramatically underprice meat becomes clear.” He has his sights set on China, where he pointed out that a switch to a full Western diet would consume nearly the world’s entire supply of chicken.

No plant-based meat substitute will ever perfectly replace a good steak or roast chicken,

future where people reserve their consumption of “real meat” for special occasions. But I wouldn’t be surprised if the trend went even further. Perhaps the people of 2050 will shake their heads in incomprehension at our feedlot economy the way we do at our ancestors’ plantation economy, and will no longer expect sentient animals to do the work of converting grain into juicy bundles of protein.

**Why Not?**

Paradigm shifts rarely happen as we think they do, with the needle slowly moving from Normal to New Normal. Instead, they tend



**HAVE YOUR STEAK AND EAT IT, TOO**

*Big food challenges call for big food changes, but small choices can add up as well.*

So you want to reduce the environmental and food security impacts of your diet, but vegetarianism isn’t an option, synthetic meat scares you and you’d rather starve than have insects show up at your table? Turns out there are plenty of things we can do to eat meat more sustainably.

Maybe cutting back would work for you. Meatless Mondays — an idea initiated during World War I to conserve resources — is being revived as a way to encourage people to forgo meat one day a week for environment and health benefits, including water conservation and reduced fossil fuel dependence.

Another approach is to do a species switch-out. It takes far less grain (and therefore cropland) to produce a pound of pig or poultry than to produce a pound of cow — so choosing chicken fajitas over beef tacos could help.

If you’re really craving a burger or succulent steak, buying beef from well-managed grazing systems can be another easy swap for sustainability. Compared to feedlots, such systems reduce soil erosion, water pollution and biodiversity loss (though production of methane, a potent greenhouse gas, may be higher). Scientists are also working to reduce cattle’s environmental footprint through improved diet, genetics and manure management.

– BY JOHN SISSER

to follow the gay marriage model, burbling in the collective unconscious for years as an outlandish idea until one day everybody shrugs their shoulders and says, “Why not?” “First they ignore you, then they laugh at you, then they fight you, then you win,” said Gandhi. Most meat-alternative proponents are still at Gandhi’s stages 1 and 2.

The moment my skepticism about novel proteins turned to outright boosterism came a few seconds after Rachael Young finished her presentation to the Waitsfield Elementary School kids. I was standing on the side, holding the bowl of spicy mealworms, having distributed the salted crickets and cricket tortillas to the other teachers.

“Okay,” Young said, “who’s ready to eat yummy bugs?” A feral squeal went up from the kids and they charged, hitting us like a wave. Small fists dug into my mealworms and I found myself fighting to get my share. Suddenly it felt like the most natural thing in the world to be popping handfuls of these crackly, toasty, mushroom-scented sticks into our mouths. Mealworms, I thought, are the gateway bug.

Afterward, Young had the kids write flavor descriptors on a blackboard. Under the crickets, they wrote “potato chips,” “burnt popcorn,” “thick!” and “hard to swallow (legs).” Under the mealworms: “Stale corn chip,” “flacky,” “smooshy” and “weird/good.” In the debriefing afterward, one girl said matter-of-factly, “I think it would have been more appealing for me if the crickets didn’t have eyes.” But another said, “After you ate one, you kinda wanted to eat more.”

The proportion of students rejecting the idea of eating insects turned out to be 6/94. If that ratio, or anything even close, holds for the rest of humanity, the future of protein is about to get very, very interesting.

And why not? At some level, it’s all weird/good. First they gag. Then they giggle. Then you win. 🍷

**Rowan Jacobsen** is the James Beard Award-winning author of *Fruitless Fall*, *The Living Shore*, *Shadows on the Gulf* and other books. He is a frequent contributor to *Outside*, *Harper’s*, *Mother Jones*, *Orion* and other magazines, and his work has been anthologized in *Best American Science and Nature Writing* and other collections. His new book, *Apples of Uncommon Character*, will be published in September.



PHOTO © ISTOCKPHOTO.COM/KRAKOZAVR

## FISHING FOR A SOLUTION

With a limited amount of arable land on Earth, the challenge to feed the planet’s appetite for animal protein is going underwater.

Aquaculture, or fish farming, is the fastest growing sector of animal food production in the world, providing half of all seafood consumed by humans. That number is expected to rise, with another 40 million tons of seafood needed by 2030 to meet demand.

Is a fish sandwich any better for the environment than a cheeseburger or pork tenderloin? It is more efficient from a feed perspective. Nine pounds of feed will produce around 7.5 pounds of salmon, a far better feed conversion ratio than those for cattle and swine. In addition, aquaponics — raising fish and edible plants in a single system in which fish wastes serve as plant food — is being hailed as a particularly efficient solution to the challenge of feeding a booming population.

It’s not all smooth sailing on the aquaculture seas, however. Organic wastes from aquaculture can foul waterways. Growing feed for fish farms already requires a land area the size of the United Kingdom, and harvesting wild species for fishmeal strains marine resources. And at the end of the day, critics argue that jam-packed fishponds aren’t much different than regular feedlots, requiring antibiotics, creating a genetic monoculture and polluting the surrounding landscape.

But, much like traditional agriculture, sustainable practices exist for aquaculture, including only cultivating nonnative species in fish tanks or using lower stock densities to prevent disease. When it comes to satisfying the world’s carnivorous cravings, aquaculture and aquaponics may be a few more tools to add to the sustainability toolbox. — BY JOHN SISSER



the  
**FUTURE**  
OF CITIES

by Todd Reubold | Photo by Wenhai Tang



**By 2050,**  
seven out of every 10  
people on Earth will  
be an urban dweller.  
What the cities of  
the future will look  
like depends largely  
on decisions we  
make today.

Will we design a future where driverless cars zip around under skyscraping vertical gardens in hyperconnected, energy efficient “smart cities”? Or will we be trapped in endless traffic jams while pollution overwhelms remaining green spaces and infrastructure crumbles?



## YET TO BE BUILT

**Matthew Lynch**  
*Director of sustainable cities*  
World Business Council for  
Sustainable Development

**We turned to five visionary urban planners, designers and architects for their views on what they think cities will be like in 2050.**

**Here's what they said...**

Nine billion people living well within the limits of the planet by mid-century. That is the simple but powerful “Vision 2050” that the World Business Council for Sustainable Development, or WBCSD, has for the future of humanity.

There is no doubt that sustainable cities are central to this vision. Seventy percent of the world — 7 billion people — will be living in urban areas by 2050. Our cities can be the cornerstone of the green circular economy, supporting resilient societies and inclusive communities with universal access to public services and economic opportunity.

This future is absolutely possible. However, we must act now and take full advantage of the fact that much of our cities and infrastructure is not yet in existence, particularly in the developing world where urban growth is fastest. For example, more than 50 percent of the buildings [needed] to support the 300 million more city dwellers in China by 2030 are yet to be built. We have a critical one-off window to create compact, mixed-use, transit-oriented urban centers incorporating sustainable, low-carbon infrastructure and prioritizing access and inclusion.

Central to realizing this opportunity is bringing together two of the most powerful forces we have for driving sustainability transformation: the leadership of city governments and the innovation and delivery capacity of the

private sector. Building strategic engagement and “co-innovation” between cities and business has been the core focus of the WBCSD’s Urban Infrastructure Initiative, or UII, made up of 14 leading global companies and 10 cities around the world working collaboratively to identify innovative and practical solutions to help cities realize their long-term vision for prosperity and sustainability.

The UII is one of a number of major local and global initiatives that are tackling the key challenges we face in driving a sustainable urban future. I know it is unfashionable these days to be an optimist, but I do believe that Vision 2050 can be a reality.



## A MAJOR SHIFT

**Tigran Haas**  
*Associate professor and director of*  
*Civitas Athenaeum Laboratory and*  
*director of the Ph.D. program in*  
*urban and regional studies*  
KTH Royal Institute of Technology’s  
School of Architecture and the  
Built Environment

The complexities of contemporary global urban, political, economic and environmental issues are evident as we are now confronted with the greatest challenge that we have ever faced. As we move toward 2050 we are facing the consequences of accelerating urbanization and

population growth, the rise of megacities and megaregions, the scarcity of natural resources and their mismanagement, the impact of major errors in our responses to disasters, and the increasing demand for and complexity of greatly expanding transportation flows.

Our societies have also undergone rapid and radical shifts in terms of age and class, increasing inequities between the rich and poor and intense demands for democracy in the public realm.

All of this requires immediate solutions but also change of worldviews from architects, urban planners, designers, landscape architects and urbanists. We need these professionals and experts to contribute their most imaginative, pragmatic, resilient, innovative and just solutions.

The way forward is sustainable and resilient cities: energy-efficient neighborhoods and districts and green urbanism, but also civic design that will help shape and organize the city on basis of diversity, human scale and preservation.

Equally important are the new visions for neighborhood housing redevelopment that should support a human, economic, just, social and cultural recovery and renewal.



## INCREASING UNDERSTANDING

**Luis M.A. Bettencourt**  
*Professor of Complex Systems*  
Santa Fe Institute

By 2050 most nations on Earth will be highly urbanized, including Africa, parts of Asia and India, where presently only about one-third of the population lives in urban centers. In fact, at a point between now and 2050, some of the

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*“At a point between now and 2050, some of the largest cities in China and India will surpass Tokyo (currently with 35 million people) as the largest cities in the world.”*

— Luis M.A. Bettencourt

The systems and processes that we put in place to achieve these ends can be thought of as the software of the community, which includes formal societal services and institutions as well as the community’s informal structure, and cultural and social relationships.

For any of this to happen, a major shift and change in habits, customs and adaptation to an uncertain future will be required from all citizens, and without a consensus of all, the vision of a 2050 sustainable and resilient urban world will not be possible.

largest cities in China and India will surpass Tokyo (currently with 35 million people) as the largest cities in the world.

Cities in 2050 will continue to perform their primary function as places of intense human interactions (“social reactors,” as I like to call them), but in some ways will look and feel very different from what they look like today — especially those in the developing world. They will have to devise new ways to manage the congestion and the severe environmental impacts that beset them today. They will have to

be safer, develop better governance and attract people from all over the world.

Cities at their best are social environments where creativity and human development go hand in hand. The great challenge for cities in the decades to come is to promote universal socioeconomic development that is open-ended and sustainable.

This means achieving many age-old fundamental human aspirations, such as eliminating poverty and creating inclusive societies where equal opportunities are a reality and the “pursuit of happiness” is an attainable goal to everyone.

To be sustainable, this will also mean that we will need new technologies to harness more energy, not less, and to generate it and use it in clean and safe ways, ultimately from fully renewable sources. This, together with improved “cradle-to-cradle” design, would allow us to recycle nearly all of what we consume, generating positive interactions between cities and Earth’s natural environments.

Cities are dynamical environments capable of promoting great change very quickly. The universal attraction of cities today is a sign that this is becoming possible to everyone, especially in developing nations.

In the short term, however, urbanization and development are creating many of the their familiar unintended consequences on a massive scale, including the growth of urban poverty, the severe inadequacy of older political structures, insecurity, and massive pollution and greenhouse gas emissions, with potentially devastating consequences for climate change. Solutions to these problems are best found at the source — in cities.

The greatest obstacle to successful urbanization is our present lack of the understanding of cities. As a consequence, much urban policy is often inadequate, shortsighted and unsustainable.

Through new communication and information technologies and citizen participation, it is now possible to create new types of urban infrastructure to share knowledge about very

local conditions at the global scale. In this way, we may be able to cumulate information in a more interdisciplinary body of scientific knowledge about cities and use policy interventions as learning opportunities that transcend local conditions.

will potentially build 20,000 to 50,000 new skyscrapers and have more than 220 cities with populations of more than 1 million.

The romantic notion of future cities is that they will be smart, well connected with zero-

tural land and a high number of social protests over loss of resources.

The future of cities and their residents can be either bright or bleak — or both at the same time. To chart the path, many questions will



## TWO PATHS

**Tony Chan**  
Associate director  
Arup

In China, urbanization is occurring at an unprecedented scale. By the end of 2012, the mainland of the People's Republic of China had a total urban population of 712 million or 52.6 percent of the total population, rising from 26 percent in 1990. It is projected that 70 percent of the population will live in urban areas by 2035. Over the next two decades China

emission vehicles, powered by renewable resources and self-sustaining, and have buildings equipped with green technologies while still providing all the fun, excitement and ample economic opportunities for all residents.

However, dystopian future scenarios also exist — where city residents and corporations fight over a resource-constrained world, cities are highly polluted and crime ridden, residents are monitored without any privacy, and there is a chasm of disparity between the have and have-nots.

We see glimpses of both futures in China now. There are cities with magnetic levitation trains able run at over 500 kph, supercapacitor public buses, electric cars and bicycles, smart traffic monitoring systems, LEED Platinum-rated buildings and developments, smart personal devices and sensing technologies, record numbers of wind turbines and solar photovoltaic installations, and numerous eco/smart cities planned. At the same time, cities in China are experiencing record pollution levels, unprecedented traffic gridlocks, loss of agricul-

need to be answered: How will cities be powered? Can “waste” resources be utilized? Are buildings and infrastructure resilient enough for climate change? Where will our food come from? Are the needs of all residents being addressed? When does “sensored” become censored? How will the lack of access to new knowledge and digital technology affect the poor and marginalized in terms of economic opportunities? Can we manage the use of resources in cities with the regenerative capacity of the ecosystem?

I think there will be both futures for cities. How we design, set policies, finance, govern and manage these immense challenges will define different futures for different cities.

I am optimistic that there is a great future for most of us in cities and that good design and policies will eventually prevail, but not until after we've learned plenty of tough lessons along the way. In order to see the best possible future for all, we have to ensure that everyone has a say rather than just a select few.

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*“The future of cities and their residents can be either bright or bleak — or both at the same time.”*

— Tony Chan

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# The Bright Side of the Megacity

Writing in *Foreign Policy*, journalist Jonathan Kalan argues that the media, non-governmental organizations and environmentalists focus too much on problems in the world's megacities (cities where the population is greater than 10 million), such as air pollution

and traffic. “Megacities hold enormous value for the developing world,” Kalan writes, “and ensuring that they deliver this value starts, fundamentally, with no longer seeing them as utter catastrophes.” Read more at [ensia.us/megacities](http://ensia.us/megacities).



## HOPE FOR THE FUTURE

**Shawn Gehle**  
*Principal*  
Gensler

Contemporary cities have consisted of mostly single-purpose or single-use buildings. In the future I think we'll see more and more vertical diverse buildings. The Shanghai Tower that we're currently completing in China is effectively a city within a building. You have multiple uses vertically that are stacked on top of each other. Going vertical is a really fascinating development and I expect we'll see more of this.

The point where buildings become self-sustaining — be it water and power neutral or water and power positive, meaning they give back more resources than they consume — is certainly within the realm of possibility over the next three decades.

No matter where cities are situated, though, I think it's important that they are resilient to site-specific climate change issues.

I think the cities of tomorrow also need to consider the availability of open space — and not only open space for a select group of people, but open space available to everyone. These spaces provide locations for idea exchange and a shared point of view where people can come together and see themselves as part of a collective community. The retention of open spaces will become increasingly important as land becomes more valuable in and around the center of cities.

Effective urban planning for the future requires vision and will to create something with more vitality than what was there before — proposals with longevity and relevance for generations to come. If we use those as metrics by which we measure success for city building and planning, then we'll be on the right course. ☺



## the FUTURE OF TRANSPORTATION

**What will transportation be like in 2050? Will we all be stuck in one giant traffic jam? Flying to our appointments in personal airborne delivery systems? Teleporting ourselves and our stuff around? Or not going anywhere at all?**

**In large part, the answers to these questions will depend on how we answer two other questions today: What would we like it to be like? And what would it take to get it there?**

**We asked five innovative thinkers from the U.S. and China to share their visions for transportation in 2050. Read their answers at [ensia.us/transportation](https://ensia.us/transportation).**

PHOTO BY YUKO HIRAO



# ZERO WASTE WORLD

• BY MARC GUNTHER •  
ILLUSTRATION BY ANN MACARAYAN

# 44 D

DON'T LET FASHION go to waste," says H&M, the global clothing retailer that booked \$20 billion in revenues last year. So I brought a bag of old T-shirts, sweaters and khaki pants to an H&M store in Washington, D.C., where it took them, no questions asked, and gave me a coupon for 15 percent off my next purchase. H&M takes back clothes in all of its 3,100 stores in 53 countries.

Next, I pulled an ancient iPod and an iPhone 4S with a cracked screen from a desk drawer. On the website of a company called Gazelle, I answered a few questions and learned that the company would pay me \$37 for the pair. (Without the cracked screen, the iPhone would have been valued at \$135.) I printed out a free shipping label, and they were on their way. Not to landfills, but to a new life.

Meanwhile, not far from my home, a garage owned by the Washington Metrorail system is about to undergo a makeover. Existing lighting fixtures will be replaced by LEDs that are expected to reduce energy usage by 68 percent. The LEDs will be manufactured, owned and monitored by Philips, which will take them back when they need to be repaired or replaced.

Welcome to the emerging world of the circular economy. Faced with rising prices for energy and raw materials, along with pressures from environmentalists and regulators who have passed "extended producer responsibility laws" in Europe and some U.S. states, forward-thinking companies are finding ways to take

tem that is restorative or regenerative by intention and design. Inspired by nature, a circular economy aspires not merely to limit waste but to eliminate the very idea of waste: Everything, at the end of its life, should be made into something else, just as in the natural world, one species' waste is another's food.

## REFINED & REBRANDED

This isn't entirely new, of course. Recycling has been around for centuries — iron pots, for example, were melted down to make armaments during the American Revolution — and, when done right, it delivers significant environmental benefits by reducing demand for raw materials, energy and water. (It takes around 700 gallons of water to make a cotton T-shirt like those I brought to H&M.) In the 1990s and 2000s, pioneering environmental thinkers such as Paul Hawken, Amory Lovins, Hunter Lovins, Janine Benyus and William McDonough laid the intellectual groundwork for the circular economy by developing such concepts as natural capitalism, biomimicry and cradle-to-cradle design. But they were slightly ahead of their time, as pioneers often are.

Now their ideas have been refined and rebranded by influential business thinkers as the circular economy — and they are getting the attention of big companies. The timing is no accident: Prices for oil and energy have more than quintupled since 1998, metals prices have tripled and food prices have risen 75 percent, according to *Resource Revolution: How to Capture the Biggest Business Opportunity in a Century*, a new book by Stefan Heck and Matt Rogers. "What we are seeing are two concurrent trends," explains Heck, a former McKinsey consultant.

More important, Heck says, is the fact that an estimated 2.5 billion people in China, India and other developing countries will be moving out of poverty and into cities by 2030. They're going to want apartments, cars, air conditioning and electronics, creating massive demand for energy and raw materials.

No wonder companies see the circular model as a business opportunity. The transition to a circular economy could generate savings of more than \$1 trillion in materials alone by 2025, according to an analysis by the U.K.-based Ellen MacArthur Foundation, McKinsey & Co. and the World Economic Forum, which are collaborating to promote circular thinking. The foundation's partners include Philips, Cisco, Unilever, Renault and Kingfisher, Europe's largest home improvement retailer, all of which are testing circular models.

"Companies are getting much more interested in how they can recover products at the end of life," says foundation former CEO Jamie Butterworth.

## USERSHIP, NOT OWNERSHIP

Philips has gone further than most. The company began incorporating circular-economy thinking into its activities two years ago, the company's CEO, Frans van Houten, recently told the *McKinsey Quarterly*. The thinking is being applied to the company's lighting and health care businesses.

LED streetlights in Singapore and Buenos Aires, like the new fixtures in Washington, D.C., Metro garages, will be owned by Philips, saving government customers the capital outlays. The governments will pay monthly fees based on usage. In Amsterdam, an office building being designed for the accounting firm Deloitte will showcase a smart lighting system equipped with sensors that will deliver information to building managers about which offices are occupied and which need to be heated and cooled. The system is owned and managed by Philips, which will upgrade the technology as needed, while Deloitte pays for lighting as a service.

"We keep the ownership of the products, and we redesign them in such a way so that they have more value at the end of life," says Henk de Bruin, head of sustainability at

*Inspired by nature, a circular economy aspires not merely to limit waste but to eliminate the very idea of waste.*

back, reuse, refurbish or recycle all kinds of things that would otherwise be thrown away. In contrast to the traditional "take-make-dispose" linear economy, which depletes resources, a circular economy is an industrial sys-

"First, the cost of extracting resources is going up dramatically. That's driven by the fact that we went after the cheap and easy stuff first." (Think about the costs of drilling for oil in the Arctic or extracting it from Canada's tar sands.)

Philips. “Usership rather than ownership is a trend we see emerging.”

Stockholm-based H&M has been taking back clothes worldwide since 2013. The fast-fashion retailer contracts with a Swiss-based company called I:Co (which stands for I Collect) that collects the used clothes, sorts them by hand and then either sells them for reuse in poor countries or recycles them into a variety of products, including automobile seats, insulation and stuffed toys.

The economics work well, according to H&M sustainability manager Henrik Lampa — enough revenues are generated at the end of the life to pay for the collection and sorting and fund research into recycling innovation. However, “there’s a big need for technology development,” Lampa says. Chemical as opposed to mechanical recycling could enable used cotton to be turned into new clothes without degradation in quality.

“Ideally, we want to make new commercial fibers out of this,” says Lampa. “Then we will have new materials that do not have the price volatility of agricultural commodities.”

## RAPID UPGRADE

The circular model makes particular sense for technology products that go through rapid upgrade cycles. By buying back and refurbishing mobile phones from customers who no longer want them, Sprint has saved “over a billion dollars” that it would otherwise have spent buying new devices from manufacturers like Apple, Samsung and LG, says Darren Beck, director of environmental initiatives. About 90 percent of the phones collected by Sprint are returned to the market as replacements for lost or damaged phones or as “certified pre-owned phones” that are sold to new customers. For its part, Verizon recently introduced a free application that gives customers an instant quote for their used device, which can then be returned for cash at a Verizon store. All told, the U.S. consumer electronics industry took back or recycled 620 million pounds of electronics in 2013, twice as many as 2010, according to the Consumer Electronics Association.

The number would be higher, Beck said, if device makers could be persuaded to design

phones so that they can be disassembled or recycled more easily. Some manufacturers — HP and Herman Miller are among the leaders — have embraced the idea of designing goods with their end of life in mind by, for example, using screws instead of glue to hold things together and choosing pure materials over composites.

machines from Keurig, Nestlé and Starbucks, and fast fashion from companies like H&M and Zara — generating more waste, not less.

So are we moving closer to the circular economy — or further away? Accurate data is hard to come by, but the U.S. Environmental Protection Agency estimates indicate that re-

## *Some manufacturers have embraced the idea of designing goods with their end of life in mind.*

While market forces are the primary driver of circular practices, government regulation has played a role, too. More than two dozen U.S. states have passed laws mandating recycling of electronic waste, according to the Electronics TakeBack Coalition. States with stronger laws report that their efforts generate 5 pounds or more of recycling per person, while those with weak or no laws bring in much less, the group says.

Barbara Kyle, the coalition’s national coordinator, says that without government intervention, electronics with little or no value, like TVs with cathode ray tubes or accessories made of cheap plastics, are unlikely to be recycled. “It’s negative cash flow to take back CRTs,” Kyle says.

In U.S. states without regulation, electronics recycling is harder than it needs to be. While Best Buy, the nation’s biggest electronics retailer, has a comprehensive take-back policy, neither Walmart nor Amazon makes it easy for consumers to return electronics they no longer want.

## INTRIGUED

How consumers feel about all this is unclear. Young consumers appear to be intrigued by circular models. Millennials are buying fewer cars and driving less, and the marketplace is responding with companies like Zipcar that facilitate car-sharing. Rent the Runway enables women to rent designer dresses and accessories, reducing the demand for new clothes.

“A lot of venture capital money is going into start-up companies that enable greater asset productivity,” says author Stefan Heck. Yet those same young consumers buy single-serve coffee

cycling rates grew rapidly from 1980 through 2000, and only gradually since then. Disposal of waste to landfill declined from 89 percent of the amount generated in 1980 to 54 percent — about 135 million tons — in 2012.

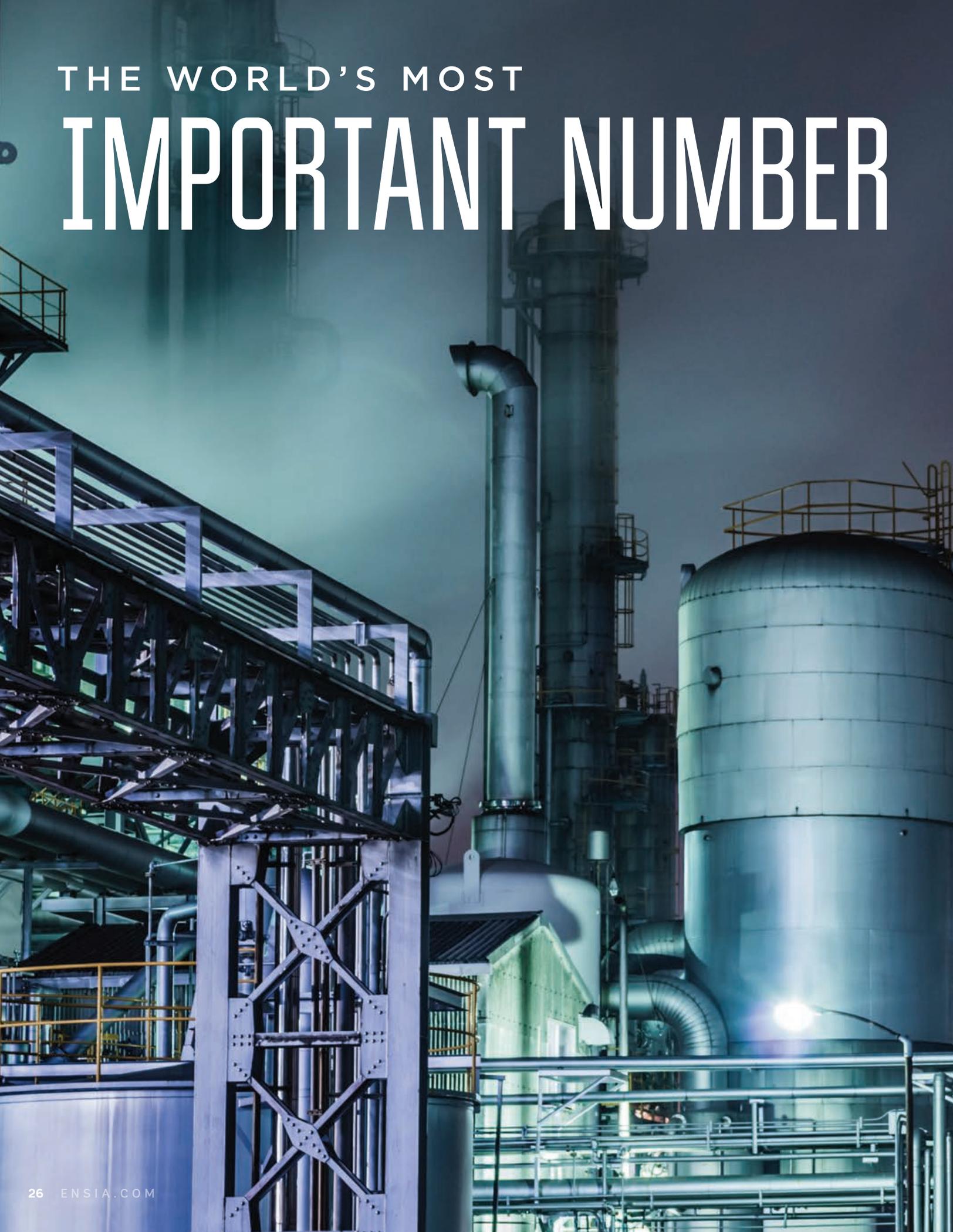
Clearly there’s lots of work ahead for advocates of the circular economy. But the vision they are pursuing is a bold one: In a truly circular economy, where waste becomes nutrients and energy is renewable, economic growth would be decoupled from environmental restraints. Companies could sell more stuff without generating pollution. Consumers could buy more stuff, without guilt. What’s not to like? ☺

**Marc Gunther** writes and speaks about business and sustainability. He is editor at large of Guardian Sustainable Business U.S., a contributor at *Fortune* magazine, a senior writer at Greenbiz.com and a blogger at marcgunther.com.



THE WORLD'S MOST

# IMPORTANT NUMBER



# 6%

growing economically at current rates without exceeding 2 C warming of average surface temperature over preindustrial levels, carbon intensity — the amount of carbon released per unit GDP — needs to be reduced by 6 percent annually from now to 2100. The problem? That’s nine times the current rate of decarbonization.

**IN THE BIG PIVOT,** green business guru Andrew Winston writes, “the six-percent-per-year target may be the most important metric of our collective well-being.” But what does he refer to?

According to audit and consulting firm PwC, for the world to continue

# 2034

**GIVEN THE CURRENT** rates of carbon intensity, we’ll use up this century’s entire carbon budget — the amount of carbon that can be released while still retaining a reasonable probability of limiting warming to 2 C — by 2034.

# 92%

**NINETY-TWO** percent of the reduction in carbon intensity in 2012 was due to energy efficiency — the “low-hanging fruit,” according to PwC.

## STEPS FORWARD

The following activities, if scaled up (or down) drastically, could move us closer to the 6 percent target. Some — such as nuclear energy and biofuels — are surrounded by considerable debate.



IMPROVE EFFICIENCY



INCREASE RENEWABLE ENERGY



COMMERCIALIZE CARBON CAPTURE & SEQUESTRATION



RECONSIDER NUCLEAR ENERGY



ADVANCE LOW-CARBON BIOFUELS



DECREASE DEFORESTATION



REDUCE EMISSIONS FROM AGRICULTURE



ADVANCE CIRCULAR ECONOMY

## THE BIG SOLUTION

One solution rises above all others in the PwC report: A global climate deal that could “provide the regulatory framework and financial stimulus to catalyze a low-carbon transition.” A climate agreement that includes carbon pricing would be the biggest step forward.

**SOURCES:** Pacala, S., and Socolow, R. 2004. Stabilization wedges: Solving the climate problem for the next 50 years with current technologies. *Science* 305:969–72; Romm, Joseph. 2008. Cleaning up on carbon. *Nature Reports Climate Change* 7:85–87. doi:10.1038/climate.2008.59; PwC. 2013. *Busting the Carbon Budget: Low Carbon Economy Index 2013*. pwc.co.uk/en\_UK/uk/assets/pdf/low-carbon-economy-index-2013.pdf; The Ellen MacArthur Foundation. *Circular Economy*. ellenmacarthurfoundation.org/circular-economy; Winston, A. 2014. *The Big Pivot*. Boston: Harvard Business Review Press; International Energy Agency. *iea.org*  
**CREDIT:** Infographic text by Todd Reubold; infographic layout and icons by Anna Egelhoff; photo by Yuko Hirao



In  
water  
*We Trust*



Downstream beneficiaries of clean water are anteing up to protect water supplies at their source.

BY ALESZU BAJAK | PHOTO BY JUAN C. RIOS

**B**ELOW THE snow-capped mountains of Ecuador and Colombia lie the *páramos*, high-altitude grasslands of the northern Andes threaded by frigid rivers and covered in rugged brush, cloud forests and lagoons. This landscape captures and stores a vast amount of water upon which downstream residents depend, from smallholder farmers to city dwellers.

Today, expanding agriculture and demand for water from growing cities are putting increasing pressure on such mountain watersheds. What can be done to ensure they will be able to continue to meet the needs of future generations? One intriguing solution is the establishment of trust funds that pay dividends for conservation projects to protect ecosystems and the valuable water they harbor. Such funds have already been used to fend off threats to watersheds in more than a dozen locations across Latin America, and are being explored in Asia and Africa.

## THE QUITO EXPERIMENT

The first experiment with water trust funds was set up in Ecuador in the early 1990s. The Nature Conservancy had charged its director of Latin American operations, Juan Black, with finding a way to protect the Condor Bioreserve, which sits east of the capital city of Quito and provides the city with 80 percent of its water. The problem: The *páramo* inside and directly abutting the bioreserve was being degraded as farmers were slowly expanding their grazing lands. Black knew that Quito needed to protect the ecosystem and guarantee the continued safety of its Condor Bioreserve watershed. He also knew that Quito's water company EPMAPS (at that time it was named EMAAP-Q) and other businesses were being directly affected by upstream activities. Working out of a small office in Quito, Black decided to take an economic approach to safeguard the region.

At the time, conservation organizations were setting up programs devised by ecological

economists called payments for ecosystem services, or PES. A buyer — likely the end user of the water — would contract with those living in fragile catchment areas upstream to reduce (or at least not increase) their impact on the watershed. It seemed simple. After all, the infrastructure for water delivery and payment was already in place. But past experience in Latin America had shown that paying farmers not to farm could spark blackmail, corruption in local municipal governments, and other unintended and undesirable consequences. As Craig Kauffman, a political scientist at the University of Oregon who has studied Ecuador's water funds and environmental governance, notes, "Basically, you're paying farmers not to deforest but rather conserve an area that is strategic to the watershed functioning, but these incentive structures can become perverse."

After Black died from cancer in 1996, TNC hired Colombian environmental resources manager Marta Echavarría to hammer out a plan. Looking at watershed conservation financing schemes around the world, Echavarría figured Quito's system would have to be independent of the PES approach to avoid the undesirable consequences and guarantee there would always be funds for conservation projects — whatever form they took. She and her colleagues came up with the idea to set up a trust fund and to get local stakeholders to contribute to it. Once the fund was sufficiently capitalized, the interest it

## With 14 water trust funds in place and plans for another 14, TNC is counting on water funds to provide the financial backbone for protecting watersheds throughout Latin America.

earned could be used to finance any conservation effort its water management committee deemed appropriate.

So in 2000, with seed money from TNC and a large donation from Quito's water company, the FONAG Fund for the Conservation of Water was created. Quito's electrical company signed up, as did private companies such as a local brewery, Cervercería Nacional, and a water bottling company, Tesalia Springs. Aurelio Ramos, TNC's director of conservation programs for Latin America, says the FONAG water fund is now up to US\$12 to \$14 mil-

lion. Even with a moderate interest rate, it is paying out tens of thousands of dollars per year to fund conservation and rehabilitation projects such as fencing off livestock from streams or allowing natural vegetation to grow back, as well as education initiatives to teach locals outside Quito about watersheds and water management.

"That money is also paying for park rangers, the gasoline for their vehicles, and to work with the communities to introduce agroforestry and *páramo* restoration efforts," says Ramos.

## FINDING THE BALANCE

TNC and other organizations such as Nature and Culture International have tried to replicate the success of Quito's water fund in other Latin American cities with varying degrees of success. One major hurdle is attracting and holding the interest of stakeholders. Colombia's capital, Bogotá, has a water fund financed by Bavaria brewery and the Colombian national parks agency Parques Nacionales Naturales de Colombia that stands at around US\$1 million. But the city's water utility, arguably the most important stakeholder, has flip-flopped time and again about being a partner.

"Everything was going well until there were problems with a change in Bogotá's city government," says Alejandro Calvache, TNC's water funds coordinator for Colombia. "The fund was working the whole time, but it didn't have the impact we wanted it to have." Fund managers have recently begun funding some conservation projects such as reforestation campaigns around Bogotá's reservoirs

— which means pulling money out of a fund that's supposed to be growing as fast as possible.

"Almost every one of the water funds makes investments immediately to show investors results. It's a strategic move and a lesson we learned from the Quito water fund," explains Ramos. That fund drew heavy criticism from politicians for choosing to finance itself for five years before paying anything out for conservation projects. Ramos points to funds like Colombia's Valle del Cauca and Mexico's Monterrey as examples where conservation projects began immediately upon starting the trust fund.

This is one of the delicate maneuvers with starting and managing a water fund — choosing how much funds to invest versus how much to pay out for conservation, rehabilitation and education projects.

“You could capitalize these things a lot faster if you take 100 percent of donations and invest it into the fund,” says Kauffman. “But that’s politically unpopular. Having dirt fly on the ground immediately in the short term is key to the success of these programs.”

Kauffman says that various trust funds have tried various ways to balance investment and spending. The sweet spot seems to be putting 60 percent away and using 40 percent on projects. And, in fact, that’s precisely the balance Bogotá’s fund has struck.

## WATER FOR THE FUTURE

With 14 water trust funds in place and plans for another 14, TNC is counting on water funds to provide the financial backbone for protecting watersheds throughout Latin America. (It has set up three in Brazil but due to local laws, they do not function as endowed trust funds).

Echavarría notes that a big advantage to such funds is that they are long term. “The law in Ecuador permits ours to operate for 80 years. In Peru it’s 35 years, and 25 years in Colombia,” she says. That means water funds are immune from political cycles, says TNC’s Ramos.

But the challenge of attracting and satisfying stakeholders speaks to what water funds do not do. They do not address political frameworks, nor do they have any regulatory power. And, depending on the buy-in of water utilities, they do not necessarily pass the costs to the consumer. This makes it difficult to conserve the resource, because consumers aren’t made aware of its value.

Others criticize water trust funds as a “businessification” of water. “The environment shouldn’t be turned into a business chain,” says Jaime Ignacio Vélez Upegui, a professor in the Water Institute at Medellín’s National University in Colombia. “Water funds are too speculative. Despite investing in water, they do not directly result in water.” Vélez Upegui argues that water trust funds take advantage of the public’s environmental sensibilities to build a system for business. He says this may lead to stakehold-

ers feeling cheated and refusing to participate in future activities to protect the environment.

Echavarría agrees that water trust funds aren’t the only way to mitigate watershed degradation. With the environmental firm Eco-Decisión she directs, water funds are just one tool in a set of tactics (such as setting up carbon markets) she uses to protect the environment in Ecuador. “Each situation depends on the stakeholders and the needs of the basin,” she says.

Whatever the approach chosen, Echavarría underscores the importance of doing something to protect water supplies for future generations.

“In the end, protecting water is protecting nature as a whole,” she says. “If we don’t invest in its rehabilitation and conservation, it will stop being the goose that lays the golden eggs.”

**Aleszu Bajak** is a science journalist based in Cambridge, Mass. He is currently a Knight Science Journalism Fellow at the Massachusetts Institute of Technology and founder of LatinAmericanScience.org, a resource for science news out of the region. He grew up in Bogotá and has lived in Lima, Buenos Aires and Santiago.

Residents from the Chumillos Community work with The Nature Conservancy and partners on conservation activities as part of the Quito Water Fund, FONAG. PHOTO BY TIM BOUCHER/TNC



# EAT 'EM AND BEAT 'EM

NYC restaurateur **Ryan Chadwick** aims to take a culinary tack to conquering invasive lionfish.

BY JOSS FONG | PHOTOS BY MICHAEL WESCHLER

**NEW YORK CITY IS HOME** to thousands of restaurants, including eight places offering a hybrid Chinese-Mexican menu, and at least 12 spots where you can eat a goat's head. But if you'd like to dine on lionfish, your options narrow to one: Norman's Cay, the small Caribbean eatery that opened last year on Manhattan's Lower East Side.

Co-owner Ryan Chadwick is proud to serve this ecosystem-disrupting fish, which was introduced into the Atlantic 30-odd years ago and has been preying on native species there ever since. He figures it's his contribution to keeping the troublesome invader in check. But there's a reason he's the only restaurateur in New York with lionfish on the menu. Although they're disastrously abundant in the wild, these fish remain nearly impossible to obtain. In fact Norman's Cay was only able to serve lionfish at its October 4 opening because Chadwick spent the previous week underwater in the Bahamas, collecting fish from the reefs and flying them back in a cooler.

Chadwick charged more than \$40 for his whole-fried lionfish entrée on opening day. After months of working tirelessly to jerry-rig a supply chain, he's been able to move the price down to \$27 and add two other lionfish items to the menu. He hopes to eventually serve as a lionfish purveyor for other restaurants in the region.

"I'm too far in to give up," says Chadwick, a tall, tanned Northeasterner whose relaxed demeanor belies a strong entrepreneurial drive. Despite the scale of the lionfish invasion, Chadwick maintains that a commercial market could make a dent in the problem.

Plucked from the Indian and Pacific oceans, lionfish have long been popular in the aquarium trade for their fantastic display of brick-red stripes and venomous spines. Biologists believe someone first dumped them off Florida's coast in the 1980s; the population

mushroomed as the invaders moved toward North Carolina, colonized the Caribbean and advanced into the Gulf of Mexico. Insatiable and indiscriminate hunters, they suck up dozens of species of economically, ecologically and recreationally valuable reef fish. And nothing will eat them — except, Chadwick hopes, us.

After finding lionfish meat to be white and mild, officials at the U.S. National Oceanic and Atmospheric Administration launched an "eat 'em to beat 'em" campaign



in 2010. With the depletion of Atlantic cod giving strong evidence that humans are capable of fishing a species to near extinction, NOAA surmised that perhaps we could do it on purpose this time.

Three years later, there are still no major distributors dealing in lionfish due to the uncertain supply and demand. But Chadwick didn't know that when he decided the invasive predator would be the flagship dish at his new restaurant.

"I figured we're helping the ecosystem by creating a demand for this fish, and also doing something that other restaurants aren't doing. It was a win-win," says Chadwick, who also owns the Nantucket-inspired Grey Lady restaurant in New York. "I didn't realize that there was no fishery for it."

An entrepreneur whose previous areas of focus included ice supply, dry cleaning, delivery services and crib rentals, Chadwick stumbled into this latest venture on a trip to the Bahamas a year ago, when he met a group of Tufts University biology students who told him that lionfish were threatening the reefs and, incidentally, were also delicious.

After a couple of trips to catch his own fish, Chadwick convinced a seafood supplier in the Bahamas to send some dive fishermen out for lionfish. The fish they harvested, however, were often too small and at times not available at all, and he ultimately decided he couldn't justify paying the costs of international shipping for product that turned out to be inconsistent.

For now, he's turned to a fish market in the Florida Keys, where lionfish wander into traps meant for spiny lobsters. Chadwick pays a dollar more for lionfish than local restaurants pay, and has them shipped overnight to New York. The only problem is that lobster season is only from August to April. To fill the seasonal gap, Chadwick started cold-calling dive shops in the Keys earlier this year, aiming to convince commercial or recreational divers to spear lionfish for him. He even put up a Craigslist ad.

What he hasn't considered is replacing lionfish with a more profitable, less sustainable catch. "I could do tilapia tacos all day and make a lot of money," says Chadwick. "But it's not helping the ecosystem, and it's not doing what we said we would do." 

**Joss Fong** is a journalist living in Brooklyn, N.Y. She recently graduated from New York University's Science, Health and Environmental Reporting Program and worked as an intern at *Scientific American*. Prior to grad school, Fong was the energy/environment editor at *Media Matters for America*.



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# THE KALUNDBORG SYMBIOSIS

A Danish industrial complex aims for nature's standard: no waste, only nutrients.

BY WILLIAM F. HEWITT | PHOTO COURTESY OF THE SYMBIOSIS CENTER

**WHEN WE LOOK CLOSELY** at systems in nature — coral reefs or rainforests, for instance — we see something we don't often see in human systems: mutually beneficial relationships and energy flows among the various elements, such as air, water, rocks, soil, and plant and animal life. If we emulate these relationships in our cities and in our industrial infrastructure, we can vastly improve the sustainability of natural resources and energy use.

That's exactly what the municipality of Kalundborg, 64 miles west of Copenhagen, is doing. In fact, for over 50 years, Kalundborg has been home to the first — and still the most advanced — example of this concept: the Kalundborg Symbiosis. Anchored originally by a power and district heating plant, this innovative industrial complex has grown to include some large and profitable enterprises, including the biggest oil refinery in the Baltic Region; an insulin-producing plant with 2,700 employees; factories making enzymes for use in everything from bioenergy to textiles, and gypsum for lightweight building materials; and the largest sewage treatment plant in northern Europe. Heat, water and a host of other resources that would otherwise be treated as waste supply some of the energy and many of the feedstocks to these operations and to the surrounding municipality, including farms.

“To some visitors, it can be a little confusing here because it's old and new, private houses and industrial area,” says Lisbeth Randers, a project officer with the Symbiosis Center, the complex's outreach arm. “The way it works in Denmark is that residential and industrial have to find a way to live and work next to each other. If the industries were polluting a lot, there would be many complaints and penalties. But environmental protection is so good in Denmark, we don't have that.”

The heart of the industrial complex at Kalundborg occupies 4 square kilometers, nearly 1,000 acres. Throughout the site, inputs and outputs weave together like strands of thread, creating a tapestry of efficiency. The DONG Energy power plant, for instance, provides not only electricity to the grid but steam to four industrial plants, as well as heat to the local municipality and to a fish farm. In return it receives water from a refinery and the municipality, and gas from the refinery. It also sends its fly ash for processing by the cement industry and its gypsum to be made into building materials.

The energy company has a biomass gasification plant and a project that converts municipal solid waste to biofuel, recyclables and refuse-derived fuel. Working with partners, it's advancing the “Kalundborg Integrated Energy Concept,” or KINEC, which aims to substitute the biomass-based energy streams at the Kalundborg power station for coal. Straw — 30,000 tons of it per year — comes from the local farmers as a major feedstock for ethanol, which then goes to the power plant. Meanwhile, yeast slurry goes from the insulin plant to the nearby farms, where it is used as pig feed.

Another initiative moving forward is Cluster Biofuels Denmark, an advanced research project using algae for removing and incorporating nitrogen, phosphorus and carbon from industrial wastewater, as part of a process to create oils, enzymes and pigments for commercial use.

“In 2006, 85 percent of our production was coming from, you can call it ‘black’ fossil fuels, the rest from green sources,” says Niels Christian Kjær, a top executive at DONG Energy and past president of the Kalundborg Symbiosis. “By 2040, we will switch that number: 85 percent will be green energy.”

With support from the central and municipal governments and the European Union, along with the companies, Kalundborg has attracted the attention of business people and investors, policy makers and students from all over the world who come to learn how they can create their own industrial symbiosis. In 2014 alone, they've had visitors from Turkey, Thailand, Finland, Sweden, Kenya and Denmark, representing a farmers' association, a development agency, an industrial think tank, an environmental institute, a waste management company, and several universities and high schools.

“What is excellent about Kalundborg is that the town hall has full focus in this,” says Kjær. “They want to be the leading town, number one in innovation. They want to have people come from all over the world to learn and say, ‘Wow.’” 

**William F. Hewitt** is a writer and an adjunct assistant professor at New York University's Center for Global Affairs. His book, *A Newer World: Politics, Money, Technology, and What's Really Being Done to Solve the Climate Crisis*, came out late in 2012.

**7**  
number of energy  
exchange projects

**14**  
number of water  
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**>30**  
number of commercial  
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each year

**528**

millions of gallons  
of groundwater saved  
each year

**275,000**

tons of CO<sub>2</sub> emissions  
avoided annually

# THE END OF SUSTAINABILITY

The realities of the Anthropocene demand a new approach to environmental governance.

BY MELINDA HARM BENSON AND ROBIN K. CRAIG | ILLUSTRATION BY GLEN LOWRY

**THE TIME HAS COME** for us to collectively reexamine — and ultimately move past — the concept of sustainability. The continued invocation of sustainability in policy discussions ignores the emerging realities of the Anthropocene, which is creating a world characterized by extreme complexity, radical uncertainty and unprecedented change. From a policy perspective, we must face the impossibility of even defining — let alone pursuing — a goal of “sustainability” in such a world. It’s not that sustainability is a *bad* idea. The question is whether the concept of sustainability is still *useful* as an environmental governance framework.

In general, “sustainability” refers to the long-term ability to continue to engage in a particular activity. “Sustainable development” reflects a broader goal about how development should proceed — namely, with sufficient consideration of the environment to ensure the continued availability of natural capital. The international community embraced sustainable development at the 1992 United Nations Conference on Environment and Development in Rio de Janeiro, incorporating it into both the Rio Declaration and Agenda 21.

The idea of sustainable development evolved in an era of emerging concern about climate change. The pursuit of sustainable development goals, however, has not resulted in either sustainability or effective mitigation of climate change. Greenhouse gas emissions and resource consumption patterns have continued to increase. In anticipation of Rio+20, the U.N. Environment Programme released a report concluding that as human pressures on the planet accelerate, critical global, regional and local thresholds are quickly being approached or, in some cases, have already been exceeded.

Despite this alarming and unpredictable situation, policy discussions remain framed by the goal of sustainability, ignoring the fact that the concept has failed to meaningfully change human behavior.

By definition, sustainability assumes that there are desirable states of being for social-ecological systems, or SESs, that humans can maintain indefinitely. In practice, sustainability goals proved difficult to achieve in many SESs even before climate change impacts became noticeable. With climate change, we face a future in which we have no idea what we can sustain. Therefore, we must begin to formulate environmental governance goals by some metric other than sustainability.

The concept of resilience holds promise as a new way of addressing the challenges ahead. While not inherently incompatible concepts, resilience and sustainability are not the same. The pursuit of sustainability

assumes that we a) know what can be sustained and b) have the capacity to maintain stationarity (i.e., keep the system operating within an unchanging envelope of variability). In contrast, resilience thinking acknowledges disequilibrium and nonlinear, continual change — often as a result of crossing a “tipping point” or threshold — and offers a tool for assessing the dynamic relationships between systems, which is a facet of SESs that will become increasingly important given current rates of globalization and increasingly complex socio-ecological challenges. It also has the potential to be more helpful than sustainability when examining social justice and other human development concerns because it requires an assessment of not only what we value but also the extent to which those values are reflected in our policies and approaches.

Shifting the governance focus from sustainability to resilience is not admitting defeat. It reorients us to focus on *coping* with change. Research to develop baseline data is still important — not as a guide for

what we can “sustain,” but instead to identify tipping points that might provide insight into future systems change and help to identify critical ecological thresholds.

Unfortunately, while the concept of resilience is gaining the attention of natural resource managers and policy makers, it is already in danger of becoming — like sustainability — a rhetorical device with little influence on actual decision making. Adaptive

governance and adaptive management offer promise in terms of putting these ideas into practice but, to date, they have not yet been integrated into legal and regulatory frameworks in enforceable ways.

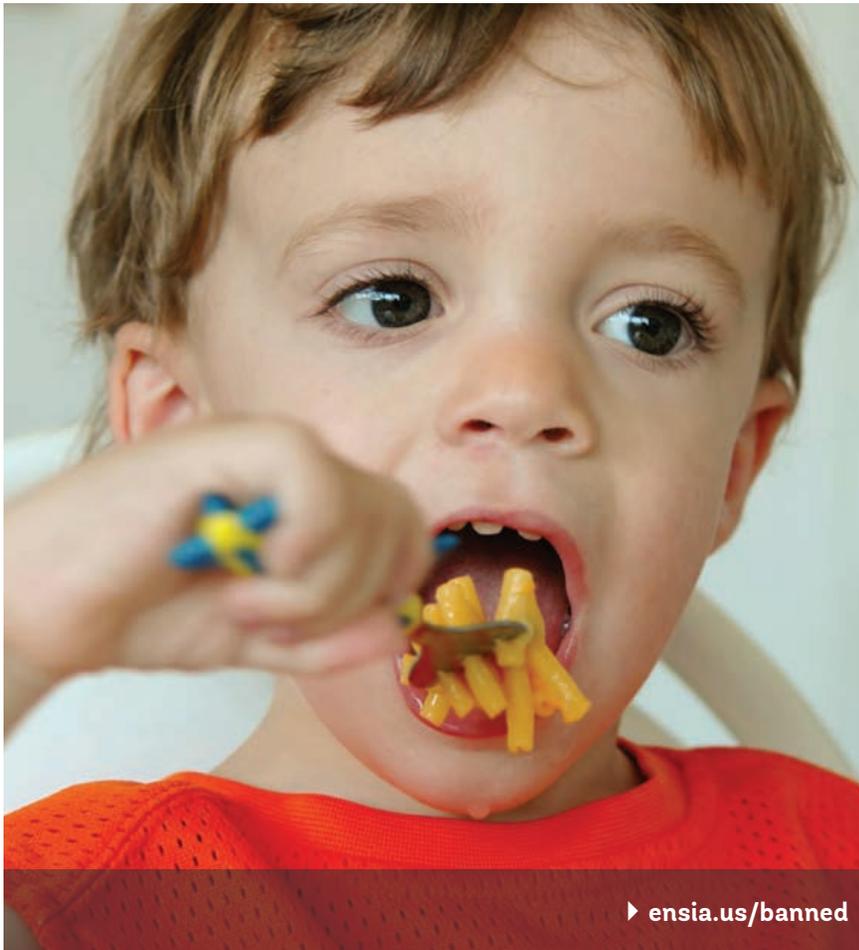
What we need are new policies and institutions that accommodate uncertainty and anticipate nonlinear change, both of which are realities of the Anthropocene. Scientists, policy makers and others must work together to design and implement environmental policies that promote and build adaptive capacity while also providing stronger, more legally enforceable and institutionally supported goals — goals that reflect the adaptation strategies necessary to negotiate our complex and rapidly changing world. 

**Melinda Harm Benson** is associate professor of geography at the University of New Mexico. **Robin K. Craig** is William H. Leary professor of law in the University of Utah S.J. Quinney College of Law. This is an abbreviated version of “The End of Sustainability,” an article published by Taylor & Francis Group in *Society & Natural Resources: An International Journal* on 07/05/2014, available online: [ensia.us/endofsustainability](http://ensia.us/endofsustainability)



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A photograph of a cornfield at sunset. The sky is filled with dark, dramatic clouds illuminated from below by the setting sun, creating a warm orange and yellow glow. The corn plants in the foreground are dark green. Overlaid on the image is the text 'KEEPING OUR LIGHTS ON ILLUMINATES FOOD FOR ALL.' in a glowing, neon-like font. 'KEEPING OUR LIGHTS ON' and 'ILLUMINATES' are in a reddish-pink color, while 'FOOD FOR ALL.' is in a bright white color.

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