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Solutions for Sustainable Progress

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POPULATION & Sustainability

Can We Avoid Limiting the Number of People?

Carbon Capture

How to Grab CO_2 from Coal Power Plants

Methane Time Bomb

The Arctic Thaw Could Make Warming Worse

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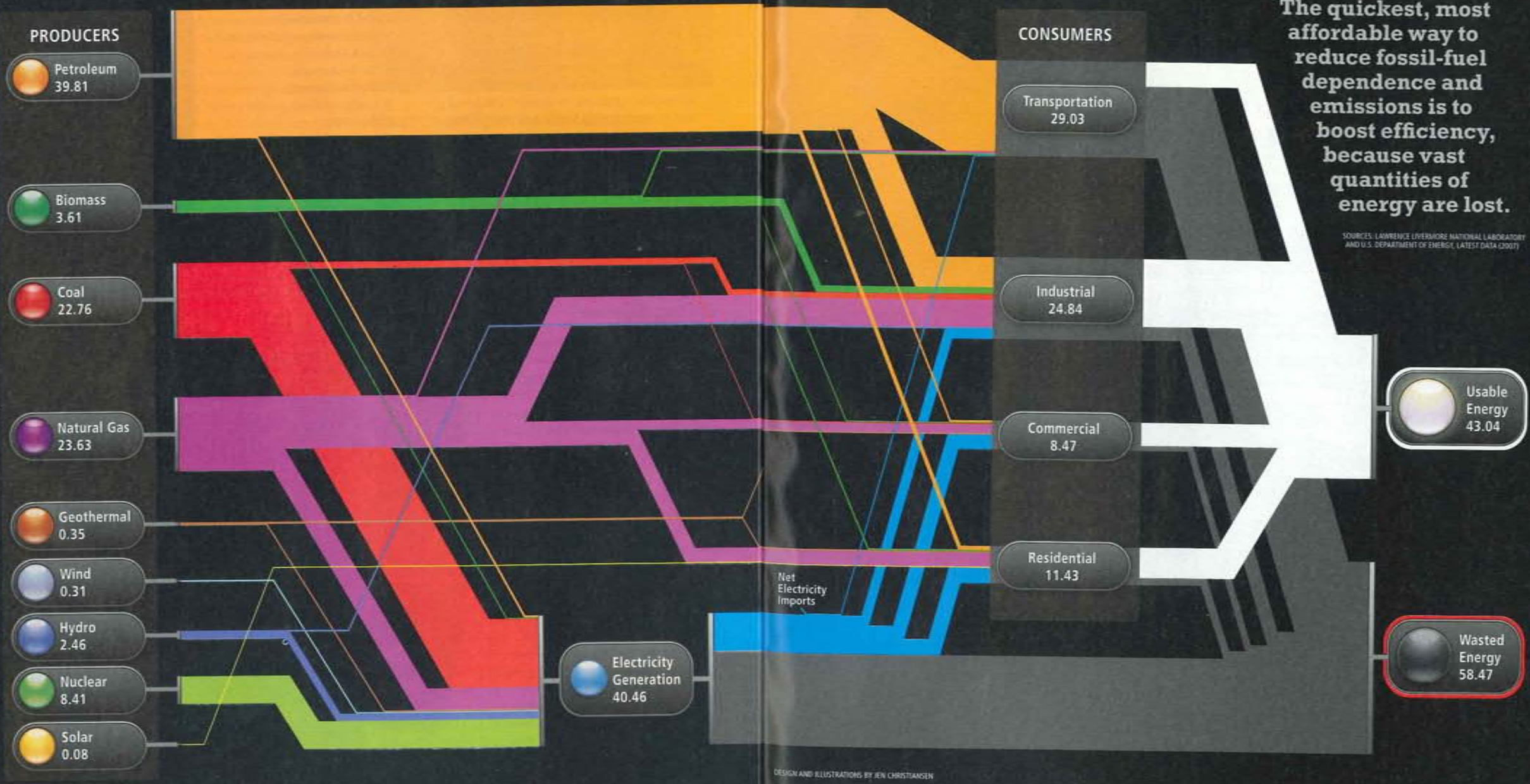
The Efficiency Solution

More than half of all energy supply is wasted

U.S. ENERGY FLOW (Quadrillion Btu)



The quickest, most affordable way to reduce fossil-fuel dependence and emissions is to boost efficiency, because vast quantities of energy are lost.

SOURCES: LAWRENCE LIVERMORE NATIONAL LABORATORY AND U.S. DEPARTMENT OF ENERGY, LATEST DATA (2007)

DESIGN AND ILLUSTRATIONS BY JEN CHRISTIANSEN

Green for green: Funds from the 2009 American Recovery and Reinvestment Act will gradually be released over months. How will energy and the environment benefit? Follow the money.

Energy

$11 billion: Smart electricity grid

$6.3 billion: Energy efficiency and conservation grants

$6 billion: New loan guarantees for projects in renewable energy and electricity transmission

$5 billion: Weatherization assistance program

$4.5 billion: Green technology to increase energy efficiency of federal buildings

$3.4 billion: Fossil energy research and development

$2.5 billion: Energy efficiency and renewable energy research

$2 billion: Grants for manufacturing advanced batteries and components and vehicle batteries

$1 billion: Alternative-fuel trucks and buses, electric vehicle charging stations and energy-efficient appliances

Environmental and Water Cleanup

$6 billion: Cleanup of former weapons production and energy research sites

$6 billion: Local clean water infrastructure improvements

$1.3 billion: Loans and grants for water and waste disposal facilities in rural areas

$1.2 billion: Environmental Protection Agency's nationwide environmental cleanup programs, including Superfund

Transportation

$8.4 billion: Investments in public transportation

$1.5 billion: Competitive grants to state and local governments for transportation investments

Infrastructure

$4.2 billion: Modernization and energy-efficiency projects at Department of Defense facilities

$1 billion: Bureau of Reclamation, to provide reliable drinking water to rural areas and ensure water supply to drought-stricken West

Public Housing

$4 billion: Capital projects at local public housing agencies, especially to improve energy efficiency in aging buildings

$250 million: Energy retrofitting and green investments in Department of Housing and Urban Development–assisted residential projects

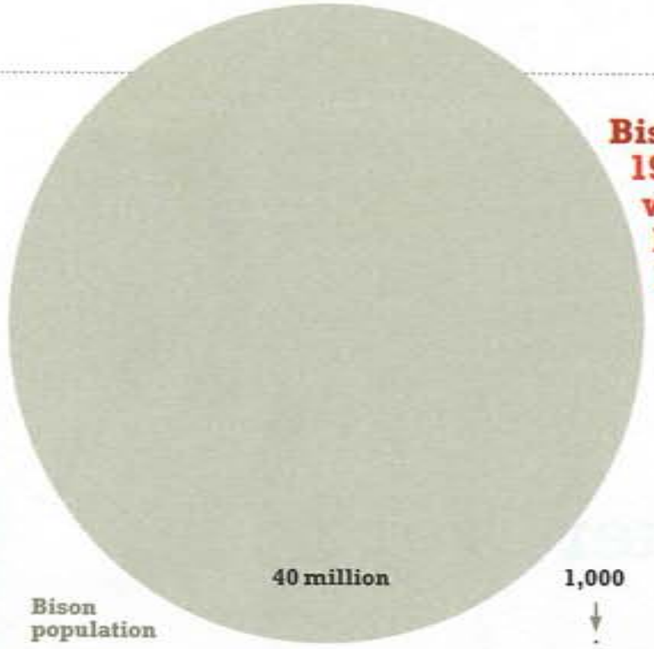
Science

$2 billion: Science research at the Department of Energy, including $400 million for Defense Advanced Research Projects Agency energy programs

$830 million: National Oceanic and Atmospheric Administration

SOURCE: U.S. FEDERAL REGISTER

Bison are back: From 1700 to 1900, mass slaughter nearly wiped out the American bison. Conservationists have built the number back.



MICHAEL DUVA Getty Images (bison); SOURCE: NATIONAL BISON ASSOCIATION

Satellite view, Gulf of Mexico

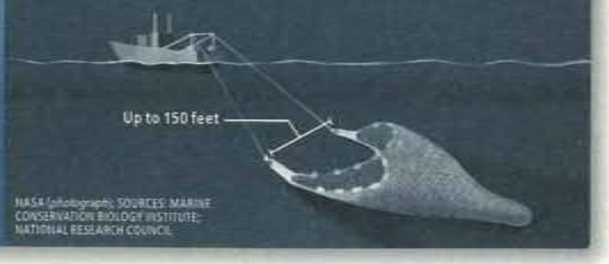
Huge drag: Bottom trawlers tug enormous nets armed with steel plates and rollers across the seafloor to catch fish and shrimp, tearing up entire ecosystems in weeks. Worth the destruction?

By-kill of other species for each pound of desired catch:
Up to 20 pounds

Destroyed in the path of a single tow:
Up to 55% of coral, 67% of sponges

Annual global seafood produced:
Less than 1%

Seafloor area already altered by U.S. trawlers:
Greater than state of California



NASA (photograph); SOURCES: MARINE CONSERVATION BIOLOGY INSTITUTE; NATIONAL RESEARCH COUNCIL

Too many and too much: Tokyo's Harajuku shopping district epitomizes the crush of population and consumption that burden the world's resources in tandem. Sustainability strategies too often focus only on consumption, ignoring the ticklish, culturally and politically charged issues of population.

RUDY SULGAN *Corbis (photograph);* SOURCE: ROBERT ENGELMAN *(historical population graph)*

such as "sprawl" (the theoretical culprit in pollution of the Chesapeake Bay, for example) or the economy (the theoretical driver of increased greenhouse gas emissions). You are more likely to read about population growth in a letter to the editor than in a news story or editorial.

When President-elect Barack Obama pledged in late 2008 to bring U.S. carbon dioxide emissions to their 1990 levels by 2020, environmentalists struggled to swallow their dismay. The European Union, after all, had committed itself to 20 percent *reductions* from 1990 levels. But on a per capita basis, President Obama's pledge was somewhat *more* ambitious than the E.U.'s was. Because of much more rapid population growth than in the E.U., Americans would be cutting their individual emissions by 26 percent under his plan and Europeans by 25 percent under theirs. Any pledges to lower emissions by a uniform percentage among industrial countries will be much harder for the U.S. to achieve, simply because it is gaining people so fast through immigration and a birthrate that is higher than average for a developed nation.

The bitterness of the immigration debate has helped keep U.S. population growth off-limits in the national conversation. In industrial countries outside of North America, however, population is creeping back into public and even political consciousness. In the U.K., an all-party parliamentary panel issued a report called "Return of the Population Growth Factor" and called for stronger efforts to slow that growth. And the concern in the U.K. is not just about the people "over there" in developing countries. In early 2009 Jonathon Porritt, chair of the government's Sustainable Development Commission, whacked a hornet's nest by calling parents of more than two children "irresponsible" and blasting mainstream environmental groups for "betraying" their members by fearing to call for small families. "It is the ghost at the table," Porritt said of population in an interview with the *Daily Telegraph*, a London broadsheet. Blog comments on his remarks, most of them supportive, soared into the thousands.

Meanwhile, in Australia, as summer temperatures hovered near 117 degrees Fahrenheit (47 degrees Celsius) and murderous flames converted forests into carbon dioxide, a new book entitled *Overloading Australia: How Governments and Media Dither and Deny on Population* issued an unusual ecological battle cry: ignore all admonitions to conserve the country's increasingly scarce water supplies until the government eliminates "baby bonuses" in the tax code and clamps down on immigration. A former premier of New South Wales spoke at the book's launch.

With comments such as these gaining attention—and in some circles, approval—are environmentalists and eventually policy makers likely to renew the decades-old call for "population control"? Would they be wise to do so?

A Number of Us

Two big questions present themselves as population reemerges from the shadows: Can any feasible downshift in population growth actually put the environment on a more sustainable path? And if so, are there measures that the public and policy makers would support that could actually bring about such a change?

Nature, of course, couldn't care less how many of us there are. What matters to the environment are the sums of human pulls and pushes, the extractions of resources and the injections of wastes. When these exceed key tipping points, nature and its systems can change quickly and dramatically. But the magnitudes of environmental impacts stem not just from our numbers but also from behaviors we learn from our parents and cultures. Broadly speaking, if population is the number of us, then consumption is the way each of us behaves. In this unequal world, the behavior of a dozen people in one place sometimes has more environmental impact than does that of a few hundred somewhere else.

Consider how these principles relate to global warming. The greenhouse gases already released into the atmosphere are likely to bring us quite close to the 3.6 degree F (two degree C) increase from the preindustrial global temperature average that many scientists see as the best-guess threshold of potential climate catastrophe. Already the earth is experiencing harsher droughts, fiercer storms and higher sea levels. If the scientists are right, these impacts will worsen for decades or centuries. Indeed, even if we ended all emissions tomorrow, additional warming is on the way thanks to the momentum built into the earth's intricate climate system. (The oceans, for example, have yet to come into equilibrium with the extra heat-trapping capacity of the atmosphere. As the oceans continue to warm, so will the land around them.)

Our species' demographic growth since its birth in Africa 200,000 years ago clearly contributed to this crisis. If world population had stayed stable at roughly 300 million people—a number that demographers believe characterized humanity from the birth of Christ to A.D. 1000 and that equals the population of just the U.S. today—there would not be enough of us to have the effect of relocating the coastlines even if we all drove Hummers. But instead we kept growing our numbers, which are projected to reach 9.1 billion by midcentury.

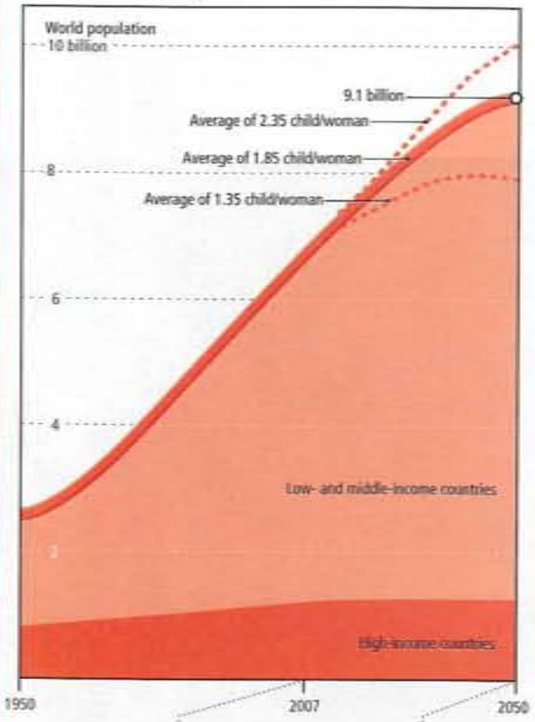
Humanity's consumption behaviors consequently did and do matter, and in this arena, all people have not been created equal. Greenhouse gas release has been linked overwhelmingly, at least up until recently, to the high-consumption habits of the industrial nations. As a result, in an ethical outrage as big as all outdoors, the coming shifts in climate and sea level will most harm the world's poor, who are least responsible for the atmosphere's composition, and will least harm the wealthy, who bear the biggest responsibility.

All-Consuming Passions

What part can the size of the human race play in finding a happy ending to this morality play? Population scenarios cannot directly address the inequity in emissions patterns—but they are far from unimportant.

Countries with the highest emissions per capita tend to have smaller families on average, whereas those with low emissions per capita tend to have larger ones. Americans, for example, consumed 8.6 tons of oil or its commercial energy equivalent per cap-

Human Population Growth



2007 Populations (millions)	2050 Projected Populations (millions)
1. China 1,318	1. India 1,747
2. India 1,132	2. China 1,437
3. U.S. 302	3. U.S. 420
4. Indonesia 232	4. Indonesia 297
5. Brazil 189	5. Pakistan 295
6. Pakistan 169	6. Nigeria 282
7. Bangladesh 149	7. Brazil 260
8. Nigeria 144	8. Bangladesh 231
9. Russia 142	9. Dem. Rep. of Congo 187
10. Japan 128	10. Philippines 150

The challenge to sustainability: For most of its history, the human race has numbered no more than several million and has expanded only slowly. As late as A.D. 1000, our species was smaller than the current population of the U.S. Only in the past few centuries have our numbers exploded, especially (during recent decades) in low- and middle-income nations, with increases in consumption habits following suit. Projections suggest that by 2050 or so, the population will probably stabilize around 9.1 billion. But very small changes in fertility could shift that figure up or down by about a billion—with a powerful impact on innumerable sustainability issues.

SOURCE: UNITED NATIONS POPULATION DIVISION, *WORLD POPULATION PROSPECTS: THE 2006 REVISION* (top graph); POPULATION REFERENCE BUREAU, *2007 WORLD POPULATION DATA SHEET* (population numbers)

TOP 25 green energy LEADERS

Forward-thinking companies, universities and municipalities are finding creative ways to run on renewable power

By Katherine Harmon

IT IS NO LONGER ENOUGH TO JUST CONSERVE ENERGY. MORE AND MORE CORPORATIONS, government agencies and entire cities are making large, long-term commitments to ensure that the power they *do* use comes from renewable sources. To recognize these trendsetters, the U.S. Environmental Protection Agency publishes a quarterly list of the top American users of green power: organizations that generate their own renewable energy, buy it from suppliers, or purchase offset credits to compensate for their traditional energy use. To put things in perspective, the average U.S. home consumes about 10,656 kilowatt-hours (kWh) of electricity a year. That means number 25 on the list buys enough green energy to power more than 14,000 homes.

The most direct method to make energy consumption more sustainable is for a user to generate its own power by, for example, installing solar panels or by burning waste gas. A major do-it-yourself project, however, might not fall within the expertise of, say, a clothing retailer, so some entities hire outside operators to do it for them.

A second path is to purchase power directly from alternative energy producers, such as a nearby wind farm. The third and most common route is buying credits to offset the amount of conventional energy an organization is using. The bulk of these trades is orchestrated by brokers such as 3Degrees and Sterling Planet, which make a commission. For example, buyers can request 300 million kWh of wind power from Texas. Once energy enters the grid, it cannot be isolated, so even the biggest buyers aren't literally powering their air conditioners with breeze-buffeted turbines. But offsets are like certified environmental karma: what comes around in the end is cleaner power production.

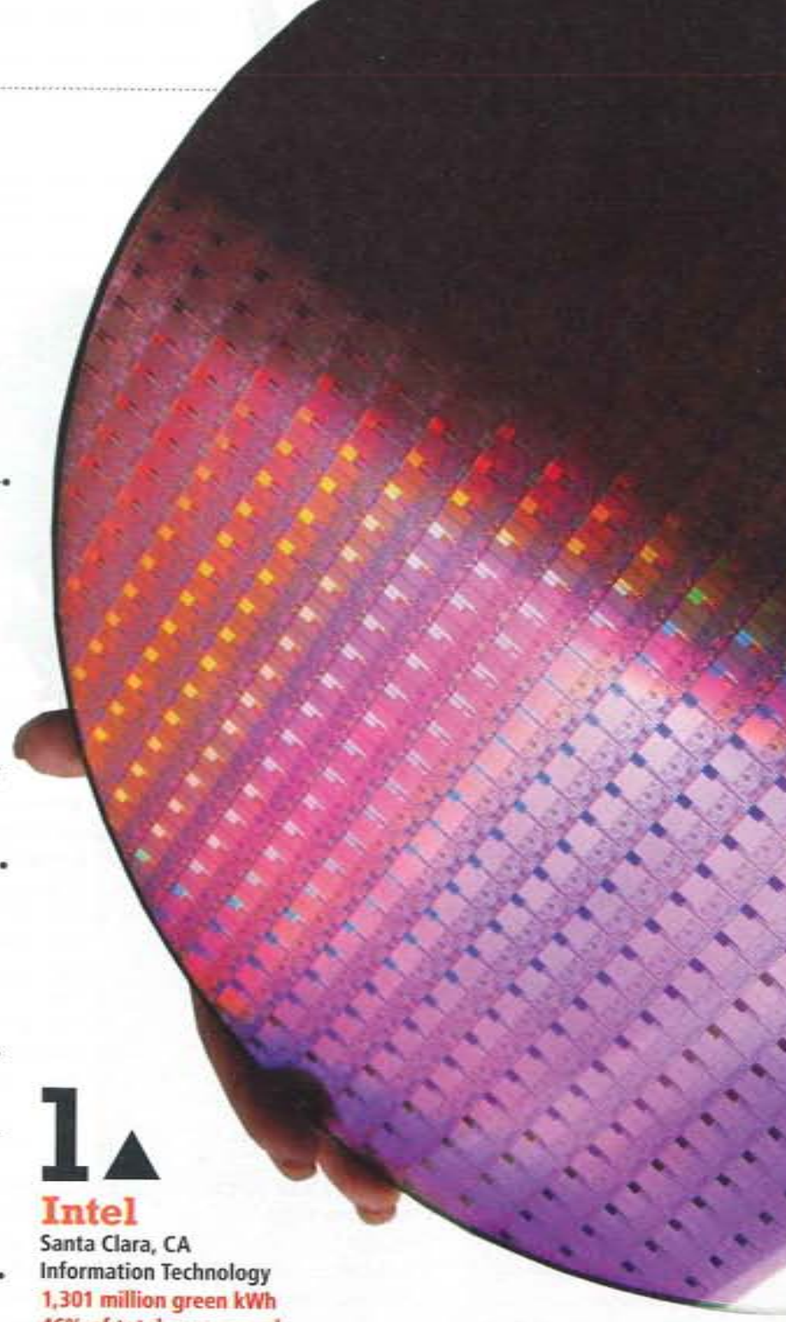
Ranking determined by U.S. EPA, based on total kilowatt-hours used.

2
PepsiCo
Purchase, NY | Food & Beverage
1,145 million green kWh
100% of total power used
The conglomerate, which is separate from the Pepsi bottling groups, made a splash when its headquarters went all green with its power buys in early 2007. PepsiCo drinks in $39 billion in net revenues through brands from Aquafina to Quaker Oats; it has turned to renewable power brokers to purchase offset credits.

3
Kohl's Department Stores
Menomonee Falls, WI | Retail
601 million green kWh
50% of total power used
This chain is already the biggest solar electricity host in the U.S. To soak up rays on 60 (and counting) store and corporate rooftops, the retailer has partnered with SunEdison, which owns and maintains the solar panels and sells the electricity to Kohl's. The largest setup is the roof of a distribution center in San Bernardino, Calif., where 6,208 panels can crank out a full megawatt of power.

4
Dell
Round Rock, TX | Information Technology
554 million green kWh
158% of total power used
In August 2008 managers declared Dell's headquarters "carbon-neutral" after buying energy credits, increasing efficiency and reducing emissions. As a result, the company reported saving $3 million, disproving skeptical claims that running on green technology is bad for staying in the black. To compensate for overseas operations, Dell buys more U.S. offset credits than it needs at home; hence the 158 percent figure.

5
Whole Foods Market
Austin, TX | Retail
527 million green kWh
100% of total power used
Since December 2005 Whole Foods Market has entirely offset conventional power consumption at its stores nationwide. At that time, its buy was the biggest renewable energy purchase ever in North America. Employees at the regional or store level determine what kinds of energy to purchase (or generate) for the most locally sound decisions.



1
Intel
Santa Clara, CA
Information Technology
1,301 million green kWh
46% of total power used
Buying the most renewable energy in the country is actually an honor Intel could do without, according to Will Thrope, vice president of Intel's corporate sustainability group. The company's massive purchase is not just to stay ahead of the curve, he says, but "to give confidence to people who are creating sustainable energy." Meaning that with increased green power supply, costs will go down for everyone—Intel included. The computer chipmaker buys the eco-sound electricity through offset credits, which pay for greener energy to enter the grid even though Intel can't isolate it for use directly. The credits can be expensive, but Thrope notes that shareholders have been behind the program. "Economics have shown," he says, "that companies that maintain a more sustainable footprint have done better—even in economic meltdown—than those that don't."

◀8
U.S. Air Force
Various bases | Government
426 million green kWh
5% of total power used

The air force's program started with Edwards Air Force Base in California about 10 years ago. Engineers there "were doing renewable energy before there were renewable goals," says Jim Snook, renewable energy program manager. Since then, bases around the country have started finding ways to buy and generate renewable energy "simply because it was the right thing to do," Snook says. About 50 bases are onboard, he estimates, and about half of those are doing on-site generation. Wind turbines at F. E. Warren Air Force Base in Wyoming can sweep up about 3.3 megawatts of power, and just outside of Las Vegas at Nellis Air Force Base, solar panels can produce 30 million kWh a year, which the air force asserts is the largest solar energy installation in the Western Hemisphere.

6
Pepsi Bottling Group
Somers, NY
Food & Beverage
470 million green kWh
100% of total power used

As the largest bottler and distributor of Pepsi products, the group jumped headlong into running fully on green energy just months after PepsiCo did (*#2 above*). The group, which sells more than 1.7 billion cases of drinks annually, offsets all its U.S. power use through credits.

7
Johnson & Johnson
New Brunswick, NJ
Health Care
435 million green kWh
38% of total power used

Johnson & Johnson began setting sustainability goals in 1990. These days, to meet more than a third of its U.S. power consumption, the company plays the full trifecta: on-site generation, energy purchases and offset credits. It generates power from landfill gas and solar panels, purchases both wind and hydropower directly, and buys offset credits for biomass and wind power.

9
Cisco Systems
San Jose, CA
Information Technology
401 million green kWh
46% of total power used

By switching nearly half its operations to renewable energy, Cisco has eliminated the carbon emissions equal to those of more than 31 million gallons of burned gasoline. That is the equivalent of removing 335,000 car trips (at 30 miles per gallon) between New York City and Los Angeles.

10
City of Houston
Texas
Government
350 million green kWh
27% of total power used

Look out Chicago, Houston might be on its way to stealing the Windy City moniker—and not because of the politicians or the climate. The city's government is now running on 27 percent fixed-rate wind power. Although that is less than a third of its total demand, Houston's sizable purchase makes it the largest city or state buyer in the country.

JOSEPH SOHM Visions of America/Corbis

12 (tie)
Commonwealth of Pennsylvania
Harrisburg, PA | Government
300 million green kWh
30% of total power used

In the summer of 2008 Governor Ed Rendell of Pennsylvania signed more than $650 million to the state's Governor's Green Government Council, which was created 11 years ago by former governor Tom Ridge. A chunk of that change is earmarked to help boost renewable energy use and development in the commonwealth—an industry that in 2008 already employed 3,000 people.

12 (tie)
HSBC North America
Buffalo, NY | Banking & Financial Services
300 million green kWh
93% of total power used

The international institution set itself apart from the rest of the finance crowd in October 2005 when it became the first bank to assert that it was carbon-neutral. To make up for the 7 percent of power consumption it hasn't purchased through renewable energy credits, the bank ponies up for carbon offsets.

14
U.S. Environmental Protection Agency
Washington, DC | Government
285 million green kWh
100% of total power used

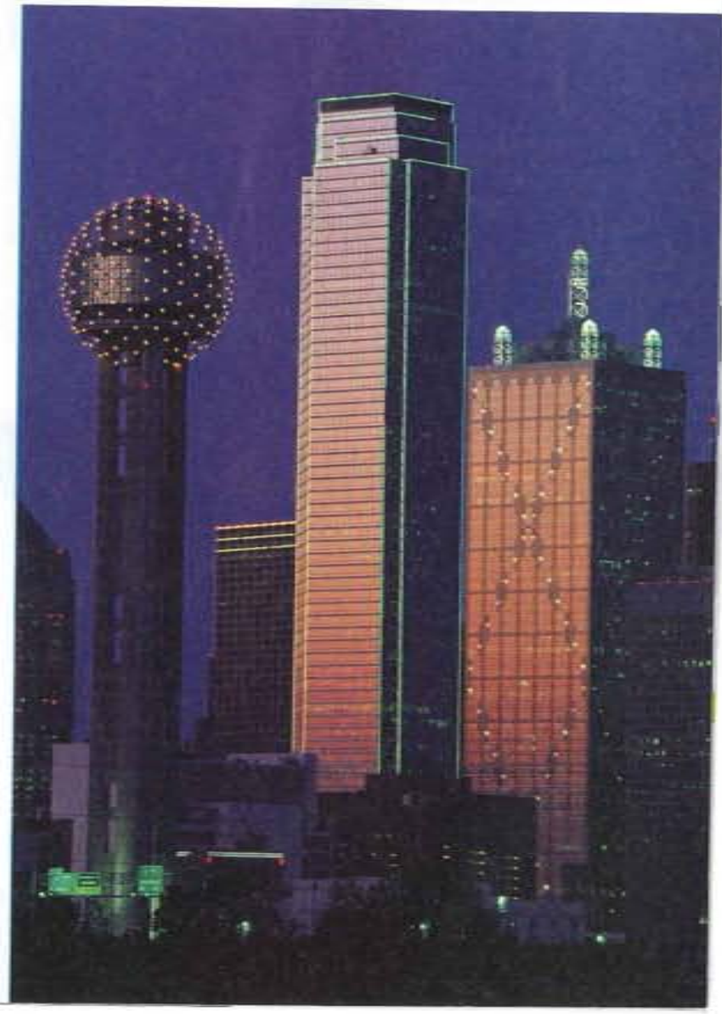
The organization that launched the Green Power Purchasers project—way back in 1999—comes in at number 14 on the list. Since 2007 the agency has offset all the power it uses to run its 200 buildings and labs with the purchase of renewable energy credits.

15
Wal-Mart
Texas, California | Retail
243 million green kWh
8% of total power used

Leave it to the world's largest retailer to lock in wind power at a market rate. Wal-Mart has a four-year contract to buy energy from a West Texas wind farm to help power the state's hundreds of stores and facilities. Additionally, solar panels have been going up under 10-year contracts on some buildings in California. All this might be a drop in the blue-and-white bucket, but the bargain box chain has set a goal of eventually going all-renewable.

11▼
City of Dallas
Texas | Government
334 million green kWh
40% of total power used

After hosting an eye-opening climate conference, the city government decided to help lower statewide ozone levels by decreasing its conventional power use, says Jill Jordan, an assistant city manager. Right off the bat, the city went 40 percent green, primarily with wind power. It hasn't been a penny saver yet, Jordan says: "You actually pay a premium." But "it was just a commitment on the part of the council and the city ... to be good leaders." In June 2008 Dallas became the first U.S. city to be certified for its Environmental Management System by the International Organization for Standards, which recognizes companies and institutions across the globe for compliance with rigorous criteria.

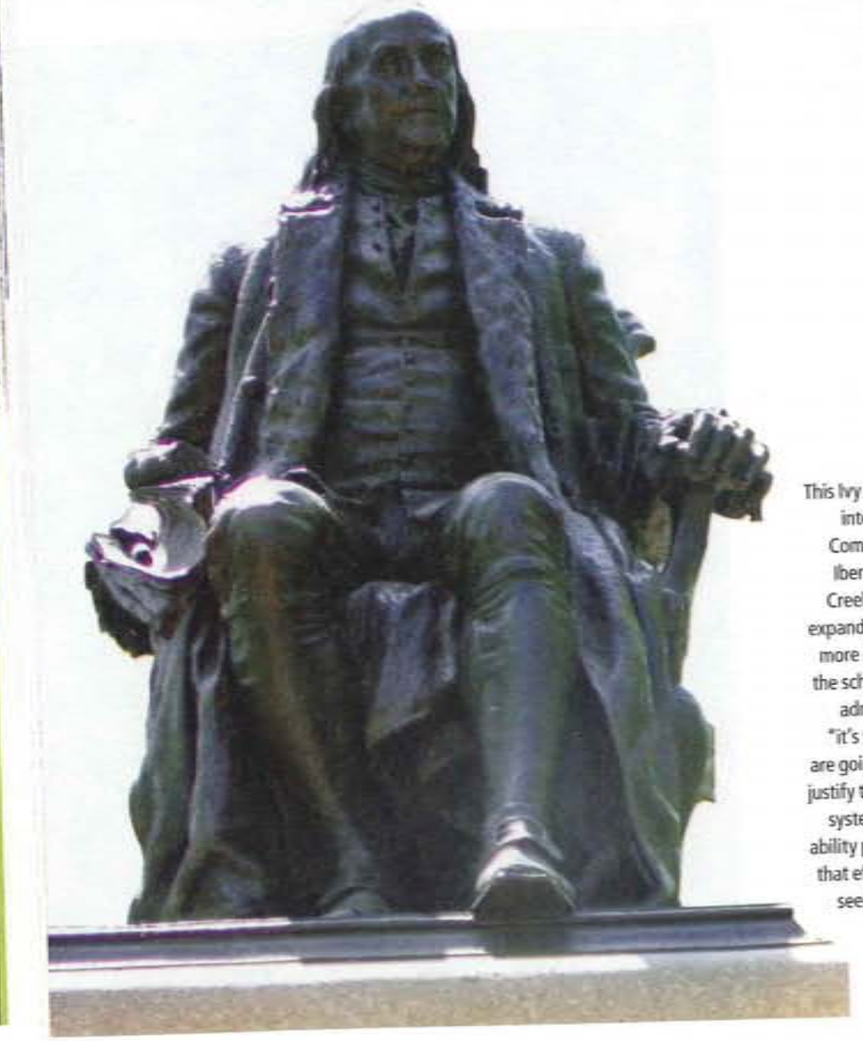


16
Kimberly-Clark
Dallas, TX
Consumer Products
223 million green kWh
7% of total power used
The maker of paper products from Kleenex to Huggies has landed on the list simply by putting waste to good use. The papermaking process doesn't just produce pristine rolls of paper; it also generates wood scraps, chemicals and other by-products rich in potential energy. By incinerating some of these would-be wastes, the company is helping to power facilities from Alabama to Washington State—and cutting costs by doing so.

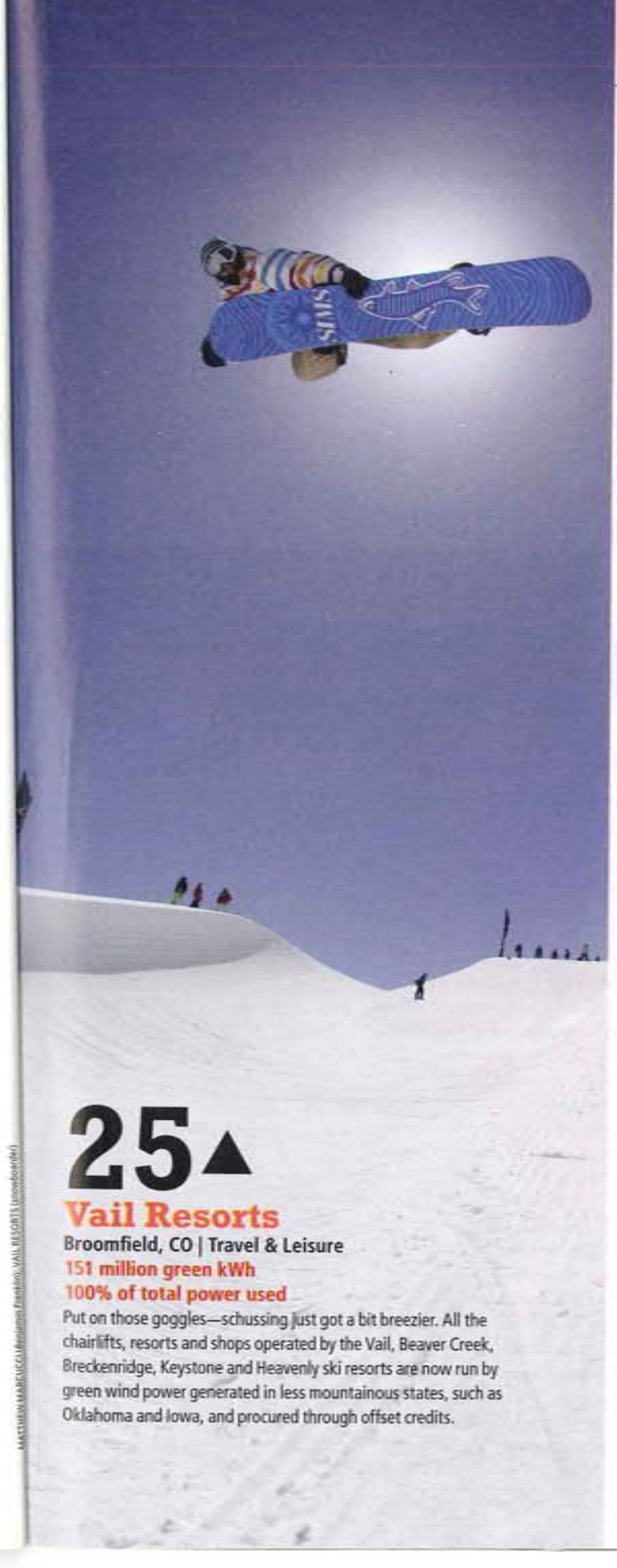
17
City of Chicago
Illinois
Government
215 million green kWh
20% of total power used
The Second City has outsourced its sustainable power generation to its western neighbor, Iowa. Des Moines–based MidAmerican Energy owns a wealth of wind farms, which generate the electricity Chicago funds through offset credits.

18
Starbucks
Seattle, WA
Restaurants
211 million green kWh
20% of total power used
A 2006 audit showed that a whopping 81 percent of the coffee giant's greenhouse emissions came from the conventional energy it used to power its North American stores; each square foot consumed an average of 6.57 kWh of electricity a month. Today the renewable wind energy the chain buys can supply more than 30 million square feet of coffeehouse—room for a whole lotta latte.

20
DuPont
Wilmington, DE
Chemicals
180 million green kWh
4% of total power used
Ten years ago the chemicals giant committed to running on 10 percent renewable energy by 2010. It still has a way to go—more than 200 million kWh, in fact—but the company is already getting energy from a wide range of sources, including biomass incinerated to make steam energy and landfill gas that fuels boilers.



◂19
University of Pennsylvania
Philadelphia, PA | Education
193 million green kWh
46% of total power used
This Ivy League university has greened its halls by locking into a 10-year renewable energy credit contract with Community Energy (now owned by international giant Iberdrola Renewables), which has a wind farm in Bear Creek, Pa. Since that first purchase, the school has also expanded into the national market, where buyers can get more offset credit per dollar, according to Dan Garofalo, the school's environmental sustainability coordinator. He admits that the energy is not cheap now but says that "it's very, very difficult to anticipate what energy prices are going to do." School administrators have been able to justify the price tag by upgrading to more efficient cooling systems for the campus. Garofalo praises other sustainability practices such as recycling, at the same time noting that efficiencies and credits—"the stuff that people don't see"—have a much bigger impact on the environment.



25▲
Vail Resorts
Broomfield, CO | Travel & Leisure
151 million green kWh
100% of total power used
Put on those goggles—schussing just got a bit breezier. All the chairlifts, resorts and shops operated by the Vail, Beaver Creek, Breckenridge, Keystone and Heavenly ski resorts are now run by green wind power generated in less mountainous states, such as Oklahoma and Iowa, and procured through offset credits.

MATTHEW MARKOW (Benjamin Franklin); VAIL RESORTS (snowboarder)

21
Wells Fargo & Company
San Francisco, CA | Banking
175 million green kWh
14% of total power used
Like many organizations, Wells Fargo has been purchasing credits to offset some of its prodigious energy use. But as a lender, it has also invested hundreds of millions of dollars in renewable energy projects, among them a wind farm in Texas and a 64-megawatt solar-photovoltaic plant outside of Las Vegas.

22
Los Angeles County Sanitation Districts
Whittier, CA | Government
171 million green kWh
54% of total power used
What could be clean about a landfill? The energy it yields, of course. The sanitation districts, which manage landfills and wastewater treatment facilities, run 10 power plants off their own waste. Most of the energy comes from burning methane gas that seeps from landfills (as garbage decomposes) or that is emitted from water treatment (as bacteria break down solids). The departments are required by law to recapture the gas, and they've been turning it into energy since the 1970s. How long will the landfills keep coughing up fuel? One of the power plants is still running off a dump closed in the 1960s. The group is set to open a new 12-megawatt landfill power plant in Calabasas, Calif., in October.

23
U.S. Department of Energy
Washington, DC | Government
158 million green kWh
3% of total power used
The Energy Department is partially powering its own headquarters through offset credits from geothermal energy, and its goal is to reach 7.5 percent renewable power by next year. The department's National Renewable Energy Laboratory in Golden, Colo., also promotes research and design of new and improved technologies.

24
PepsiAmericas
Schaumburg, IL | Food & Beverage
157 million green kWh
100% of total power used
Quick to follow the lead of PepsiCo, PepsiAmericas—which, like the Pepsi Bottling Group, is one of the largest manufacturers and distributors of the soda company's products—went all-renewable in a flash. By July 2007 energy for all its U.S. operations was entirely offset by green energy credits.