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RMI Solutions NEWSLETTER

Reaching Out to China

Peking University Opens its Doors to RMI Teaching Delegation

By Christina Page

Here at RMI, we like to think in terms of leverage points. How can we create the maximum amount of positive change given limited time, energy, and money? Once change is created, how do we ensure that it perpetuates itself and spreads as far and effectively as possible?

Few nations present a bigger or more crucial leverage point in the 21st century than China. Recently, RMI had an unprecedented opportunity to teach the Institute's core concepts to graduate students at Peking University in Beijing.

One-fifth of the planet's population—1.3 billion—is Chinese. China is the world's fourth largest industrial base. Foreign investment in China in 2002 is estimated at a record $50 billion. It has the fastest sustained economic growth rate of any major country on the planet—over ten percent annually during the past decade. General Motors (GM) plans to buy $1 billion worth of its auto parts annually from Chinese manufacturers in 2003. Building construction is booming—of the top ten wealthiest Chinese listed in *Forbes* magazine, six are involved in real estate. When last measured, Chinese use of the Internet was doubling every six months, and by some projections, Mandarin will overtake English as the dominant web language in this decade.

The fallout from this kind of industrial and human juggernaut reads like a Greek tragedy. China contains nine of the ten most polluted cities on the planet (number five is the city of Rajkot in Gujarat, India). China mines and burns a billion tons of coal a year—a quarter of the world's supply. Three-quarters of the country's energy needs are met by coal. While China currently trails the United States in overall greenhouse gas emissions, current trends

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RMI's Huston Eubank leans far beyond the choir.
Photo: Christina Page

What's Inside...

Reaching Out to China

"Give me a lever long enough
and a fulcrum on which to place it,
and I shall move the world."

Archimedes

suggest that they may nose us out of the number one position by 2020.

With this in mind, Rocky Mountain Institute accepted an offer and a challenge from Peking University. This fall, we launched a semester-long university course on natural capitalism and whole-systems design to the university's graduate students in environmental planning, engineering, and science. Influencing the best and the brightest minds in China seemed to us to be the best possible lever for moving the world in the direction of

sustainability. Peking University, one of the top two universities in China that together educate almost all of China's senior leadership, offered us the best possible fulcrum.

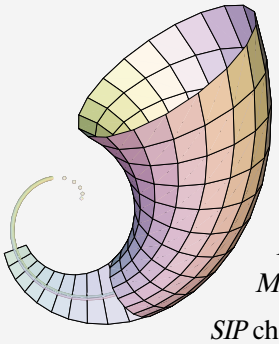
Six experts from RMI's network, including CEO Amory Lovins, taught the course on a rotating basis. Topics included sustainability frameworks, green building design and corporate practices, integrated energy systems, Hypercar® vehicles and the hydrogen economy, sustainable communities, and integrated water management.

Forty-eight students enrolled in the class, but the 8:00 a.m. lecture typically drew between 60 and 70 people. Because the students are non-native English speakers, we were forced to slow down, simplify, and use creative storytelling to communicate complex topics. We edited RMI's notoriously text-intensive slides and tried to deliver our content in a way that is simple, elegant, and comprehensible without losing the groundbreaking context.

Numerous natural capitalism examples fired students' interest.

RMI *in the news*

SIP Garners Top *Economist* Honors for 2002



Rocky Mountain Institute's August 2002 book about the benefits of decentralized electricity resources, *Small Is Profitable: The Hidden Economic Benefits of Making Electrical Resources the Right Size*, was named a Book of the Year for 2002 by *The Economist* magazine in its 14 December 2002 issue.

SIP, as it's known, was one of three titles named Book of the Year in *The Economist*'s "Economics and Business" category. The other two books were *What Management Is: How It Works and Why It's Everyone's Business* by Joan Magretta and Nan Stone, and *Martha Inc: The Incredible Story of Martha Stewart Living Omnimedia* by Christopher Byron.

SIP challenges the long-standing notion that large, centralized electricity generation facilities are economically sound, and shows through example how small, distributed generation facilities placed close to end users provide cheaper and more reliable electricity. The book demonstrates that properly valuing the benefits of distributed generation brings great economic advantages. The increases in value that result can be large enough—typically around tenfold—to make seemingly expensive technologies economically viable—a revolutionary concept for the electricity industry.

In the 14 December 2002 edition, editors at *The Economist* wrote, "In a provocative and well considered work, Amory Lovins and his colleagues at Rocky Mountain Institute, a Colorado natural resources think tank, expose the folly of building gigantic power plants and make a convincing case that the world is about to be turned on its ear by the rise of micropower." *SIP* was written by RMI CEO Amory Lovins and six coauthors: E. Kyle Datta, Thomas Feiler, Karl Rábago, Joel N. Swisher, André Lehmann, and Ken Wicker.

The Economist is one of the world's most respected publications, and describes itself as an "international news and business magazine for financial and governmental decisionmakers." The weekly publication has a worldwide circulation of 870,000 and a readership of three million. For more information, visit www.economist.com/books.

Also, *SIP* was recently given its own website. The www.smallisprofitable.org website features excerpts from the book, reviews, author and publisher profiles, and handy links to organizations involved in energy, energy policy, energy information, and distributed generation.

The best and brightest minds, class of 2020?

Electrolux's pay-per-wash program, where households pay for each load of laundry (as at a laundromat) rather than for washing machine, prompted a lively debate on life-cycle manufacturer responsibility. John Todd's natural wastewater treatment Living Machines were intensely interesting to the Chinese, particularly since a Living Machine was recently installed to clean the highly polluted canals of Fuzhou, a city in Fujian Province.

The students were critical thinkers. While excited by the ideas presented in the class, they challenged their applicability to China. In the first discussion session, one of our best students declared that she didn't think sustainability was achievable in China. I asked her, if she doesn't believe sustainability is possible, then why did she choose to focus her studies here?

She looked at me. "But, I am not studying sustainability," she said. "I am studying chemistry!"

"But do you think chemistry is important to sustainability?" I asked.

"Oh, yes!" she responded. Clearly, she knew sustainability matters, but she was uncertain what China's role in a sustainable world will be.

Later, over lunch with the same student, we discussed her concerns. She is highly skeptical that China will be able to avoid pollution—the first aim is to make money. Then, after a standard of wealth is achieved, they will be able to turn their attention to sustainability (an approach often described as "get rich quick dirty, then clean up"). Particularly for the 80 percent of Chinese still living in poor rural areas, improving their standard of living is a top priority.

In a subsequent lecture, RMI's Huston Eubank, AIA, tells a cautionary tale common in sustainability circles. If you put a frog in a pot of boiling water, it will immediately try to jump out. But if you put the frog in a cool pot of water and slowly heat it, the frog will contentedly sit there until it boils to death. The danger of problems like global warming, urban air pollution, or sprawl, Huston pointed out, is that we will all end up like the boiled frog.

Professor C.S. Kiang, our host and dean of Peking University's new College of Environmental Sciences heard the story and issued his usual challenge to make the ideas as relevant as possible to China. "Boiling frogs, bah!" he snorted. "In China, we worry about crushing the frog, not boiling it!"

Kiang's comment points out one of the biggest problems in China today: since 1998, over 26 million workers have been laid off, largely due to public-sector reforms. In spite of the country's one-child policy (enforced mainly in the cities), demand for jobs is increasing—China will have to create approximately 100 million new jobs in the next decade to accommodate laid-off workers, migrants, and those leaving school.

While the pressures are daunting, the opportunities are enormous as well. Energy intensity in the Chinese economy has been steadily decreasing, owing to investment in energy efficiency and improved technology; since 1980, China has cut its carbon emissions in half per dollar of GDP. In anticipation of the 2008 Olympics, the central government has pledged to reduce coal consumption in Beijing by half and eliminate the problem of dust storms in the city. Studies indicate a strong potential for reducing total industrial carbon output by up to 50 percent. A shift from coal to natural gas would both reduce carbon output and address the significant air quality problems that plague China's urban areas.

Some of our best moments and greatest learning opportunities have been outside the classroom. One of our environmental planning students spent an entire Sunday with us, poking around the mazelike corridors of Beijing's *hutongs*—traditional neighborhoods made of single-story dwellings and teeming with culture. Many of these communities have already been razed and replaced with modern high-rise buildings that can hold more people, but these new neighborhoods lack the rich cultural web of the hutongs.

Reaching Out to China

"In China, we worry about crushing the frog, not boiling it!"

Professor
C.S. Kiang

After class one afternoon, we joined a group of students on their bicycles to tour a new green building at nearby Tsinghua University. The ride to the building became an event in itself—half of the students (and I, as well) had to double up and ride side-saddle as we wobbled our way through the tight, rush-hour Beijing traffic. The trip took ten minutes; by car it would have taken 45.

Bikes are integral to life in Chinese cities and are used to transport people, haul garbage, peddle fruit, and transport landscape trimmings. On my way to work one day, I saw a cage with four chickens strapped to the back of a bicycle—a fifth was perched on top of the cage. But even the bicycle culture is changing. In Shanghai, 54 major roads are now off-limits to bicycles in order to reduce congestion for cars. Violators are fined, and the restrictions make it difficult for bicyclists to access the city's new financial center.

RMI's challenges for this course became clearer and more urgent over the three months we spent there. First, we have to keep identifying positive, innovative stories that relate directly to students' concerns and fears about environmental problems. These have to include examples that come from China itself. While the students are beginning to identify and share stories of their own, more are needed.

Next, we have to challenge them to question their assumptions. Does China have to follow the historical path of the West to prosperity, via pollution-intensive industry? Or can it leapfrog past the United States and other countries to a future that is clean, efficient, and provides a quality of life they all aspire to? And can we really continue to assume that environmental needs come second, rather than being intertwined with basic human needs for survival, like clean water and air?

As one student wrote to me recently: "The ideas expressed in class have sparkled me in a broad way."

In spite of the unanswered questions, I'm feeling pretty sparkled myself—and eager to make the course even better in fall 2003.

Christina Page leads RMI's natural capitalism educational initiatives.

RMI *in the news*

Leading the Way to Better Chinese Buildings

落基山研究所

Rocky Mountain Institute isn't working only on the content of environmental education in China—we're also working on the places it gets taught. Recently RMI began working on the new College of Environmental Sciences Building for Peking University. The 250,000-square-foot facility will be the centerpiece of a research campus adjacent to the East Gate of Peking University. It will house six departments as well as a 150-person design firm, a water quality research lab, and a materials offgassing test cell.

RMI's Green Development Services team is helping the college assemble an international team to design the building. Bill Browning, founder of RMI's Green Development Services, traveled to China in December to meet with University officials and other members of the design team and to help launch the project.

RMI will also be involved in setting the building's environmental performance standards. A schematic design of the new building will be complete by June 2003 for presentation to China's new premier, with whom Bill Browning met last December (*RMI Solutions*, Summer 2002).

University officials and building designers are aiming to achieve a U.S. Green Building Council LEED rating of Platinum, and the building has already been designated as the first official demonstration building by the Beijing 2008 Olympic Organizing Committee.

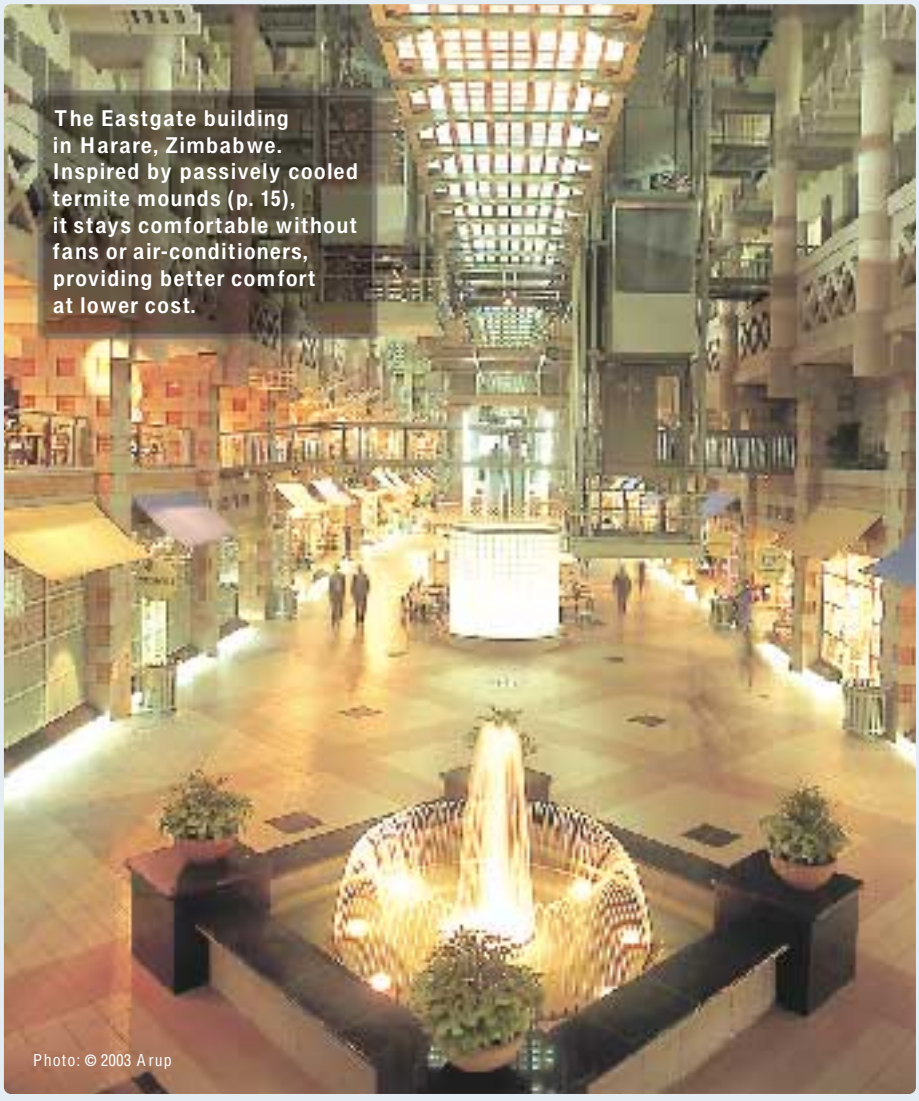
An Introduction to Green Building

Part 2: Environmental Sensitivity with Building Materials

By Alexis Karolides, AIA

Like most animal species, humans have long crafted their environments with collected, nontoxic, easily manufactured, and naturally recycling materials. Then along came the Industrial Revolution, and suddenly we began using the most intense energy source yet known: the plants and animals buried beneath the earth's surface as fossil fuels. We learned to manufacture useful materials, like steel and plastic, and we could transport them around the world. The seemingly endless supply of fossil fuels and the environment's ability to absorb the toxic byproducts of burning them seemed to ignore the simple, evolutionary rules followed by all other animal species: local supply, low energy, non-toxicity, recyclability. And this ignorance is a problem.

First, a stored resource is like a savings account, and the United States' account of fossil fuel reserves—once seemingly endless—is dwindling. Second, the earth's ability to assimilate the toxic and slow-to-degrade byproducts of human manufacturing is no longer guaranteed—all of the earth's major life support systems are either stressed or in decline. Finally, our own products are making us sick—they are made with chemicals that our bodies cannot process. Worse, we have made our buildings nearly airtight, and we are spending 90 percent of our time indoors. So how do we pick the right products to make our buildings more environmentally sensitive?



The Eastgate building in Harare, Zimbabwe. Inspired by passively cooled termite mounds (p. 15), it stays comfortable without fans or air-conditioners, providing better comfort at lower cost.

Photo: © 2003 Arup

We can start by specifying materials that don't release large quantities of volatile organic compounds (VOCs) or contain other harmful substances. Instead, specify low-VOC paints, adhesives, and millwork, as well as low-mercury lamps. Minimize porous surfaces upon which mold might thrive (for example, if tile is used, seal the grout), and carefully detail building assemblies to avoid condensation. Finally, if possible, eliminate finish materials, such as ceiling tile or carpet, altogether.

If carpet is to be used, modular carpeting (carpet tile) is recommended because only tiles in the wear pattern need frequent replacement. Recyclable carpet further enhances waste reduction and raw materials savings.

Purchasing local products reduces transportation and its associated energy consumption and pollution, supports the local economy and culture, and maintains regional identity by promoting the use of indigenous and traditional materials.

A more technical way of evaluating a material is to consider its embodied energy—the energy required to produce it. Estimated embodied energy of some common materials is listed in the box on the next page.

The high embodied energy in plastic and aluminum means these products are especially important to recycle—recycling saves most of the energy in certain plastics and 95 percent of the energy in aluminum. Life-cycle assessment, a very involved process, takes a much larger perspective on the comparative impact of material use. It considers a material's embodied energy as well as its durability, efficiency, reusability/recyclability, and overall environmental impact (in both its extraction and its use). Although there is not enough space here to go into great detail about various materials, I'll outline some important considerations.

Troubles With Concrete

The manufacturing of cement, the binding agent used in concrete, accounts for approximately 0.6 percent of total U.S. energy use, and is a major source of greenhouse gases. The energy to make cement comes from coal-fired power plants, and the cement manufacturing process also releases CO_2. Indeed, for every ton of cement manufactured, 1.25 tons of CO_2 are released into the atmosphere. World-wide, cement production accounts for over eight percent of human CO_2 emissions. Also, concrete can cause water pollution if washout water from equipment at concrete plants finds its way to local waterways. The pH of washout water is high, and thus toxic to aquatic life. Fortunately, up to 70 percent of the cement used in traditional concrete can be replaced with fly ash, a waste product from power plants. Replacing a high percentage of the cement with fly ash reduces energy consumption, reduces solid waste, and makes the concrete stronger. Because power plants are common in most cities, the fly ash can usually be obtained locally.

Estimated Embodied Energy of Common Building Materials (in MJ/kg)

baled straw =	0.2
kiln-dried hardwood =	2.0
cement =	7.8
float glass =	15.9
fiberglass =	30.3
virgin steel =	32.0
recycled steel =	10.1
expanded polystyrene plastic (EPS) =	117.0
virgin aluminum =	191.0
recycled aluminum =	8.1

Source: www.physics.otago.ac.nz/eman/403downloads/AS4_EmbodiedEnergy Coeffs.pdf.

Green Building Blocks

In general, masonry (brick, block, and stone) has very little embodied energy. It can usually be obtained locally, and masonry is resistant to deterioration from moisture and insects. It is also well-suited for warm climates where less insulation is required. Adobe is an especially environmentally friendly masonry product, using less than one-sixth the production energy of concrete block.

Metals

Metals are strong, durable, and generally don't cause indoor air quality problems (airborne dust from lead paint is a notable exception). However, there's no clear answer to the debate over which is the "greener" framing material—steel or wood. While wood is a renewable resource, steel is highly recyclable and its raw materials are plentiful. Clear-cutting forests has caused habitat destruction and siltation of streams (and pesticide-laden, monoculture plantation forests are not much of an improvement). Strip mining for the iron and limestone used in steel

RMI *in the news*

Sustainable Settlements Work Grows Global Roots

Rocky Mountain Institute's 2001–2 work on sustainable settlements is getting wide distribution. Several organizations have taken information from the two refugee camp charrettes and are sharing it with the world.

CareBridge.org, a website devoted to helping displaced people live healthier, better lives in environmentally sustainable ways, was created during the summer of 2002 by RMI friends Eric Rasmussen, MD, FCAP, former surgeon for the U.S. Navy's Third Fleet, and Barrett Brown of the Boulder, Colo.-based Sustainable Village. CareBridge has also reprinted an RMI article (by Staff Editor Cameron Burns) about our February 2002 charrette in Santa Barbara. (See www.carebridge.info/community/charrette2.jsp.)

The same article will appear in the soon-to-be-released book *Building Without Borders: Sustainable Construction in Cross-cultural Contexts*, edited by Joe Kennedy and published by New Society Publishers. Kennedy is the Director of Builders Without Borders, a California-based non-profit organization. The same article is also to be used on Design for the World's website (www.designfortheworld.org). The Barcelona-based Design for the World "works in partnership with various organizations, ranging from grass-roots associations to international humanitarian organizations and governmental agencies."

Carebridge.org is seeking seed funding to promote field applications of the RMI charrettes' design innovations.

has caused severe erosion, ecosystem destruction, and leaching from tailings piles into water systems.

The choice of wood or steel should depend on the application. Wood, for instance, is a natural insulator, whereas steel is a conductor (it is 400 times more conductive than wood). The "thermal bridging" that occurs at exterior walls where steel studs span from inside to out can halve the overall R-value of a wall with cavity insulation (as compared to the R-value of the same wall framed with wood). This presents a major energy-efficiency problem for steel-framed exterior walls. Although providing a layer of continuous exterior insulation does not completely solve the thermal bridging problem, it can significantly increase the overall R-value of the steel stud wall.

Structural Support Members

Years ago, the dwindling supply of old-growth timber spurred the wood products industry to manufacture structural products with smaller, lower-quality logs. Engineered wood products include glu-lam beams and prefabricated wood trusses and joists. These products enhance quality control while reducing pressure on remaining old-growth forests. They can make use of up to 80 percent of each log as compared to solid-sawn lumber, which only uses about 50 percent. Glu-lam beams are composed of wood boards glued together to create high-strength beams with depths ranging from five inches to four feet (or more—depths and spans are limited only by shipping constraints). Trusses are more structurally efficient than solid beams (because forces are aligned along components of the truss); therefore they achieve high strength with smaller dimensional components. Similarly, prefabricated I-joists are more structurally efficient than solid joists, so they require less wood. Unfortunately, they can be toxic to factory workers if the wrong glue is used.

Sheathing

Composite sheathing products made with recycled wood fiber or using sawmill waste or small-dimensional lumber help to conserve forests. For applications that do not require high strength, consider recycled and recyclable sheathing products. Some currently available are made of up to 100 percent recycled wood fiber, are themselves up to 99 percent recyclable, and use a relatively nontoxic bonding agent. Recycled sheathing products are manufactured using less energy than oriented strandboard (OSB) or plywood.

About the Author

RMI's Alexis Karolides, a former Richter Fellow, holds a Master of Architecture degree from Rice University. A registered architect with six years' commercial experience, she was previously the sustainability manager for the architectural firm Sussman Tisdale Gayle. This three-part series on the basics of green building is adapted from the recently released book Green Building: Project Planning & Cost Estimating, *coauthored by Karolides. It is available from the publisher at 1-800-448-8182 or at www.rsmeans.com, in the website bookstore under "New Releases."*

Outdoor Wood Applications

Avoid wood that is pressure-treated with CCA (chromated copper arsenate). This chemical is toxic, both in production and transport, and the CCA-treated wood cannot be disposed without potential issues of toxic runoff (or toxic smoke if the wood is burned). Using naturally rot-resistant woods (redwood and cedar) is also problematic because these woods generally come from old-growth forests. Better alternatives are to use wood treated with less toxic preservatives, such as ACQ (for wood exposed to weather) or borate (for wood not exposed to weather, but requiring pest-resistance), or to use wood substitutes such as plastic lumber.

Architectural Woodwork & Cabinetry

Use of reclaimed timbers where available helps preserve old-growth forests while making use of, rather than discarding, a valuable existing resource. To reduce VOCs, fiberboards with formaldehyde-free glues should be specified. Some products are additionally ecologically friendly because they are made out of agricultural waste products such as wheat straw.

Choosing "green" building materials is not a cut-and-dried process. There are many considerations—sometimes conflicting—including indoor environmental quality, energy use, embodied energy, location of product source, durability, end-of-life considerations, resource renewability, and environmental impact. No project will be composed of a perfectly green set of materials and strategies; rather, designers and owners must determine what the most important characteristics are for the project and what the occupants need.

Debunking an Urban Legend

By Jonathan G. Koomey

"A scientific worldview—
defined broadly as a respect for evidence and logic, and for the incessant confrontation of theories with the real world; in short, for reasoned argument over wishful thinking, superstition, and demagoguery."

Alan Sokal, Physicist

I'm a data guy. I love data because they help me understand how the world works. This fascination has served me well in my role as a scientist at a government research lab (Lawrence Berkeley National Laboratory, or LBNL). One focus of mine has been energy usage in the United States. How much is used? By which appliances? By whom?

At the height of the California electricity crisis in early 2001, appliance energy consumption became an issue of great interest. My research challenged some widely held misconceptions: that computers use a lot of electricity, that they were the cause of the California power crisis, and that electricity demand growth was accelerating because of the information technology revolution.

These misconceptions originated in a *Forbes* magazine article titled "Dig More Coal—the PCs Are Coming" by Peter Huber and Mark Mills. The article claimed that the Internet and associated computer equipment were responsible for eight percent of all electricity use in the United States. The article further claimed that computing equipment not associated with the Internet accounted for an additional five percent, making for a total of 13 percent of all electricity used in the United States driving computer-related equipment and the Internet. That total, said the article, would grow to half of all electricity use in 10–20 years. These claims surprised me, since a study I had finished four years earlier found that computers in commercial buildings (which constitute by far the lion's share of all computing equipment) used only two percent of U.S. electric power. Something didn't quite add up, and I resolved to investigate.

Why did I care?

I had previously studied electricity used by office equipment, and I was one of the experts in the field. It was logical for me to investigate, and easier for me than for many others. I also hold what physicist Alan Sokal calls "a scientific worldview—defined broadly as a respect for evidence and logic, and for the incessant confrontation of theories with the real world; in short, for reasoned argument over wishful thinking, superstition, and demagoguery." While some issues cannot be resolved using a scientific approach, the amount of electric power used by computers surely can.

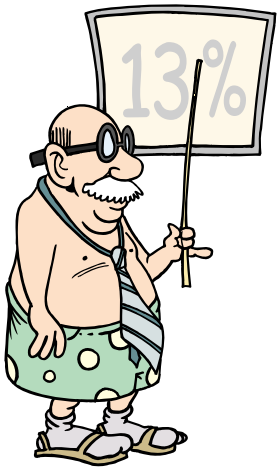
Finally, I believe that getting numbers right really matters. Only the foolhardy embark on major decisions without collecting data and analyzing them. If the *Forbes* numbers were true, many more fossil-fuel-fired power plants would have to be built than currently expected, so the policy implications were significant. Perhaps not coinci-

Fictional Facts Have Consequences

Tom Burke, environmental advisor to top British industrial and political leaders, wondered why President Bush had rescinded America's signature on the climate-protecting Kyoto Protocol. As Mr. Burke reported in the *Independent*, the reasons "were outlined to me with chilling clarity by a senior member of his staff as we sat in the White House on the day the decision was made: America is running out of electricity, coal is the only cheaply available fuel for electricity generation, nothing can be done that will put up the cost of generating electricity from coal, and so there will be no controls on the emissions of carbon dioxide." But the argument went further: more electricity, he was told, was needed to keep powering economic growth driven by information technology and E-commerce.

The Western Fuels Association (a coal-promoting trade organization long in the forefront of opposing climate protection) made a modest investment in creating the Huber/Mills myth of an electricity-guzzling Internet. That investment, it seems, paid off beyond the coal lobbyists' wildest dreams. One wonders whether such mythmakers—like tobacco companies—will ultimately be held accountable for the consequences of the deliberately misleading "science" they invent.

—Amory B. Lovins, CEO, RMI



dentally, the *Forbes* article was based on estimates created by Mills in a research report funded by the Greening Earth Society, an offshoot of the Western Fuels Association.

Chronology

In June 1999, a few weeks after the article was published, several colleagues approached me about crafting a response; I readily agreed. We worked carefully and deliberately. Our first technical memo appeared in December 1999, and our first full paper on the topic appeared six months later. Follow-up work continues today.

In the meantime, Mills and Huber convinced futurist George Gilder to publish their "Digital Power Report," which gave stock recommendations based on the estimates summarized in *Forbes*. Soon afterward, they began lecturing to investors and investment analysts about their views.

Within a year of the original *Forbes* article's publication, dozens of news organizations had quoted the numbers, usually without indicating their source. As credible critics of these numbers emerged, some news organizations cited both sides of the debate but only a few dismissed the *Forbes* data because of the flaws revealed by the published critiques. By mid-2002 our results, as well as a corroborating analysis published by Arthur D. Little, Inc., had put to rest most technical debate about this issue. Unfortunately, the incorrect numbers keep popping up.

The core of the debate

The *Forbes* analysis presented estimates of power used "by the Internet" for eight categories of energy-using equipment or processes:

1. major dot-com companies
2. websites
3. telephone switching equipment (used for dial-up access)
4. personal computers (PCs) in offices
5. PCs at home
6. routers on the Internet
7. routers in local area and wide area networks (LANs and WANs)
8. energy to manufacture all this equipment

Mills estimated the total electricity used by equipment in each category by specifying the population of each equipment type, and the average operating hours and power used for each device. Electricity consumption in kilowatt-hours is the product of power in kilowatts times hours of operation times the number of devices, so the calculation is a simple one.

In our December 1999 memo, we examined the *Forbes* numbers and in every case found the analysis overestimated electricity use. For example, the Greening Earth Society report stated the assumption that a PC, including all peripheral equipment and unspecified other equipment, uses 1,000 watts.

Modern PCs typically have active power levels of 60–80 watts. A typical 17-inch cathode ray tube monitor uses about 90 watts in active mode, but the new flat panel displays of comparable size use a half or a third that amount. After accounting for other peripherals and "behind the wall" equipment, we concluded that 200 watts (not 1,000 watts) is a reasonable estimate for the active power of PCs plus monitors, a factor-of-five reduction from Mills's estimate. Of course, many PCs reduce their power use after a certain period of inactivity, thanks to the Environmental Protection Agency's Energy Star program, but that fact was not included in the *Forbes* calculations or in our critiques.

One would expect small differences between such independent estimates, but when the differences are all large and in the same direction, it is likely that there is a bias in one of the analyses being compared. The *Forbes* article, it turns out, overestimated power used by the Internet by a factor of eight, and overestimated power used by all computers by a factor of four.

In addition, key indicators of electricity use and energy use over time, produced by the Department of Energy's Energy Information Administration, challenged the *Forbes* numbers indirectly. These indicators were systematized and plotted by Joe Romm of the Center for Energy and Climate Solutions, a division of the not-for-profit Global Environment & Technology Foundation. Romm's plot shows annual growth rates for U.S. electricity use, primary energy use, gross domestic product (GDP), and

carbon dioxide emissions for 1992–1996 and 1996–2000. While GDP grew faster in the second period, electricity, energy use, and CO_2 emissions all grew more slowly in that period than between 1992 and 1996. If the *Forbes* thesis were correct, we would expect electricity demand growth in the latter part of the 1990s (the heyday of Internet growth) to have gone up, but in fact the opposite occurred. These data appear to contradict the assertion that demand growth was stronger with the widespread use of the Internet.

ADDITIONAL READING:

- For a detailed account of the controversy over electricity used by computers and the Internet, see enduse.lbl.gov/projects/infotech.html.
- Darrell Huff, *How to Lie With Statistics*, W.W. Norton, New York, 1993. A numeracy classic. First published in the 1950s, it's still fresh and useful today.
- Jonathan Koomey, *Turning Numbers Into Knowledge: Mastering the Art of Problem Solving*, Analytics Press, Oakland, Calif., 2001. Hone your critical thinking and numeracy skills with this readable and entertaining book (www.numbersintoknowledge.com).
- Alan D. Sokal, "A Plea for Reason, Evidence, and Logic," *New Politics*, vol. 6, no. 2, 1997. A brilliantly clear and concise exposition of the scientific worldview, in the context of his now famous parody of postmodernist relativism (www.physics.nyu.edu/faculty/sokal).

From urban legend to common knowledge

The legend of energy-gulping computers proliferated quickly, driven by a superficially plausible story line and a high-profile crisis in the California electricity sector. Before the dot-com bust, most people considered information technology "the wave of the future." Many therefore found it plausible that computers should also use a lot of electric power.

Forbes itself lent credibility to the argument simply by publishing it. The trade press and the popular media repeated the key claims (often without citing a source), thus enshrining the erroneous figures as "common knowledge." Leaders in business, government, and academia further propagated the errors, thus ensuring their proliferation. The Electric Power Research Institute and the Silicon Valley Manufacturers Group reiterated the erroneous figures in press releases and other reports. Although both institutions later distanced themselves from those numbers, they had unwittingly used their considerable credibility to perpetuate mistakes.

At least six investment banks wrote reports based on the claims in the *Forbes* article, and functionaries of both political parties began citing the bad numbers. The California electricity crisis propelled the issue to the front pages, and many reporters who had not covered electricity before had to learn the difference between a kilowatt and a kilowatt-hour. The media's inexperience with energy issues clearly contributed to a misunderstanding of critical aspects of these issues.

Media interest in this topic was intense. During January 2001, at the height of the power crisis, I received 23 calls from media organizations (about one per workday). February was slower—about 15 calls. Roughly 60 percent of the calls related to electricity used by office equipment, and the rest were more general inquiries about causes of the California crisis.

RMI *in the news*

RMI's Kinsley Advises Australian Island Leaders

With a permanent population of 900 (devoted primarily to sheep growing and fishing) and an average of a few dozen tourists each day, Flinders Island is one the world's few remaining unblemished places. Off the northeast coast of Tasmania, it's roughly the size of one of the smaller Hawai'ian Islands. Its beaches and mountains are a short flight from Melbourne's growing population, so the island is poised for tourism development. Fortunately, its leadership is approaching the issue very cautiously. RMI's Michael Kinsley, who co-founded RMI's community program in 1985, recently met with several island leaders to discuss ways in which the island might carefully expand its tourist economy while preserving its rural beauty. The situation Flinders finds itself in is unique. "I've not seen another picturesque, unspoiled community anywhere that has both the opportunity and the inclination to develop correctly," Kinsley said.

Scientific credibility standards are rooted in careful acquisition and handling of data, evaluation of logical arguments, and peer review.

Why does it matter?

What harm could it do to have someone believe that computers use a lot of electric power if they really don't? It's when information affects an important decision that erroneous statistics are most pernicious.

Some decisionmakers were affected by the *Forbes* "urban legend." For example, I received a call from power engineers at General Electric (GE) in fall 2000 asking whether the assertions about faster electricity growth were true. General Electric manufactures power plants, and if electricity demand were to pick up suddenly, that would have large implications for its business. Fortunately, these engineers investigated before implementing their strategy, and they avoided basing critical strategic decisions on incorrect information.

I also gave a seminar on my results to staff of a large energy trading company, and the story was news to them. Like the GE engineers, they also appreciated getting the real story on this urban legend before they had committed resources based on faulty information. Other people and institutions were not as careful and used the *Forbes* assertions without investigation.

An ad in the *Wall Street Journal* promoting an alternative energy fund, for example, got good mileage out of the erroneous numbers: "From rolling blackouts to soaring fuel costs, the world is facing an energy crisis. It's gotten to a point where a well-placed turbine windmill can generate more income for a farmer than a whole crop of alfalfa. And demand is only going to go up. In fact, computer usage alone is expected to account for 50 percent of the total U.S. electric consumption by 2010."

That statistic was from the *Forbes* article as filtered through an investment banking report by Stephens, Inc. I don't know if anyone invested in the alternative energy fund because of that one outrageous number, but there it was, in all its glory.

Reports created by ostensibly knowledgeable investment analysts are widely circulated but are rarely checked for accuracy or peer-reviewed in the academic sense. The six major investment banks that cited the numbers gave little or no indication that there was even any controversy about them. The reports' purpose was to highlight the analysts' own stock picks, which I hope were based on better analysis than the *Forbes* numbers, but I cannot help but wonder.

Some lessons

As shown in this article, numbers frequently become separated from the original source and detached from any caveats. Rough numbers are often elevated to conventional wisdom when no other numbers are available, and some incorrect numbers are repeated often enough that they become accepted.

In the case of the Mills and Huber piece, two industry trade groups played major roles by citing the numbers in their press releases, and many reporters repeated the press releases verbatim. This lesson is an important one. "News" items can be little more than regurgitated press releases, because news organizations often reprint press releases without much critical evaluation of their content.

Of course, there are also facts about which reasonable people can agree. For example, the power used by a typical PC is a quantity that can be measured. When someone makes claims about measurable quantities (for example, "a PC uses 1,000 watts"), then his credibility should suffer if measurement shows that statement to be in

About the Author

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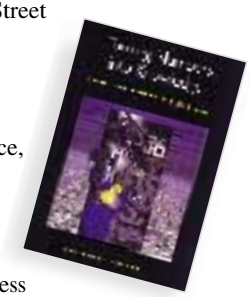


error. Unfortunately I see no such consequences for either the authors of the article or for *Forbes* itself.

The media and scientific communities evaluate credibility in different ways. Scientific credibility standards are rooted in careful acquisition and handling of data, evaluation of logical arguments, and peer review. Like the scientific community, the media community also acquires, processes, and interprets data, then communicates its findings. Unlike the scientific community, however, the media practice little peer review and have few mechanisms of censure.

Educating the people

This example indicates that many in our society (including bankers, journalists, trade organizations, and businesses) need to go back to school. Numbers have assumed major significance in the modern world and intrude with ever-greater insistence into the fabric of society.

Today's citizens must learn to process their daily information onslaught. They should be fortified with strong foundations in both conventional and numerical literacy. This cautionary tale will have fulfilled its purpose if readers acquire a new urgency to hone their critical thinking skills and apply an informed skepticism to each and every important statistic that crosses their paths.

RMI *in the news*

Quenching Arizona's Thirst for a Water Strategy

In late summer 2002, a report coauthored by RMI's resident water expert Richard Pinkham made headlines around Arizona. "Cities urged to consider water efficiency and conservation," was the headline on an Associated Press article on 2 August, announcing its release.

The report was written for Coconino County, the city of Flagstaff, and the Grand Canyon Trust (www.grandcanyontrust.org), a nonprofit organization whose mission is "to protect and restore" the canyon country of the Colorado Plateau. The three organizations are concerned about water supplies and resources in and around Northern Arizona's fast-growing communities.

The report found, as Shaun McKinnon of the *Arizona Republic* wrote, that "growing northern Arizona communities should wring as much water as possible from existing supplies before spending millions of dollars to find new sources.

"Instead of building a $300 million pipeline from Lake Powell or spending millions to drill wells to provide drinking water for thirsty northern Arizona communities, a new study by a consulting group identified with conservation and energy efficiency says it is time to tap a 'new' water supply that is right under our noses," wrote Gary Ghioto, *Arizona Sun* reporter in a story titled "Study: Conserve, Don't Drill for Water." "Billions of gallons of water go down the drain each year because of inefficient plumbing fixtures, wasteful landscape irrigation and a lack of conservation measures."

Nikolai Ramsey of the Grand Canyon Trust was quoted saying, "It's a provocative concept, but Rocky Mountain Institute is teaching us that if we can save 30 to 50 percent of our existing water by using better technology, you have, in a sense, created a new supply."

"Together with our project partners, Planning and Management Consultants, I think RMI has helped change the terms of the water debate in northern Arizona," said Pinkham. "The U.S. Bureau of Reclamation has now put together a plan of study that aims to address all possible options, both supply-side and demand-side. It's a positive step toward the kind of integrated resources planning that RMI promotes and the region needs."

The report also praised several communities involved in forward-thinking efficiency activities, notably wastewater reclamation and reuse, rainwater harvesting, and conservation and education efforts. As of *RMI Solutions* presstime, the articles were available online at www.arizonarepublic.com/arizona/articles/0802nazwater0802.html and www.azdailysun.com/non_sec/nav_includes/story.cfm?storyID=45939.

RMI's 20 years of work on water efficiency has had many practical successes, including cancellation of a number of costly and destructive dam projects in favor of more productive water use.

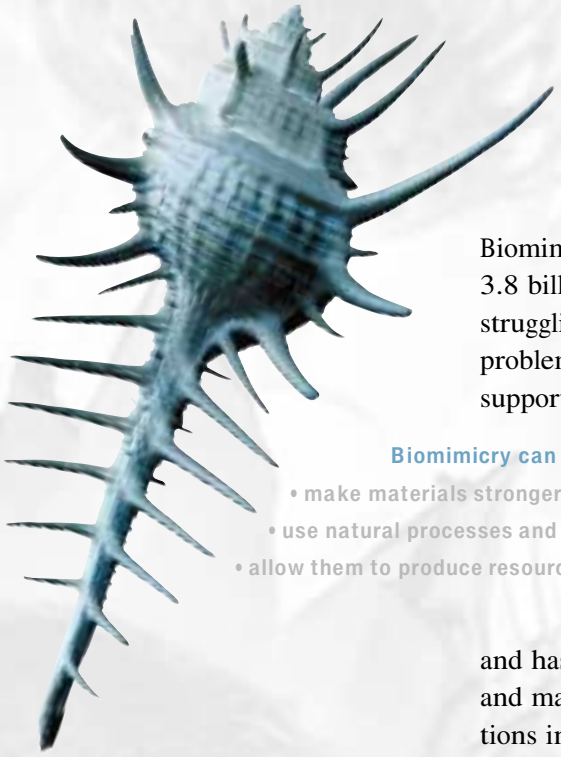
Biomimetic Buildings

Understanding & Applying the Lessons of Nature

By Onno Koelman

"We do not seek to imitate nature, but rather to find the principles she uses."

Buckminster Fuller



Global population continues to grow, and in the coming century we will probably build more and faster than we ever have just to keep ourselves sheltered. The question is, will we be able to do it without completely annihilating the natural environment? In 1996 we sent over 299 billion pounds of construction and demolition waste to the landfill, much of which could have been reused or recycled. Our buildings consume two-thirds of U.S. electricity. And these numbers keep growing. In the words of William McDonough, "our culture has adopted a design stratagem that essentially says that if brute force or massive amounts of energy don't work, you're not using enough of it." Can we keep building and building while at the same time slowing, then reversing, our damage to the environment? Is there perhaps a way that building could have a restorative effect? RMI believes there is.

For years RMI has been promoting green building techniques (*e.g.*, passive solar heating, daylighting, natural ventilation) to help decrease the environmental footprint of buildings.

RMI's super-efficient HQ: an integrated design rooted in nature.

Now we are adding a new and extremely valuable approach—biomimicry—to our toolkit. Previously ("Building the Future of Buildings," *RMI Solutions*, Fall 2002), we introduced the topic of biomimicry as conceived by noted science writer Janine Benyus. We learned that biomimicry can be applied to buildings in three fundamental ways: (1) to make stronger, tougher, self-assembling, and self-healing materials; (2) to use natural processes and forces to accomplish such basic building functions as heating and cooling; and (3) to produce resources, rather than drain them, by using/applying the biomimicry principles of zero waste and co-evolution. In keeping with the natural capitalism model, we aim to show that incorporating natural materials and processes into a more holistic design paradigm for buildings is not only environmentally sensitive, but also eminently practical and profitable.

Biomimicry makes sense. For some 3.8 billion years, nature has been struggling with many of the same problems we now face (structure and support, coloring, heating and cooling) and has developed the most energy- and materials-efficient design solutions in order to survive. Whether we are designing or specifying building materials (*e.g.*, insulation, interior and exterior color, fire protection, waterproofing) or building systems and processes (*e.g.*, temperature regulation, fresh air, water supply, and cleaning), we can learn from nature.

Biomimicry can be applied to buildings in order to:

- make materials stronger, self-assembling, and self-healing
- use natural processes and forces for basic building functions
- allow them to produce resources by integrating natural systems

A tremendous database of natural solutions is all around us, but to access it we need to pose the right questions and frame them in a way that biologists—the keepers of the database—can understand. With this in mind, RMI has chosen six of today's biggest building problems, and we are seeking mechanisms in nature that might provide solutions to them. The problems are scaling in pipes, toxic adhesives and clumsy fasteners, concrete production and use, interior and exterior coloring, cooling in hot, humid climates, and unhealthy interior mold growth. We do not have solutions for any of these problems yet, but with the help of a biologist we have entered Nature's

Biomimetic Buildings

Nature cannot afford a global network where one locale is stripped to provide resources for another, with fossil-fuelled transportation as the carrier between.

library of solutions and browsed a few abstracts. In October 2002 RMI hosted a biomimicry brainstorming session involving *Biomimicry* author Janine Benyus and RMI's GDS team to catalyze a flow of biomimetic ideas and applications. Some of our results appear below.

Pipe scaling causes millions of dollars of damage each year, and attempts at removing it release disagreeable chemicals to waterways around the globe. It may not be immediately obvious that nature could offer a solution to this man-made problem, until we consider that scaling is simply the deposition of calcium carbonate onto the pipe. Knowing this, we can now look in nature's database for a creature that has learned to manipulate the landing and placement of calcium compounds.

One creature particularly good at this is the deep-sea abalone. It forms a rock-hard shell by inducing calcium ions from surrounding seawater to fit exactly into its ionic blueprint. But why doesn't the shell keep on growing forever? When the shell is large enough, the abalone secretes specialized "stop" proteins that prevent further calcium ions from accreting. If we could coat our pipes with similar proteins (or mimic the shape of these proteins with another material), then calcium ions could no longer adhere. The problem of scaling would be eliminated, thus saving millions of dollars in chemicals and pipe replacements with a simple preventive solution.

Another intriguing problem we are tackling is the energy-intensive production of concrete, specifically its key ingredients. Production of Portland cement, a key ingredient of concrete, is responsible for eight percent of world CO_2 emissions (p. 6). Also, mining the raw materials that go into cement and concrete damages


Dream home.

landscapes and ecosystems. Nature cannot afford a global network where one locale is stripped to provide resources for another, with fossil-fuelled transportation as the carrier between. Neither can we. So how would nature produce a strong, hard building material that can be shaped to any form? Termites do it with their own saliva and abundant local material: dirt. Perhaps more interesting, the versatile abalone goes through a process of self-assembly called "bio-mineralization." To form its inner shell, twice as tough as ceramic, the

RMI *in the news*

New Zealand Associates Bring RMI Down Under


Norman Smith

RMI has fans worldwide, but until recently, no formal representation abroad. After several recent RMI-based initiatives in New Zealand, Robert Bishop and Norman Smith have now joined the Institute as senior adjunct associates. Based in New Zealand, and with full access to the staff and resources of RMI in Colorado, one of the pair's first efforts was the creation of a local website www.rminz.org.nz.

Canadian-born mechanical engineer Bishop, a New Zealand resident since 1985, is a former RMI research scholar and a senior coauthor of what is now the E SOURCE *Space Cooling Technology Atlas*. He is well known for his expertise in energy engineering and operates his own energy engineering consultancy, Energy Solutions, Ltd., based in Wellington. A former chair of the Energy Management Association, he has trained engineers in energy efficiency and published several books on energy efficiency.

Smith, a student of the native Maori language and culture, has implemented economic renewal and energy efficiency programs in New Zealand and he has been collaborating with RMI for several years using RMI programs and resources. He also organized Institute cofounder and CEO Amory Lovins's New Zealand visit in November 2002. In January 2003, he reported encouraging New Zealand achievements to an RMI staff meeting.

"Formalizing our relationship with RMI was the logical next step," he said. "We look forward to a fruitful relationship and a win-win situation for RMI and New Zealand."

For more information, visit www.rminz.org.nz, or email Smith at norman@rminz.org.nz and Bishop at rob@energysolutions.co.nz.

abalone sets up a three-dimensional, electrostatically charged lattice (imagine scaffolding) that attracts calcium ions to fill in the gaps. This creates hard "bricks" of chalk, "mortared" by layers of squishy polymer that absorbs impacts and halts crack propogation. The result is a repeatable, perfectly ordered, crack-resistant, nearly indestructible shell—all produced from a few proteins, a little seawater, and the selective pressure of otters pounding on the shells with rocks—a strong incentive not to crack and get eaten.

In an attempt to mimic the laminated hard/soft construction of this natural abalone nacre, Jeff Brinker at Sandia National Labs has developed a rapid self-assembly approach. Common detergents organize inorganic and organic precursors (building blocks) into hundreds of alternating layers in a single step. The process currently produces coatings, but its extension to building materials might be envisioned. Imagine if we could spray a self-assembling template onto some basic scaffolding and then throw on buckets of seawater and watch it coalesce into a strong, sturdy wall. Seawater is a renewable resource and the process requires no external energy. There is even evidence suggesting that bio-mineralization sequesters CO_2. Conceivably, then, a biomimetic concrete might allow us to reverse global warming instead of accelerating it, and give us a more durable, versatile concrete as well.

Animal architecture is another database we can search for advanced materials and processes. From a whole-systems perspective, the African termite mound might be the supreme example of advanced animal architecture. It incorporates exquisite solutions to pervasive design problems (structural strength, elemental protection, ventilation, humidity control, etc.) that we also face. So far at least one building has been highly successful in mimicking this sophisticated ventilation system. The Eastgate building in Harare, Zimbabwe (p. 5), uses the termites' innovative design to keep the building cool during the hottest days. Using nature-inspired design to circulate fresh air into the building in place of noisy, electricity-hogging air-conditioners and fans improves comfort and cuts energy bills. This makes for happy building occupants who pay less and are more likely to renew lease agreements.

So how do these ideas become reality? How are they developed from a hopeful possibility into an end product? Learning nature's secrets and then making the conceptual leap to biomimetic buildings and products will require a synthesis of fields. Architects, engineers, biologists, and designers all need to work together to both understand nature's innovations and collaboratively use these innovations to create healthy, delightful environments.

This synthesis of fields makes the best use of each professional's experience for achieving a common goal: the nonviolent overthrow of bad engineering. The trials humanity now faces are so interrelated in their scope that working together has ceased to be an idealistic dream—it is now a necessity.

Our buildings need to work together as well. If we were to design them with a specific ancillary function (*i.e.*, an opera house that is also the community lung), we could then weave them into the fabric of a more robust, interesting neighborhood. This approach to biomimicry goes beyond the level of an individual building and what materials it contains to present an overview of a whole system working in harmony.

After all, a forest is more than just a collection of individual trees.

The next article in this series will show how biomimicry can be applied to create these communities, and will tie together the nine principles of biomimicry into a complete solution for making buildings an effective restorative tool not only for local communities, but for local (and global) ecosystems as well.

Those further interested in biomimicry can order a copy of our newest publication "Bio-Inspired Design: Ideas, Wisdom, and Applications from Nature" on our website (www.rmi.org). The paper targets six top modern design and/or construction issues and provides leads on biomimetic solutions to these problems. It also provides a methodology for approaching problems in a biomimetic way. Funding for this paper and Onno's internship was generously provided by Mineral Acquisition Partners as part of its new Summer Energy Fellows program (www.maproyalty.com/sef.html).

Flexibility Key to Important Missions

Marty Pickett, Executive Director

As this issue of *RMI Solutions* goes to press, the United States is on the verge of war with Iraq. Unlike the 11 September terrorist attacks of 2001, we've been alerted that this war is coming. We can track preparations day by day. Our world is in great flux, and in times of great flux, flexibility is critical.

Flexibility remains crucial to RMI's work as well. In 2000, RMI crafted a "strategic thinking" document that guides the organization in its prioritization and decision-making. By staying flexible, RMI is better able to encourage new insights and perspectives and experiment with what works and retire what doesn't.

Part of RMI's strategic planning calls for a periodic updating of the plan itself as well as a look at how we're doing. Having recently finished the updating process, I can report that RMI is doing extremely well. Much of our updating process centered on reexamining our mission. Though the wording changed slightly, the renewed commitment to reaching our mission was an honored and important exercise for our staff and Board. RMI's mission is

> to foster the efficient and restorative use of natural, human, and other capital to make the world secure, just, prosperous, and life sustaining.

RMI accomplishes its mission by

> inspiring business, civil society, and government to design integrative solutions that create true wealth.

The revisions primarily reflect the organizational learning that has come from RMI's being more engaged in "doing," in applied research/consulting. Through this work RMI is more focused on realizing change through groups of people and institutions, with less emphasis on individuals; and whereas RMI had traditionally not considered government policy-making as a high priority for accomplishing its mission, it now views this sector as another important arena for change.

The recent strategic planning process also affirmed RMI's fundamental commitments to being independent, nonadversarial, and transideological, with a strong emphasis on market-based solutions. Since late 2001, our research and consulting staff have been operating within three teams: Energy & Resources Services, Commercial & Industrial Services, and Green Development Services. These teams better reflect the core areas of our work. RMI selects its projects based on whether the work will match RMI's mission, have prominence, encourage fundamental and not incremental change, provide internal and external leverage, and have high integrity. Our goal is to ensure that the work be measurable, scalable, and replicable. As you read through this newsletter, I hope you'll agree that RMI is successfully meeting its mission's challenges.

Editor's Notes

Things Have a Funny Way of Resurfacing

Cam Burns, Editor

In recent years, RMI's leadership has been working on ways to measure the impact of our work. After all, it's the impact of our efforts—not the efforts themselves—that matters. Although we haven't yet established measurement techniques, RMI staff member Michael Kinsley recently emailed me about the uptake of RMI's Communities Department work. I was thrilled to read it, and quote him liberally here:

"Just last week, I received a call from a community leader in Applegate, Oregon, reporting the establishment of an organic produce marketing cooperative. This concrete outcome comes five years after economic development workshops that, at the time, seemed to fall flat. This experience echoes many of RMI's economic development projects. Here are a few more examples:

"RMI conducted a green-renovation workshop for the Pentagon five years ago, but it was resisted by the official in charge of renovation. Later, he was transferred. Later, the agency implemented a green renovation program that was even more aggressive than that outlined in the workshop, including energy efficiency measures and elimination of PVCs.

"A design workshop for the Boston Convention Center seemed to result in no progress until three years later when the design included such measures as efficient mechanical systems, rainwater capture, and daylighting."

Kinsley's email was uplifting in many ways. Who knows? One day soon we might see changes in federal energy policy (courtesy of the NEP Initiative), redesigned refugee camps, and a sustainability revolution in industry.

Robert Sardinsky, Rising Sun Enterprises

Editor's note: In this and coming issues of RMI Solutions, *we will profile former RMI staff members.*

Since leaving his position as an RMI researcher in the 1980s, Robert Sardinsky (affectionately known to all as "Sardo") has built a nationally prominent lighting design and consulting firm. Sardo and his staff design and install energy-efficient lighting systems for corporate headquarters, schools, and public buildings.

Rising Sun Enterprises is both a consultant and a supplier of fixtures and hardware. The company does lighting design for people who just want great lighting, Sardo said, but also does energy-efficient lighting.

"It's really satisfying when we can do both," Sardo said. "I'm fanatical about the environment, but I'm even more fanatical about function." Rising Sun's modern 5,000-square-foot facility in Basalt, Colorado is a showplace for lighting. The overall lighting seems subdued, yet everything in the space is appropriately illuminated.

Rising Sun actually predates Sardo's association with RMI. Starting in 1983, he advised New Englanders who wanted to live self-sufficiently as to the best solar- and wind-powered systems and the most efficient appliances and lighting. In 1985, RMI co-founder Amory Lovins asked Sardo to join the Institute as a research associate.

"My focus took a quantum leap," Sardo said. He graduated from working with adventurous homeowners to working with *Fortune* 500 businesses, major utility companies, and global security issues. He and Lovins collaborated on a book on state-of-the-art lighting in 1986. But there was a demand for his services outside of the Institute's walls, and after a couple of years, he left RMI.

"Amory kind of kicked me out," Sardo joked. "He said, 'We need more people implementing this stuff.'" Sardo's consulting business had survived the move to Colorado and continued to function despite its owner's long hours at RMI. With Sardinsky's full attention, Rising Sun began to grow rapidly.

Lovins notes that "nudging out of the nest"— in this case with an offer to take Sardo back if it didn't work out—set an RMI pattern of calving off enterprises that are ripe to become self-sustaining for-profit businesses—four so far.

Since leaving RMI in 1987, Sardo has built Rising Sun from a tiny dining-room operation to a busy firm with a staff of ten designers and engineers, sought after by big developers and giant utility groups. The firm designs lighting for millions of square feet of new office space every year.

"We try to create more healthy working environments," Sardo said. "The cost for people dwarfs the cost for lighting." People working in healthy, comfortable spaces are more productive, so lighting can have a significantly favorable effect on a company's bottom line.

Smart lighting is good for retail businesses, too; lighting is a key part of modern merchandising. Managers from the local American Furniture Warehouse store came to Rising Sun to help them achieve more sales through effective lighting design. But Sardo sees this as an opportunity to strike a blow for the environment.

"What's really fun," he said, "is we can dramatically reduce the electricity consumption." *—Jeremy Heiman*

Robert Sardinsky and Rising Sun Enterprises have accumulated an impressive portfolio of lighting design and consulting work, embodied in buildings throughout the country. A lighting retrofit at Cable News Network's Atlanta headquarters building ten years ago has resulted in operation and maintenance savings of $237,756 annually, reaping an annual return on investment of 53 percent. Total payback on CNN's initial investment was achieved in 1.9 years. The new lighting saves over two million kilowatt-hours annually, eliminating the need for the burning of almost 3.5 million pounds of coal annually and avoiding the emission of nine million pounds of carbon dioxide into the atmosphere.

Rising Sun consulted on plans for Washington State University's new Student Recreation Center, a 160,000-square-foot building with an indoor pool. Lighting that Rising Sun designed for the building operates at 25 percent below the power usage mandated by Washington State's energy code. This job earned a 2001 International Illumination Design Award for interior lighting and energy efficiency from the Illuminating Engineering Society of North America.

This wasn't the first time Rising Sun won an IIDA. The company's work on the Millennium Plaza Park in Lake Oswego, Oregon was a 1999 IIDA winner. The company works in its local area, too. Rising Sun consulted on a lighting retrofit for the Red Brick Gymnasium, in a former school building converted into a community center in nearby Aspen. Replacing metal halide lamps with color-balanced linear fluorescents provides a 48-percent energy saving and illumination that gym users say is much easier on the eye. *—JH*

Joel Swisher, RMI Energy & Resources Services

Joel Swisher, leader of RMI's Energy & Resources Services team, is an energy engineer who tackles the most demanding consulting and analysis problems around. He has a Stanford Ph.D in environmental engineering and is a registered civil and mechanical engineer. He is advising the City of San Francisco on how best to use $100 million in bond money for solar and wind power, and he has authored more than 100 technical publications. However, on some weekends Swisher can be seen running at a blistering pace through the woods while looking at a compass.

Those weekend long-distance runs are done in the name of the physically- and mentally-demanding sport of orienteering. Maybe Swisher does it because of the enjoyment he gets out of burning a bunch of calories on the weekend after spending his weekdays saving energy. Or perhaps he enjoys plotting a course through the woods as much as he enjoys plotting a course toward energy independence. Whatever the reason, he has been orienteering for 20 years.

Swisher has participated both in this country and in Scandinavian countries, where the sport was invented and where it is still more popular than golf. In fact, his European experience enabled him to compete at the highest level when he returned to the United States.

At the start of an orienteering event, each participant is given a detailed topographical map marked with several destinations, called "control points," or "controls." A competitor must visit each control in order, finding them with only the map and a compass. The object of the game is to complete the course in less time than any of the other competitors. Most often, the participants are runners, but orienteering meets are sometimes conducted on cross-country skis or mountain bikes.

Swisher first experienced orienteering in the United States, about 20 years ago. Later, living in New Zealand in the mid-1980s, he participated more often. But he didn't get deeply involved in the sport until he was living in Sweden, from 1991 to 1993. Swedes are consumed with orienteering, Swisher said.

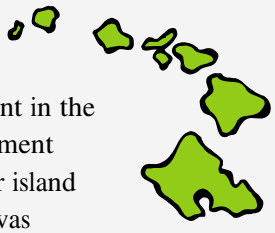
"It's like little league and the country club all rolled into one," he said. "It's really cool. You'll see two or three generations of a family—they'll all go to compete in their own age group," he explained. "It's really kind of nice to see mom and dad and grandma and the teenagers all out there." The family members compare notes on the difficulty of their courses after the meet. There's a big difference between Europe and America in the level of participation and the numbers of people at meets.

"In Sweden, almost everybody does it, but in the United States, it's kind of the Subaru *Outback* crowd," said Swisher, a serial Subaru owner himself.

He also participated frequently while living in Denmark. He estimates he ran in well over 100 meets during his four years in Europe. The events are held year round in the Scandinavian countries. Swisher, who joined RMI early in 2001, was a visiting professor at Sweden's Lund University, where he worked on energy efficiency research. In Denmark, he was an employee of the United Nations Environment Programme (UNEP), at that organization's Collaborating Centre on Energy and the Environment, an office dedicated to seeing that environmental problems and opportunities are incorporated into energy planning and policy worldwide. He speaks Swedish, German, Spanish, and Portuguese.

RMI *in the news*

RMI's Swisher Participates in Hawai'i Energy Roundtable



Joel Swisher, RMI's Energy & Resources Services team leader, was recently a key participant in the Hawai'i Energy Roundtable—aimed at creating concrete plans that will encourage the development of sustainable energy on The Big Island. The November roundtable's goal was to bring together island leaders and energy planning and economic development experts to produce plans. The event was sponsored by the Kohala Center and the Hawai'i Island Economic Development Board. Swisher led a panel session entitled "New Directions," spoke about "Small Is Profitable: The New Distributed Paradigm," and led a breakout session on addressing infrastructure challenges.

In the future the roundtable will look for new energy opportunities for Hawai'i, evaluate potential project ideas, recommend public and private actions, and implement portions of the energy plan.

Most often, orienteers start one by one on the course, with enough of a time gap so that a runner can't just follow the previous one to the next control point. Controls, generally located at mapped features such as a hilltop or the confluence of two streams, are marked with an orange and white flag. Adult orienteering courses generally have between ten and 20 control points, Swisher said, and may be five miles or more, while courses for kids are much shorter.

"The winter in Scandinavia is about eight months long and it's really dismal," he said. "It's tempting to just sit inside like a mushroom." The friendly competition provided motivation to get outside, maintain some fitness during the eight-month-long northern winters. Although orienteering is highly competitive in Europe, Swisher has done well in this country, winning the 40-to-44 age group event in the U.S. National Championships in 1998 and 2000. He also finished second in the championships in 2001 and 2002.

Swisher continues to compete around the United States for fun. His club, the Rocky Mountain Orienteering Club, had its annual week-long series of competitive meets in the Medicine Bow National Forest near Laramie this year, and he served as the course setter at one of the national championship events.

—Jeremy Heiman

RMI *in the news*

User-Friendly rmi.org is Saluted in Design Book

Rocky Mountain Institute's 615-plus-page website (www.rmi.org) was recently recognized in a new book on website design. *Designing Usable Web Interfaces*, released in August, is an instructional manual describing the process and architecture of website development. The book uses analogies and website examples as it explores the conceptualizing, planning, and designing of usable, efficient, and effective websites. RMI's website is included alongside sites by IBM, the Jane Goodall Institute, Rainforest Action Network, Volkswagen, and other noteworthy organizations.

The author, Ameeta Jadav, Ph.D, is Academic Director of media arts, animation, multimedia, and website design at the Art Institute of Atlanta. She told RMI that she has a bias towards websites that have to do with nature and environment; she chose www.rmi.org as an example of a good, usable interface in a section on "Navigation Aids and Interaction Design."

"I was also impressed with the fact that the RMI site has a lot of detailed content," she said. "The content is made accessible through an unassuming, simple, and consistent interface. Each page is clearly labeled and provides navigational cues that could help a visitor move around the site without feeling lost. I am especially impressed by the fact that most of the navigation and interface on the site is through text. This should mean minimal waiting time. I used the site as an example of text links. I feel that it effectively demonstrates the use of text links rather than the more expensive graphic links that one often finds on many sites."

"I am honored to have RMI's website included in the book," said RMI Webmaster Bill Simon.

On average www.rmi.org gets about 2,100 visitors per day. Although RMI's virtual visitors are primarily located in Australia, Canada, Europe, Japan, and the United States, the Institute also has users in such places as Costa Rica, Egypt, Kenya, and Trinidad and Tobago.

"Not everyone has the option of broadband (T-1 or DSL)," said Simon. "So our website is designed with slower Internet connections in mind. On a website, images can be memory hogs, so we use them primarily as location identifiers and, on occasion, to support or enhance text."

With over 615 web pages and nearly 150 PDFs (some running to hundreds of pages) on www.rmi.org, there is a lot of content to manage.

"We are constantly looking at improving page-loading speeds and downloading times," said Simon. "If we can make a page load quicker or a PDF download faster, we are saving someone time, energy, and maybe even frustration—it's one of those things you don't necessarily notice when it's fast, but you sure notice it when it's slow."

Designing Usable Web Interfaces (ISBN: 0-13-088854-0) is published by Prentice-Hall and available at bookstores and online.

Why Should Proponents of Sustainable Development Care about Deadly Conflict and Terrorism?

By John Richardson

In U.S. foreign defense and national security policy, terrorism now takes center stage. For us, terrorism is a new phenomenon. For most of the rest of the world, however, terrorism is only one manifestation of protracted, deadly conflict. U.S. citizens and leaders have much to learn from nations in which protracted deadly conflict has been an experience of years or even decades—Rwanda, Colombia, India, Pakistan, Sudan, Bosnia, Egypt, Palestine, Israel, and many others.

For the past 20 years, as a faculty member of American University's International Service School, I've used computer modeling to explore connections between development and deadly conflict. I came to focus on the question that forms the title of this article and on two other questions: (1) why are the good-hearted efforts of development practitioners so often coincident with escalating, protracted deadly conflict, and (2) how do we craft development scenarios that will be simultaneously peaceable, humane, and sustainable?

Why should we care?

Sustainable development advocates must address deadly conflict prevention because environment, development, and deadly conflict are part of one system. Development failures cause social pathologies that contribute to violent conflict. Violent conflict makes development failures more probable. In concert, development failure and violent conflict can create a pervasive, vicious cycle—and the outcomes can be devastating. Just a few days of deadly conflict can destroy physical, economic, and social infrastructures that took years and millions of dollars to create. Stable ecosystems that have required eons of evolution can be ravaged overnight.

I became aware of the relationship between environment, development, and deadly conflict in Tehran in 1975. At a luncheon commemorating the completion of a long-term development planning model for the Shah of Iran's government, I asked then Prime Minister Amir Abbas Hoveda if he was concerned with the potentially destabilizing social unrest that might be an unintended side effect of his government's aggressive development programs. "We know our people" was Dr. Hoveda's confident reply. Four years later, after several months of imprisonment and a brief hearing, he was sentenced to death by a revolutionary tribunal and immediately shot. The scenario that played out in Iran made me worry about the unintended consequences of development, in the Middle East and elsewhere.

The most cost-effective strategy for managing protracted deadly conflict is to prevent it altogether. Effective, sustainable development doesn't guarantee this, but it is a big help and must be championed by development practitioners.

There is another rationale for caring about conflict prevention: money. It is on conflict prevention (a.k.a. national security) that sovereign governments are most willing to expend not only their treasure, but the lives of their young men and women. Compare U.S. expenditures fighting terrorism with the paltry sums it has grudgingly spent on development since the days of the Marshall Plan. The opportunity costs of chronic deadly conflict are obviously just as big.

How do sustainability practitioners deal with deadly conflict?

Two legacies of global modeling, emphasized in the Brundtland Commission Report, point to ways in which practitioners might deal with deadly conflict. First, sustainable development must incorporate our grandchildren's quality of life, and our grandchildren's grandchildren's. The Brundtland Report compelled development practitioners to extend their time horizon; a time horizon extending out two generations made linkages between global carrying capacity and the exponential growth of population, capitalization, resource consumption, and pollution more salient.

More importantly, the Brundtland Commission Report validated a way of speaking about issues that enabled development practitioners and environmental advocates to see themselves as partners rather than competitors. Post-Brundtland, development and environ-

mental practitioners could unite on follow-up initiatives that included the Rio Conference on Environment and Development, the United Nations Framework Convention on Climate Change, the Kyoto Protocol, the Convention on Biological Diversity, the Convention to Combat Desertification, the Convention Concerning the Protection of the World Cultural and Natural Heritage, and most recently the conference in South Africa. The fact that U.S. government policy, under President George W. Bush's administration, now opposes some of these initiatives makes them more important, not less. We must hold on to this notion of shared efforts.

For the past 15 years or so, a Sri Lankan colleague, Professor Samarasinghe, and I have tracked the civil war in his nation. Using systems modeling methods, we examined the connections between development and deadly conflict. One of the more interesting aspects of modeling social systems is that their variables are connected via feedback loops. Examining Sri Lanka's feedback loops revealed that state-sanctioned violence and protracted deadly conflict are related to many interconnected issues, including development.

There are two basic types of feedback loops. Reinforcing Loops produce exponential growth and collapse patterns that economists sometimes call virtuous or vicious cycles. Balancing Loops produce equilibrating and goal-seeking patterns. The balancing of supply and demand—via prices in an economist's "perfect market" and the way the human body maintains its temperature at 98.6 degrees Fahrenheit in both cold and hot climates—are two examples of behavior produced by balancing loops.

A stable democracy manages conflict effectively by being open to political feedback about what is not working in the country and responding with remedial measures. It is a trial-and-error system. Possible remedial measures include changes in policies; if those are not sufficient, changes in leadership; if those are not sufficient, even changes in the constitutional "rules of the game." When a democracy is working well, the majority of a nation's residents are either sufficiently satisfied with the status quo or at least reasonably confident about the mechanisms that exist to make things better.

One-party states (like China and Singapore) and dictatorships (like North Korea, Burma, and Iraq) exhibit both stable and unstable forms that can be represented within the context of a deadly-conflict system model. Space does not permit the exploration of each, but that's not necessary because instabilities in each are linked to the same general set of causes. I call these the syndrome of escalating deadly conflict.

The syndrome of escalating deadly conflict?

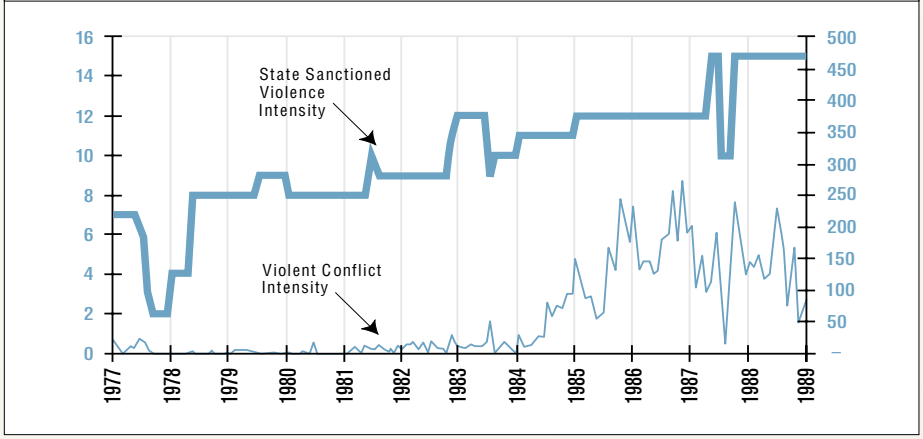
A syndrome is defined as the "concurrence of several symptoms in a disease." Instability dynamics in democracies, one-party states, and dictatorships, as well as the contending theories of deadly conflict escalation mentioned above, all share five common symptoms: deteriorating economic performance, increasing development failures, rising deprivation in ethnic groups, declining effectiveness of state-sanctioned violence, and the growth of militant movements.

These symptoms are linked in two reinforcing feedback loops, both with significant delays between causes and effects. Development is defined as "successful" when it is perceived by a country's residents as responding to their needs and aspirations; a failure when harming them.

Development failure usually triggers a cycle of deadly conflict, typically caused by some mix of bad policies, ineffective governance, and deteriorating economic circumstances. Policies that reduce development failures are the high-leverage interventions that can reverse trends caused by this loop, but implementing such policies becomes increasingly difficult because of the economic damage that violent conflict produces.

The other type of reinforcing feedback loop involves conflict escalation from the ineffectiveness of state-sanctioned violence. The agents of state-sanc-

State Sanctioned Violence and Violent Conflict Intensities in Sri Lanka's North and East



tioned violence—principally police forces and the army—will be ineffective when they lack resources or, are corrupt, undermanned, poorly trained, poorly led, and politicized. Bad policies and adverse economic conditions contribute to ineffectiveness. But violent conflict escalation due to development failures, evoking state-sanctioned violence that makes things even worse, is the more common scenario.

Policies that increase security force effectiveness, while maintaining high levels of state-sanctioned violence until violent conflict subsides, are the high-leverage interventions in this loop. Implementing these policies while a conflict is ongoing is difficult, however. Deteriorating economic performance complicates matters still further, especially since security force and development budget priorities will compete. This is why outside intervention, both to restore order and to restart the development process, is so often necessary.

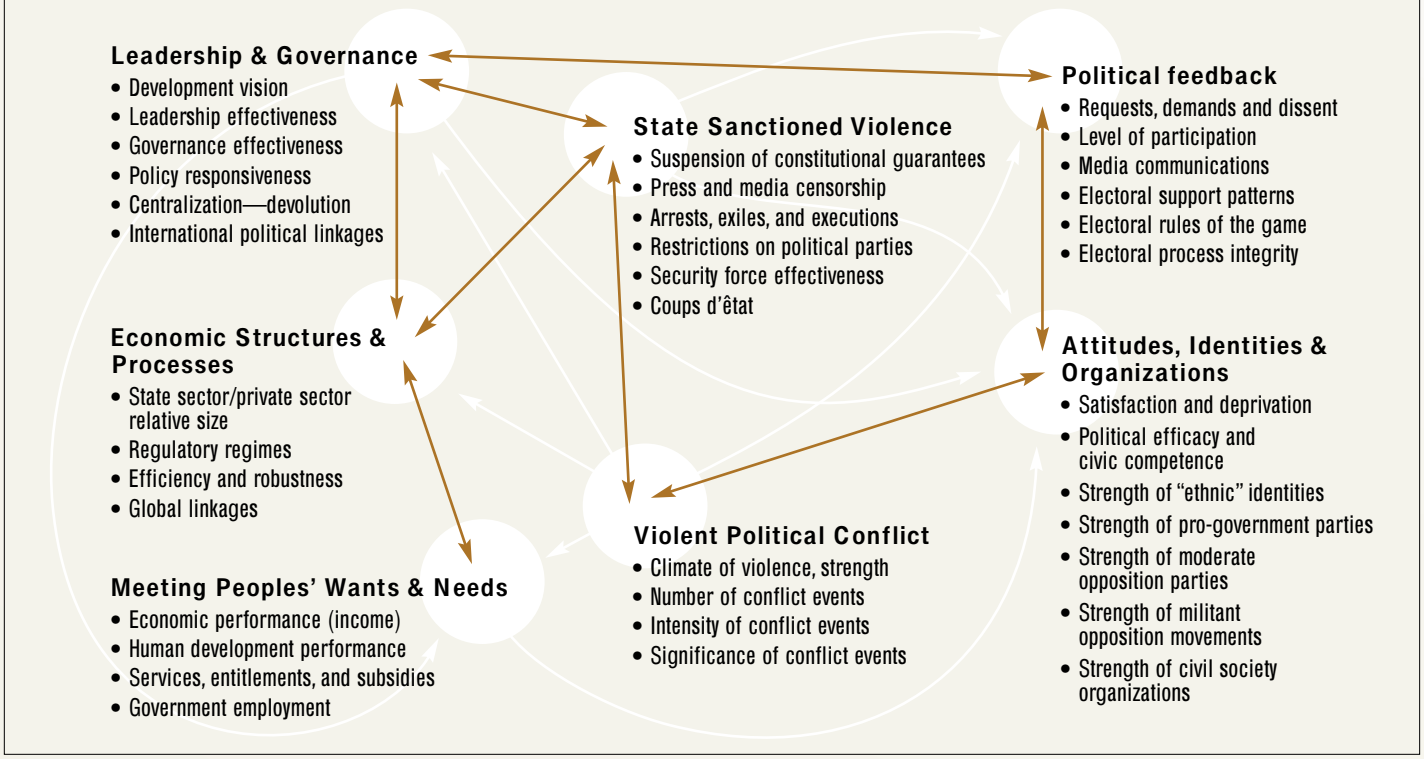
Lessons for politicians and practitioners

Clearly, we know more than enough to choose policies that will help prevent protracted deadly conflict and to avoid policies that will cause protracted deadly conflict. The situation is quite similar to our knowledge about the relationship between cigarette smoking and lung cancer. We know that smoking is a principal cause of lung cancer, though there are other causes. We know that refraining from smoking is the best way of avoiding lung cancer, though some nonsmokers may still contract the disease.

Our study of Sri Lanka's civil wars identified ten development failures which, if avoided or corrected, could have prevented or mitigated protracted deadly conflict. The seven most generally relevant are: (1) unsustainable entitlement programs, (2) polarizing political rhetoric and tactics that capitalize on ethnic differences, (3) failure to devolve power to local authorities—an "outstation" mentality in implementing development programs, (4) perpetuation of statist economic management schemes long after their economic inefficacy has been demonstrated, (5) structural adjustment reform policies that are over-ambitious and over-politicized, (6) politicization and ethnic homogenization of the police and military forces, and (7) attempting to subdue an ethnically motivated insurrection with police and military forces clearly incapable of attaining that goal.

These development failures correspond to smoking in my metaphor. The smoker's body corresponds to a country that the development/deadly-conflict system model represents. Protracted deadly conflict is the cancer that consumes and may destroy it. But a medical practitioner would not simply advocate abstinence; he or she might recommend regular exercise, a healthy diet, and a regimen of antioxidants. The pre-

Development—Deadly-Conflict System Model



scriptions of an ayurvedic physician, treating the body as a whole system, would include much more. "Avoid development failures" is an insufficient directive for preventing protracted deadly conflict. Politicians, practitioners, and the people upon whose support they ultimately depend need more proactive remedies. Many are little more than common sense, but that does not make them less useful.

Maintaining public order and preventing social turbulence from escalating into protracted deadly conflict are prerequisite to the success of all other development policies.

Polarizing political rhetoric and tactics should be forgone, however tempting their short-term benefits might seem. Like mustard gas, which had to be abandoned as a weapon in World War I, this strategy tends to drift back and settle on the user. Meeting the needs and aspirations of fighting-age young men should be the first priority of national development polices and of programs funded by international donors. Developing countries should have internal security forces (police and paramilitary) that are generously funded, professional, apolitical, and trained to meet the complex challenges of maintaining public order in a changing society. Development policies that meet human beings' common aspirations—to feel good about their lives, the circumstances in which they live, and future prospects for themselves and their children—will contribute most effectively to keeping violent conflict within acceptable bounds.

Those who frame development policies should seek a middle path between capitalism's efficient-but-Darwinian precepts and socialism's egalitarian-but-stultifying precepts.

Reinforcing Loops **produce exponential growth and collapse patterns that economists sometimes call virtuous or vicious cycles.**
Balancing Loops **produce equilibrating and goal-seeking patterns.**

Good governance and democratization should be part of the "successful development" mix. Most important are governance institutions that are open to bad news and self-correction. Multinational corporations, businesses, and business organizations should play a more active role in supporting successful development policies, good government, and democratization. Successful development requires a long-term view. Giving sufficient weight to the long term requires institutional mechanisms and discourses that extend beyond the next election or term of office. If policymakers are realistic about opportunity costs—the "what might have beens"—then there are few circumstances where they have no choice other than precipitating or escalating deadly conflict.

A role for proponents of sustainable development

How might proponents of sustainable development play a more effective role in preventing deadly conflict? The goal—promoting people-centered sustainable development—need not change, but it must be defined broadly so that development/deadly conflict linkages are more fully taken into account. I believe there is a more common vision of what this means than we may think. As Dana and Dennis Meadows and Jørgen Randers noted in *Beyond the Limits*, they include sustainability, efficiency, sufficiency, justice, equity and community, honest and respectful leaders, material sufficiency and security, communal norms, low death rates, low birth rates, stable populations, dignifying jobs, incentives, an economy that serves the human community and the environment, political structures that balance short-term and long-term considerations, political representation for our grandchildren, skills in the arts of nonviolent conflict resolution, and reasons for living and thinking well that don't require material possessions.

Protracted deadly conflict is predictable and preventable. Proponents of sustainable development and proponents of "internal security" should be functioning as colleagues, not inhabitants of distinct cultures that rarely communicate with one another. They share a common goal, to shape more humane and peaceable development scenarios. Such scenarios could make it unnecessary for future generations to contemplate protracted deadly conflict's legacies—devastation, suffering, and hopelessness. Our goal should be a day when no children, women, and men will have to look about them and ask in bewilderment, "How did we come to this?"

About the Author

John Richardson is Director of American University's Center for Teaching Excellence and Professor of International Development in the School of International Service, Washington DC. This article is adapted and condensed from an address given to members of the Balaton Group (the International Network of Resource Information Centers) at their September 2002 annual meeting, held in Csopak, Hungary. His new book, Development and Deadly Conflict: Lessons for Politicians and Practitioners from Sri Lanka's Civil Wars, *will be published by Sage, India, in 2003.*

Adele Simmons

Adele Simmons, a member of RMI's Board of Directors since the spring of 1999, is a big fan of RMI's work in China.

"If you can make progress in a place like China, the impact is huge," she said. With China's giant population and relatively undeveloped status, she noted, if efficiency measures are in place, the savings in energy and resources can be leveraged to a great extent as the nation develops. RMI has ongoing education and green building consulting projects in China, a semester-long graduate class in natural capitalism at Beijing's Peking University (see story, p. 1), and consulting work on a landmark green building project at the same university (p. 4).

Simmons first met RMI founders Amory Lovins and Hunter Lovins through her involvement with the John D. and Catherine T. MacArthur Foundation. She was its president from 1989 to 1999; Amory is the recipient of a MacArthur Fellowship.

After first meeting Amory Lovins in the late 1980s, Simmons visited RMI several times where she also met RMI cofounder Hunter Lovins. She was immediately impressed with the pair: "I liked their commitment to solving basic problems of sustainability," she said. Moreover, Amory and Hunter were not satisfied with making small changes here and there. They had the vision necessary to make sweeping changes. "What was important to me is that they were interested in changing people's thinking," she said.

Frequent family vacations to Snowmass Village made more regular visits possible, including tours of RMI's main building and the Windstar Land Conservancy. Simmons was already an acquaintance of Windstar co-founder John Denver—the two worked together on President Jimmy Carter's Commission on World Hunger.

Simmons holds down two day jobs. She is vice chair of Chicago Metropolis 2020, a group looking into growth management issues in the six-county Chicago area. And she is senior advisor to the World Economic Forum (WEF), an organization that provides a collaborative framework within which the world's government and business leaders address global issues. The issues are varied and big, ranging from globalization to world health. The WEF annual meeting in Davos, Switzerland has become one of the world's greatest idea exchanges—the world's most important and influential leaders go there to swap ideas and information. Amory Lovins and Hunter Lovins gave presentations on natural capitalism at the 1999 meeting.

Simmons also sits on the boards of The Union of Concerned Scientists, Environmental Defense, and Chicago's Field Museum. She is former president of Hampshire College in Amherst, Mass., where the School of Cognitive Science building now bears her name. She is a senior associate of the Center for International Studies at the University of Chicago and a director of Marsh & McLennan Companies. And she was a member of President George H.W. Bush's Council on Environmental Quality.

Simmons believes her long experience in the non-profit world prepared her for the RMI board, she believes her strengths lie in helping the board to function effectively and in providing Institute staff and managers with the support they need. She said she's certain the actions taken by RMI's board in the past year or two will be successful in making the consulting team more effective and strengthening the Institute's financial foundations.

Simmons' near-term hopes for the Institute are general, rather than specific. One goal is to push for the expansion of RMI's influence in the corporate world.

"My hope is that the consulting practice will develop and evolve," she said, noting her fascination with the concept of natural capitalism. "It involves business in the solution rather than treating business as the enemy."

—Jeremy Heiman

RMI *in the news*

Minnesota Foundation Seeks RMI's Advice on Rural Economic Development

In late November, staff from the Blandin Foundation assembled five experts, including RMI's Michael Kinsley, to critique its pilot program for strengthening rural Minnesota towns. Blandin is a Minnesota-based foundation dedicated to developing innovative thinking and problem-solving skills in rural leaders. Next year, the foundation's pilot "Community Advantage Leadership Program" will show leaders from several communities how to develop projects that could improve their local economies.

Blandin staff chose Kinsley for his extensive experience in sustainability and community-based economic development.

His Idea of Community Service? A Well-Built Human Environment

If there's one thing RMI supporter Jonathan Rose can tell you, it's that community service can be realized in many different—and sometimes not so-obvious—ways. High-quality design of the built environment is one aspect of community service because, as RMI has been advocating for years, happy, healthy inhabitants and workers are assets to any community.

"One reason so many people are against development is justified: so much of it is so bad," he explained recently. "We believe that if we are going to solve many of a community's problems, we are going to have to build the solution, so the design had better be worth living with for a long time."

Rose grew up learning all about high-quality urban planning. His childhood was spent in Scarsdale, NY, an older suburb of New York City where kids walked or cycled to everything—schools, the train, and the town center. There was (and still is) a wonderful preserve, Butler Woods, where the young Rose played. Rose's childhood environment was rich, yet he was well aware that people crafted it. His family, you see, runs one of the most socially responsible real estate development firms this country has ever seen, Rose Associates. Founded by Rose's grandfather and great uncle in the early 20th century, the firm has, since the 1920s, always built its projects within two blocks of a train or subway station, and it has always been deeply committed to affordable and middle-income housing. Indeed, Rose Associates built New York State's first state-funded affordable housing project, in 1930. Jonathan Rose's father, Frederick P. Rose, also dedicated a great deal to philanthropic work, giving both money and, more importantly, his time. "When I was younger, he spent most of his time helping social service agencies—building summer camps for poor urban youth, or things like schools for the deaf," Rose said, "As he grew older, he spent more time working on cultural projects, such as the Rose Center for Earth and Space."

The rest of the Rose family was and remains similarly involved. Sandra Priest Rose, Jonathan's mother, was an urban activist deeply committed to teaching teachers to read properly. For many years she has run the Reading Reform Foundation, which helps New York City public school teachers teach effectively. Jonathan's older sister Deborah works for the U.S. Public Health Survey, while his brother Adam is currently president of the family firm, Rose Associates. Jonathan's late brother Sam was a Ph.D psychologist, teacher, and author. Meanwhile, his wife Diana is president of the Garrison Institute. Their older daughter Ariel is a teacher; their younger daughter Rachel is a student.

At Yale, Jonathan Rose combined majors in Psychology and Philosophy, and co-led the Yale environmental action group, which ran the recycling program. Using his Advanced Placement credits, he took his last semester off and worked his way from Istanbul to Nepal overland (via Afghanistan) as a bus mechanic. Sitting in a small village in the Himalayas, he decided that planning was a positive transformative route to his goals.

He then headed off to earn a master's degree in regional planning from the University of Pennsylvania, which had one of the only environmental planning programs in the country.

Having learned a great deal from his father and having been inspired by his U. Penn. mentor Ian McHarg, Rose eventually formed his own planning firm, Jonathan Rose Co., which over the years has steadily grown. Today Jonathan Rose Companies have about two dozen employees in offices in Albuquerque, Denver, Katonah, N.Y., and Manhattan, with an affiliate in Washington, DC, and the companies currently manage about $300 million worth of development.

"We do five things," Rose explained. "We serve as planners for all or parts of communities; we help communities or not-for-profits develop projects; we do consulting work; we develop our own projects; and we acquire smart growth and telecom real estate, and are starting a smart growth acquisition fund."

Naturally, Rose's activities brought him in contact with RMI. He first heard of CEO Amory Lovins's work in 1975, when he was living in the Bay Area and volunteering at Friends of the Earth; there was much excitement about Lovins's then-forthcoming book *Soft Energy Paths*. In the late 1990s, Rose hired RMI to consult on green building systems for the Denver Dry Goods building, which in 1999 was selected by the American Institute of Architects as one of the 10 greenest buildings in the country. "Being a great admirer of RMI's approach, a combination of vision and practicality, I naturally became a supporter," he said. "Something every reader should do!"

RMI's and Jonathan Rose Companies certainly complement each other, and the future might bring more collaboration: "Our mission is to repair the fabric of communities," Rose said. "And there is a great deal of work to be done."

Generosity Comes in All Shapes and Sizes

Dale Levy, Development Director

Donors are incredibly creative and find unique ways of helping RMI. Read the three examples below and I think you'll agree with me.

About two years ago I met Robert Jones in Asheville, N.C., to thank him for his financial support and to get acquainted. Near the end of our conversation, Bob told me about his son Sam who was running the investment business he had started in Denver. Bob asked me whether RMI would consider a gift of gemstones in which he and his son had invested. Some two years later—this past December—we received from Sam Jones a box with one pear-shaped blue sapphire weighing 2.26 carats and 19 iolite gemstones weighing a total of 33.2 carats. The gemstones had been appraised at more than $10,000. What a gift indeed!

Now we're searching for one or more other creative friends who would like to purchase from RMI these gems for investment or to use in custom jewelry. If you're interested and would like to see photos of the gems, please contact me at dalelevy@rmi.org.

RMI Board member Brian Rosborough, his wife Lucy, and RMI friend Steven MacAusland organized an October dinner party for Boston-area donors and prospective donors. More than 20 attended the get-together that featured CEO Amory Lovins talking about a range of current and future projects and a lively question-and-answer period. This one event introduced 22 people to RMI for the first time, and resulted in several substantial gifts and the possibility of new consulting work for our Green Development Services team. What a wonderful start to building a wider base of support in the Boston area.

Two Adobe employees contacted RMI independently with the question: what software do you need that we might be able to donate? Susan Osofsky and Chris Quartetti, who both live in Palo Alto, Calif., bought the following software and have shipped it to RMI: InDesign, Illustrator, Premiere, five licenses of Acrobat, four licenses of Photoshop, and After Effects. What great and helpful donations!

To these and others who think of RMI in unique ways—including cash and stock gifts—thank you. Any gift that could help us is warmly appreciated and intensively applied.

"I have for years been looking for an organization that I felt was truly solving problems and not simply making noise. I am convinced that RMI meets these criteria, and I am happy to commit to a monthly donation...."

J. Patrick Carroll

RMI *in the news*

Browning Keynotes Sustainable Products Conference

In early December, Bill Browning, founder of RMI's Green Development Services, presented a keynote speech ("Natural Capitalism: New Lessons in Making Products, Vehicles and Buildings") as part of a three-day event called "Sustainable Products Training" in Sundance, Utah. The conference was sponsored by the State of Utah, the Colorado Department of Public Health and Environment, the Wyoming Department of Environmental Quality, and the National Park Service. The Sustainable Products Corporation designed the event to educate architects and product purchasers and specifiers about Sustainable Products Standards and their increased use in the marketplace. The training is a response to huge growth in green buildings and sustainable products for those buildings—growth that RMI has nurtured since the early 1990s.

Browning spoke on the increased profitability and economic benefits companies can achieve by using RMI's natural capitalism principles. Conference attendees also addressed the economic benefits of sustainable products and were provided with training in a new Economic Benefits Standard.

Our sincere appreciation is offered to these friends who have contributed to RMI between 1 September 2002 and 31 December 2002. Numbers in parentheses indicate multiple donations. Please let us know if your name has been omitted or misspelled so it can be corrected in the next issue.

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RMI *in the news*

Stanford Students Get a Word From the Wise

Joel Swisher, team leader of RMI's Energy and Resources Services, has begun teaching a graduate class on Greenhouse Gas (GHG) Management and Sustainable Energy at Stanford University. Swisher, the MAP/Ming Visiting Professor, is teaching the class through the Civil and Environmental Engineering Department during the winter and spring quarters of 2003. Swisher received both his advanced degrees from Stanford. The class will address GHG mitigation through energy efficiency and demand-side management, energy in high-technology industry, distributed power and co-generation, the role of renewable energy in GHG management, fuel cells and the hydrogen transition, carbon sequestration, policy options, carbon trading, and business strategies. Students enrolled in the class receive a complimentary copy of *The New Business Climate: A Guide to Lower Carbon Emissions and Better Business Performance* (p. 35).

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RMI *in the news*

Shell Global Solutions Gets Efficiency Stimulus

On 5–7 November 2002, members of RMI's Commercial & Industrial Services (CIS) team led an Innovation Workshop for Shell Global Solutions at the Woodside Petroleum facility in Karratha, Australia. Innovation workshops are intense three-day events in which RMI network experts creatively interact with members of a client organization and help them apply whole-systems solutions to design challenges. The RMI team included CEO Amory Lovins, CIS Team Leader Catherine Greener, and CIS team members Michael Kinsley, Jason Denner, and Joanie Henderson. During the workshop, the team found major opportunities for improving the economic and environmental performance of the giant facility—the world's second-largest liquefied natural gas plant.

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RMI *in the news*

NatCap Now Showing at a Television Near You

RMI is pleased to announce the release of "Natural Capitalism: A Presentation by Amory Lovins." Produced for corporate leaders and business innovators who want a condensed version of natural capitalism for corporate training seminars and employee meetings, this one-hour video is also an excellent resource for high school, college, and graduate-level teachers of resource efficiency and whole-systems design.

The high-quality VHS video outlines how the productivity of natural capital can be and is being increased. Lovins, co-founder and CEO of RMI, explains that before the Industrial Revolution made humans vastly more productive, low worker output and a relative scarcity of people were the main limits to exploiting a seemingly boundless natural world. Today the situation is reversed. Labor is abundant and productivity is high. But modern businesses are liquidating a huge and essential part their own capital—natural capital. That's because only two of the four kinds of capital—financial capital and manufactured capital—are correctly valued on today's balance sheets. The other two kinds, natural capital and human capital (labor, intelligence, and culture), are essentially unvalued.

"Natural Capitalism: A Presentation by Amory Lovins" shows how and where we can do far better. When we use power plants and light bulbs to turn coal into light, for example, up to 97 percent of the coal is wasted. Even worse, a modern car uses only one percent of its energy to move a person from Point A to Point B. What is needed is a radical increase in the productivity of natural capital—the resources, living systems, and ecosystem services that modern business takes for granted.

Lovins uses practical examples to explain how applying natural capitalism can make businesses not just sustainable but also more profitable by applying the four principles of natural capitalism: 1. Radically improving resource productivity, 2. Shifting to biologically inspired production, 3. Shifting from making and selling things to providing services in a way that rewards the first two steps, and 4. Reinvesting in natural and human capital. Production of "Natural Capitalism: A Presentation by Amory Lovins" was funded by The Educational Foundation of America. To order a copy, please visit www.rmi.org/store/p385pid2420.php, call 970-927-3851, or email pubs@rmi.org.

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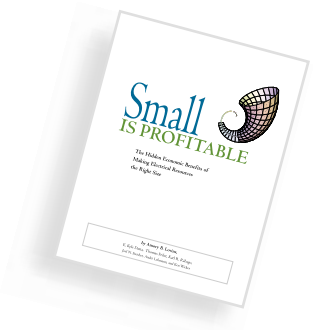

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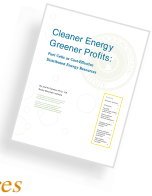

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About the Institute

RMI is an entrepreneurial nonprofit organization that fosters the efficient and restorative use of natural, human and other capital to make the world secure, just, prosperous, and life sustaining. We do this by inspiring business, civil society, and government to design integrative solutions that create true wealth.

Our staff shows corporations, communities, individuals, and governments how to create more wealth and employment, protect and enhance natural and human capital, increase profit and competitive advantage, and enjoy many other benefits—largely by doing what they do more efficiently.

Our work is independent, nonadversarial, and transideological, with a strong emphasis on market-based solutions.

Founded in 1982, Rocky Mountain Institute is a §501(c)(3)/509(a)(1) public charity. It has a staff of approximately 50. The Institute focuses its work in several main areas—business practices, climate, community economic development, energy, real-estate development, security, transportation, and water—and carries on international outreach and technical-exchange programs.

Hot Off the Press!

101 countries have ratified the Kyoto Protocol, which together represent 44 percent of total 1990 CO_2 emissions from Annex I countries.

A **Guide** to
Lower Carbon Emissions
and Better Business Performance

Own or manage a business? Then this book is for you. Efforts your company makes now to reduce its global warming impacts can be rewarded immediately. Markets are now in place for trading carbon emissions and reducing atmospheric carbon. Improvements in energy efficiency can cut your operating costs and build your bottom line. And new business opportunities are multiplying rapidly for companies and institutions that get involved in renewable energy, fuel cells, energy efficient products, and climate-change remediation technologies such as methane recovery.

Businesses can now learn all they need to know to become more profitable and efficient while reducing their global warming impacts from *The New Business Climate: A Guide to Lower Carbon Emissions and Better Business Performance*, published by Rocky Mountain Institute. This easy-to-follow guide is designed to be useful to businesses of all sizes, and is equally handy to government and educational institutions. *The New Business Climate* was researched and written by RMI principal Joel Swisher, a recognized authority on energy and carbon emissions issues. The attractive 100-page guidebook is richly illustrated with photos, diagrams, and tables. Recommendations for climate action (brief insights, or "punch lines," revealed by the author's experience with the study, analysis, and design of carbon management strategies) follow most sections of the book.

The *New Business Climate* reveals that, like the earth's climate, the climate in which business is conducted is changing. At some point, emissions of greenhouse gases such as carbon dioxide may be regulated in the United States, requiring actions and investments by the private sector to achieve compliance. In the near term, however, the Kyoto Protocol is expected to be in force soon. Canada ratified the agreement in December, bringing the total membership to 100, up from only 52 last spring. Only ratification by the Russian Federation is needed now for the protocol to go into force, and that nation's parliament is expected to act within months. Once Kyoto is in effect, any U.S. business hoping to attract clients in member nations will be placed at a competitive disadvantage. Some European Union members have already begun to impose greenhouse gas emission limits on transactions within their borders, and businesses that are first to deploy low-carbon technologies will most likely remain competitive.

The first voluntary U.S. pilot pro gram for reduction and trading of greenhouse gases is already open in Chicago, the nation's center of commodities trading. Credits for emission offset projects, solar and wind energy projects, and certain carbon sinks are being traded. A market-based approach, as RMI has long advocated, provides flexibility and incentives to find least-cost solutions for achieving carbon reduction targets and also provides direct financial incentives for controlling emissions.

There's action in DC, too, that could bring America into the carbon-constrained world. A domestic "cap-and-trade" system for controlling greenhouse gas emissions was proposed in a Senate bill on 8 January. The proposal would mandate the reduction of industrial carbon dioxide emissions and stimulate the carbon trading market. Introduced by Senators John McCain (R-Ariz.) and Joseph Lieberman (D-Conn.), the bill has received input from a group of prominent corporations. Although passage of this legislation is far from assured, it's another indication that changes in the way business is conducted in America, as well as the rest of the world, are well on their way.

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RMI Solutions NEWSLETTER

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