

# Solutions

SUMMER 2016  
VOL. 9 NO. 1

## Journal

### A WORLD OF OPPORTUNITY

Greening Energy in China and Beyond

HELPING CHINA INNOVATE NEW ENERGY SOLUTIONS

TAKING CLEAN ENERGY TO DEVELOPING NATIONS

PLUS: AMORY'S ANGLE, RMI'S INNOVATION CENTER, AND MORE



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### Our Printing and Paper

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# GLOBAL OPPORTUNITY

## Expanding Our Impact in China, Africa, the Caribbean, and Beyond

By Jules Kortenhorst

Just this past May, scientists predicted that at two carbon dioxide measuring stations in distant parts of the world—in Australia and Hawaii—the levels will not dip below 400 ppm again. The effects of climate change are visible everywhere, perhaps nowhere more so than on islands, greatly impacted by rising sea levels, increased storm intensity, and high energy costs. China, now the world’s largest emitter of greenhouse gases, is facing debilitating smog in many of its urban centers. And as emerging economies around the world continue to grow, they are expected to become major sources of air pollution and greenhouse gas emissions.

Although the world’s energy problems might

seem daunting, there is much reason for optimism. In the past year, President Obama and China’s President Xi Jinping reaffirmed their determination to move ahead decisively to implement domestic climate policies, to strengthen bilateral coordination and cooperation, and to promote the transition to low-carbon and climate-resilient economies. And in Paris, delegates from nearly 200 countries approved a historic agreement to address climate change.

Yet emerging economies and developing countries need our help to translate their Paris commitments into implementation plans. That is why Rocky Mountain Institute, with your help, is working to transform energy use on a global scale.

The Mauna Loa Observatory, in Hawaii, is the premier CO<sub>2</sub> monitoring station on the globe.



### GLOBAL REACH

In this issue of *Solutions Journal*, you will read about our work with the Chinese government and influential partners to deliver an economically compelling alternative development path for the country, through our Reinventing Fire: China program. You will discover how the Alliance of Peaking Pioneer Cities (APPC) is helping 23 Chinese cities peak carbon emissions early and low by providing technical support and resources, and how we are working with the APPC to create a peaking handbook that any Chinese city can use to do the same. You will also learn how we are freeing Caribbean and other islands from their dependence on expensive, imported oil, and helping increase access to affordable, reliable electricity in sub-Saharan Africa. Our Islands Energy Program and SEED Program (Sustainable Energy for Economic Development) are critical to these countries’ necessary integrated energy transitions.

As the world becomes more connected, and climate change affects each and every one of us, a global viewpoint is crucial. So we speak with our board member Maria van der Hoeven, former head of the International Energy Agency, about energy security and the importance of collaboration to transform our energy future.

### HELPING AT HOME

Of course, we are also working close to home. In this issue we take you on a photo tour of our new Innovation Center in Basalt, Colorado. Our net-zero energy office building serves as a “living lab” and a practical model to propel the industry toward deep green buildings.

These and other stories within these pages show that a clean energy future is within our grasp. But we need to act faster to reach the targets set in Paris, and keep global temperature rise well below 2 degrees Celsius. Through the international projects described in these pages—along with our work decreasing emissions of the global shipping and aviation industries, and in the U.S. accelerating the transition from fossil fuels to renewables, transforming mobility in cities, improving the efficiency of trucking, addressing fugitive methane emissions, and increasing building efficiency—RMI is working hard to help realize a global energy revolution.

But we can’t do it alone. Our industry and philanthropic partners are integral to our success. With your support, we can transform global energy use to create a clean, prosperous, and secure low-carbon future.

There is plenty of reason for optimism about addressing the world’s energy problems for the next generation.

Jules Kortenhorst is chief executive officer of Rocky Mountain Institute.

### GET INVOLVED

Philanthropic support makes RMI’s work possible. Join us by making a donation today to help create a clean, prosperous, and secure low-carbon future.

Give an unrestricted gift or target your gift to support an RMI project that addresses your passion.

[www.rmi.org/donate](http://www.rmi.org/donate)

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# SOFT ENERGY PATHS

## Lessons of the First 40 Years

By Amory B. Lovins

When the 1973 oil shock threatened security and prosperity, America's initial policy responses were confused and ineffectual. Intensifying business as usual—drilling oil and gas wells, building giant coal and nuclear plants, perhaps developing coal-to-liquids synfuels—was vigorously proposed, but soon began looking too costly, dirty, slow, and difficult. The huge capital requirement would choke off other needed investments and ultimately make energy prices soar, so faltering demand couldn't pay for the costly new supplies. Yet by autumn 1976, no coherent alternative vision had been articulated. Policy imagination was stuck.

At that teachable moment, my *Foreign Affairs* article "Energy Strategy: The Road Not Taken?" reframed the energy problem and added an alternative vision of U.S. energy strategy. The "hard path" was more of the same; the "soft path" combined energy efficiency with a shift to renewable supply. The article soon became that venerable journal's most-reprinted ever, spreading as virally as pre-Internet technologies permitted.

Forty years later, a review of its initial reception and continued influence shows what lessons have and haven't been learned.

### A LOOK BACK TO 1976

To this 28-year-old author, it felt like dropping a seed crystal into a supersaturated solution, suddenly crystallizing the liquid into a whole new form. A year later, President Carter invited me into the Oval Office to discuss the article. He now says he found it very helpful in forming his energy policy—apart from Energy Secretary Schlesinger's synfuels effort, the most coherently pro-efficiency-and-renewables policy before or since.

Incumbent energy industries greeted the article with skepticism, scorn, even outrage. A four-inch-thick Senate hearing record compiled three dozen pairs of critiques and responses. Nowadays it makes amusing reading, reminding us that 40 years ago energy efficiency was novel and controversial, while renewable energy was strange, threatening, or absurd. Some people still cling to those views.

When the hubbub died down, ARCO's chief economist, Dr. David Sternlight, nicely captured the conclusion of sober observers: He for one didn't care if I were only half right—that would be better performance than he'd seen from the rest of them. Over the next decade, the article's thesis gained enough credence that many of its harshest critics hired RMI, founded in 1982, to help them adopt it. By the current decade, two leading journals of the electricity industry generously recognized our approach's prescience, and the article's thesis has broadly prevailed in the energy marketplace.

The article was so influential because rather than just proposing yet another portfolio of energy investments, it redefined their purpose and logic. Previously, the problem was *where to get more energy*—more, of any kind, from any source, at any price. Planners extrapolated historic growth in energy demand and built supply to meet it. The article started at the other end by asking

what we want energy *for*—what "end-uses" we sought, such as hot showers, cold beer, mobility, comfort, smelted alumina, baked bread—and how to deliver each of those services by providing the amount, kind, scale, and source of energy best suited to the task. This end-use concept soon merged with Roger Sant's "least-cost" language, resonant with the emerging Reaganomics emphasis on free markets. The resulting "end-use/least-cost" approach revealed the most cost-effective solutions, chosen via competition or planning, to such questions as whether to keep warm in winter by gas or electric heating, or by insulation and weatherstripping.

Different questions yield different answers, so the article contrasted two ways the U.S. energy system could evolve (Figures 1A and 1B).

### SAVINGS: ACCURATELY ENVISAGED

A later scholarly review found the article had been the only one of dozens of mid-1970s studies with accurate foresight about total U.S. primary energy use in 2000 (foresight, but explicitly not a forecast, as it is often still mischaracterized). The soft path shown in Figure 1B is 0.8 or 4.0 percent below actual 2000 energy use, normalizing to actual GDP growth or not, respectively. But the best contemporaneous econometric forecasts were approximately 60–70 percent too high. Then in 2000–15, far from turning upwards, energy intensity fell by a further 24 percent.

Figure 2 compares the hypothetical energy-intensity trajectory the article suggested as feasible in 1976, falling 72 percent in 50 years, with its actual 56 percent fall in 40 years. The "near-halving" envisaged by "about the turn of the century" occurred in 2008.

To make a dollar of real GDP, the U.S. in 2015 used 56 percent less total primary energy than in 1975, 59 percent less coal, and 65 percent less oil and directly used natural gas. Coal's 2015 share of primary supply (16.0 percent) was below its previous post-World War II low (16.6 percent in 1972). Instead, the U.S. got 10 percent of its primary energy use and 14 percent of its electricity use from renewables, which were 68 percent of new added generating capacity.

Electricity is the costliest form of energy, yet Americans have saved electricity only half as fast

FIGURE 1A: A "hard" energy path representing government and industry forecasts of total U.S. energy use during 1975–2025.

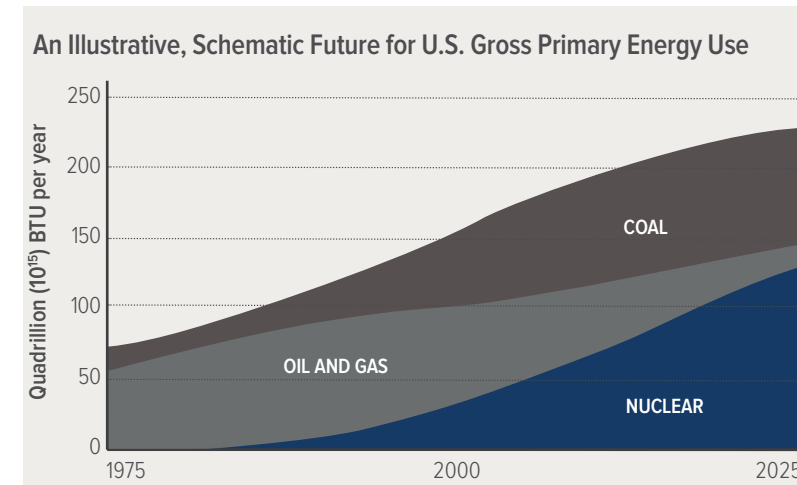


FIGURE 1B: An illustrative alternative "soft" energy path yielding the same GDP growth but combining efficient use with right-sized, right-quality, renewable, and widely accessible sources ("soft technologies").

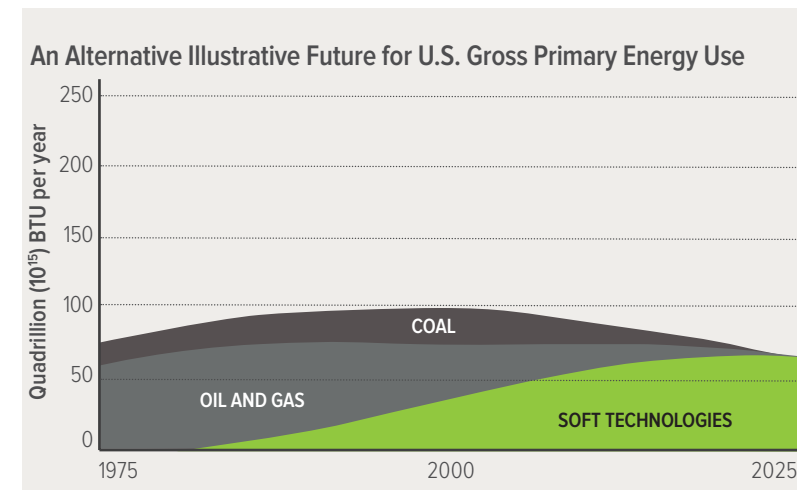
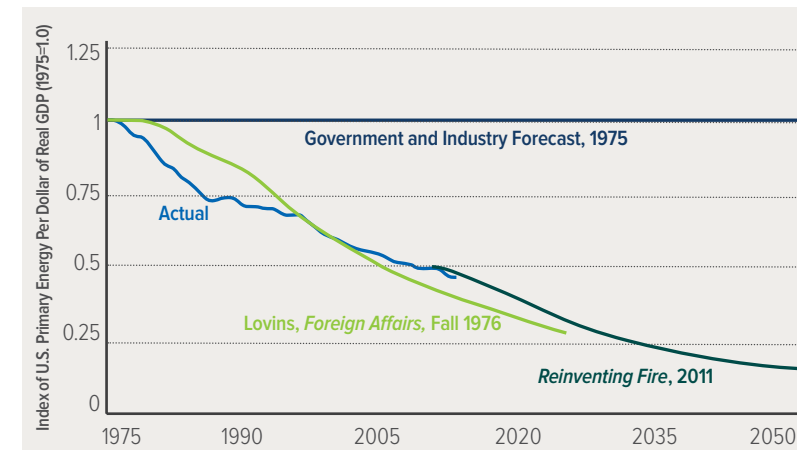


FIGURE 2: U.S. primary energy use per dollar of GDP ("energy intensity") as officially forecast around 1975, or as suggested by Lovins in 1976, compared with actual data—and with the threefold further gain found in RMI's *Reinventing Fire* (2011) to be feasible at even lower cost. The decreased intensity achieved so far is due roughly one-third to structural shifts in the economy, two-thirds to better technical efficiency.



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President Carter and Amory discussed the article in the Oval Office in 1977.



PHOTOS: top left, © Rocky Mountain Institute; bottom left, courtesy Amory B. Lovins



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The hard energy path required investments, infrastructure, and institutions that precluded the soft energy path.

as direct fuel. That's partly because until about 2001, 48 states' utilities were still rewarded for selling more energy; even now this is done in 36 states for electricity (with reforms pending in 8) and 28 for gas (with reforms pending in 4). But as such perverse policies begin to fade, electricity use has drifted down from its 2007 peak. In the long run it may shrink by about 1 percent a year despite solid economic growth and all-electric automobiles.

**SUPPLY TRANSITION: DELAYED BY CONTRARY POLICY**

The demand-side foresight of the projected soft path wasn't matched on the supply side (Figure 3). Though some states like California successfully pursued their own soft paths, powerful lobbies and hence national policy strongly favored the hard path in energy supply.

The differences between Figures 3A and 3B have three main causes affecting each element of supply:

- Natural gas was then thought to be a scarce byproduct of dwindling oil, so federal policy outlawed its power-plant use in 1978–87 and strongly promoted coal-fired generation instead. That vast coal fleet, long exempted from Nixon-era environmental laws, is only now fading while resurgent gas persists.
- Once President Ford got auto-efficiency standards passed into law in 1975 (effective 1978), U.S. oil intensity fell by an average of 5.2 percent per year. But the resulting 1985–86 oil price crash fostered complacency. This helped lobbyists persuade Congress to ignore—for 25 years for cars and for about 17 years for light trucks—the legal mandate to raise efficiency standards in step with technologies. Light-

vehicle efficiency worsened in 1987–2004, taking 22 years just to regain its 1987 level: The pace of saving oil fell by two-thirds, and approximately 99 percent of the major gains in engine efficiency boosted acceleration rather than saving fuel. Legislation was blocked until President G.W. Bush's 2007 update, then the new rules were suspended amid Detroit's distress a year later. This stagnation wasted two turnovers of the auto fleet, prolonging high oil demand for a quarter-century while oil interests sought to suppress competing biofuels.

- The rapid growth of “soft technologies” (diverse, right-sized, right-quality, widely accessible renewables) in Figures 1B and 3B, predicated on “aggressive support,” instead got largely hostile federal policies for 32 of the past 40 years. Even the fossil-fuel companies that invested in renewables impatiently dumped them just as they were poised for success. President Carter's 1978 PURPA law, which let independent and distributed generation compete fairly, enabled a false dawn of renewables in the early to mid-1980s. Though weakened by legal and regulatory attacks, PURPA destroyed the rationale for utility monopoly and laid the groundwork for today's competitive power markets, which now replace PURPA in half the nation. Thus after a long, bumpy detour, renewables since about 2010 have at last taken off as hoped in 1976—but roughly 35 years late.

**THINGS I GOT RIGHT**

Climate understanding isn't new. The 1976 *Foreign Affairs* article says of the hard path:

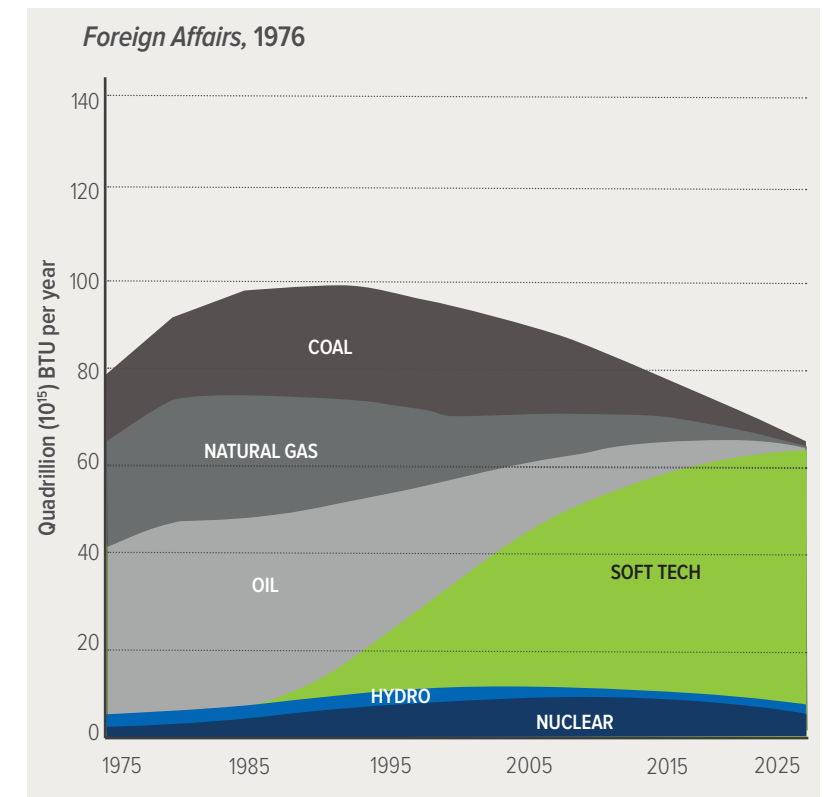
The commitment to a long-term coal economy many times the scale of today's makes the doubling of atmospheric carbon dioxide concentration early in the next century virtually unavoidable, with the prospect then or soon thereafter of substantial and perhaps irreversible changes in global climate. Only the exact date of such changes is in question.

Are we there yet? Cue the Clean Power Plan and the Paris Agreement.

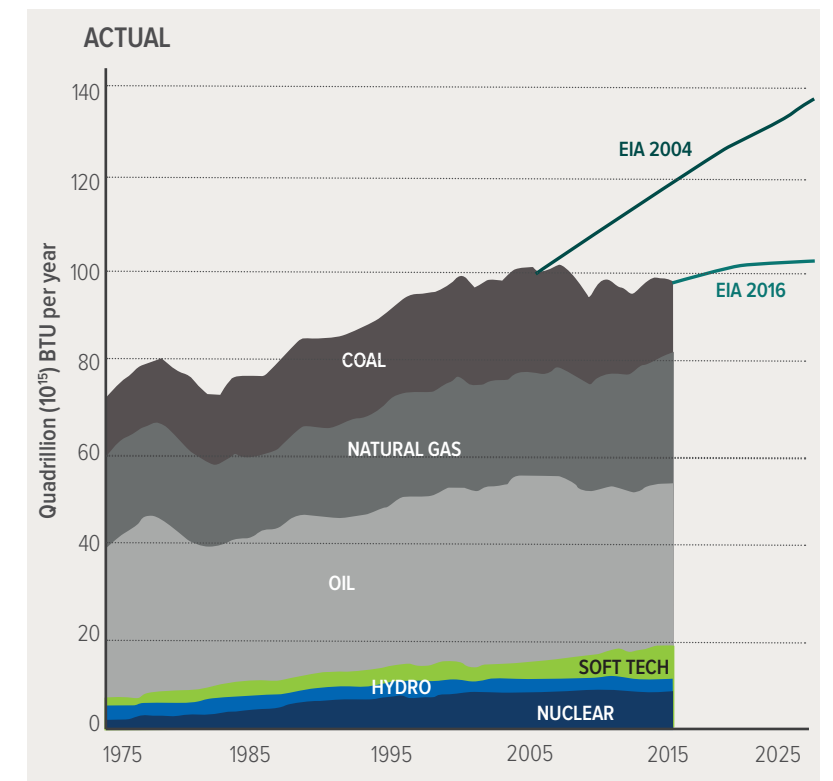
Anticipating RMI's 2002 book *Small Is Profitable* and today's market trends, the article says avoided grid costs and diseconomies of scale could reduce electricity costs, and “an affluent industrial

PHOTO: iStock.com

**FIGURE 3A:** Lovins's 1976 soft-energy-path sketch, with hydropower and nuclear power (explicitly omitted from Figure 1 as “minor and relatively constant”) added back by 2016 estimation applying similar methods to the information available in 1975.



**FIGURE 3B:** What happened instead, together with the Energy Information Administration's 2004 and 2016 Reference Case forecasts, declining to converge with reality. Actual 2015 primary consumption (97.5 QBTU) exceeded Figure 1B's by ~18.5 QBTU, of which 15.4 QBTU reflects the one-third smaller actual 2000–15 intensity decline shown in Figure 2. Figure 3A's soft technologies also avoid electrical system losses. Figure 1B excludes but Figure 3B includes feedstock uses (4.5 QBTU in 2011) for which this comparison doesn't adjust.



economy could advantageously operate with no central power stations at all!" It also notes that "Energy storage is often said to be a major problem of energy-income technologies." But partly since thermal storage is easier and cheaper than electrical storage to do the same tasks, "On the whole...energy storage is much less of a problem in a soft energy economy than in a hard one." So

## “One of the article’s most controversial claims—that soft and hard energy paths are mutually exclusive—has unfortunately been borne out.”

says the market today. Renewables' lower costs, risks, and hassles; favoring market-led over policy-driven adoption; and reinforcing individual and community choice are all now commonplace.

The hard path's political risks sound familiar too:

In contrast to the soft path's dependence on pluralistic consumer choice in deploying a myriad of small devices and refinements, the hard path depends on difficult, large-scale projects requiring a major social commitment under centralized management.... The hard path, sometimes portrayed as the bastion of free enterprise and free markets, would instead be a world of subsidies, \$100-billion bailouts, oligopolies, regulations, nationalization, eminent domain, corporate statism.

The grave vulnerabilities of overcentralized systems, later amplified in *Brittle Power* (1981/82), are also now visible.

Amory B. Lovins is  
cofounder, chief  
scientist, and chairman  
emeritus of Rocky  
Mountain Institute.

Other gratifying content from the article includes the utility death spiral, backcasting, integrative design (demonstrated in my house seven years later), institutional barriers and solutions, cogeneration, reliance on market principles and mechanisms, and utilities' financing customers' solar systems (though "solar" in 1976 meant solar-thermal, as photovoltaics were still "exotic").

### THINGS I'D CHANGE

The article's main error was about natural gas. Had the scientific community known in 1976 that U.S. gas is often unassociated with oil, quite abundant, and profitably recoverable from deep and tight

formations, I'd have treated it separately from oil, and emphasized natural gas rather than advanced coal as a transitional technique used "briefly and sparingly to build a bridge to the energy-income economy of 2025." These insights weren't obvious until the past decade.

The "temporary and modest (less than twofold at peak)" expansion of 1975 coal mining ended up at 2.16-fold due to the unnatural policy-driven suppression of gas and expansion of coal power. (Modern combined-cycle gas-fired power plants emerged only in the 1980s.) The climate-protecting vision of squeezing at least the oil part of the oil-and-gas wedge between efficiency and renewables is finally getting underway, and coal is now squeezed between efficiency, renewables, and gas.

The article's most consequential failure was not convincing policymakers to use the power of the U.S. example to slow or stop the spread of nuclear weapons. When I enlarged this argument in *Foreign Affairs* four years later, it again sank without trace because nuclear advocates dominated most nations' energy policy, as they still do in many including our own. Thirty years after that, far stronger evidence in *Foreign Policy* still had little effect. Therefore we worry today about self-inflicted risks from North Korea, Pakistan, and Iran.

### DEEPER LESSONS

One of the article's most controversial claims—that the soft and hard energy paths are mutually exclusive, because each requires investments, infrastructures, institutions, and attitudes that inhibit or preclude the other—has unfortunately been borne out. It's visible daily as hard and soft technologies fight for market share and political influence. Dangerous delays in the transition to a post-fossil-fuel and climate-safe energy system, the article warned in 1976, "are exactly what we can expect if we continue to devote so much money, time, skill, fuel, and political will to the hard technologies that are so demanding of them."

Slowly but with gathering speed, markets have begun to triumph over incumbents' political means of enforcing their natural desire to protect the old energy system, not enable the new. Yet the challenge of speeding that shift remains, while the imperatives of climate, public health, security, development, and democracy heighten its urgency. 🌱

# RMI-CWR IN BRIEF

## News From Around the Institute



Participants in NY Change Lab, convened by RMI in June, came together to address how low-income households can increase access to clean energy and its benefits.

### CLEAN ENERGY FOR LOW-INCOME HOUSEHOLDS IN NEW YORK

In June, RMI held the third meeting of the NY Change Lab, an initiative of RMI's e-Lab Leap program to increase access of low-income households and communities to energy efficiency and renewables. In total, 35 lab participants and 10 guest experts attended, representing more than 40 different organizations. These meetings strengthen the capacity for diverse stakeholders to work together, and enable progress on five unique lab initiatives designed to drive innovative solutions to low-income challenges. And in July, RMI piloted a workshop for accelerating the development and implementation of business models that provide low-income tenants with access to on-site solar, attended by 21 participants representing specific stakeholder roles.

### SHIPPING RETROFIT DEAL WINS BUSINESS GREEN AWARD

Business Green awarded its prestigious Energy Efficiency Project of the Year award to the landmark collaboration between shipowner Hammonia Reederei and charterer Intermarine, which was facilitated by a grant from Carbon War Room, an RMI business unit. The deal saw three vessels retrofit with multiple efficiency technologies, each expecting to see 25 percent fuel savings. The unique contractual agreement shares the risk and the profits between the shipowner and its charterer. The deal is a

model for the industry to achieve greater savings, while creating win-win scenarios for both charterers and owners. The grant was funded by the Dutch Postcode Lottery, which granted €1 million to Carbon War Room to expand its impact in the shipping industry.

### A BOOT CAMP TO TRANSFORM THE ELECTRICITY SECTOR

In April, RMI convened the third annual e-Lab Accelerator event, bringing together teams from throughout North America working on high-impact and innovative projects to address complex electricity system challenges and increase the deployment of distributed energy resources. Thirteen teams from Hawaii to New York brought a mix of decision makers—including state and city government officials, utility executives, and technology providers—to work on issues such as microgrids, zero-carbon communities, solar plus storage, resilience, and the integration of electric vehicles.

### A BUSINESS MODEL FOR NET-ZERO ENERGY DISTRICTS

RMI created an integrative business model for developing net-zero energy or ultra-low energy districts, in a way that is attractive to the district developer, parcel developer, and tenants, as well as beneficial to the local electric grid and neighboring community. The business model was developed specifically for Almono, a 180-acre development in Pittsburgh, and shows how pursuing net-zero energy is not a cost, but rather a significant value driver that can create new income streams. This innovative business model can be used to develop net-zero energy districts around the world, and China has already expressed great interest in the approach.

### ACCELERATING CORPORATE RENEWABLE ENERGY PROCUREMENT

RMI's Business Renewables Center (BRC) is streamlining and accelerating the procurement of renewable energy by some of the world's most influential companies. As of July 2016, there were more than 128 BRC members and over 4,000 MW of renewable energy deals completed by BRC members. The market impact is substantial: Clean Edge, a research and consulting firm, used BRC membership as a criterion to rank large corporations and determine which are clean energy leaders. The BRC continues to be at the center of the corporate renewables market to enable 60 GW of new renewables by 2030.

### + WEB EXTRA

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# RECIPE FOR LASTING CHANGE

## John “Mac” McQuown on what makes RMI tick

By David Labrador

John “Mac” McQuown knows a thing or two about innovation. *Bloomberg Markets* magazine described him as “one of the architects of the modern investing system” for, among other things, his role in pioneering the creation of the first stock index fund in the late ‘60s. Mac has been a strong supporter of RMI for nearly as long. “Amory and I go back to the late 1970s,” Mac said. “His point of view rang a responsive chord in me.” Part of RMI’s new Innovation Center is named for Mac and his wife, Leslie, because of their belief that the right ingredients for creating lasting change include out-of-the-way places like Basalt, Colorado, institutions like RMI, and philanthropists like them.

### UNEXPECTED INNOVATION HUBS

Mac and some others created the first stock index fund at what was then a small regional bank in San Francisco, far from the centers of financial orthodoxy. Mac says, “It’s interesting that some of the innovations in finance took root in San Francisco under the auspices of Wells Fargo bank, not at the big money-center banks in London or New York. That’s not an accident.” In much the same way, he says, “It’s pretty interesting that RMI emerged out of the head of Amory and a few other people 35 or 40 years ago in Colorado, and not at a particular bastion of higher learning; it certainly didn’t start in Washington.” He is convinced that original thinking should be supported where it is found, and that underlies his philanthropy to RMI

“That’s where innovation occurs,” Mac says, “where you get people and capital that come together that want to do it.” He’s been the creator who was grateful for “the attitude of a couple of CEOs back in the ‘60s and ‘70s who were willing to innovate,” and now he’s underwriting other innovators, in turn. “Those of us who were involved in the work at Wells get a lot of credit, but, I’ll tell you, even more credit goes to the management who were willing to put up a lot of capital over a long period of time in order to see that innovation through,” he says.

### CONFRONTING CLIMATE CHANGE

Mac’s passion for environmental stewardship stems from his youth as a farm boy in the Midwest. Life on his uncle’s farm was marked by thrift, conservation, and “a consciousness of what we were doing to the land upon which we lived and depended for our livelihood,” he says. “There was no throwaway culture.”

Mac always felt the importance of stewardship of land and water. But about 15 years ago, he joined the Director’s Council of the Scripps Institution of Oceanography in San Diego, and became immersed in Scripps work in atmospheric science, including its CO<sub>2</sub> measurements at the Mauna Loa Observatory in Hawaii (see photo on page 2). This data set, nearly 60 years in the making, is the foremost indicator of rising greenhouse gases, and it set Mac on a path to do what he could to combat climate change.

“I’ve been up front and personal with this research for a number of years now,” says Mac. “And it certainly has sensitized me to the need for we humans to start paying a whole lot more attention to the consequences of our consumption and production.” Does this have a bearing on Mac’s philanthropy? “It does,” he says, “for certain.” In 2010, Mac and Leslie made a \$25 million gift to the University of Chicago, where Mac works with a project on measuring the social cost of carbon. And they are strong supporters of RMI’s work.

### SUPPORTING THE RIGHT APPROACH

“We spend a fair amount of time paying attention to what’s actually going on at RMI,” Mac says. He and his wife believe strongly that institutions they support should be apolitical and committed to openness and innovation. “We don’t give to any institute or any pursuit that doesn’t have these critical

characteristics. We sit back and pay attention to it before we do it, and RMI passes muster, in spades.”

“The best example I can think of is *Reinventing Fire: China*,” Mac says. Mac bought the original, U.S.-focused *Reinventing Fire* book when it was first published, and gave copies to many friends, including some Sinophiles like Jack Wadsworth. “We began to ask: suppose you looked at China through the lens of *Reinventing Fire*, what picture would emerge?” Mac and Jack became major

**“It’s pretty interesting that RMI emerged out of the head of Amory and a few other people 35 or 40 years ago in Colorado, and not at a particular bastion of higher learning.”**

supporters of the *Reinventing Fire: China* project (see page 14). “In order to do that, we had to have a lot of confidence in the ability of RMI to focus on a critical issue and bring the right kind of intelligence and data to the problem,” Mac says. “What does Amory say? ‘In God we trust; all others bring data.’”

### CLEAN ENERGY FUTURE AT HOME, TOO

Mac and Leslie are immersed in the kind of transformative energy work in which RMI is a leader. They are building a microgrid at their Sonoma farm, testing several cutting-edge clean energy technologies. Arresting climate change is “going to take data and engineering and free markets,” Mac says, and he’s collecting some of that data himself. In addition to three separate battery systems and about three-quarters of a megawatt of generating capacity, Mac says, “We’re electrolyzing gray water to produce our own hydrogen. It’s under study by a team from MIT. Everything’s being measured and it’s all open source.”

The point is that “We’re going to have go through a major process of technological substitution,” he says. “First of all, we’ve got to figure out what technological substitutions we really need to do.” This spirit of experimentation underlies the test bed microgrid at the Innovation Center and at the Amory Lovins Green Home, RMI’s first headquarters. It’s key to RMI’s theory of change, and is a big part of why Mac has been supporting Amory and RMI for nearly 40 years. 🌱

John and Leslie McQuown at their Sonoma farm, where they are immersed in transformative energy work.

David Labrador is a writer/editor at Rocky Mountain Institute.

### WEB EXTRA

For more information on this topic visit: [rmi.org/our\\_goals](http://rmi.org/our_goals)

# GLOBAL PERSPECTIVE

## Maria van der Hoeven on energy security, energy access, and collaboration

Interviewed by Laurie Guevara-Stone

**A** member of RMI's Board of Trustees since October 2015, Maria van der Hoeven has had a long career working on challenging modern energy issues. She served as executive director of the International Energy Agency from 2011 to 2015, was on the Advisory Board for the UN Sustainable Energy for All initiative, and served as minister of economic affairs of the Netherlands and as Dutch minister of education, culture, and science. *Solutions Journal* recently spoke with Ms. Van der Hoeven about critical global energy issues.

***Solutions Journal:*** You spent four years as executive director of the International Energy Agency, which focuses on energy security. How do renewables and efficiency, and by extension RMI's work in those areas, help improve energy security?

**Maria van der Hoeven:** The IEA started in 1974, during the height of the oil crisis, and focused on oil, then gas, then coal, as an answer to the energy crisis. But energy security means you have affordable, reliable, uninterrupted energy for all, and renewable energy and energy efficiency are a big part of that. You can't have energy security without reliable locally sourced power. So in 2012 and 2013 we put out midterm reports on renewables and energy efficiency, the first time the IEA addressed those issues. It was quite apparent to me and to many others that those two issues are a huge part of energy security.

***SJ:*** You also worked with the UN Sustainable Energy for All initiative. What do you think the biggest challenges and opportunities are for bringing access to sustainable electricity to developing countries?

**MVH:** One of the biggest challenges is the sheer numbers involved. We have 1.2 billion people on the planet without access to electricity. Many of these people live in sub-Saharan Africa and Asia, where there is a huge growth in energy demand and in population. So when we talk about a million

people—or even tens of millions of people—getting out of energy poverty, the number of people left is still huge. How to help people get out of energy poverty is another challenge, and an opportunity as well.

Even though there are a lot of projects happening, to make a project sustainable one must take a whole-systems approach. Too often, when an organization implements a project and then leaves, the project disappears. The organization has not taken into account the supply chain, the service chain, added value, capacity building, and other important issues. That's why RMI's project in Rwanda is an excellent test case (see page 22). We are bringing all of these things together and doing it with all the different stakeholders, including the government.

***SJ:*** What do you think is the most critical energy issue globally today?

**MVH:** We are living in a moment of growing geopolitical tension. This makes it harder to collaborate. But we need to collaborate on carbon and emissions reductions. Take, for instance, the INDCs [intended nationally determined contributions] from COP21. To reach these targets, countries need to work together. The INDCs will definitely be difficult to achieve. Right now they're still on paper. The proof is going to be seen in the next five years. But if developed and developing countries work together, we can reach our targets.

***SJ:*** The IEA publishes a yearly *World Energy Outlook*, an incredible source of energy market analysis and projections. What do you think the energy mix will look like in 2050?

**MVH:** The World Energy Outlooks use different scenarios based on different policies to project outcomes. It is clear that different policies get you to a different outcome. In the most positive one we stay within two degrees, and in another scenario we may go beyond six degrees.

My hope is that everything that has been said and been promised about phasing out coal and putting a price on coal and carbon is going to happen. But it depends on how well policymakers will work to make it happen. In 2050, we will still have fossil fuels, not only in power generation, but also in other parts of industry. But it will be and needs to be less than now. That's where energy efficiency comes in, and of course renewable energy, and even innovation in fossil fuels. What RMI is doing now to reduce fugitive methane emissions is excellent;

it is also part of the solution. When policy, innovation, and the market all come together, change can happen.

***SJ:*** The June 2016 *World Energy Outlook* focuses on energy and air pollution. How do market-based approaches help address these issues? And do you think it's possible to solve the world's air pollution problem while also sustaining economic growth?

**MVH:** There are quite a few countries where the word "climate" doesn't resonate as much as in other countries. In China for example, air pollution is a huge problem, caused by coal-fired power plants (see page 14). That's why focusing on air pollution can

### “Focusing on air pollution can be a great vehicle to limit fossil fuels.”

be a great vehicle to limit fossil fuels. Many people say coal is cheap, but coal isn't cheap at all. Buying coal is cheap, but the use of coal brings in a lot of costs—health costs, environmental costs, and more. It's important to show people who don't believe in the climate issue that air pollution is a huge problem that needs to be improved. And yes, it is definitely possible to solve the air pollution problem while sustaining economic growth. There are examples from all over the world where there has been a decoupling of the two, for example, in both the U.S. and China.

***SJ:*** What excites you most about our work?

**MVH:** One exciting thing for me about RMI is the commitment and engagement of the staff and donors. There are so many people who want to work with us. Not only do we have dedicated donors, but we have an incredibly committed, dedicated, and skillful staff. That kind of engagement is exciting. You can have the money, but without the right staff, you can't deliver, and vice versa. Another thing is that RMI is well respected. Being an independent nonprofit gives the organization a lot of credibility.

I also like that RMI is working on disruptive approaches. But what really makes the difference is the approach—getting business involved, getting innovation involved, and getting the financial world involved. Programs like e-Lab and the Business Renewables Center are excellent, bringing together innovation and industry. That makes it possible to scale up. And in the end, we need to have a certain scale and impact to make a difference. 🌱

*Laurie Guevara-Stone is a writer/ editor at Rocky Mountain Institute.*

**+** WEB EXTRA

For more information on this topic visit: [rmi.org/international](http://rmi.org/international)



# CLEARING THE AIR IN CHINA

Rocky Mountain Institute works with China to peak carbon emissions early and low, and to follow a clean energy pathway for its large and growing economy

By Kate Chrisman



Pollution in much of China is an urgent public health crisis—and a climate crisis.

On a fall day in 2015, RMI's Beijing staff woke up to off-the-chart pollution levels. The city issued its first ever “red alert,” warning residents to stay indoors and take precautionary measures. Days like these—when air pollution levels exceed 200 parts per million (ppm), way over the World Health Organization's recommendation of less than 10 ppm—are far too common.

Air pollution is just one of the many physical manifestations of an energy system built on fossil fuels, but China faces challenges larger than smog. Some thirty years ago, China's skylines were mostly buildings of five stories or fewer and the country was a net exporter of oil. On a global scale, the country's contributions to carbon emissions and energy use were negligible. Today China is the world's largest carbon emitter, the world's largest net importer of oil, and the world's factory. Four of mainland China's cities—Shanghai, Chongqing, Guangzhou, and Shenzhen—rank in the top ten for cities with the most skyscrapers in the world.

The changing skyline of China's biggest, and its smallest, cities alludes to a larger development picture. China is urbanizing faster than any

other major nation in the world, and it's doing so at crucial point in history—when the world is collectively facing the challenges and dangers of climate change. Now China is being asked to grow without polluting and at the same time to be the world's factory at rock-bottom prices.

The outlook could be dire, but a combination of domestic initiatives (China is already a world leader in renewable energy) and pan-Pacific partnerships is changing the equation. In June 2014, after decades of rapid economic growth fueled primarily by fossil fuels, China's President Xi Jinping called for “a revolution in the production and consumption of energy.” Subsequent actions and public commitments by the government indicate a strong desire to fulfill this vision.

At RMI, we imagine a China that not only runs on renewable energy, but is a global leader in the movement toward clean fuels. We imagine a China that blazes a path for all developing countries, proving that clean energy can be a powerful instrument of economic growth. And we imagine a China where access to energy is equitable and affordable. From conducting groundbreaking research, to convening influential players in

China's industry, to assisting cities to peak carbon emissions sooner, we are working tirelessly to make this vision a reality.

But this vision cannot be accomplished alone. Problems in China come in one size: bigger. Efforts to tackle those problems must be ambitious and incorporate the top thinking from governments, companies, and nongovernmental organizations (NGOs). At RMI, we are dedicated to helping solve China's greatest energy problems by partnering with leading organizations to effect change.

### CHARTING A CLEAN ENERGY PATH

In 2011, RMI published *Reinventing Fire*, a clean energy roadmap for the United States. It outlined a bold economic strategy to transition the U.S. off coal and oil by 2050 by aggressively deploying energy efficiency and renewables. A key to achieving the economic success in *Reinventing Fire*—a \$5 trillion cost savings compared to the current trajectory—is the integrated transformation of the buildings, electricity, transportation, and industry sectors.

Because of the power of *Reinventing Fire* in the U.S., forward-thinking RMI supporters asked whether

a similar approach might be applied to China. The rationale was simple: If the U.S. was dependent on coal, China was downright addicted. In fact, China uses almost as much coal as the rest of the world combined. But like any addiction, coal use has a dangerous side: It contributes to climate change and pollution. Moreover, RMI recognized that without China, any efforts to combat climate change would inherently fall short.

In 2013, with donor support, RMI launched *Reinventing Fire: China* to develop an energy plan for China that integrates the largest sectors of the country's economy to generate massive economic and energy savings.

*Reinventing Fire: China* is a partnership between RMI and three organizations that have decades of leadership in China. Our Chinese partner, Energy Research Institute (ERI), is a government think tank that helps set national policy on energy issues. This gave us an inside look at the challenges China faces, as well as the opportunities to shape the future (see page 20 for ERI's view on the partnership). Our U.S. partner is the China Energy Group at Lawrence Berkeley National Laboratory (LBNL), an organization that has been active in China since 1988 and has an impeccable reputation for pushing energy efficiency forward and driving low-carbon solutions in China. And finally, Energy Foundation China (part of the San Francisco-based Energy Foundation), an established advisor to the Chinese government and a grant-making charity organization, has helped fund and shape the clean energy and environmental revolution, advocating the adoption of supportive policies that deliver the *Reinventing Fire* vision.

**“We imagine a China that blazes a path for all developing countries, proving that clean energy can be a powerful instrument of economic growth.”**

“When we initially thought about how to transform the Chinese energy economy, we knew we had to partner with the best minds already working in the space,” says Jon Creyts, a managing director at RMI and director of its China Program. “Our partnership with complementary expert teams led by Dai Yande from ERI and Lynn Price from LBNL has resulted

in extraordinary fact-based insights. Together, we are now using those findings to drive real change.”

For the past three years, over 40 scientists on both sides of the Pacific have been developing one of the most comprehensive and sophisticated models on China’s energy use yet, and plotting a revolutionary yet practical pathway toward a sustainable, clean energy system for China. The project shows how different stakeholders with a similar vision for the future, each with their own strengths, can effectively work across borders, languages, and cultures to accelerate progress together.

In the forthcoming publication *Reinventing Fire: China*, we show how China can grow its economy while making an aggressive transition to a low-carbon society. The high-level conclusions are inspiring and exciting, showing how China can:

- **Cut the use of coal:** In 2050, China could use 60 percent less coal than it did in 2010.
- **Dramatically increase the use of nonfossil energy:** In 2050, non-emitting electricity sources could generate 82 percent of China’s electricity needs.
- **Limit 2050 energy use to 2010 levels:** By 2050, China could use approximately the same amount of energy it did in 2010 (but with significantly more renewable power) and still grow its economy 600 percent over that timeframe, providing a better standard of living for its people.
- **Decouple economic growth from carbon emissions:** Carbon emissions could peak in 2025—far more quickly than a business-as-

usual scenario—and carbon intensity (carbon emissions per unit of GDP) could drop 93 percent by 2050, compared with 2005 levels.

- **Achieve these results and realize a net savings:** China could save \$3.3 trillion by following the path laid out in *Reinventing Fire: China*.

What’s more, the research has already informed the bilateral agreements announced by President Xi Jinping and President Barack Obama in November 2014 and March 2015; contributed to China’s planning process in the lead up to the Paris Agreement; and provided key insights to the energy authors of China’s 13th Five-Year Plan, which guides the country’s social and economic development.

Our partnership with ERI, LBNL, and Energy Foundation China will continue after we publish *Reinventing Fire: China*. All four organizations are already taking the findings beyond the pages and helping to realize them through national, provincial, city-level, and pilot projects. RMI now has our sights set on driving deeper and faster impact, continuing our existing partnership and forging new ones.

## ON-THE-GROUND CHANGE

One way we’re expanding our involvement in China beyond the *Reinventing Fire* project is through our work with the Alliance of Peaking Pioneer Cities (APPC), which we’ve supported since its founding at the 2015 U.S.–China Climate Leaders Summit. The APPC is a group of Chinese cities and provinces committed to peak carbon

emissions earlier than the national goal of 2030. “Chinese cities are where many of the policies and strategies need to be implemented to peak carbon emissions and transition to renewable energy,” says Li Ting, a principal with RMI and head of the Beijing office. “Successfully achieving China’s national goals requires urgent city leadership.”

Indeed, China is rapidly urbanizing. Less than a decade ago, more than half of the population was rural. By 2030, more than 70 percent of the population will live in cities. With support from the national government, the APPC is shepherding 23 cities to peak carbon emissions early and low by providing technical support and resources. Under the leadership of China’s National Development and Reform Commission, the APPC expects its membership to reach 100 cities in the near future.

“RMI is excited to support the APPC in finding ways to peak its member cities’ carbon emissions faster and lower, and in finding ways to scale what is learned rapidly to other cities,” says Li. This spring, RMI teamed with the APPC to share the progress that pioneering cities have already made on peaking plans and how other cities can replicate successful programs. The results of that work were published at the second U.S.–China Climate Leaders Summit held in Beijing in June.

But understanding what cities have done is not enough—cities need help developing and implementing emission peaking plans. That is why RMI brought together more than 20 other nonprofits, government bodies, universities, think tanks, and institutions to organize the best work already done on this topic. RMI is now working with the APPC to draft a comprehensive emissions peaking handbook that any Chinese city can use. The handbook will be released late this fall, but the collaborative team is already working closely with cities to ensure that it meets their needs. These efforts are all aimed at one goal: help the APPC orchestrate activity to ensure cities curb emissions faster and more aggressively than otherwise possible. RMI will continue to work with the APPC to establish standard interventions and tools, help share and institutionalize successes from both sides of the Pacific, and help cities track progress.

In another city-focused project, earlier this year RMI teamed with LBNL and Energy Foundation to conduct a peaking analysis for Wuhan, an industrial city of 8.3 million people 500 miles west



of Shanghai. With LBNL’s modeling expertise, RMI’s focus on economics, Energy Foundation’s policy experience, and other local expertise, the team helped identify targets and program priorities to shift Wuhan toward a cleaner energy profile. By continuing to develop progressive pilot projects such as this one, and working closely with private sector partners, RMI is helping to demonstrate clear cases for how China can leverage business to tackle climate change. This is just the first step in an ongoing collaboration with Wuhan and other cities.

## TRANSFORMING POWER, TRUCKING

Cities are an important catalyst for change, but some problems are best tackled at the national or sector level. One of the biggest challenges China faces is decarbonizing its power supply. In fact, China’s power sector accounts for 10 percent of global emissions and 25 percent of global coal consumption. Entrenched interests and old dispatch models make incorporating renewable energy and utilizing innovative programs difficult.

Guiyang is one of the Alliance of Peaking Pioneer Cities, committed to peak its carbon emissions earlier than the national goal of 2030.



More than 50 industry and government leaders from China’s trucking and logistics sector gathered in April for a two-day charrette RMI held to explore ways to reduce carbon emissions and pollution while saving money.

RMI is working on bringing new models to China, including green dispatch, to shift the energy supply. Initial estimates show that even simple reforms in how China utilizes its generating fleet can save 10 percent of emissions *today*, resulting in almost 1 percent reduction in global emissions.

“RMI’s work to reform China’s power dispatch is one of the best opportunities to cut carbon emissions globally,” says Cyril Yee, an RMI principal. “By prioritizing its most efficient generating units and renewables, China can reduce global carbon emissions while saving billions of dollars. This does not require expensive capital investments, just regulatory and operational reforms.” But the government needs good counsel and support to realize its ambitions. RMI’s years of electricity reform experience can inform, align, and accelerate the actions that will capture the opportunity.

At the sector level, RMI has been working to improve efficiency in Chinese trucking and logistics. In April 2016, RMI held a two-day charrette in Shenzhen, which brought together more than 50 industry and government leaders from the sector to better understand and capture opportunities for reducing pollution and carbon emissions while saving money. From the solutions identified at the workshop, RMI is working with partners to develop a regional pilot freight program in Guangdong province with hopes to scale it nationally. This and other ideas from the charrette can help improve the efficiency of Chinese logistics markets and ultimately reduce costs, reduce carbon emissions, support sustainable economic growth, and improve public health and urban quality of life.

“Our Shenzhen transportation charrette brought together some of the most influential players from the transportation field in a way rarely done in China,” says Wang Zhe, an RMI associate. “Having such frank conversations about what is going right and wrong helps lay a foundation for building successful programs and strong partnerships.”

All of these cooperative efforts between the U.S. and China are just the beginning of the journey toward rewriting the global energy story. *Reinventing Fire: China* maps a path for one nation, yet Beijing’s work moving forward should help blaze the path for other developing economies, proving that clean energy can be a powerful instrument of economic growth. Together with our partners, RMI is proud to be a leader in the pursuit of this future reality. 🌱

*Kate Chrisman is a senior research associate at Rocky Mountain Institute. She is the editor of Reinventing Fire: China. Previously she lived and worked in Beijing, Shanghai, Singapore, and Taiwan.*

**+** **WEB EXTRA**  
For more information on this topic visit: [rmi.org/reinventing\\_fire\\_china](http://rmi.org/reinventing_fire_china)

# A PARTNER'S PERSPECTIVE

## Mr. Dai Yande

Interviewed by Kitty Bu

**S**olutions Journal is pleased to have recently had the opportunity to discuss RMI’s partnership with China’s Energy Research Institute (ERI) with its deputy director, Mr. Dai Yande (far left in the photo). A Chinese think tank that’s part of the National Development and Reform Commission, Energy Research Institute is one of RMI’s partners in the Reinventing Fire: China research program.

**Solutions Journal:** Can you talk about how the partnership between ERI and RMI and our work on Reinventing Fire: China came about?

**Mr. Dai:** RMI released its famous book *Reinventing Fire* in 2011, and the partnership between ERI and RMI started from there. The four-year cooperation has been divided into two stages. First we jointly carried out the Reinventing Fire: China research, then we started more extensive research collaboration on issues like energy transition and climate change mitigation. ERI and RMI have also collaborated on the U.S.–China Climate Leaders Summit and the Alliance of Peaking Pioneer Cities.

**SJ:** What makes the collaboration with RMI and your other partners (Lawrence Berkeley National Laboratory, Energy Foundation China) unique in its ability to effect change?

**Mr. Dai:** Of all the research programs executed by ERI, Reinventing Fire: China, with its in-depth research, strategic origin, advanced methodologies, and global vision, was a landmark project. It not only provided critical guidance for research in energy efficiency and renewables transition in China, but also involved innovative collaboration. RMI and LBNL’s China Energy Group were technical partners for research, while the China Sustainable Energy Program of Energy Foundation China played an important role in providing financial support and coordinating and promoting new ideas.



Left to Right: Reinventing Fire: China team members Dai Yande (ERI), Lixuan Hong (LBNL), Lynn Price (LBNL), Jon Creyts (RMI), Nan Zhou (LBNL), Clay Stranger (RMI), and Amory Lovins (RMI), along with Lin Jiang (Energy Foundation China), Jules Kortenhorst (CEO of RMI), Gao Dongshen (China’s Ministry of Industry and Information Technology), and Lu Xingming (China’s National Development and Reform Commission).

As an independent, nonpolitical, nonprofit think tank, RMI provided advanced knowledge in energy efficiency and renewables. Furthermore, RMI strived to understand China and how to adapt technology to the specific conditions of China.

**SJ:** The government sought views from many stakeholders in formulating China’s 13th Five-Year Plan. Was RMI one of the stakeholder groups?

**Mr. Dai:** The innovative ideas, methodologies, and main conclusions of the Reinventing Fire: China program have been widely acknowledged and actively spread by the steering committee composed of decision makers, managers, and senior consulting experts.

The program provided essential decision-making evidence for China in tackling climate change, achieving a clean energy revolution, and formulating the 13th Five-Year Plan and follow-up development plans. RMI is a very important technical partner in the process.

**SJ:** Why should people who provide financial support to RMI care about the work we’re doing together in China?

**Mr. Dai:** The cooperation between RMI and ERI deserves extensive attention from all sides.

Climate change is a global challenge faced by all human beings. China and the United States are major leaders in mitigating global climate change. As the largest developing country in the world,

China’s low-carbon development strategy is not only critical for China itself, but also as a guide for other developing countries.

**SJ:** What are you most proud of having already achieved with the Reinventing Fire: China effort?

**Mr. Dai:** Many things. First, I’m proud of how the program is the joint outcome of several leading international organizations. Second, the findings will not only assist China in tackling regional pollution, but also contribute to economic development. Third, the program was based on a solid theoretical foundation, utilized scientific methodologies, and was analyzed technically and economically to prove its benefits. Finally, the findings can inject new energy into the prosperous development of China’s economy.

**SJ:** What would you say to other countries wishing to embark on a similar project with RMI?

**Mr. Dai:** RMI has a unique advantage for being not only a world-class think tank in the energy field, but also a “do tank” in the areas of energy efficiency, clean energy, and low-carbon development. RMI is a very sincere partner, which would devote all its strength and resources to a partnership.

Thanks to its enormous accomplishments and influence, RMI brings not only innovative ideas, but also various resources such as partners in different fields, successful case studies, etc. Other countries or regions that cooperate with RMI would definitely benefit significantly. 🌱

*Kitty Bu is communications director of RMI’s China Program.*

# AFFORDABLE, CLEAN ELECTRICITY FOR ALL

Rocky Mountain Institute's work in sub-Saharan Africa and the Caribbean improves people's well-being

By Allyn Harvey

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Sub-Saharan Africa and the Caribbean are separated by a mighty ocean, but are united by the need to significantly improve their energy situation. In Africa, millions of people live without access to electricity, and many who do have access have unreliable access at best. On the other hand, most Caribbean island residents have access to electricity, but spend a large portion of their income on the imported energy that fuels their islands' diesel power plants. They spend such a large portion, in fact, that many of them are considered to be living in energy poverty. They also both largely depend on getting energy from fossil fuels. For their sake, and the world's, it is important for these regions to gain the affordable, reliable electricity they need while avoiding a major increase in carbon emissions.

When communities are electrified, additional benefits accrue, including improved literacy rates and grades because children can study after dark.

Rocky Mountain Institute has been working on energy issues in both regions, albeit with somewhat different approaches. RMI's new Sustainable Energy for Economic Development (SEED) program focuses on sub-Saharan Africa, collaborating with governments and stakeholders to develop clean energy plans and establish the relationships and mechanisms needed to implement them. The Islands Energy Program, led by the Carbon War Room (CWR) business unit of RMI, takes on both design and implementation, providing strategic planning and on-the-ground support with requests for proposals, community engagement initiatives, and more. And both programs are demonstrating the value of pragmatic, unbiased analysis and advice to governments, utilities, development partners, and the private sector about how to improve access, reduce costs, and make significant gains in the use of renewable resources.

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**“Access to even a little bit of electricity can have an enormous effect on human well-being and economic development.”**

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In sub-Saharan Africa, RMI experts are working with top government officials in Rwanda, development partners, utilities, and companies to rapidly improve electricity access for large segments of the population that are currently underserved or have no access to electricity. For the government and other stakeholders, collaborating with the SEED program means key decision makers get the information they need to direct spending toward projects that enhance

and expand the existing grid, and toward off-grid systems that complement the grid and improve the daily life and businesses of Rwandans.

In the Caribbean, RMI is working with the Clinton Climate Initiative to facilitate the switchover from diesel-generated electricity to renewable generation systems. For the eleven nations working with the Islands Energy Program, RMI's analysis and guidance offer a chance to stabilize the unpredictability that comes with fluctuations in oil prices and to replace diesel systems—many of which have been in place since World War II and are past their design life—with reliable, renewable energy generation.

“The theory of change in both cases is that if we provide solid strategic advice and project analysis, we will be able to help funders, governments, and

utilities direct money to projects that make the most sense and do the most to achieve their goals,” says Stephen Doig, the RMI managing director in charge of the work in both regions. For RMI, the goal is to create a model that can be duplicated as developing economies generate more demand for electricity—one that avoids greater impact on the climate and lowers costs, increases access, lowers risks, and increases security of supply.

### SUSTAINABLY POWERING THE POPULATION IN RWANDA

Efforts to electrify the African continent have been slow. The current trajectory suggests that a similar percentage of people will lack adequate access to electricity in 2040 as today. RMI conceived the SEED program in sub-Saharan Africa to address this challenge. The aim is to accelerate access to electricity by promoting energy efficiency, cost-competitive renewables, and thoughtful development of distributed energy resources.

In Rwanda, the first country in Africa to engage in the SEED program, only 24 percent of the population has access to electricity. The government's goal is to raise that number to 70 percent by 2018 with a combination of on-grid and off-grid technologies.

“Having access to and using even a little bit of electricity can have an enormous effect on human well-being and economic development,” says Eric Wanless, a principal at RMI working on the SEED program. With electricity, children can study at night. Businesses can remain open after dark, increasing economic opportunities for business owners and allowing people who work throughout the day to have time to buy their daily staples. And industries such as grain milling to make flour can provide far more service at greater speed and lower cost when powered by electricity.

The energy challenges in Rwanda are significant. Electricity can be expensive to generate, especially when diesel is used, and, depending on the location, significant energy can be lost in the transmission and distribution of electricity. What's more, the emergence of off-grid electrification solutions and minigrids makes coordinated planning across the public sector, private sector, and development community even more difficult.

Another challenge is too much information. Key decision makers in Rwanda and throughout the



developing world are constantly being contacted with proposals. “There is so much information coming in, and it's often presented in inconsistent ways that make it very difficult for decision makers,” Wanless says. “Working collaboratively with local partners to identify no-regrets solutions like investing in energy efficiency can buy time for countries to take a step back and evaluate the options on the table.”

Funded by Virgin Unite, work started late last year in Rwanda with a robust technical and economic diagnostic that involved extensive in-country interviews with local experts and stakeholders, government officials, the private sector, and development partners like the World Bank and the U.K.'s Department for International Development. The diagnostic was delivered this spring with succinct and actionable recommendations that allow the RMI team to work with stakeholders to capture near-term opportunities and hand off ongoing responsibility for implementation.

The fact that RMI began work in late 2015 and is now helping Rwanda take action is one thing that makes the SEED project unique. Most studies of the scope delivered in Rwanda take years and millions of dollars to complete. “In Rwanda, we've been moving much more quickly with the government to identify the most important things the country can do to advance the goal of providing electricity that is both affordable and efficient,” says Wanless. “Rapid work and deployment of solutions are really important to deliver meaningful change.”

One important first step is to take advantage of near-term opportunities, which can save money and buy time for the work to proceed. In Rwanda, there is an opportunity to save \$20 million per year by switching out compact florescent lighting (CFLs) with LED lighting. The RMI team also provided a critical eye on the development of minigrids, which provide sustainable energy in smaller communities. They have captured the attention of funders but present real challenges in transforming from donor-funded efforts to lasting business models.

The diagnostic also provided a set of policy recommendations that need to be implemented quickly in order to create the conditions necessary for future success. The RMI team remains in Rwanda to help policymakers fit those recommendations into the nation's legal framework.

The goal in Rwanda is to supply around 50 percent of the population with power from distributed resources via the grid, and over 20 percent of the population with power from off-grid systems by 2018. During the diagnostic, RMI worked with private sector companies to make off-grid development affordable and compatible with the grid, and to build a robust market that can be scaled up rapidly. The government is now looking at a combination of regulatory changes and a public information campaign to help achieve its ambitious goal.

For several months, RMI will continue to help the Rwandan government, the utility, and development

Workers learning to install solar panels at health clinics in Rwanda, where only 24 percent of the population has access to electricity.

### ELECTRIFICATION IMPROVES WELL-BEING

Access to clean, affordable, reliable, high-quality energy can dramatically improve standards of living. Studies show that when communities are electrified additional benefits accrue:



#### OVERALL HEALTH IMPROVES

The 780 million women and children who breathe kerosene fumes inhale smoke equivalent to smoking two packs of cigarettes a day.



#### CHILDHOOD SAFETY IMPROVES

Kerosene lanterns cause half the burns that are the number two cause of childhood injury or death in southern India.



#### LITERACY RATES AND GRADES IMPROVE

When a village in Sudan received solar power, the number of students passing exams doubled.



#### FEMALE EMPLOYMENT IMPROVES

Rural electrification in South Africa more than doubled female employment (by 9.5 percentage points over a baseline employment of 7 percent).



#### ENTREPRENEURSHIP INCREASES

When nonelectrified communities in Ghana received electricity, the number of microenterprises more than doubled.



#### INCOME GOES UP

In Vietnam, rural electrification increased income 46 percent. School enrollment increased 31 percent for boys and 66 percent for girls.

partners implement recommendations from the diagnostic. “It’s important that we aren’t analyzing the situation and providing recommendations from an office in Colorado,” Doig says.

## REFORMS DRIVE RENEWABLE ADOPTION IN THE CARIBBEAN

The Islands Energy Program was launched in 2012 at the Rio+20 Summit with attendance and endorsement by Christiana Figueres, then-executive secretary of the UNFCCC, Sir Richard Branson, CWR founder, and CWR leadership. Today the Islands Energy Program is working with 11 island government and utility partners, mostly in the Caribbean, to accelerate the transition off fossil fuels. As in sub-Saharan Africa, these nations are developing economies with limited resources. Island nations such as Saint Lucia, Aruba, and Grenada typically spend about 20 percent of their GDP on oil imports. The average island resident spends 12 percent of his or her income on electricity, above the 10 percent threshold that is considered to impose fuel poverty.

### “Island nations are at the forefront of adapting alternative energy systems into national energy grids.”

The average cost of producing electricity is high: \$0.35/kWh—and in some countries as high as \$0.52/kWh—compared with about \$0.10 in the United States. Far from being carbon neutral, diesel generation systems are antiquated and dirty, affecting public health and the environment. “Nowhere else do you have locations where there is such a high cost of electricity coupled with such high potential for renewable electricity,” says Justin Locke, director of the Islands Energy Program.

The fact that island nations pay some of the highest electricity prices in the world and are among the most vulnerable to the effects of climate change puts them at the forefront of work underway to adapt alternative energy systems into national energy grids. “These nations are in a unique position to inform the transition of other isolated economies, and potentially large economies, to adopt high levels of renewables and put in place the regulatory framework to support this adoption,” says Locke.

For the outside observer, it would seem that making the transition to a system that employs the abundance



of wind and sunshine that exists in the Caribbean would be a no-brainer. Renewable energy promises a cleaner environment and lower-cost power that is not at the whim of world oil markets. But the transition is more complex than meets the eye. “Island governments are challenging the status quo of diesel-based utilities that are monopolies,” Locke explains. “But in order to provide reliable, affordable electricity, utilities must be solvent. Changing the way in which utilities provide and are paid for electricity is a difficult challenge—and one that they must get right the first time.”

In order to address this challenge, the Islands Energy Program is pursuing a three-prong strategy. The RMI team begins by aligning stakeholders around a shared vision, and then conducts a detailed analysis of how to pragmatically achieve that vision, which includes identifying the most cost-effective renewable energy investments. Finally, the team supports utilities and governments in reducing risks involved with implementing projects and ensuring they are prepared to execute them at the lowest cost possible. Underpinning this work, RMI is working with the Caribbean utility association (known as CARILEC) to ensure that the lessons learned are shared among utility engineers and executives working in the renewable energy space.

Several attempts by island governments to introduce alternative energy systems through foreign investment have been unsuccessful. But the RMI team was recently able to help the government of

Saint Lucia and its utility lay out a plan to meet their renewable energy targets, and more importantly to develop the optimal ownership structure for reducing consumer costs. This success came after RMI completed a diagnostic that demonstrated that it is more efficient to adopt renewable energy when the utility retains ownership of the assets, such as solar panels. Likewise, energy loads are better managed and consumers end up paying less. This is an important step for the future of Saint Lucia, and it can provide insight to other island nations. In addition to the progress made in Saint Lucia, positive outcomes in recent months include:

- A contract with Colombia to carry out an energy transition strategy on two islands, San Andres and Providencia
- Solar microgrid projects underway on select islands in Belize and the Grenadines in Saint Vincent
- Advisory support to the Turks and Caicos utility on its recent integrated resource plan, and an RFP for a 1 MW solar photovoltaic (PV) project
- Creation of a regional forum (called CAREC) that enables members, including utility management, systems operators, policymakers, and regulators, to exchange expertise and good practices
- An RFP for a 7 MW solar PV project in Aruba
- An RFP for a 3 MW PV project in Saint Lucia, which will be one of the largest renewable projects to date in the Eastern Caribbean, supplying up to 10 percent of the island’s peak demand

Early results have been achieved, in large part, because RMI provides analysis of infrastructure

and policy recommendations at a reduced cost. “When we develop projects, the utility and government don’t have to pay us \$300,000 or \$400,000,” Locke explains. “We subsidize those costs in order to de-risk these projects and provide expertise to make them happen, recovering some of our costs when the project is completed.”

### CHANGING THE TRAJECTORY

In addition to providing a model for energy access and development, RMI’s work in Africa and with island nations demonstrates how to reduce the carbon impact of developing economies, which are projected to be one of the primary sources of growth in greenhouse gas emissions over the next several decades.

With SEED and the Islands Energy Program, RMI is creating a template to support rapid development of electricity distribution and direct it toward more sustainable solutions. The work is garnering attention, and support. The SEED program received funding from Virgin Unite and The Rockefeller Foundation to expand its reach to another four to six countries over two years. The Islands Energy Program has secured funding from the Global Environment Facility, the Government of Colombia, and the Dutch Postcode Lottery to scale its impact over the next three years.

“There is a need in developing countries to improve access to sustainable electricity in a cost-efficient manner,” says Doig. “We are building on 30-plus years of work and experience to bring 21st-century solutions to those most in need.”

Renewable energy such as solar photovoltaic promises a cleaner environment and lower-cost power.

*Allyn Harvey is a freelance writer and public relations consultant based in Carbondale, Colorado. He has written on the environment and energy issues for a number of publications over the last 25 years.*

### ⊕ WEB EXTRA

For more information on this topic, visit: [rmi.org/smart\\_island\\_economies](http://rmi.org/smart_island_economies)

# 33 YEARS OF IMPACT

Longtime staffer Michael Kinsley retires. His influence carries on

Interviewed by Laurie Guevara-Stone



When Michael Kinsley joined Rocky Mountain Institute in 1983, he didn't foresee how his contributions would improve communities across the United States and around the world. He retired this summer as one of RMI's longest-tenured team members. Michael's work in the communities practice—which he led for 20 years—fostered sustainable local economic development and collaborative decision-making in many communities, and took him to 43 states across the U.S. and several foreign countries. Through strategic guidance and workshops, he helped several U.S. cities in their efforts to develop sustainability plans.

As a Pitkin County commissioner for 10 years, he helped put the Colorado county, which includes Aspen, on a sustainable path. He was also instrumental in helping plan RMI's new Innovation Center facility (see page 30), where visitors are greeted in the lobby by one of his paintings of nearby mountains.

*Solutions Journal* sat down with Michael to ask him about his years at RMI.

***Solutions Journal:*** You have been with RMI pretty much since its founding in 1982. Why did you choose to join RMI?

**Michael Kinsley:** We chose one another. I was a county commissioner working on sustainability issues at the time Amory and Hunter Lovins were forming RMI. They wanted a community component. I attended some of their lectures, and we began talking. They actually helped me write about energy alternatives for a pamphlet I was putting together about the implications of oil shale, so we began to work together and they hired me to help create their Economic Renewal Program focused on sustainable communities.

The work I was doing as a county commissioner aligned perfectly with the work I was doing at RMI. When I became a county commissioner in 1975, I was attempting to take the county on a more sustainable path. We had no affordable housing, no public transportation, and high growth rates; it was clearly unsustainable. I realized that at RMI I could help a lot of other communities get on a sustainable path.

***SJ:*** You have been involved in many different initiatives with RMI over the years, working with communities, corporations, and college campuses. What accomplishments are you most proud of?

**MK:** There are many, but I'll give you three that first come to mind.

The first was developing a message about sustainable communities that was attractive to people in very conservative communities—people who might not regard themselves as environmentalists.

When I went into a community, I asked people what they valued about their community, and I helped them make economic development decisions consistent with those values. Things people said they valued included community cohesiveness, clean air, good fishing, and other things without using “environmental” or “sustainable” terms. In contrast, people often make economic development decisions contrary to their values. We showed that economic development could happen, not only without compromising those values, but also in a way that supports many different points of view. And we did it without having to use the word “sustainable.”

Second was developing a collaborative strategic process for communities to develop sustainably. We first tested this approach in 1986 in Carbondale, Colorado. We knew we needed an unusual community to be the guinea pig for the project. We had to stop the process at one point, revise our method, and restart it. But they tolerated that experimentation and it worked, and helped put Carbondale on a sustainable path.

It's hard to say how many other communities used our process, because we developed it to attribute success to the community, not to us. One of the ways Amory and I first aligned was our mutual esteem for verse 17 in the Tao Te Ching, which says that leaders are best if, when their work is done, the people say they did it themselves. From the beginning, Amory and I had the same view on leadership.

The third accomplishment was using what we learned in collaborative strategic planning in communities and adapting that for corporations, then designing and executing RMI workshops for companies.

I realized that, though quite different, corporations are akin to communities in a few important ways—for example, the unconscious belief in maximizing economic throughput, whatever the cost. Community leaders often endure the negative effects of certain kinds of development, such as sprawl, because they unwittingly believe that maximizing throughput is always good, even if it significantly compromises

their values. Similarly, having found important ways to reduce cost and carbon, many corporate leaders reject such investment opportunities in favor of capital expenditures that increase output, even if the result is less profit—and more carbon.

***SJ:*** What's one of your most memorable moments at RMI?

**MK:** It's hard to pick just one, but one that I'll never forget is when I was introducing the concept of economic renewal in a town in Colorado. After the introductory presentation, a woman in the back stood up waving a piece of paper saying she had proof that RMI was a satanic organization. From my years of being a county commissioner I thought I was good at fielding

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**“You don't have to be an environmentalist to agree with RMI about energy investments. What RMI offers is the business case for reducing carbon.”**

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aggressive attacks, but for that one I was left speechless. Fortunately, others quieted her and that town went on to adopt some of our ideas and is now thriving.

***SJ:*** Along those lines, you have worked in many communities and with many companies that people might consider to be quite conservative. Why do you think RMI has been successful reaching so many different sectors?

**MK:** That's one of the things I think is so magnificent about RMI. You don't have to be an environmentalist to agree with RMI about energy investments. It's how we work in communities, campuses, and corporations. Each organization has internal disputes between factions—one group pushing for carbon reductions, the other holding back. What RMI offers to those arguments is the business case for reducing carbon. RMI is pragmatic and nondoctrinaire. In effect, by developing the business case for energy efficiency and renewables, RMI helps the faction that cares about energy and climate prevail.

Climate change is a huge threat that can be frightening and debilitating. But one of the great things about working at RMI is seeing the wide range of extremely encouraging and large-scale signs of progress. And I am very proud to be part of that change. 🌱

*Laurie Guevara-Stone is a writer/ editor at Rocky Mountain Institute.*

**+** WEB EXTRA

For more information on this topic visit: [rmi.org/communities](http://rmi.org/communities)



# RMI'S INNOVATION CENTER

## 5 Reasons It's the Office of the Future

By Kelly Vaughn

The RMI community is still celebrating the opening of our new Innovation Center in Basalt, Colorado. Why? Ask any employee who works in the building, or the thousands of RMI supporters, neighbors, collaborators, and industry professionals who have attended an event or taken a tour: It is truly a shining example of the office building of the future, “creating delight when entered, and regret when departed,” as Amory Lovins intended it when the design process kicked off nearly three years ago.

Halfway through a year-long commissioning process, we are already learning significant lessons about the importance of integrated project delivery, passive integrative design, energy monitoring and data collection, and the role occupants play in achieving some of the most ambitious building performance goals in the country (see “Performance Highlights,” page 33). Behind the numbers are more anecdotal, and arguably more powerful, stories of how this building allows RMI to take our work to the next level, and that showcase how net-zero energy buildings can be better for owners, occupants, and the environment.

The Innovation Center serves as a living lab to demonstrate how high-performance buildings are designed, constructed, and occupied. This building of the future is also supporting the most critical work of our future. Here are five reasons we believe the Innovation Center is so, well, innovative.

### 1. It increases staff productivity, satisfaction, and collaboration

Our goals not only focused on energy efficiency, but also included creating a healthy, productive, and aesthetically pleasing office space and world-class convening center. Not coincidentally, the same design principles achieve both goals. Staff benefit from an entirely day-lit, open office plan, which minimizes the energy needed to maintain healthy airflow through spaces. High ceilings and giant windows on the south side maximize views of mountains, aspen trees, and the Roaring Fork River, keeping staff healthier and happier on a day-to-day basis.

### 2. It gives people control over their personal comfort

Traditional office buildings use a large HVAC system to maintain a set room temperature, which uses a lot of energy and has little to do with how comfortable a person feels. The Innovation Center focuses on the six factors that influence individual comfort (e.g., humidity, air velocity, clothing, etc.) and uses integrative design and technology that eschews a one-size-fits-all approach and allows individuals to control their own comfort. For example, on the coldest winter days, staff can warm up with electric floor mats that provide targeted radiant heat.





**3. It achieves unprecedented levels of integration, automation, and control**

When most of us think “office building of the future,” we envision cutting-edge technologies and gadgets. The Innovation Center does feature impressive new technologies (like personal heating and cooling chairs), but how technologies, building materials, and systems work together is what’s cutting-edge. The building’s automation system uses sensors and set points, plus predictive weather controls, to activate various building features that maintain temperature, lighting levels, and ventilation. To ensure the building operates as it was designed requires a careful balance of automation and manual controls. For example, certain windows open and close automatically to control temperature and air movement, while other windows can be manually operated.



**PERFORMANCE HIGHLIGHTS**

If every commercial building in the U.S. increased its efficiency to the Innovation Center’s level, enough energy would be saved in one month to power New York City for one year.



**17.2 KBTU/SF** expected energy use intensity (compared with 80 kbtu/sf for the average U.S. commercial building)



**74%** more efficient than the average office building in its climate



**1 OF 200** net-zero commercial buildings in the U.S. (as of 2015)



**0** number of central cooling and heating systems

**4. It is as productive for the electricity grid as it is for our staff**

The Innovation Center produces enough solar energy on-site to supply the energy needs of the building plus six electric vehicles, thanks in part to an 83.08 kW solar photovoltaic (PV) system. A lithium-ion 30 kW battery storage system helps keep the building’s peak energy demand below 50 kW (keeping us in a financially beneficial small-commercial rate class). An energy dashboard in the lobby and available online provides live data on PV production, energy consumption, and the amount of clean energy being stored in the battery versus sent to the electricity grid so we can make thoughtful adjustments to our energy management strategy.

**5. It harnesses the power of convening**

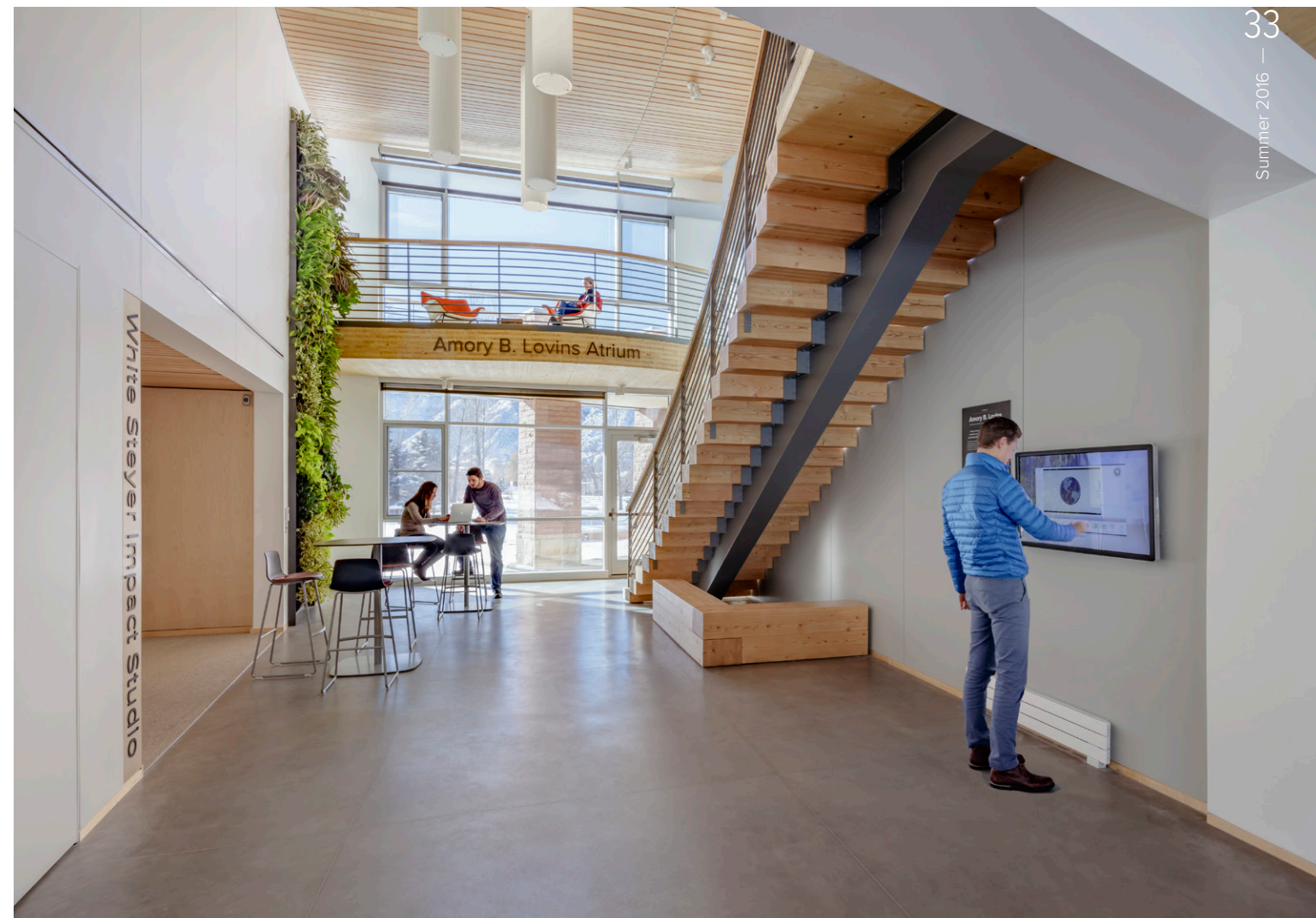
Collaboration was the mantra behind the Innovation Center from the get-go. The very idea of the Innovation Center brought together a powerful network of RMI supporters whose philanthropic leadership brought the building from vision to reality. Convening was the driving force behind the integrated project delivery process we used to guide design and construction, which involved collaboration across disciplines, common goals, and shared risks and rewards. Finally, the White Steyer Impact Studio, which accommodates 80 people in a lecture or workshop-type setting, is where diverse leaders and partners from across the global energy landscape can gather to tackle our greatest energy challenges.

*Kelly Vaughn is a marketing manager at Rocky Mountain Institute, who supports its buildings work and development efforts.*

**+ WEB EXTRA**

*Learn more and take a virtual tour at [www.rmi.org/innovationcenter](http://www.rmi.org/innovationcenter)*

PHOTOS: previous page, © Tim Griffith; bottom far left, © Pat Sudmeier; top and bottom left, right, © Tim Griffith





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#### About Rocky Mountain Institute

Rocky Mountain Institute (RMI)—an independent 501(c)(3) nonprofit organization founded in 1982—transforms global energy use to create a clean, prosperous, and secure low-carbon future. It engages businesses, communities, institutions, and entrepreneurs to accelerate the adoption of market-based solutions that cost-effectively shift from fossil fuels to efficiency and renewables. In 2014, RMI merged with Carbon War Room, whose business-led market interventions advance a low-carbon economy. The combined organization has offices in Basalt and Boulder, Colorado; New York City; Washington, D.C.; and Beijing.

