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RMI Retrofits America's Favorite Skyscraper

Spring 2009

In this issue—

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Feature Stories

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Rocky Mountain Institute®

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We foster the efficient and restorative use of resources to make the world secure, just, prosperous, and life-sustaining.

Solutions
Journal

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Contents

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Greg Franta

An Appreciation

By Amory B. Lovins, Hon. AIA

Greg Franta, FAIA, was "revered nationally and internationally as an architect and green building consultant, with special expertise in solar design and daylighting of buildings," wrote Nadav Malin on www.buildinggreen.com. But he was more than that. Many felt, as I did, that he was the very best—the world's leading integrative architect of superefficient, beautiful, and delightful buildings. In his private practice and then at RMI after our practices merged in 2005, Greg helped to design upwards of a thousand buildings in about fifty countries, including one-third of the world's LEED Platinum buildings. Even more importantly, Greg probably more than anyone else shaped the modern understanding of integrative design, both through projects and through an enormous amount of teaching: green architect Bob Berkebile says Greg did "probably more workshops, training, and teaching than any other architect."

When I met Greg around 1982, he'd already received his architecture degrees from the University of Colorado (1973) and Arizona State (1976), the latter after studying under passive-cooling pioneer Jeff Cook. Greg had hatched a little practice called SunDesigns "tucked under the rafters" (as Alex Wilson reports) of Aspen's top architect, Fritz Benedict. He joined Solar Pathways, founded in Glenwood Springs in 1976 by Robert Clarke, who went on to found and lead Alpen Glass in Boulder. ENSAR Group—the name evokes Energy and Solar Architecture—grew out of that practice. ENSAR did the 1982 energy simulation for my passive-solar banana farm in Old Snowmass, among the first of the world's most energy-efficient buildings that Greg helped to design—but four years earlier, his own passive-solar house had earned that accolade as the cover story in *Solar Age* magazine. In the late 1970s he was also on the Board of the American Solar Energy Society, bringing solar-energy designers and architects together.

Greg's mastery and reputation steadily grew. He led commercial-buildings research at the Solar Energy Research Institute (SERI), which later became the National Renewable Energy Laboratory. Quickly promoted to Senior Architect, he coauthored SERI's *Solar Design Workbook* in 1981, developed vital simulation tools, and invented the "elimination parametrics" technique that's now at the core of understanding the interactions betweens a building's different energy uses. Leaving SERI to found ENSAR's Denver office, Greg became the world's top practitioner of daylighting and of tuned superwindows, helping us all understand how these tools, properly integrated, could transform both energy and aesthetic performance while reducing construction cost. Having coauthored the American Institute of Architects' *Energy in Architecture: Techniques and Applications* in 1981 and *Energy Design for Architects* in 1988, then *Solar Building Architecture* (MIT Press, 1990), Greg coauthored AIA's 1997 *Glazing Design: Handbook for Energy Efficiency*, and had me write its foreword, as we realized together that this remarkable technology permitted largely or wholly passive buildings in nearly any climate.

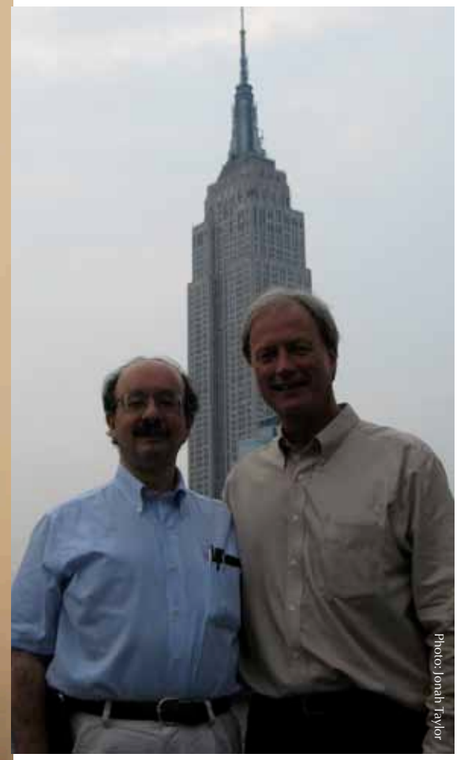


Photo: Jonah Taylor

Meanwhile, Greg worked hard to reform architecture's leading institutions. He helped found and chaired AIA's first Energy Committee in 1973, then was instrumental in founding in 1990 AIA's Committee on the Environment, which he chaired in 1994 and which absorbed the Energy Committee. These Committees and their networks led the transformation of the profession with tools like the AIA's Top Ten Awards—still the benchmark of green design—and the *Environmental Resources Guide.* AIA's initiatives to ban ozone-depleting building materials and put efficient buildings at the core of federal energy policy were highly influential, setting the stage for today's national energy strategy. As Greg inspired and informed thousands of designers to see how all parts of the design could fit together to create something far greater, and the profession recognized the profound implications of his work, he became President of the American Institute of Architects' Colorado chapter in 1978, and seven years later, the youngest-ever member of AIA's national Board. Later he also chaired the Sustainable Buildings Industry Council.

Along with his predecessor leading RMI's green-buildings work—our Senior Fellow Bill Browning, Hon. AIA, who perhaps more than anyone invented the whole concept of green development—Greg was among the handful of bold leaders who from the early 1990s created the U.S. Green Building Council and its LEED Standards, of which he became one of the five senior teachers and examiners. The U.S. Green Building Council recognized Greg just last fall, when its President, Rick Fedrizzi, said:

> When the USGBC was just an embryo, this group of astounding achievers came together to become what we consider at USGBC to be the founders of the green building movement. These amazing individuals have leadership abilities that are transforming our world, and thanks to them, we've got a movement now, we've got energy now, and we've got true collaboration between groups like USGBC and AIA.

Photo: USGBC

The last emails I had from Greg were about another of those green-architecture pioneers, our colleague


Photo: RMI Staff


Photo: RMI Staff

Gail Lindsay, FAIA, who also died too soon, just a week before him.

Greg and I worked closely together on scores of projects from the mid-'80s onward, including the Greening of the White House, whose nongovernmental side he and Bill Browning co-led. His better-known projects included the Sydney Olympic Village, Wal-Mart's first Eco-Mart, and the Greening of the Pentagon. We had wonderful adventures all over the world, on probably every continent but Antarctica, including several notable weeks in Tbilisi. For months in 1992, I even lived in Greg's Boulder house while writing *The State of the Art: Space Cooling*.

By the '90s he was our top charrette leader for the most challenging and consequential engagements. Our collaborations were exceptionally effective, thanks not just to his technical mastery but to how he could get people to work together, open their minds, and make magic happen. As Bob Berkebile says, "Most people in architecture met Greg as a daylighting expert first, and then as an energy expert. But the reason he was on so many [design] teams was his broader skill in team-building and his personal energy and enthusiasm." Green-building pioneer Alex Wilson, too, notes how Greg catalytically imparted

> …his humor and unbridled energy to groups often including many hard cynics and skeptics of sustainable design…pulling pinstriped, corporate and institutional CEOs from deep in the green-design end zone to later emerge as sustainable-design leaders.

One of Greg's most potent tools was his disarming humor—from his Norwegian-farmer jokes delivered deadpan in Minnesota dialect over a drink, to technical slideshows that would suddenly wake you up by illustrating "footcandle" as a candle cast in the shape of a human foot. His infectious humor, though, wasn't just a mark of a really funny guy, but also a way to penetrate defenses with insidiously effective ideas about how green design could make sense and make money—whether or not you cared about the environment.

By intellect, charm, warmth, vitality, and force of character, Greg led many thousands of designers and developers to do what they didn't know how to do and didn't even know they could do. To paraphrase Guillaume Apollinaire:

> Come to the edge, he said. They said: We are afraid.
> Come to the edge, he said.
> They came. He pushed them. And they flew.

Greg's charrettes often subtly and irresistibly enticed us to leave our comfort zone and discover new ways to design that transcended what we'd imagined was possible. He'd figured out the wonderful trick that e.e. cummings described thus:

> There is a knack to flying. You must throw yourself at the ground and miss.

Greg's mind and spirit were always flying. Now he's just gained more altitude.

So we've lost our beloved friend and colleague at the height of his powers. But we're also lucky. Greg lived long enough and worked hard enough to embed his work irreversibly in the design and real-estate professions throughout the world. Now the thousands whom he inspired will carry it on with a passion and an energy that would make him proud of us all.

As Greg's passing reminds us, the human design is frail, life is uncertain, and there's not a day to lose. In our practice of applied hope, if we use each day to the fullest, then every day is a good day to die. I'm sure Greg would like us to live that way too. He beckoned us to the edge, and it's time for us to fly. •

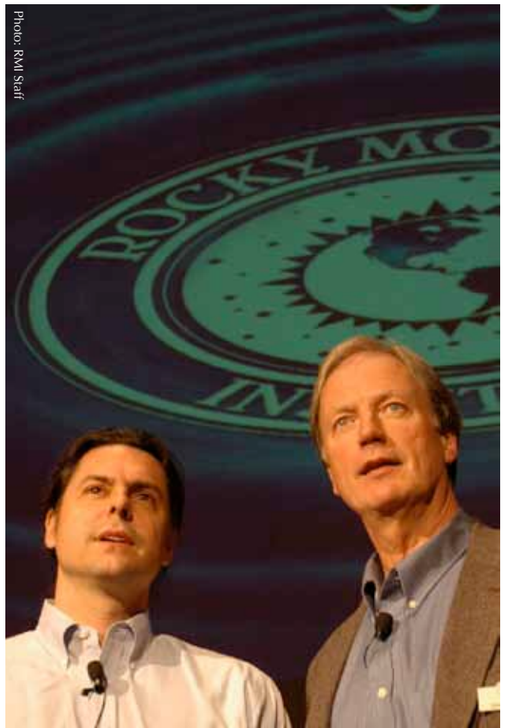


Photo: RMI Staff

In Memoriam
GREGORY ESSER FRANTA
1950—2009

Photo: RMI Staff

Working Toward a Three-fer

When Lisa Jackson, the new Administrator of the Environmental Protection Agency, gave her keynote address at the Aspen Environmental Forum in March, she urged the crowd to work towards a "three-fer."

"Maybe you're worried about what your neighborhood will be once climate change hits you," she said. "Maybe you're worried about where jobs will come from, or whether they will be exported overseas. You might also be worried about national security. However you come to this, we have an answer for you. It's the clean energy economy."

We live in a world where 75–90% of the energy we consume is wasted because of bad design and poor choices. In theory, innovation driven by market forces should work over time to wring more and more efficiency out of our systems, and to eliminate that waste.

Unfortunately, market forces are not perfect. Fuel price volatility makes it hard for entrepreneurs to focus steadily on efficiency innovations and renewable energy sources. Some societal impacts (CO_2, for example) are not yet reflected in the cost structures of our businesses. And many of our industries seem as if they were designed specifically to support wasteful practices. These factors combine to create a "roller-coaster effect," with energy policy and commercial practices veering, as President Obama put it, between crisis and trance.

Enter RMI. The RMI team works with dogged determination to reduce—and over decades, eliminate—our dependence on fossil fuels and to speed the profitable transition to a world powered by renewable energy sources very efficiently used. We believe this is the pivotal issue for our generation—even for our species. We stay on the job whether a barrel of oil sells for $150 or $35, and whether or not there is a price on carbon.

RMI's unique "hybrid" structure supports this role. Roughly two-thirds of our funding comes from philanthropic individuals and foundations, helping us to weather economic upheavals and to fund communication through books, films, and the web. The remaining third comes from fees for our consulting and design services—helping to create radically efficient buildings, vehicles, and industrial processes, for example—by which we demonstrate to leaders of vital industries, over and over, that "whole-systems thinking" pays off and that efficiency is the most effective energy solution.

Each of us at RMI has our own personal priorities. Some of us care most about climate change, others about economic opportunities, and still others about national security. But as Amory Lovins likes to say, "We hold and support all of these motivations—and they all lead to the same right outcomes."

The outcome we seek is a world thriving, verdant, and secure, for all, for ever. To get there we need to solve the energy problem. We need to achieve Lisa Jackson's "three-fer." With your help, we believe we can.


Photo: Jackie Daily

Michael Potts
President and CEO

Life at RMI

Martha C. Pickett, Executive Director


Photo: Jackie Daily

We are delighted to welcome three new members to RMI's distinguished Board of Trustees. Our trustees bring a diverse set of talents and expertise and a broad perspective to RMI's work.

Thomas Dinwoodie is the founder and Chief Technical Officer of SunPower Corporation Systems, a global supplier of the world's highest efficiency solar cells and systems to residential, commercial and utility-scale power plant customers. Prior to founding SunPower, Tom conducted photovoltaic research at the M.I.T. Energy Laboratory, founded a windpower development company, and was a principal of an architectural firm. Tom has authored numerous papers and holds more than 30 patents on building-integrated photovoltaics and related products.

Tom, who lives in the Bay Area, is a major donor to RMI and brings insights and expertise on issues related to reducing the cost and increasing the use of renewable energy, which is key to RMI's mission.

Peter Boyer, who lives in San Francisco, has been a fan of RMI for many years, and takes seriously the need to disseminate our work by carrying around copies of *Winning the Oil Endgame* in his Prius to hand out to friends and acquaintances. Peter is an accomplished fine art painter, whose works have been exhibited in both the U.S. and Japan, and are owned by numerous private and public collections. Prior to committing to his studio practice, Peter owned and operated a design and build residential construction firm for 10 years, and applies his knowledge of building materials and techniques to his mixed media style of artwork.

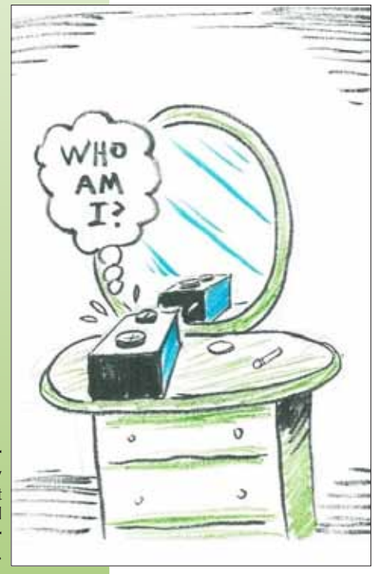
Peter, along with his wife Terry Gamble Boyer, serve as trustees of The Ayrshire Foundation, which has been a lead donor to the "Cooling the Warming" initiative at RMI. Peter recently joined the National Advisory Board of the Union of Concerned Scientists, and is the co-chair of RMI's National Solutions Council.

Reuben Munger has been involved with RMI for more than ten years as a major donor and valued advisor. He is currently serving as Chairman of Bright Automotive, an RMI spin-off company based in Indiana, that is developing a 100-mpg plug-in hybrid electric vehicle for mass production; and he recently testified before the House Select Committee on Energy Independence Implications of the Auto Bailout on December 9, 2008.

Reuben is a seasoned investment professional and Managing Partner of Vision Ridge Partners, LLC. Prior to founding Vision Ridge in 2008, Mr. Munger was a Managing Director at The Baupost Group, LLC, a $15 billion investment firm. During his decade long tenure at Baupost, the firm grew from under $1 billion in assets under management to over $12 billion. Before joining Baupost in 1997, Mr. Munger was a consultant to Texas Pacific Group and an investment banker with James D. Wolfensohn, Inc.

In addition to his work on climate and environmental issues, Reuben is Chair of the Governing Board of EdVestors, a Boston based non-profit focused on driving positive change in urban public schools through smart, strategic private investment. He also works with Stand for Children as Chair of the Massachusetts Advisory Board and as a member of the National Board of Directors. Reuben and his wife Mindy live in Boston with their two young children.

The mass adoption of plug-in vehicles could support increased use of renewable energy. Plug-ins could store wind energy generated at night and supply it back to the grid during peak demand or use the electrons for the next day's commute.



When batteries are no longer ideal for plug-in vehicles, they still have a significant amount of energy storage capacity and hence could be sold at a lower price for alternative purposes.

Separate parties (OEMs, utilities, etc) need to collaborate in order for the accelerated adoption of plug-ins.

Infrastructure needs to change in order to accommodate plug-ins but uncertainty about regulation makes it difficult to move forward.

Sketches: Bryan Gough and Neal Skorpen

Smart Garage

By Cameron Burns

Project Get Ready. Charge, Baby, Charge. Consumer Demand.

Strange sounding, perhaps, but these are the names of three concrete and very important initiatives that were spawned at RMI's Smart Garage Charrette, held October 8–10, 2008, in Portland, Oregon (see RMI Solutions Journal, July 2008). The problem, our Charrette participants found, is of the "chicken-and-egg" variety—the question being which will come first: the plug-in electric car or the charging infrastructure and consumer demand?

Charrette attendees decided to enlist a few willing accomplices to break the chicken-and-egg stymie. Thus, Project Get Ready, Charge, Baby, Charge, and Consumer Demand were born. Their goal: to make sure the first million plug-ins are a smashing success, and accelerate the arrival of the next million. The progress electrified vehicles make in the next five years will dictate long-term success. For this reason, the team is raising money for 2009 to focus on how to increase the number of electrified vehicles on the road by 2015.

"We have great momentum, starting with Project Get Ready, which aims to accelerate the adoption of electrified vehicles in leading communities by providing leaders with the key research and information they need to become plug-in ready," notes Consultant Matt Matilla of RMI's MOVE Team. "Project Get Ready also provides an online presence where partner communities can interact to share solutions to challenges they face. We've already got four communities on board, and will expand to 20 by June."

On the Web site www.projectgetready.com these communities can track their progress against MOVE's recommendations for preparing for plug-in vehicles. Charge, Baby, Charge analyzes the business case for installing charging stations at offices and retailers. Project Consumer Demand seeks to close the knowledge gap surrounding new technologies by designing and launching an educational campaign.

"What proved most surprising was the concept of the Smart Garage is a lot closer to realization than we previously thought," said Laura Schewel, MOVE Team Consultant and manager of the project. "We found there were many misconceptions—including that technology to make all this possible was not available—when in fact the opposite is true." •

Photo: flickr.com, flatlow411

10xE RETHINKING ENGINEERING, BOTH PEDAGOGY AND PRACTICE

By Cameron Burns

There's a joke e-mail that seems to circulate on the Web every eight months or so. It includes images of outrageous design blunders, like a surveillance camera mounted behind and pointing at the back of the monitor it feeds. There's a picture of a faucet that's about six inches away from the sink into which the water should fall. There's another of a man using an automatic teller machine that's about nine feet above the ground. All good for a laugh, but the truth is, bad design is more common than most of us realize. Bad engineering design, specifically, is simply wasteful. Poorly designed processes and systems gobble up energy and resources as if they were free or nearly free, and the inefficiency is generally invisible to most observers, including consumers who have to pay for the energy and resources.

Throughout the Institute's 27-year existence, RMI's staff has sought to influence the design, building, and retrofitting of power and industrial plants, commercial and residential buildings, and vehicles and transportation systems early in the development process so they're designed correctly upfront, eliminating costly late redesigns and inefficient outcomes.

One of the basic challenges our practioners run into, year after year, is that the people creating inefficient processes and systems are simply unaware they are doing so, and they don't know how to do things differently. The reasons are many and complex, but often boil down to a few familiar parameters: assumed cost (e.g., capital resources, risk, reward, etc.), time (e.g., regulatory requirements, demand, etc.), tradition (e.g., what has worked before), and skills.

"Engineering schools don't specifically teach bad engineering design," notes Alok Pradhan, RMI's project manager for 10xE. "It's just that current engineering practice is very siloed and there's a lack of integration and whole-system consideration. Designs are typically optimized for the wrong parameters. That is, they will optimize the component individually, and the pieces—when they fit together—don't work that great as a system."

Several years ago, RMI kicked off a modest project to address these problems in engineering. Known around the Institute as Factor Ten Engineering (or 10xE for short), this RMI initiative is fairly straightforward: the goal is to create a series of teaching tools that will help engineers design the things they design so that they use radically less energy

and resources than they otherwise would have, without compromising performance. These teaching materials—centered around a casebook of extremely efficient projects and systems—will be used to teach efficiency concepts and design to both engineering students and practitioners.

10xE has its genesis in the Factor Four notion put forth by Ernst Ulrich von Weizsäcker, Amory Lovins, and L. Hunter Lovins in their 1995 report to the Club of Rome, *Factor Four: Doubling Wealth, Halving Resource Use*. In the report, the authors argue that energy and resources can be used much more efficiently, to the tune of at least four times as efficient. "Factor Ten represents Amory Lovins's belief that we can do even better," notes Alok. "It might not necessarily be ten times the efficiency. It might be eight times or six times, but the basic premise of this project is to see, when these principles are applied, what's possible."

This year, the effort has gained some financial support and is picking up momentum.

"It's something we've been thinking about for a long time at RMI, but now, with Alok, we have a full-time project manager, a little seed money, and the momentum to move forward," notes Lionel Bony, who heads the Office of the Chief Scientist at RMI. "We are going from concept phase to implementation, which is very exciting."

Photo: flickr.com, pro-zak

Something as simple as unnecessary right angles in piping can lead to a tremendous amount of waste in a system.

A Different Kind of Engineering Ideal

The main focus of the 10xE project is the casebook. In it, RMI and the Institute's research partners (university engineering schools, engineering firms, and their customers) are assembling several dozen case-studies in which regular, dis-integrated engineering will be compared with highly efficient engineering design, laid out on facing pages so the reader can easily compare them and understand why the superefficient design typically costs less to build.

The cases themselves will span the range of engineering disciplines and main applications. More importantly, they'll be chosen to illustrate and develop practical principles of design integration to achieve big energy and resource savings more cheaply.

"We do want to make these cases broad so they cover multiple disciplines, and, more importantly, demonstrate the whole-system considerations that have gone into the design," Alok notes.

A case study of a data center that is currently being developed is a good example of the types of projects the book will include, he says. Researchers will compare the superefficient data center design with a normal one.

"In that particular data center they managed to eliminate chillers, which is a huge energy savings; they made the computer code more efficient so the center didn't actually have to do as much computing; they removed extra load and unnecessary servers; they changed some of the electrical hardware to make the servers 'best in class'; and they retrofitted the buildings," Alok notes. "The project was made much more efficient in terms of at least three disciplines: mechanical, electrical, and civil engineering."

While the cases will compare efficient engineering projects with projects that weren't designed to be efficient, not all the comparisons will be parallel. With Amory Lovins's 1982 superefficient home in Snowmass, Colorado, for example, researchers plan to do some energy modeling and compare the building as it exists (including an elaborate data-monitoring system now being commissioned) to a hypothetical version of the building built simply to meet the local building code.

At present, RMI researchers are working with partners along the engineering value chain to refine how the casebook will come together during the next few months, with the possibility of a "summer study" in July or August, convening researchers for intensive collaboration over a two-week period. The book itself will likely be published in 2010.

"It's very important that we drive change as soon as possible," Lionel says. "The things we design now have a lifespan of anywhere between 15 and 20 years for a car and 50 and 100 years for a building. The more we wait, the longer it's going to take to have an impact."

Perhaps more important will be 10xE's influence on people. Some leading professors and practicing engineers are already using the term "brown engineering" for standard engineering practices, and engineering students who've been exposed to "green engineering" quickly become diehard advocates, helping to build momentum for superior design. Once these young engineers enter the marketplace, their very existence will help create further demand for green engineering.

"10xE will hopefully foster an entire generation of newly and better-educated students who will go on to do amazing things because they have been properly trained," notes Lionel. "This won't just change the built world around us; it'll change our fundamental relationships with both what we build and the Earth itself." •

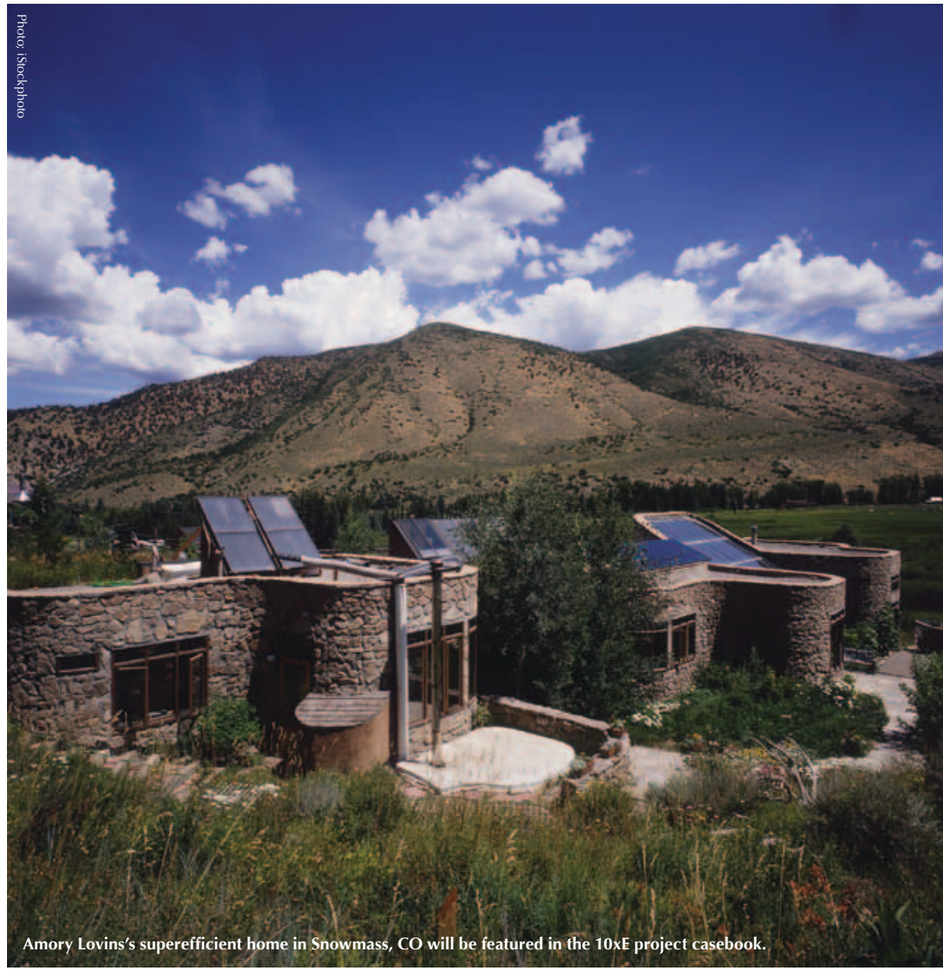


Photo: iStockphoto

Amory Lovins's superefficient home in Snowmass, CO will be featured in the 10xE project casebook.

One interesting project related to 10×E is an effort by ABB engineer Robert Martinez, who recently took a sabbatical at RMI to complete a handbook on making fossil-fueled power plants more energy efficient. Robert focused his efforts not on the plants' primary fossil-fuel-driven generation but instead on the "auxiliaries," also known as the "balance of plant" systems (fans, pumps, etc.) because they actually run on the electricity generated at the plant and can gobble up a whopping 8–15 percent of the electricity produced. He was able to reconfigure typical auxiliaries to achieve a 6 percent energy improvement with a three-year payback. This may not sound like much, but such power plants emit about 41 percent of U.S. and 32 percent of global fossil carbon.

The book will be made available to ABB's roughly 15,000 engineers. ABB is the number one provider of electrical infrastructure (transformers, transmission and distribution equipment, metering equipment, etc.) on Earth and strongly influences the electric power industry. Additionally, Robert and his ABB colleagues are helping apply their book to a new coal plant proposed in the western United States.

"I think it [the handbook] will inspire changes in a lot of designs," Robert says.

Closing the Efficiency Gap (CEG): America's Untapped Opportunity

By Kelly Sweitzer

An enormous efficiency opportunity exists right under our noses. Electricity, the most versatile kind of energy, is used in limitless applications, ranging from transportation to heating, communications to lighting. The backbone of modern industrial society is, and likely will remain, the use of electrical power because of the services it provides and the standard of living it delivers. Despite our reliance on electricity in the United States, concerns about emissions from coal-fired energy production and their direct contribution to global climate change have resulted in an escalating awareness of the importance of energy efficiency. However, while the benefits of efficiency are increasingly espoused, the United States has relatively low implementation rates.

"Assessing the Electric Productivity Gap and U.S. Efficiency Opportunity," recently published by RMI's Energy & Resources Team's (ERT), unveils just what is possible when efficiency measures are effectively implemented. Through their research, ERT discovered that the electric productivity (measured in dollars of gross domestic product divided by kilowatt-hours consumed) of U.S. states varies dramatically. If lower-performing states could achieve the electric productivity of the top-performing states through energy efficiency, the nation could save 1.2 million gigawatt-hours and displace more than the equivalent of over 60 percent of America's coal-fired generation. This could also save consumers more than $100 billion.

According to Natalie Mims, a Consultant with ERT, "closing the electric productivity gap through energy efficiency is the largest near-term opportunity to immediately reduce electricity use and greenhouse gases and move the United States forward as a leader in the new clean energy economy."

With enormous implications for both the environment and the economy, how could an opportunity of this magnitude remain untapped? ERT's Closing the Efficiency Gap (CEG) research team, led by ERT Vice President Stephen Doig, Natalie Mims, and ERT Fellow Mathias Bell, decided to recast the problem itself and explore energy efficiency within a completely new framework—and on a much larger scale. They know that reframing the challenge is a critical step in the team's strategy to accelerate the adoption of energy efficiency and move towards the utility of the future.

Reframing the Efficiency Problem

For years, researchers have grappled with commonly cited barriers to energy efficiency adoption that contribute to the myth that efficiency measures are either too costly or technically unfeasible. "Decoupling" has been explored by a few states as a viable solution to promoting efficiency. When decoupled, a utility's rates are set so that the utility earnings are not bound to the amount of electricity it sells. This can ensure that a utility's revenues will not suffer, and can actually benefit, from implementing efficiency measures. A number of states have used decoupling in efforts to align their utilities' financial interests with the delivery of cost-effective energy efficiency programs.

Photo: flickr.com, jordi.martorell

Dated electric infrastructure leads to serious losses in transmission.

While the project was still in its infancy, Natalie decided to research the impact that decoupling has had on energy efficiency in various states. After some preliminary exploration, however, she realized that focusing solely on decoupling might fail to incorporate the other factors that could increase in efficiency. Energy savings can be prompted by other things, including customer behavior, building energy codes, and appliance standards.

While decoupling offers utilities a way to promote energy efficiency measures, the CEG research team decided that in order to expand the scope of the research, and move beyond a "known" solution, they needed to conceptually reframe the problem. The new framework, they decided, would be electric productivity, which measures, in dollars, gross domestic product divided by kilowatt hours consumed—in short, what society achieved with the power it used.

This seemingly simple change of focus turned out to have a significant effect on both the approach to the research and what it sought to uncover. Rather than limiting themselves to one particular solution for utilities, an analysis of electric productivity allowed ERT to better understand opportunities to use energy efficiency. This meant a broader menu of strategies and solutions that were already being explored but weren't being implemented to their full potential. "Looking at productivity helped us not only better understand how effectively each state uses its electricity, but also how states compare to one another," says Mathias. "While combing through this data, some of our initial findings were staggering. The disparities between states were much larger than we anticipated."

There was another benefit to focusing on electric productivity: the economics. RMI has long promoted market-oriented solutions as an approach to driving energy efficiency, and ERT's VP Stephen Doig advised the team that a clear economic component needed to be the guiding force of the research.

According to Doig, "People often get stuck on the technical details of efficiency. We wanted there to be a clear message that not only is there high efficiency potential in many places but there are large economic benefits to be had as well." For maximum impact, opportunity linked to a dollar amount had a huge potential to not only spark interest among utilities but also motivate implementation.

Looking at the Bigger Picture

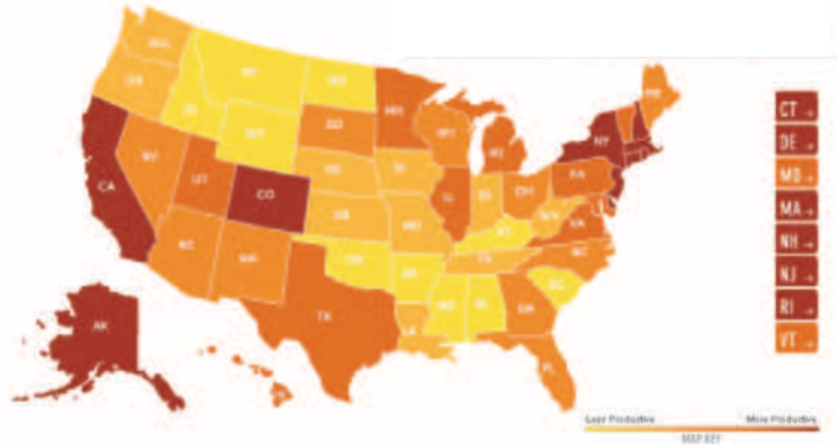
With a broadened framework also came a broadened focus. State-by-state opportunities were magnified in the bigger picture: the nationwide opportunity was an incredible 1.2 million gigawatts.

Over a period of six months, Natalie and Mathias assessed the electric productivity of all fifty states, adjusted for climate and economic mix—variables that enhance data accuracy. These factors allowed ERT to create an adjusted electric productivity target for each state. Mississippi, the state with the lowest electric productivity for example, had a target of over 24,000 gigawatt-hours of untapped efficiency potential, which is the equivalent of the electricity consumption of 2 million households.

While each state is unique, ERT points out that many lessons can be learned from the collective national knowledge on best practices, utility regulatory experience, and technology adoption. According to Natalie, "Taking lessons from efficient states will facilitate adoption and prevent states from sinking resources into 'reinventing the wheel' of state efficiency programs and implementation practices."

The electric productivity of top-performing states, such as New York, California, and Connecticut, can serve as successful examples of how to overcome barriers to efficiency practices, regulate utilities, and implement new technologies. Poorest-performing states, like Alabama, Kentucky, and Mississippi, have a huge opportunity to build on the success of higher-performing states by closing their electric productivity gap using known and tested technology and policy.

Electric producity is dollars of gross domestic product divded by kilowatt hours consumed ($GDP/kWh). This map ranks how effectively each state uses electricity in relation to its economy.



The Next Steps

An essential part of closing the gap between what's being done and what's possible will be identifying key levers to increase adoption. Determining how to take advantage of both physical levers, (such as compact fluorescent lights, weatherization, or more efficient appliances) and policy levers (like stricter building energy codes and appropriate utility compensation for energy efficiency) is a critical research component that both Natalie and Mathias have been actively pursuing to push CEG into its next phase.

The next step of ERT's research will be to create a roadmap to close the efficiency gap in each state. The roadmap will use each state's adjusted electric productivity as a baseline, allowing RMI to measure the success of different efficiency measures on a case-by-case basis and prioritize which actions states should pursue to achieve the highest levels of electric productivity. "The goal of the research was not just to solve a theoretical problem," says Natalie, "but to fix the real problem." •

To see how efficient your state is, and what you can do about it, visit RMI's CEG interactive map at http://ert.rmi.org/cgu/index.html.

RMI Retrofits America's Favorite Skyscraper

The Empire State Building, a New Model for Energy Efficiency

By Molly Miller

When you gaze out over the vast canyons of Manhattan from the 86th floor observatory deck of the Empire State Building (ESB), you are looking at one of the greenest cities in the United States. New York City's per capita emissions are a third of the national average because of public transit use, density, and smaller residences. New York also vows to reduce current carbon emissions by 30 percent by 2030.

And, if the Empire State Building—built during the Great Depression in just over a year and at that time the highest building in the world—embodies the ambition of New York, then it only makes sense for it to be going green now, too. Such was the visionary thinking when the owners of the building took a planned capital improvement renovation to a new level by asking Rocky Mountain Institute and a team of experts convened by the Clinton Climate Initiative (CCI) to recommend sustainability measures that could be incorporated during the planned renovations.

"We have a very deep commitment to sustainability," says Tony Malkin of the Empire State Building Company. "It's our belief that sustainable practices in everything are critical to our future."

The renovations will let Malkin's company offer state-of-the-art office amenities in a historic building, and with RMI's recommendations, they have the potential to greatly reduce both energy use and carbon emissions. While retrofits typically reduce energy consumption by 10–20 percent, RMI proposed an integrated approach to realize savings of almost 40 percent.

To date, few, if any, examples of great pre-war multitenant building retrofits that achieve these standards exist, and the ESB project offers a practical model for other building owners to replicate. Setting this precedent is especially important now as nearly 75 percent of the U.S. commercial building stock is at least 20 years old. Working on the Empire State Building to create an exemplary building retrofit project for the rest of the world to replicate came about in large part due to RMI's collaborative work with the Clinton Climate Initiative on their Energy Efficiency Building Retrofit Program, launched in New York City in 2007.

"Historically, improvements in existing buildings are made on an ad hoc basis," says Kathy Baczko, New York City director of CCI. "However, so much more energy efficiency and savings can be obtained by taking a whole-building approach, when integrated solutions and blended savings bring long-term benefits. Building owners and operators everywhere should be inspired by this icon of American architecture becoming an example of innova-

Photo: iStockphoto

tion in building management."

"The idea that the Empire State Building would undergo a green retrofit is immensely inspiring to building owners across the board, whether it's in New York or in any other city, because the Empire State has always been the signature building of New York," adds Carol Willis, founder, director, and curator of the Skyscraper Museum.

The 102-story Art Deco skyscraper at the intersection of Fifth Avenue and West 34th Street has been named by the American Society of Civil Engineers as one of the Seven Wonders of the Modern World. The building and its ground floor interior are designated landmarks of the New York City Landmarks Preservation Commission, and it was designated as a National Historic Landmark in 1986.

"This building is a great example of the right kind of building to retrofit," says Caroline Fluhrer, a consultant with RMI's Built Environment Team. "The fact that it is an iconic building that is going to be around for a long time to come means it makes sense to invest in it. And the fact that it could be coordinated with a major capital improvement project made it really cost-effective and the owners can save a lot of carbon. "

The capital improvement plan, for example, called for resealing all the windows so they open and close properly. "If you are going to be disturbing tenants and moving them around anyway to work on windows, you might as well put in new energy-efficient windows," explains Caroline.

Wendy Fok, an architect with Jones Lang LaSalle, who worked with RMI and the rest of the team on the ESB recommendations, explains the process for retrofitting the Empire State Building's 6,514 operable windows for energy efficiency: "We use the frames, remove the sashes, reuse the glass, clean it. But between the glass, you'll have an intermediate material which is actually a low emissivity (low-E) film, so even though they call it a triple glazed window, it's actually reusing the existing glazing and inserting a (low-E) film between the two pieces."

The air-handling units offer another example of how RMI's recommendations capitalized on the pre-existing capital improvement plan. RMI recommended that instead of replacing old units with the same models, as was the practice, ESB should replace them with higher quality floor-mounted units when they wear out. While the cost would be marginally higher, the energy efficiency would be much greater and ESB would only need two units per floor instead of the four units per floor they have installed in the past.

RMI's Team

Aalok Deshmukh: Project Manager
Greg Franta: Principal-in-Charge
Caroline Fluhrer: Consultant
Eric Maurer: Financial Modeling
Stephen Doig: Reviewer
Amory Lovins: Advisor
(Core team above was ably and substantially supported by at least 20 other RMI staff members from various teams, as and when needed)

The ESB Retrofit Team

RMI partners on the project included Clanton & Associates (lighting engineers), Rumsey Engineers (mechanical engineers), and Alpen Energy Group (glazing experts). Johnson Controls, Inc. (JCI) was selected as the preferred energy service company (ESCO), while Jones Lang LaSalle (JLL) was selected as the project manager. The RMI team provided engineering consulting services, including peer reviews of the development of JCI's package of facility improvement measures, and supported the project documentation and outreach process.

"It really was a collaboration," says Caroline. "We work with others all the time, but we truly worked as a team. It was challenging but instilled a lot more confidence in the owner. When three world-renowned groups come to the same conclusion, it makes it easier to move forward."

KEY FINDINGS and RECOMMENDATIONS

The project kicked off on April 14, 2008. Collaborative team activities took place over a six-month period between April and November of 2008. At the conclusion of the seven-month project development process, the team found that at current energy costs, ESB could cost-effectively reduce energy use by 38 percent and save 105,000 metric tons of carbon dioxide over the next 15 years. Achieving an energy reduction greater than 38 percent appears to be cost-prohibitive, given current economic conditions.

To achieve these results, ESB would need to implement eight key projects or measures. The recommended measures also reduce cooling load requirements by 33 percent (1,600 tons) and peak electrical demand by 3.5 megawatts, benefitting both the building and the utility. The measures also improve indoor environmental quality for tenants by way of enhanced thermal comfort from better windows, radiative barriers, and superior controls; they improve indoor air quality through tenant demand-controlled ventilation; and they create better lighting conditions that coordinate ambient and task lighting. The measures include projects related to:

- Direct Digital Controls (DDC),
- Tenant Lighting, Daylighting, and Plugs,
- Variable Air Volume (VAV) Air-Handling Units (AHUs),
- Retrofit Chiller Plant,
- Building Windows,
- Tenant Energy Management Program,
- Radiative Barrier, and
- Tenant Demand Control Ventilation (DCV).

Tenant Design

The team has identified three key programs to influence tenant energy use: the tenant pre-built program, tenant design guidelines, and a tenant energy management program. Nearly 40 percent of tenant space will turnover in the next four years, so aggressive guidelines are needed immediately. RMI's proposed green pre-built design will save $0.70–0.90 per square foot in operating costs annually for an additional cost of $6 per square foot and help ESB demonstrate design principles for all tenants to adopt. Design guidelines, based on this pre-built program, will provide green ESB standards. Tenants can verify the technical and economic validity of the recommendations by using a financial tool RMI created specifically for ESB. For the tenant energy management program, ESB will begin sub-metering all tenant spaces and manage a feedback/reporting system to inform tenants about their energy use. This program will also help tenants with their own carbon reporting efforts.


Photo: RMI Staff

Tenant Pre-Built Space

The ESB team designed a space on the 42nd floor (currently under construction) for the Empire State Building to use in marketing space to prospective tenants. Key design features include a low-pressure drop HVAC system, an indirect layered lighting system (ambient–task–accent lighting), new high-performance glazing, light shelves and blinds, and local, high-recycled content construction materials.

Next Steps

The ESB team is in the process of evaluating all the recommendations for increasing energy efficiency and lowering carbon emissions to determine which measures will be incorporated during the renovations. Regardless of the measures adopted, RMI hopes other building owners can use the analysis and recommendations to replicate the process when retrofitting buildings.

"There is further work to be done to capture the lessons learned, systematize the process and disseminate the results to a broad audience," says RMI Vice President Stephen Doig, who consulted on the project. According to Stephen, some of the lessons from the project include:

"Carrying out retrofits in sync

Energy Model & Financial Tool

RMI helped make the financial case for the energy retrofit measures by providing the retrofit team with tools to make financial and energy analyses. Because of the formal documented analysis with these tools, the project had unusual transparency. This transparency allows anyone to test the results and to replicate them in other circumstances and on other projects.

In collaboration with RMI, JCI ran energy analyses using DOE-2.2 (eQUEST interface), a building energy simulation tool that allows for the comparative analysis of building designs and technologies. After climatic, building geometry, material properties, equipment schedules, and system components information have been put in, the program computes building loads and outputs building energy use.

Once the preliminary energy savings estimates for individual measures were generated, the team turned to the financial model (developed by RMI specifically for this project) to determine how to create packages of measures that maximized greenhouse gas savings while providing reasonable economic benefits.

Iterations between these models helped the ESB team make final recommendations to ESB ownership regarding specific short-term and long-term projects and programs they can implement.


Photo: RMI Staff

Amory Lovins Pokes Around the Empire State Building

I was here [at ESB] for a team meeting, and Amory Lovins and I were talking about the broadcast floors at the top of the Empire State Building. Amory got one of those looks in his eye, and we decided to escape the meeting and run up the elevator, and we were taken on a tour of the broadcast floors.

We spent a fair amount of the time putting our hands on every piece of ductwork and every pipe, trying to find high-quality sources of waste heat that could somehow be captured. Amory can be incredibly theoretical, and he can also be incredibly practical, so we were tracing airflows and seeing which side of the door the pressure was on. That was really a great experience and really gave me the indication that we were going to be looking for not just traditional improvements, but looking way outside the box for every opportunity for energy efficiency.

—CLAY NESLER, Johnson Controls

with the normal upgrades to the building makes many more options economically possible. Second, there is a natural tension between maximizing investment returns and maximizing carbon dioxide reduction. It is important to acknowledge that this tension exists and consider funding mechanisms that provide incentives to achieve the maximum efficiency improvement in an economically viable manner. The work also made clear that, in order to deliver real reductions, owners, ESCOs, tenants and building managers need to be engaged and incented by the process. We were fortunate in our project that was the case, and it needs to become the norm in the future. Finally, we learned that we need to make our approach replicable so it can be widely adopted. "

"From the larger dissemination point of view, I think the most exciting thing is the fact that the Clinton Climate Initiative brings us this platform of the 40 largest cities of the world with a pretty substantive existing building stock comprised largely of commercial office buildings," says Aalok Deshmukh, who worked as RMI's project manager on the ESB recommendations.

"All portfolio managers and real estate owners to some extent have been concerned with energy efficiency, and they've done small things," says Clay Nesler, VP of Global Energy and Sustainability at Johnson Controls. "What this project is going to show is that it actually makes sense to make large and significant energy efficiency improvements, not the 5 to 10 percent type things, but the 20 to 30 percent and more type of improvements, and that there is a business case for doing so."

The Empire State Building retrofit offers a glimpse of the kind of future that is possible for our buildings and cities.

As Carol Willis puts it, "The Empire State Building is the best place to go in order to see the city of New York and the lay of the land as you look out towards the continent or towards the ocean…The Empire State Building stands in this kind of exceptionalism that hopefully will never be compromised." •

What is an ESCO?

Energy service companies (ESCOs) retrofit buildings according to owners' investment criteria (maximum capital outlay, maximum payback period, minimum ROI, etc.) and use the generated annual energy savings to pay for the upfront investment. ESCO services and performance contracts vary among companies, yet major activities generally include investment grade audits, equipment inventories, engineering and design services, contracting, financing, installation, commissioning, training, measurement and verification, and post-construction services. Johnson Controls was chosen for the ESB project and worked with other partners to make the recommendations.

Other major ESCOs include Chevron Energy Solutions, Trane, Carrier, Siemens, TAC, Ameresco, and Noresco. An ESCO need not manufacture building energy equipment.

Clinton Climate Initiative

President Bill Clinton founded the Clinton Climate Initative (CCI) in 2006 to create and advance solutions to climate change. Through targeted projects, CCI's Cities program helps municipal governments improve energy efficiency and measure emissions reductions. CCI's Energy Efficiency Building Retrofit Program addresses greenhouse gas emissions generated by existing buildings. Within large urban areas, buildings are huge energy consumers, responsible for approximately 70 percent of a city's carbon footprint. In New York City, buildings are responsible for 79 percent of all greenhouse gas emissions.

CCI's Building Retrofit Program brings together many of the world's largest cities, building owners, energy service companies, and financial institutions to drastically reduce energy consumption in existing buildings, including the Empire State Building.

"In large cities around the globe, buildings typically produce the most carbon emissions, most atmospheric pollution; it's often 70 to 80 percent of the total energy used in a city goes into the operation of buildings. So if we can retrofit existing buildings in cities, it could have a major impact on carbon emissions," said RMI's Greg Franta.

CCI has a relationship with RMI to assist CCI in guiding and encouraging building owners to use integrated approaches to energy efficiency improvements—a method that can achieve much deeper energy savings—rather than more conventional one-off lighting or HVAC upgrades that leave deeper savings permanently unavailable.

View of the Chrysler Building through one of the retrofitted windows in the Empire State Building.

Photos: RMI Staff

January 22, 1930—
Excavation of the site where the Empire State Building would stand began.

March 17, 1930—
Construction of the Empire State Building began.

May 1, 1931—
President Hoover pressed a button in Washington, D.C., officially opening and turning on the Empire State Building's lights.

From 1931 to the present, the building has acted as an "Ambassador to New York" to many of the world's renowned political and entertainment figures, such as Fidel Castro, Queen Elizabeth, Prince Charles, Prince Andrew, The Duchess of York, Nikita Khrushchev, the King of Siam, and others.

November 13, 1930—
The masonry work for the building, which began in June of the same year, was completed.

William Lamb, an architect at the firm Shreve, Lamb & Harmon Associates, was chosen to design the Empire State Building. He happened to base most of his design on a simple pencil. The clean, soaring lines inspired him, and he modeled the building after it. Under the direction of the architects, and a peak labor force of 3,000 men, the framework rose at a rate of four stories per week. It took one year and 45 days to build.

ESB FUN FACTS

Photos: The Skyscraper Museum

The building's dirigible mast (now the base of the TV tower) was originally designed as a mooring mast for blimps (unfortunately because of several unsuccessful attempts and the volatile wind conditions at 1,350 feet, the idea was ultimately abandoned).

From the top of the Empire State Building, visitors can see into New Jersey, Pennsylvania, Connecticut, and even Massachusetts.

RMI Staff Profile: Lena Hansen

By Ben Holland

Lena Hansen has little time to rest. A Principal with the Energy & Resources Team, she rarely stays in one place for long, balancing a brimming schedule of conference calls and team meetings. It doesn't seem to faze her. With more than five years at RMI, Lena's hard work, dedication, and belief in positive change have advanced the transformational work of the Institute.

At a young age, Lena gravitated to the sciences, so from high school on, she spent her academic life in North Carolina's research triangle. Her home, however, is in Brevard, a city of seven thousand resting at the foot of the state's Blue Ridge Mountains. And if there is any question as to what led Lena to RMI, its answer might lay there, among the rolling hills and cascading waterfalls.

Like many towns, though, Brevard is undergoing substantial growth—its suburbs spreading outwards and connecting with nearby Asheville in an array of shopping centers and fast food restaurants. After earning a degree in Astrophysics from the University of North Carolina at Chapel Hill, Lena returned to Brevard and discovered a place of alarming fragility.

"There was this massive change in my hometown," she says. "All this sprawl had developed. It had destroyed greenspace, traffic was bad—it was just not the place that I remembered."

The change left an impact; but instead of focusing on disappointment, Lena took stock of her skills and saw an opportunity to apply her talents in a field that deeply resonated with her.

"I found a real need for manpower dedicated to solving the real problems of the world," she says. "I also saw that it was a type of work to which I could contribute. I had a lot of room to decide for myself what was really important."

With newfound purpose, Lena enrolled in the Masters of Environmental Management program at Duke University. The curriculum emphasized a broad scope of perspectives on solving the world's biggest environmental problems. In her first year, Lena had the good fortune to take a class with Simon Rich, former CEO for Louis Dreyfus Holdings, a major oil refiner and petroleum products distributor. While Rich seemed like an unlikely professor to influence a budding sustainability expert, his class was invaluable; he emphasized the importance of cross-boundary collaboration in solving the world's most difficult problems. It was a unique program, but it would become something greater by the time Lena left.

Lena set her sights high and sought new challenges. With the help of Rich and two fellow students, she organized "Creating a Sustainable Energy Future," Duke's first energy focused environment forum. On their own, Lena and her colleagues rolled up their sleeves and convened thirty speakers and three hundred participants, ranging from students to energy company executives to environmental leaders.

"Lena provided the cool thought leadership as we dealt with moment to moment crises throughout the event," says her former professor.

The success of the forum spawned an entirely new graduate track at Duke—an environmental management curriculum that focuses on energy economics and policy.

"She was the hardest working and most dedicated," says former classmate Mandy Schmitt, who helped Lena organize the Duke forum, and is now the Sustainability Director for the City of Atlanta. "Lena is deeply committed to the need for change in the way we use energy. She takes her work very seriously. It is a life goal."

That level of commitment makes Lena an invaluable asset to RMI. Since interning alongside former managing director, Kyle Datta, her contribution to the Energy and Resources team has been indispensable. By offering sound advice and anticipating next steps far in advance, she guides her team to impactful results. She's committed to her work and confident in its importance.

"Lena has an innate ability to see the big picture and not get mired in the details," says fellow team member, Virginia Lacy. "I trust her opinion - and ask for it often - on just about any issue our team confronts."

With the Next Generation Utility [NGU] initiative, Lena and her team are confronting an issue of boundless complexity – converting our electric system away from coal and natural gas to renewables and efficiency.

Though many factors have led to greater public support for renewable energy, few concrete strategies exist for mapping the transition to a low carbon energy system. No simple task, the integration of wind and solar demands clear, cross-boundary thinking. Its success rests upon the seamless interaction of disparate and fluctuating factors–weather, consumer demand, and technology costs.

In managing the Solar Value Chain–another ERT initiative–Lena is applying classic RMI whole systems thinking to the manufacturing costs of a highly competitive industry. Her goal is not small; she aims to reduce cost of solar photovoltaics by two-thirds.

Solar energy, she says, "has huge potential for cost reduction from increasing manufacturing efficiency and coordinating across the value chain, without requiring technological innovation. As the cost comes down, solar will become more cost-competitive with coal, and can supply more and more electricity."

Real change requires intense dedication and, sometimes, unexpected bedfellows; but as Lena learned long ago, results come from collaboration. This idea is exemplified in her work with Irving Oil, a Canadian based oil refiner with plans to build a new oil refinery in the next several years.

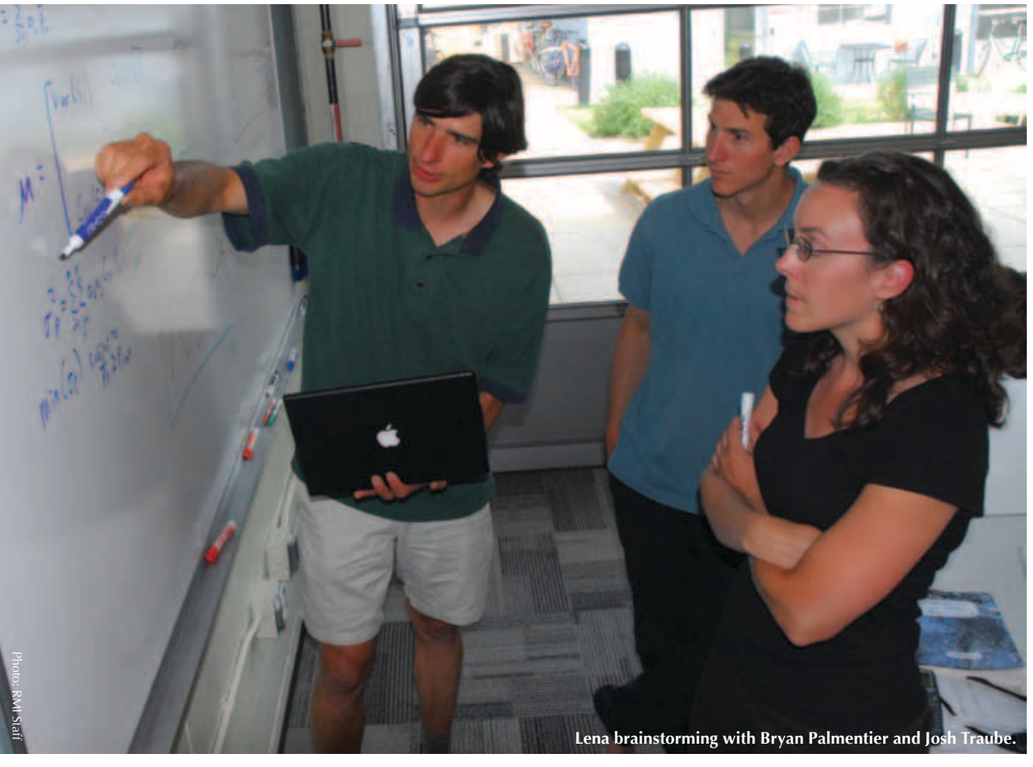
Efficiency–even in the sources of energy we seek to replace–is of great importance to Lena. A typical refinery emits an amount of waste heat equivalent to a power plant. So, she and her team are working with Irving to reduce waste by driving innovative design and implementing whole systems efficiency. The end result will be a facility that emits substantially less carbon.

Rather than creating adversarial relationships, Lena focuses driving positive results by fostering cooperative partnerships.

"Environmental problems are hugely complex. Wicked in fact," she says. "By and large, it takes a lot of people to solve these problems, and if you don't collaborate, you're much less likely to get anything done."

There's no shortage of dedicated people here. Whatever the challenge, a common thread of optimism connects every employee at RMI. Lena is no exception. She has turned her optimism into something actionable; and with aspirations bolstered by a disciplined work ethic, she is committing herself to transforming the way we use energy.

"It's an optimism about the fact that we can solve these problems, but it's rooted in a reality and practicality," Lena says. "That positive voice for change is really important." •



Photos: RMI Staff

Lena brainstorming with Bryan Palmentier and Josh Traube.

Photos: RMI Staff

Mike Simpon, Virginia Lacy, and Lena hard at work outside of RMI's Boulder office.

Getting America Off Oil: The Oil Solutions Initiative

By Cameron Burns

For many of us, 2004 might seem like yesterday, but in terms of oil, climate, and the economic situation, it feels like a different era. Oil prices hadn't skyrocketed up to $140 a barrel, the economy was doing fairly well, and the discussion about climate—though happening—didn't have the sense of urgency that it has today.

Despite the depth of commentary on the oil problem, RMI forged ahead and published Winning the Oil Endgame (WTOE), the first solution to America's oil dependence and a tangible roadmap to get the United State completely off oil by the 2050s. It was a bold and forward-looking idea.

Four years later, in the summer of 2008, oil prices spiked, hitting $140 a barrel, and solutions to America's oil addiction started proliferating. T. Boone Pickens's developed a plan. Andy Grove was also getting considerable notoriety for his plan to retrofit vehicles with electric motors. Several RMI researchers delved into the matter and found there were actually quite a few "off-oil" plans—a dozen prominent campaigns at least.

That the Institute was no longer alone in showing a way to eliminate America's dependence on oil was both encouraging and intriguing. That begged the obvious question: how are the plans different and what's going to work? Initially, one suggestion was to build an off-oil "Uber Plan," a plan that synthesized and integrated the best ideas. But, it became clear fairly quickly that that wouldn't work.

"While all of the groups we worked with agree on freeing America from oil, the actual way of going about it is a serious point of contention," notes Bennett Cohen, an RMI researcher. "A security group might propose offshore drilling in the United States, or coal-to-liquids technologies, things that make us less reliant on foreign countries. Thus, even though their goal is to reduce oil, they're going to butt heads with environmental groups like the Natural Resources Defense Council (NRDC), who want to reduce oil but replace it with things that are clean."

Biofuels are another example of such "contentious" issues, Bennett notes, as there is tremendous disagreement on how much impact the use of biofuels can have on emissions and how sustainably they can be produced. Several of the plans being circulated were very technical, some were very heavy on policy, while others were designed to generate green jobs. While some were about replacing technologies, others focused on using renewables. Many plans were broader energy initiatives. About half the plans, Bennett explains, were oil-specific and aimed at reducing use.

"At the end of the day, we want to create a vision of the future that can accomplish everyone's goals," says Kristine Chan-Lizardo, interim director for RMI's MOVE team. "How to reduce our oil needs quickly and determine what alternatives can be affordable, reliable, and environmental is the challenge."

"At the end of the day, we want to create a vision of the future that can accomplish everyone's goals."

Convening Plan Creators

Instead of allowing the differences in the plans to divert attention from the important solution these groups were all striving for, RMI partnered with the Brookings Institution and created the Oil Solutions Initiative (OSI), a multi-pronged effort to use the strengths of all the plans without losing sight of the shared goal: reducing America's dependence on oil.

RMI and Brookings then created a network which included representatives from all the groups with plans related to making the United States less oil dependent: the Alliance for Climate Protection, the Apollo Alliance, the Council on Competitiveness, the Energy Security Leadership Council, Andy Grove's "Retrofit" Plan, the Institute for 21st Century Energy, the Massachusetts Institute of Technology, the National Commission on Energy Policy, the National Petroleum Council, NRDC, the Pickens Plan, Set America Free, Brookings, and RMI.

After initial interviews with representatives from each group and research into the various plans themselves, RMI and Brookings convened the collection of stakeholders, at Brookings's Washington, D.C. facilities, during an Oil Solutions summit.

The December 18–19 event included additional experts from other areas related to oil. There were scientists, military officers, business leaders, environmentalists, and economists, among others. As part of the OSI work, RMI and Brookings split the challenge of reducing oil freedom dependence into the two areas of demand (use) and supply (fuel sources). On the demand side, OSI goals focus on reducing how much oil America uses in the transportation sector (in light and heavy vehicles, aviation, personal mobility, and "transit"); the supply side's focus is on alternatives like biofuels, supporting electrified vehicles, and mobility powered by non-oil sources. To further refine the aims of the initiative, goals have both a short-term (2012) and long-term (2030) horizon.

The 2012 horizon was established in order to show the current administration and Washington legislators what can be achieved within the next four years—and without requiring major infrastructure change or technological innovation.

"There's an urgency to capturing the oil savings from this 'low-hanging fruit,'" says Kristine. "Climate change simulations project a 'point of no return' if emissions continue to rise over the next five years."

The 2030 horizon was established in order to illustrate the more serious, long-term potential reduction in oil use and transportation industry transformation.

At the Summit, participants were split into demand and supply groups (both 2012 and 2030) and each came up with realistic targets and policies to get there.

"I think we were able to draw people out of their specific initiatives to think about the big picture and come up an overarching approach that they could support as a group," said Lionel Bony, head of RMI's Office of the Chief Scientist. "It wasn't like we took the best parts of every plan and put them together. It was all the participants' work, then we started piecing it together."

After the summit, RMI and Brookings began crafting a memo articulating certain policy recommendations that had emerged at the summit. The memo includes short-term recommendations, like a 5 percent increase in public transit utilization and a 6 percent substitution of oil with alternative liquid fuels, as well as long-term recommendations, like a 100-mile-per-gallon minimum for new light-duty vehicles and diversity in the fuels market so that no single fuel comprises more than 40 percent of demand.

"Each draft of the memo went out to all the participants for criticism, additions, changes, and updates so at the end we have a framework that'll include aspects of all these different plans and input from a diverse base of expertise" Bennett notes.

Once the memo is complete RMI and Brookings will try to solicit endorsements from a variety of organizations. One factor in getting that endorsement appears to be couching memo points in terms of goals, like reducing oil use at X percentage, rather than boosting certain technologies or approaches.

Where Next?

The memo might be presented to legislators, or even submitted to the new President. It might also signal the beginning of a lengthier collaboration with all the OSI participants.

"We built this network, we have all these collaborators," Bennett notes. "One idea is to start working on the implementation of policies. There's going to be a lot of government support for clean energy, clean technologies, and oil reduction from Washington, beginning with the stimulus package and continuing with the upcoming transit transportation and energy bills."

Another suggestion that's been made is to use the information that OSI participants have gathered to leverage the network to help make sure that dollars are spent the right way. That might mean sifting through different policy ideas or proposed projects and modeling the various oil reduction and greenhouse gas reductions impacts each has. An alternative idea is to research gaps in what is known about the technologies, practices, and actions that might come out of federal implementation of off-oil policies. Lastly, the OSI participants could be reconvened and begin working on off-oil projects collaboratively, much like Smart Garage led to a number of sub-projects aimed to foment the electric vehicle revolution.

RMI typically doesn't work in the policy arena, so the OSI Summit and related efforts have been a valuable lesson for the Institute in pushing smart solutions at the national level.

"We want to affect policy, but the process is convoluted and can be opaque to folks outside the Beltway," Bennett notes. "We are fortunate that the network we built includes D.C. insiders with a deep understanding of the policy process."

Perhaps the most surprising thing the whole process has revealed is the growing nationwide interest in getting off oil. In past decades, as soon as oil has dropped in price, it's been forgotten. By time of RMI/Brookings Oil Solutions summit, oil was back down to around $40 a barrel and the economy was tanking. But RMI and the 13 other groups' focus on oil independence shows that oil issues—that is, oil's impact on the economy, security and the environment—have become just too weighty to be ignored.

"This is an exciting time to be involved in informing our government leaders, not only at the federal level, but at the state and city level as well," says Kristine. "I expect that the work RMI is doing in convening the Oil Solutions Initiative and creating a unified voice amongst the diverse 'off-oil' perspectives is directly affecting the barriers we commonly come across in our work with corporations and communities—namely policy and funding. When we can get our policymakers to consider the priorities outlined in the OSI memo, it will pave the way towards easier implementation of many of the solutions we have advocated for the electric grid and energy-efficient transportation, as well as transit-oriented communities." •

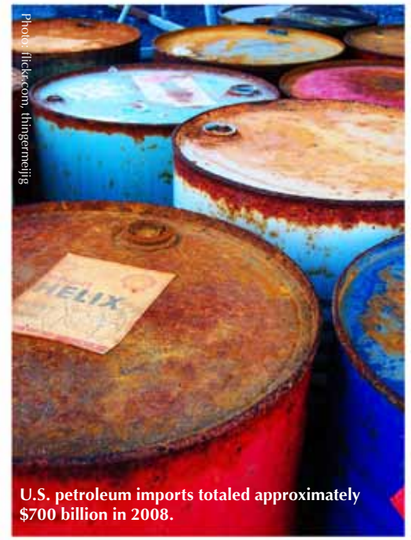


Photo: flickr.com, thingermejig

U.S. petroleum imports totaled approximately $700 billion in 2008.

Photo: Bright Automotive

Bright Automotive's IDEA is a plug-in hybrid fleet vehicle that uses advanced aerodynamics to achieve fuel efficiency of up to 100 mpg.

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"New" Nuclear Reactors, Same Old Story

By Amory B. Lovins

The dominant type of new nuclear power plant, light-water reactors (LWRs), proved unfinanceable in the robust 2005–08 capital market, despite new U.S. subsidies approaching or exceeding their total construction cost. New LWRs are now so costly and slow that they save 2–20x less carbon, 20–40x slower, than micropower and efficient end-use.[1] As this becomes evident, other kinds of reactors are being proposed instead—novel designs claimed to solve LWRs' problems of economics, proliferation, and waste.[2] Even climate-protection pioneer Jim Hansen says these "Gen IV" reactors merit rapid R&D.[3] But on closer examination, the two kinds most often promoted—Integral Fast Reactors (IFRs) and thorium reactors[4]—reveal no economic, environmental, or security rationale, and the thesis is unsound for *any* nuclear reactor.

Integrated Fast Reactors (IFRs)

The IFR—a pool-type, liquid-sodium-cooled fast-neutron[5] reactor plus an ambitious new nuclear fuel cycle—was abandoned in 1994,[6] and General Electric's S-PRISM design in ~2003, due to both proliferation concerns and dismal economics. Federal funding for fast breeder reactors[7] halted in 1983, but in the past few years, enthusiasts got renewed Bush Administration support by portraying the IFR as a solution to proliferation and nuclear waste. It's neither.

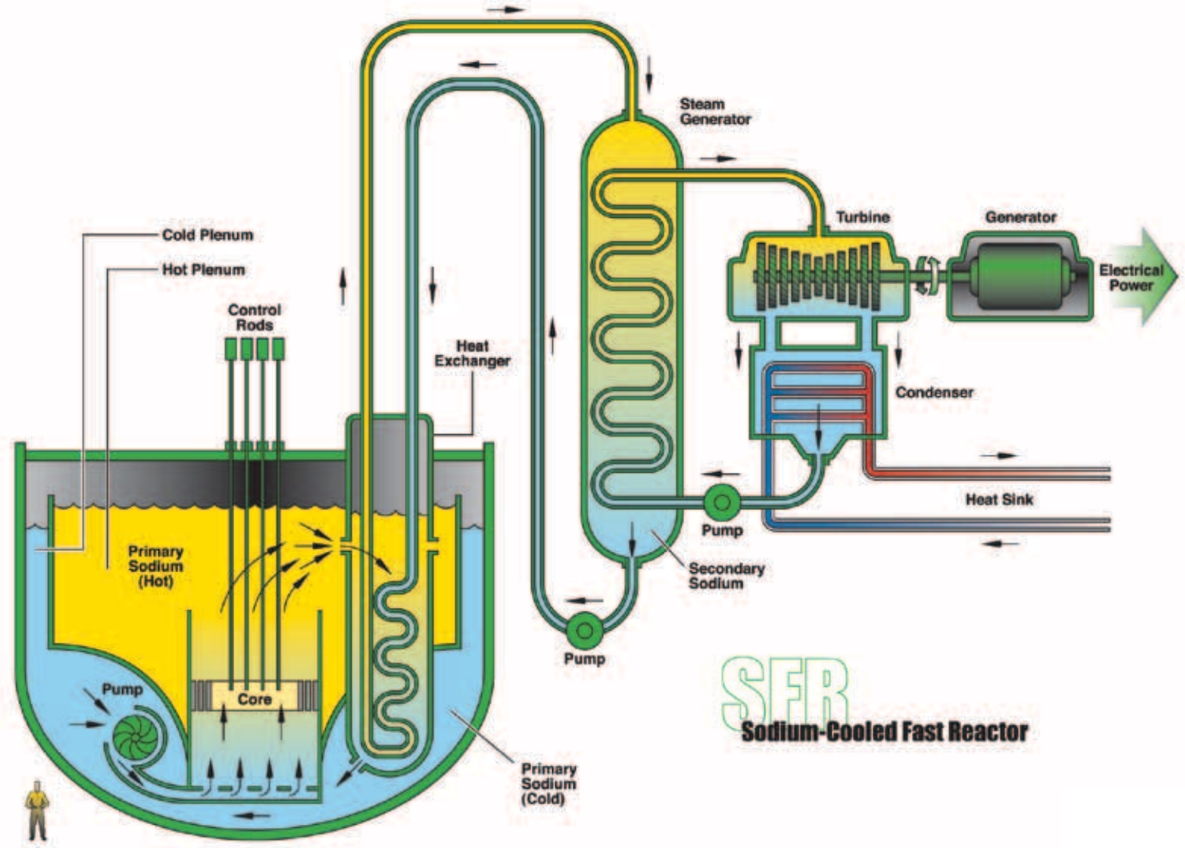
Fast reactors were first offered as a way to make *more* plutonium to augment and ultimately replace scarce uranium. Now that uranium and enrichment are known to get cheaper while reprocessing, cleanup, and nonproliferation get costlier—destroying the economic rationale—IFRs have been rebranded as a way to *destroy* the plutonium (and similar transuranic elements) in long-lived radioactive waste. Two or three redesigned IFRs could in principle fission the plutonium produced by each four LWRs without making more net plutonium. However, most LWRs will have retired before even one commercial-size IFR could be built; LWRs won't be replaced with more LWRs because they're grossly uncompetitive; and IFRs with their fuel cycle would cost even more and probably be less reliable. It's feasible today to "burn" plutonium in LWRs, but this isn't done much because it's very costly, makes each kg of spent fuel 7x hotter, enhances risks, and makes certain transuranic isotopes that complicate operation. IFRs could do the same thing with similar or greater problems, offering no advantage over LWRs in proliferation resistance, cost, or environment.

IFRs' reprocessing plant, lately rebranded a "recycling center," would be built at or near the reactors, coupling them so neither works without the other. Its novel technology, replacing solvents and aqueous chemistry with high-temperature pyrometallurgy and electrorefining, would incur different but major challenges, greater technical risks and repair problems, and speculative but probably worse economics. (Argonne National Laboratory, the world's experts on it, contracted to pyroprocess spent fuel from EBR-II—a small IFR-like test reactor shut down in 1994—by 2035, at a cost DOE estimated in 2006 at ~50 today's cost of fresh LWR fuel.)

Reprocessing of any kind makes waste management more difficult and complex, increases the volume and diversity of waste streams, increases by several- to manyfold the cost of nuclear fueling, and separates bomb-usable material that can't be adequately measured or protected. Mainly for this last reason, all Presidents since Gerald Ford in 1976 (except G.W. Bush in 2006– 08) discouraged it. An IFR/pyroprocessing system would give any country immediate access to over a thousand bombs' worth of plutonium to fuel it, facilities to recover that plutonium, and experts to separate and fabricate it into bomb cores—hardly a path to a safer world.

IFRs might in principle offer some safety advantages over today's light-water reactors, but create different safety concerns, including the sodium coolant's chemical reactivity and radioactivity. Over the past half-century, the world's leading nuclear technologists have built about three dozen sodium-cooled fast reactors, 11 of them Naval. Of the 22 whose histories are mostly reported, over half had sodium leaks, four suffered fuel damage (including two partial meltdowns), several others had serious accidents, most were prematurely closed, and only six succeeded. Admiral Rickover canceled sodium-cooled propulsion for *USS Seawolf* in 1956 as "expensive to build, complex to operate, susceptible to prolonged shutdown as a result of even minor malfunctions, and difficult and time-consuming to repair." Little has changed. As Dr. Tom Cochran of NRDC notes, fast reactor programs were tried in the US, UK, France, Germany, Italy, Japan, the USSR, and the US and Soviet Navies. All failed. After a half-century and tens of billions of dollars, the world has one operational commercial-sized fast reactor (Russia's BN600) out of 438 commercial power reactors, and it's not fueled with plutonium.

IFRs are often claimed to "burn up nuclear waste" and make its "time of concern . . . less than 500 years" rather than 10,000–100,000 years or more.



A Technology Roadmap for Generation IV Nuclear Energy Systems
Graphic: Department of Energy

That's wrong: most of the radioactivity comes from fission products, including very-long-lived isotopes like iodine-129 and technicium-99, and their mix is broadly similar in any nuclear fuel cycle. IFRs' wastes may contain less transuranics, but at prohibitive cost and with worse occupational exposures, routine releases, accident and terrorism risks, proliferation, and disposal needs for intermediate- and low-level wastes. It's simply a dishonest fantasy to claim, as a *Wall Street Journal* op-ed just did,[8] that such hypothe¬tical and uneconomic ways to recover energy or other value from spent LWR fuel mean "There is no such thing as nuclear waste." Of course, the nuclear industry wishes this were true.

No new kind of reactor is likely to be much, if at all, cheaper than today's LWRs, which remain grossly uncompetitive and are getting more so despite five decades of maturation. "New reactors" are precisely the "paper reactors" Admiral Rickover described in 1953:

> An academic reactor or reactor plant almost always has the following basic characteristics: (1) It is simple. (2) It is small. (3) It is cheap. (4) It is light. (5) It can be built very quickly. (6) It is very flexible in purpose. (7) Very little development will be required. It will use off-the-shelf components. (8) The reactor is in the study phase. It is not being built now.

On the other hand a practical reactor can be distinguished by the following characteristics: (1) It is being built now. (2) It is behind schedule. (3) It requires an immense amount of development on apparently trivial items. (4) It is very expensive. (5) It takes a long time to build because of its engineering development problems. (6) It is large. (7) It is heavy. (8) It is complicated.

Every new type of reactor in history has been costlier, slower, and harder than projected. IFRs' low pres¬sure, different safety profile, high temperature, and potentially higher thermal efficiency (if its helium turbines didn't misbehave as they have in all previous reactor projects) come with countervailing disadvantages and costs that advocates assume away, contrary to all experience.

Thorium reactors

Some enthusiasts prefer fueling reactors with thorium—an element 3 as abundant as uranium but even more uneconomic to use. India has for decades failed to commercialize breeder reactors to exploit its thorium deposits. But thorium can't fuel a reactor by itself: rather, a uranium- or plutonium-fueled reactor can convert thorium-232 into fissionable (and plutonium-like, highly bomb-usable) uranium-233. Thorium's proliferation,[9] waste, safety, and cost problems differ only in detail from uranium's: *e.g.*, thorium ore makes less mill waste, but highly radioactive U-232 makes fabricating or reprocessing U-233 fuel hard and costly. And with uranium-based nuclear power continuing its decades-long economic collapse, it's awfully late to be thinking of developing a whole new fuel cycle whose problems differ only in detail from current versions.

Spent LWR fuel "burned" in IFRs, it's claimed, could meet all humanity's energy needs for centuries. But renewables and efficiency can do that forever at far lower cost, with no proliferation, nuclear wastes, or major risks.[10] Moreover, any new type of reactor would probably cost even more than today's models: even if the nuclear part of a new plant were free, the rest—two-thirds of its capital cost—would still be grossly uncompetitive with any efficiency and most renewables, sending out a kilowatt-hour for ~9–13¢/kWh instead of new LWRs' ~12–18+¢. In contrast, the average U.S. windfarm completed in 2007 sold its power (net of a 1¢/kWh subsidy that's a small fraction of nuclear subsidies) for 4.5¢/kWh. Add ~0.4¢ to make it dispatchable whether the wind is blowing or not and you get under a nickel delivered to the grid.

Most other renewables also beat new thermal power plants too, cogeneration is often comparable or cheaper, and efficiency is cheaper than just running any nuclear- or fossil-fueled plant. Obviously these options would also easily beat proposed fusion reactors that are sometimes claimed to be comparable to today's fission reactors in size and cost. And unlike any kind of hypothetical fusion or new fission reactor—or LWRs, which have a market share below 2%—efficiency and micropower now provide at least half the world's new electrical services, adding tens of times more capacity each year than nuclear power does. It's a far bigger gamble to assume that the nuclear market loser will become a winner than that these winners will turn to losers.

Small reactors

Toshiba claims to be about to market a 200-kW$_e$ nuclear plant (~5,000x smaller than today's norm); a few startup firms like Hyperion Power Generation aim to make 10¢/kWh electricity from miniature reactors for which it claims over 100 firm orders. Unfortunately, 10¢ is the wrong target to beat: the real competitor is not other big and costly thermal power plants, but micropower and negawatts, whose *delivered* retail cost is often ~1–6¢/kWh.[11] Can one imagine in principle that mass-production, passive operation, automation (perhaps with *zero* operating and security staff), and supposedly failsafe design might enable hypothetical small reactors to approach such low costs? No, for two basic reasons:

- Nuclear reactors derive their claimed advantages from highly concentrated sources of heat, and hence also of radiation. But the shielding and thermal protection needed to contain that concentrated energy and exploit it (via turbine cycles) are inherently unable to scale down as well as technologies whose different principles avoid these issues.
- By the time the new reactors could be proven, accepted by regulators and the public, financed, built, and convincingly tested, they couldn't undercut the *then* prices of negawatts and micropower that are beating them by 2–20x today—and would have gained decades of further head start on their own economies of mass production.

In short, the notion that different or smaller reactors plus wholly new fuel cycles (and, usually, new competitive conditions and political systems) could overcome nuclear energy's inherent problems is not just decades too late, but fundamentally a fantasy. Fantasies are all right, but people should pay for their own. Investors in and advocates of small-reactor innovations will be disappointed. But in due course, the aging advocates of the half-century-old reactor concepts that never made it to market will retire and die, their credulous young devotees will relearn painful lessons lately forgotten, and the whole nuclear business will complete its slow death of an incurable attack of market forces. Meanwhile, the rest of us shouldn't be distracted from getting on with the winning investments that make sense, make money, and really do solve the energy, climate, and proliferation problems, led by business for profit. •

Amory Lovins, a student of nuclear issues since the 1960s, is Chairman and Chief Scientist of RMI. He is grateful to Drs. Tom Cochran (NRDC), Frank von Hippel (Princeton), and Hal Feiveson (Princeton) for generously sharing their insights.

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[1] A.B. Lovins et al., "Nuclear Power: Climate Fix or Folly?," RMI, 31 Dec. 2008, www.rmi.org/images/PDFs/Energy/E09-01_NuclPwrClimFixFolly1i09.pdf.
[2] E.g., Tom Blees's *Prescription for the Planet*, skirsch.com/politics/globalwarming/ifr.htm, and three retired Argonne National Laboratory physicists' 2005 *Scientific American* summary article at www.nationalcenter.org/NuclearFastReactorsSA1205.pdf.
[3] See www.columbia.edu/%7Ejeh1/mailings/20081229_Obama_revised.pdf.
[4] For a third type often proposed, see J. Harding, "Pebble Bed Modular Reactors—Status and Prospects," 2005, RMI Publication #E05-10, www.rmi.org/images/PDFs/Energy/E05-10_PebbleBedReactors.pdf; S. Thomas, "The Economic Impact of the Proposed Demonstration Plant for the Pebble Bed Modular Reactor Design," Aug 2005, www.psiru.org/reports/2005-09-E-PBMR.pdf; www.neimagazine.com/story.asp?storyCode=2030985, 6 Sep 2005.
[5] Such reactors, called "fast reactors" for short, do not slow down their neutrons with a "moderator" like water or graphite. They therefore don't depend on a small fraction of "delayed" neutrons to keep the chain reaction going, so they require different means of control and safety.
[6] See www.nationalcenter.org/NPA378.html.
[7] See http://en.wikipedia.org/wiki/Breeder_reactor.
[8] W. Tucker, 13 March 2009, online.wsj.com/article/SB123690627522614525.html.
[9] Most proposed thorium cycles need reprocessing to separate U-233 for use in fresh fuel. Some also use 20%-enriched uranium-235, which needs very little further enrichment to become bomb-usable. Diluting U-233 with U-238 also makes more separable plutonium. See A.B. Lovins, "Thorium Cycles and Proliferation," *Bull. atom. Scient.* **35**(2):16–22 (1979), **35**(5):50–54 (1979), **35**(9):57–59 (1979), all at books.google.com/books?id=GgsAAAAAMBAJ&source=gbs_summary_s&cad=0#all_issues_anchor.
[10] See ref. 1.
[11] *Id.*

Photo: flickr.com, thebmag

RMI's Amory Lovins Wins 2009 National Design Award

In May, RMI cofounder, Chairman, and Chief Scientist Amory Lovins won the 2009 National Design Award for Design Mind from Cooper-Hewitt, National Design Museum. The coveted awards recognize excellence and innovation across a variety of design disciplines. The Design Mind award "recognizes a visionary who has affected a paradigm shift in design thinking or practice through writing, research, and scholarship."

The award will be bestowed in October and is typically recognized in a White House ceremony. This is the tenth year of the National Design Awards and the fifth year of the Design Mind Award, one of the ten categories. Nominations are solicited from a committee of more than 2500 leading designers, educators, journalists, cultural figures, and corporate leaders from every state in the nation, then chosen by a distinguished jury.

"I'm honored and delighted at this award," said Amory, "and believe it reflects the growing recognition of how my colleagues and I at RMI are creating abundance by design. Design—the translation of intention into action—is not just some abstract artistic or theoretical process; it literally shapes our world, creates most of its problem, and can profitably solve them instead. RMI's job is transforming design, busting barriers, and spreading solutions for the efficient and restorative use of resources."

Cooper-Hewitt, National Design Museum, part of the Smithsonian Institution, is the only museum in the nation devoted exclusively to historic and contemporary design. The Museum presents compelling perspectives on the impact of design on daily life through active educational and curatorial programming. It is creating a traveling exhibition featuring the work of the National Design Award winners.

Photo: RMI Staff

The Dirt on Sustainability: Auden Schendler Talks about the Problems

By Cameron Burns

Walk into any bookstore these days and you'll likely find not only a selection of books on environmental issues but a section dedicated to the green business movement or green corporate principles.

Many of these books include stories about how applying green principles led to "triple bottom line" benefits (greater corporate profits, less environmental impact, and happier customers and workers), a greener supply chain, leaner operations, and a raft of other benefits. Some even tout the miraculous change of mindset of the CEO who now "gets it."

But ask Auden Schendler, Executive Director of Sustainability at the Aspen Skiing Company ("Skico") and former RMI staffer, and he'll tell you that while the stories might be true, many are not entirely complete. He should know. He spent ten years trying to implement a variety of sustainability measures on the Skico's mountains in central Colorado, throughout its offices, and in the minds of its people—successfully at times, and very unsuccessfully at others.

"The shocker for me was how reluctant people are to talk about the reality of what happens when you do this worthy work," he notes. "My biggest take-away from being at Skico for ten years is that implementing sustainable practices is brutally difficult, but it shouldn't be shameful that it's hard. It's actually a badge of honor. And that's something we need to discuss in broader forums to help people get through it. Because right now everyone in the sustainability field has a conflict where they can't talk about it. If you're a consultant or an architect or a politician or part of a government program or an NGO you have to sell this story that green is green, and makes sense, and is the right thing to do, and not even necessarily that big a challenge. And the reality is it's something we have to do and must do, but like anything in business it's extraordinarily difficult. And worse, in the case of green, it's even more difficult than most things because we're swimming upstream against bad policies."

Recently, Auden published his first book, *Getting Green Done: Hard Truths from the Front Lines of the Sustainability Revolution* (PublicAffairs, 2009). In it, he posits that climate is the most significant challenge humanity might ever face. He then reports on his trials and tribulations in addressing climate change through myriad projects at the Aspen Skiing Company's resorts, hotels, and offices.

Although the theme of the book is not exactly success, Auden has been fairly successful since he left RMI in 1999. In 2001, he and others helped the Sundeck, Aspen Mountain's summit restaurant, become the eleventh LEED-rated building on earth. In 2003, he repeated that effort in the resort of Snowmass Village, Colo., where the Skico's Snowmass Golf Club clubhouse achieved a LEED Silver rating. The company also built the Sanctuary condos, which use from 30–50 percent less energy than comparable buildings in Snowmass Village. In 2004, the Skico installed a 115-kilowatt microhydro plant that makes $15,000 worth of power annually on Snowmass's slopes and the Skico also became the first U.S. ski resort to achieve the ISO 14001 rating, an international recognition for environmental management and achievement.

In 2007, the Skico filed an "amicus" brief (thereby offering the court information so it could make the best decision) in Massachusetts v. EPA, a case that Massachusetts won and which subsequently required the EPA to regulate carbon dioxide as a pollutant (coal plants have been denied permits based on this ruling).

In 2008, Skico and several partners (Colorado Rocky Mountain School (CRMS), the Town of Carbondale, the Community Office of Resource Efficiency, and Xcel Energy, an energy utility) established the then-largest solar array in western Colorado (Rifle now has a bigger one), which makes 200,000 kilowatt-hours per year and keeps about 350,000 pounds of carbon dioxide out of the atmosphere.

Auden has dabbled in biofuels and testified on Capitol Hill in Washington, D.C. He's spoken at conferences and written for renowned business journals. And in the process he's continually moved his employer in the right direction while convincing fellow Skico employees, who a few years ago weren't quite sure what it was all about, to chug from his batch of Kool-Aid.

But in *Getting Green Done* the moral of Auden's story goes, essentially, as follows: getting the things done to address climate change is so difficult that we need to share stories—the headaches, the barriers, as well as the successes—so we can all learn from experience. The achievements listed above got done only with a massive amount of hard work, diplomacy, and humility. And Auden tempers each of these achievements by simply describing the huge headache that each was. Auden tells the story his way, and it's a much more humbling, much more down-to-earth, much more compelling story than the massive amounts of press he's gotten in national magazines and local newspapers over the years.

Auden also debunks the greenwashing that the media seems to have done on Skico's behalf. "In public talks about Aspen Skiing Company's environmental programs, I used to describe our wind-powered Cirque chairlift," he writes. "Renewable energy purchases for that lift keep 30,000 pounds of carbon dioxide, the primary greenhouse gas, out of the air annually, I'd tell my audience. Furthermore, it was the first renewably powered lift in the country. My listeners would often applaud the accomplishment. But then I'd tell them they had been greenwashed. The next thing I'd say was that the Cirque lift constituted 0.00454 percent of our total electricity requirements." Instead of letting anyone be greenwashed, Auden instead calls for brutal honesty from everyone on the climate front, and an honest and accurate examination of what companies really are doing with regard to emissions. It's a far cry from the "going green" marketing coming out of most corporate entities these days.

Auden credits a lot of his personal success to his years at RMI. Growing up in suburban Weehawken, New Jersey, he couldn't wait to get away. After studying biology at Bowdoin College, he moved to Telluride, Colo., and soon after that began working for the now-defunct Integrated Resources and Technology (IRT), an RMI spinoff that did reports on successful energy conservation programs, mostly in business, as well as doing a stint with the Energy Center in Carbondale, which weatherized thermally leaky buildings.

After a stint teaching at CRMS, Auden joined RMI in 1996 as an outreach specialist.

"It was sort of a time when I was going to go to grad school or go to RMI," he says. "Because it was outreach, part of my job was to literally read everything I could find in the files, and I read every book that anyone was talking about—from Peter Senge's stuff to Paul Hawken to Dana Meadows to whatever. It was grad school in many ways."

Today, we are on the cusp of a new era, a time when new green energy and technology are likely to get the kind of support that's long gone to fossil fuels. Climate is finally pushing aside annoying distractions, and we are seeing the emergence of true pathfinders, like Auden Schendler, who are deeply pondering, and experimenting with the answers that make money regardless.

"Auden Schendler is the real deal—an honest, fearless, outspoken, persistent, and unstoppable implementer of efficiency, clean technologies, and smart policies," notes RMI Cofounder and Chief Scientist Amory Lovins. "Working in a real company, he naturally keeps bumping into all its frustrations, imperfections, and incoherencies. So he talks about them frankly, maps the gap between where we are and where we need to go, and keeps on striving to get there. To arrive together, we all need more of what Auden's experience teaches: bold vision, relentless patience, meticulous attention to detail, and tolerant appreciation of diverse motives. These perennial lessons are valuable, and I'm grateful for his clarity in assembling them." •

Photo: Cameron Burns

The Cirque Poma at Snowmass Ski Area. Auden considers stories about the lift "greenwashing."


Photo: RMI Staff

Philanthropy in Challenging Economic Times

By Douglas Laub

A great irony faces charitable organizations during an economic downturn. Just when nonprofit programs are needed most—food banks, housing shelters, safety net organizations, and even pivotal environmental groups—the philanthropic revenue that supports their critical programs is exposed to substantial cutbacks.

At Rocky Mountain Institute, we are in a somewhat different situation. Philanthropic revenue for our '09 fiscal year is actually running well ahead of last year. However, as the world has turned to RMI for thought leadership in this new and exciting era of energy efficiency and skyrocketing interest in renewable resources, demands on the Institute to ramp up its programs continue. Thus, RMI has an aggressive budget to attain, even with prudent mid-course corrections already employed. As we enter the final quarter of fiscal year '09, we have achieved significant milestones in that quest.

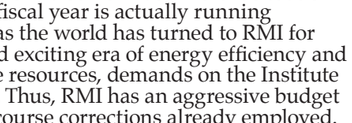
In just the last four weeks, RMI has received funding commitments from new donors for over $1.7 million, helping to make up for shortfalls from RMI's existing donor base strained under today's economy. This is indicative of the fact that the marketplace has told RMI that now, more than ever, the world needs our work . . . to help electrify transportation systems, to power the grid with renewable energy sources, to help identify transformational building design and retrofits . . . in short, to help the world shake its addiction to fossil fuels and, as a side benefit, produce millions of new jobs.

So what does this mean to you? How do you adjust your own charitable giving philosophy to accommodate these unprecedented times?
First, make sure your charitable gifts create the biggest influence for the dollar. One way of doing that is by consolidating your contributions to make larger gifts to fewer organizations, thereby achieving greater impact.

Then seek out organizations that have a past track record of turning philanthropic dollars into real-world solutions.

Finally, consider multi-year commitments if you can, so the recipient organization can plan beyond limiting short-term horizons. This is especially important to nonprofits like RMI, which take extended views toward driving change in a complicated environment.

Great thanks for your past support of Rocky Mountain Institute . . . you have chosen to support an Institute whose core mission is perfectly aligned with the needs of our local, national and global interests.

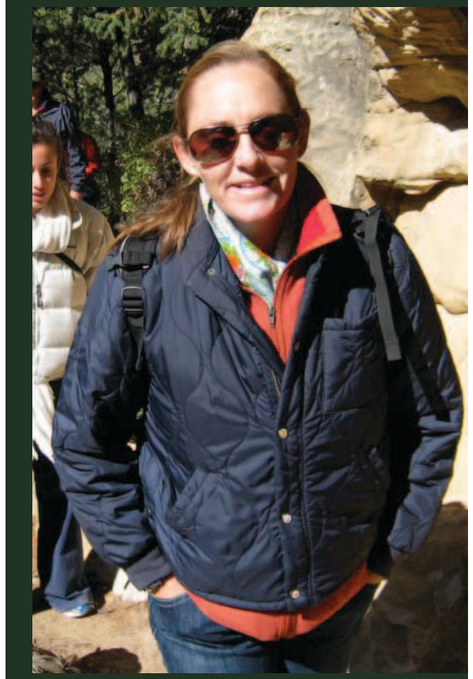


Douglas G. Laub
V.P. of Development

RMI Names New Development Committee Members of its Board of Trustees

The Rocky Mountain Institute has named Mary Caulkins of Denver, RMI Trustee, as the Chair of its Development Committee. Also selected to serve on this committee is Sharman Altshuler of Boston, and Peter Boyer of San Francisco. Sue Woolsey, Chair of RMI's Board of Trustees, is also a de facto member of the committee.

"It is a privilege to work with the entire board and staff of Rocky Mountain Institute to achieve our funding goals so that we can continue the dynamic programs of this Institute and have such breakthrough impact on our planet," said Mary Caulkins. "Sharmy and Peter join me in saying that our donor base is awesome, and we can't thank them enough!"



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Mayor Bloomberg, Anthony Malkin, and Amory B. Lovins

Amory B. Lovins and Mayor Michael Bloomberg watch President Bill Clinton at the podium

RMI and Partners Roll Out the Empire State Building Retrofit Project

On April 6th, on the 80th Floor of the Empire State Building, RMI and its partners held a press conference to announce the Greening of the Empire State Building. Please see p. 18 for the full story of the project.

The ESB Retrofit Team: Iain Campbell of Johnson Controls, Inc.; Amory B. Lovins or Rocky Mountain Institute; President Bill Clinton; New York City Mayor Michael Bloomberg; Anthony Malkin of The Empire State Building; Ray Quartararo of Jones Lang LaSalle; and Peter Malkin, former owner of The Empire State Building.

Amory B. Lovins, President Bill Clinton, New York City Mayor Michael Bloomberg and Anthony Malkin, one of the owners of the Empire State Building, backstage before the press conference

RMI Chairman and Chief Scientist Amory B. Lovins at the press conference podium

RMI2009
FROM IDEAS TO SOLUTIONS

One of the highlights of the symposium will be an opening reception at the California Academy of Sciences (CAS). RMI was a consultant on the Academy's new main building, a remarkable green structure that contains an aquarium, a planetarium, a natural history museum and a four-story rainforest. The Academy's new building recently earned the Platinum rating (highest rating possible) under the U.S. Green Building's Leadership in Energy and Environmental Design (LEED) rating system. The building is now the largest public Platinum-rated building in the world, and also the world's greenest museum.

We hope to see you at RMI's annual gathering of National Solutions Council members and other supporters of RMI's transformational work.

RMI2009: From Ideas to Solutions will be held at the Westin Market Street in San Francisco, CA. RMI2009 will bring together leaders in technology and industry for three days of focused conversation and workshops on the challenges and striking opportunities of the transition from fossil fuels to energy efficiency and renewables.

Confirmed speakers include Peter Darbee, Chairman & President of PG&E, Paul Holland (Foundation Capital), R. James Woolsey (former Director of Central Intelligence), and several others.

Mark your calendars for 30 September—3 October, 2009 in San Francisco, CA. Exciting details of the agenda for this symposium will be announced soon.

Stay tuned to rmi.org.

See you there.

National Solutions Council Members—Walking Their Talk

Paul Holland and Linda Yates invited NSC members and guests to visit their future home. Paul and Linda are in the process of building a state of the art, net zero energy, fossil fuel free home. During the NSC Salon, guests met with the green experts working on this project. Visit **rmi.org/nsc** for a peek into the process the Holland/Yates family engaged in to set clear themes and goals for a regenerative design of their home.

RMI Event Calendar

April—July, 2009

WINDPOWER 2009 Conference & Exhibition
May 4-7, 2009—Chicago, Illinois

WINDPOWER 2009 Conference and Exhibition is the largest annual wind conference and exhibition in the world featuring over 13,000 attendees and over 776 exhibitors. Each year, wind energy professionals gather at this event to learn about the latest industry developments and technologies, review new products and services in the expansive exhibit hall, and network with leading industry decision makers. Laura Schewel of MOVE will be speaking.
http://www.windpowerexpo.org

The International Battery, Hybrid and Fuel Cell Electric Vehicle Symposium
May 13-16, 2009—Stavanger, Norway

The symposium will showcase electric drive technology and facilitate networking and information exchange. RMI's Founder and Chief Scientist Amory Lovins will deliver the keynote address.
http://www.evs24.org/symposium.html

Electric Utility Consultants Inc. Seminar on Electric Vehicles for Utilities: Impact, Opportunities and Challenges for a Smart Grid
May 18-19, 2009—Denver, Colorado

The seminar will discuss the interaction between electric vehicles, utilities and the energy grid. An RMI MOVE team member will be there to discuss how to best ready cities for the shift to an electrified fleet of personal automotives.
http://www.euci.com/pdf/0509-electric-vehicle.pdf

Sustainable Future for the World Conference
June 4-6, 2009—Old Westbury, New York

This conference, being held by the New York Institute of technology, focuses on energy efficiency and the creation of green jobs. RMI BET principle James Brew will be speaking on building retrofits and cost-effective ways to reduce energy consumption.
http://www.nyit.edu/apps/calendar

Global University Leaders Forum
June 10-12, 2009—Lausanne, Switzerland

The International Sustainable Campus Network will be holding this forum to discuss the need for a focus on sustainable practices in the construction and renovation of campuses. James Brew, RMI BET principle will be delivering the keynote address.
http://www.international-sustainable-campus-network.org

Aspen Ideas Festival
June 29th to July 5—Aspen, Colorado

Divided into two overlapping four-day sessions, the Aspen Ideas Festival offers a breathtaking array of lectures, presentations, debates, and panel discussions by leading thinkers who span a vast range of critical topics, from the economy to the environment, from science to the arts.
http://www.aifestival.org

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