



RMI Solutions

NEWSLETTER

Security Meltdown

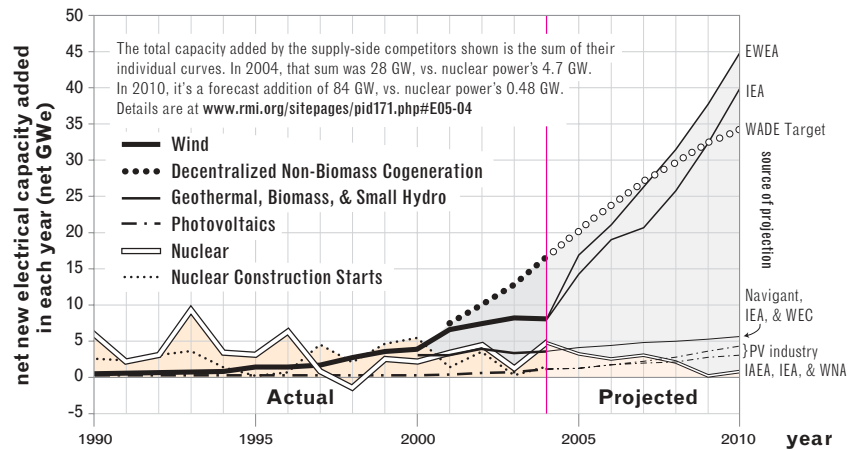
RMI'S CEO DEBUNKS DANGEROUS NUCLEAR THEOLOGY

By Amory B. Lovins

The U.S. Congress may soon accomplish an extraordinary feat: a national energy policy that undermines national security, substitutes hogs-at-the-trough market distortions for free markets, and is anti-life, anti-human-rights, and anti-federalist—all at the same time. Let's focus here just on the first part: how the energy bill that may soon become law would lastingly undermine the Pentagon's security mission.

This erosion takes three main forms: doubling and prolonging for decades U.S. dependence on the most vulnerable, concentrated, and hard-to-fix element of its oil infrastructure, the Trans-Alaska Pipeline System (TAPS);¹ putting major terrorist targets along our coasts and near our cities; and greatly facilitating the proliferation of nuclear bombs. For brevity, we'll examine here only this last piece—nuclear energy.

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Gales of Change:
Global Annual Additions of Electrical Generating Capacity

In 2004, decentralized cogeneration and renewables, excluding big hydro dams (any over 10 megawatts), added 5.9 times as much worldwide net capacity as nuclear power added, and raised annual electricity production 2.9 times as much as nuclear power did. By the end of 2004, these decentralized, nonnuclear competitors' global installed capacity totaled ~411 GW*—12% more capacity than global nuclear plants' 366 GW—and produced ~92% as much electricity. Thus the "minor" alternative sources actually overtook nuclear's global capacity in 2003, rivaled its 2004 and will match its 2005 output, and should exceed its 2010 output by 43%. They already dwarf its annual growth. Official and industry forecasts indicate they'll add 177 times as much capacity in 2010 as dwindling nuclear power will. And they're dwarfed in turn by demand-side opportunities, not graphed here because reliable global implementation data aren't available. So the big question about nuclear "revival" isn't just who'd pay for such a turkey, but also... why bother? Why keep on distorting markets and biasing choices to divert scarce resources from the winners to the loser—a far slower, costlier, harder, and riskier niche product—and paying a premium to incur its many problems? Nuclear advocates try to reverse the burden of proof by claiming it's the portfolio of non-nuclear alternatives that has an unacceptably greater risk of non-adoption, but actual market behavior suggests otherwise.

* About 266 GW (billion watts) of mostly gas-fired decentralized cogeneration (emitting ~30–80% less CO₂, depending on fuel), 47 GW of wind, 47 small hydro, 37 biomass/waste, 10 geothermal, and 4 photovoltaics.

Adaptive Management. RMI's Managing Director Kyle Datta introduces the vast range of topics in this issue of *RMI Solutions* and ties them all together. (p. 2)

States of the Nation. What does a balanced state-level energy policy look like? On p. 5, RMI energy researcher Lena Hansen explains a few basic opportunities U.S. states should consider.

Strategies for Climate. In this three-part series of articles, researcher Cody Taylor describes RMI's efforts to help manage carbon emissions at the Stanford Linear Accelerator Center (p. 8), while RMI's Will Clift relates the Institute's own emissions-trimming efforts (p. 9), and Energy & Resources team leader Dr. Joel Swisher, PE, puts it all into context. (p. 10)

Post-Tsunami Innovation. RMI's Eric Rasmussen spent considerable time in South Asia this winter, assessing the destruction wrought by the Boxing Day Tsunami and examining the possible application of sustainable reconstruction techniques and principles. (p. 12)

Farewell to a Friend. *RMI Solutions* remembers former Board member and longtime supporter Carol Noyes, who worked tirelessly for decades with numerous organizations—from Planned Parenthood to Natural Resources Defense Council to Rocky Mountain Institute—tackling some of society's greatest challenges. (p. 21)

What's Inside



Adaptive Management

By E. Kyle Datta

The world has never been a riskier place, our future more uncertain. Energy volatility, climate change, nuclear mishap, natural disasters, pandemics, species loss, deepening economic cycles—all loom as predictable surprises that await us. How business, government, and civil society address the fundamental provision of such essential services as food, water, energy, housing, and communications will dictate how well we cope with these uncertainties. We can draw our inspiration of what strategies to adopt by asking “what would nature do here?” Nature adapts. Life has not only persisted through cataclysmic events, it has relied on them to *improve* inexorably and continuously.

This issue of *RMI Solutions* considers the adaptive management response to the twin challenges of energy and climate change that confront our civilization.

Adaptive management starts with the shared recognition that the future is uncertain, and builds an appreciation of these risks by framing the problem with the right questions. It explicitly values the benefits of real options that increase flexibility to respond to unexpected changes, often through distributed and diverse resources. It is a management philosophy that defines success as the ability to prosper across a wide range of potential futures, and builds capabilities accordingly. The adaptive manager is the captain of a sailing ship, able to shift course based on the vagaries of the weather, rather than a railroad engineer, who can only choose between preset options. Consider yourselves the modern version of Ulysses.

In this issue, we will consider the adaptive management response to the twin challenges of energy and climate change that confront our civilization. We start by framing the questions the right way and confronting the big lies that obscure our true choices. We are told that we ultimately have but two choices to provide climate-safe energy: nuclear power, and coal with carbon sequestration.

We are told that only federal government policies will shift our energy consumption; states and civil society should follow this lead. We are told that scale of human suffering from natural disasters is unavoidable, an act of God. Like Ulysses facing Scylla and Charybdis, we are told by Circe to choose between the evils.

The right way to frame the problem is to ask how to provide the essential services society requires in the most resilient, economical, and robust way. How could we provide the desired quality of life using our scarce resources in the most efficient manner? What suite of technologies would cost-effectively shift the energy mix to more sustainable resource supplies? What approaches would provide adaptive flexibility in the face of change? Ulysses ultimately found his way home to Ithaca by using his courage and wisdom. So shall we.

Kyle Datta (kdatta@rmi.org) heads RMI's Research & Consulting group. See also p. 17.

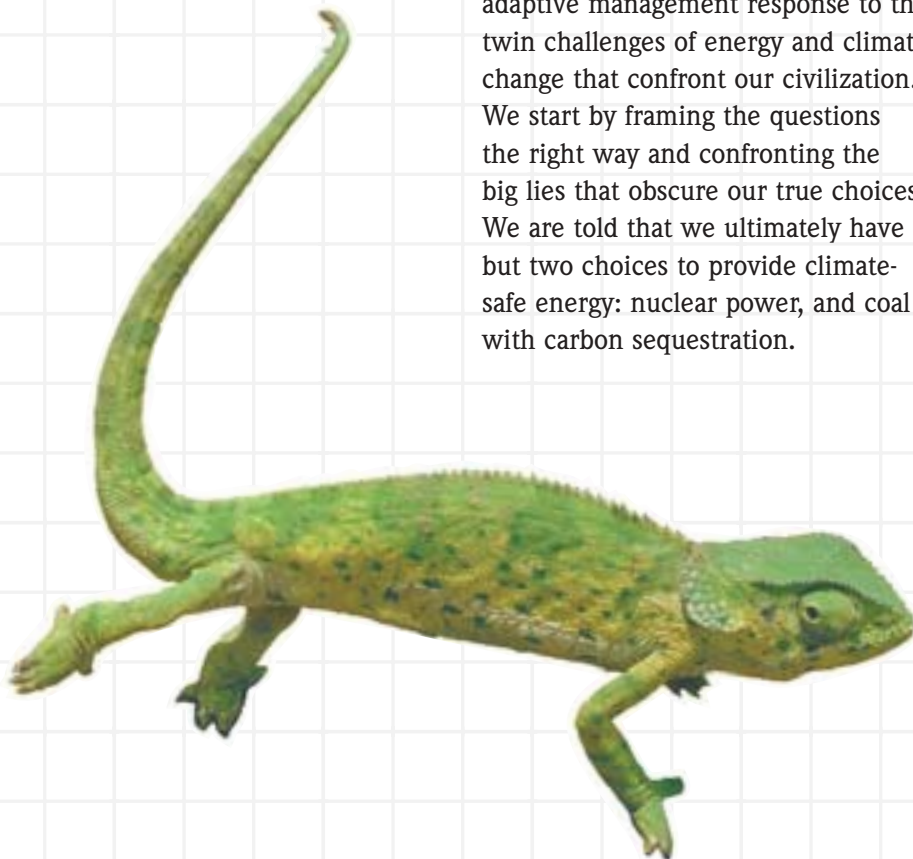
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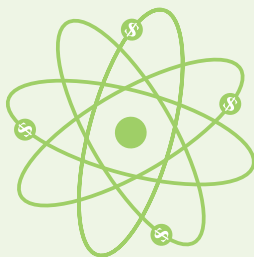
In recent months, the nuclear industry's remnants and advocates have been making a desperate last-ditch effort to create enough illusion of revival to attract a huge new wave of public subsidies and government-funded orders before its remaining practitioners fade away.

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Nuclear power, once claimed to be too cheap to meter, is now (said the *Economist* on 19 May 2001) too costly to matter. New nuclear plants deliver electricity at far higher cost than end-use efficiency, distributed cogeneration, and many renewables.² (Major studies like MIT's in 2003 examined only new central coal and gas plants, which cost more, emit more carbon, but still beat nuclear.) The market long ago figured this out, so nuclear salesmen scour the world for a single sale, invariably to a centrally planned power system, while competitors struggle to meet demand.

Nowhere do market-driven utilities buy or private investors finance new nuclear plants. None has ever been bid in a competitive power auction. Older U.S. and U.K. nukes resell at net prices too low to support building new ones. Japan's new power markets have already switched a third of big Tokyo office buildings from the nuclear utility to nonutility competitors, chiefly industrial cogenerators.

Nuclear power's market collapse should (but apparently doesn't) render moot its other unresolved issues, such as the manifest but officially denied vulnerability of nuclear plants—huge inventories of releasable radioactivity upwind of many cities—to simple but catastrophic terrorist attacks.



The nuclear industry's remnants and advocates deftly sidestep such problems, and emphasize low operating costs to distract from prohibitive capital costs. Now they're making a last-ditch effort to fabricate enough illusion of revival to elicit a tsunami of new public subsidies and taxpayer-funded orders before they perish. (Tellingly, they're not willing to risk their own capital.) This hoax has persuaded some people who should know better that nuclear power is a realistic and indeed indispensable solution to climate change.

In February 2005, for example, a passionate *Wired* article by pronuclear journalist Spencer Reiss and former RMI Director Peter Schwartz, who led Royal Dutch/Shell's scenario planning and founded Global Business Network, claimed that efficiency and renewables, though nice and necessary, are grossly inadequate in size, speed, and certainty to meet the climate challenge, leaving "only one sane, practical alternative: nuclear power"—or as Stewart Brand put it in May 2005's *Technology Review*, "the only technology ready to fill the gap and stop the carbon dioxide loading of the atmosphere...."

No analysis underlies such assertions, and none could, because they're not true. Official speech after well-orchestrated op-ed continues to proclaim them, yet actual market behavior (see graph, p. 1, and sidebar, p. 26) provides a devastating rebuttal.

Unfortunately, the debate isn't just about expanding the taxpayer bailout of a failed but still-powerful industry. Few understand that nuclear power has largely created, and its continued expansion would reinforce, President Bush's (and RMI's) prime national-security nightmare—nuclear proliferation. President Eisenhower's "Atoms for Peace" initiative has sown dragon's teeth by spreading worldwide the materials, skills, technologies, and other ingredients for do-it-yourself nuclear bomb kits. But above all, it's the innocent-looking civilian disguise that makes nuclear energy so reckless and proliferation so hard to stop. If a bomb made in North Korea or Iran or Pakistan ends up incinerating an American city, most likely it'll be thanks to the delayed side-effects of the nuclear power enterprise.

Power reactors themselves may not be the main direct source of bomb materials, though they could be:³ they make materials suitable for reliable, powerful, and plentiful bombs (hundreds per 1-GW plant per year), don't arouse instant suspicion, and come with heavy subsidies from reactor vendors' governments. Rather, proliferators expertly exploit the giant loopholes that let bomb-builders get one screwdriver-turn away from completing a bomb without quite violating the Non-Proliferation Treaty (NPT). Proliferators can claim, as Iran does and North Korea has, to be enriching uranium or separating plutonium purely for the peaceful purpose of making electricity. Their vendors piously proclaim the same innocent intent.

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Security Meltdown

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The Treaty blesses such commerce in dual-purpose technology and materials “exclusively for peaceful purposes,” but is purpose in the unknowable mind of the user or in the eye of the beholder? Now the U.S. House of Representatives has voted to revive plutonium extraction (reprocessing), halted by previous Republican Administrations because it’s grossly uneconomic and greatly complicates waste disposal but is a dandy route to bombs. This encourages bomb-hungry countries with sparser energy resources.

Imagine, however, a world that took energy economics seriously. Cheaper alternatives to nuclear power would therefore be bought everywhere instead, as market economies do now (see sidebar, p. 26). Nuclear commerce would finish its slow-motion collapse and enter an orderly terminal phase. Developing countries could take pride in adopting the modern, not the outmoded. All the ingredients needed to make bombs by any of the 20-odd known methods would cease being ordinary items of commerce. This would make them harder to get, more conspicuous to try to get, and politically far costlier to be caught trying to get *because the reason for wanting them would be unambiguously military.*

German and Spanish windpower are each adding as much capacity each year (2 GW) as the global nuclear industry is adding on average during 2000–10.

This wouldn’t make proliferation impossible, but would make it far more difficult, for both recipients and providers. The smokescreen of civilian electricity production would be blown away, revealing any hidden bomb-making intent. Intelligence resources could be concentrated on needles, not haystacks. Anyone wanting the costliest source of electricity (nuclear) instead of least-market-cost options would have to explain why.

At the same time, existing nuclear states could get serious about their own NPT obligation to phase out nuclear weapons. (The contrary U.S. rush to develop new ones and scrap the Test Ban Treaty just scuttled the NPT Review Conference without plugging a single loophole.) The NPT’s entitlement to nuclear technologies for exclusively peaceful purposes—a clause written by nuclear experts in 1965–68, when nuclear power was widely assumed to be cheap, safe, and essential—could be refocused on that bargain’s ostensible purpose (affordable energy for development) by providing today’s cheaper and nonviolent energy alternatives, such as efficiency and renewables. Had this market-driven path been adopted when we pro-

posed it in the Summer 1980 *Foreign Affairs*,⁴ today’s proliferation crisis could have been avoided and the rapidly escalating risk of urban holocausts reduced. So why didn’t it happen?

To be sure, a quarter-century ago, benign and carbon-free alternatives to nuclear power were far less mature, competitive, available, hence convincing. But the chief obstacle was and remains nuclear theology. This fervently held belief system asserts that nuclear power will become cost-effective if enough of it is bought; that its competitors, however laudable and successful, are and will always be inadequate; and that whatever it costs, and however unwilling the private capital market is to finance it, nuclear power must be bought anyway, because...well, just because.

This fixation makes the proliferation problem insoluble.⁴ It makes the nuclear waste problem politically insoluble too, because it implicitly expects host communities to accept not a limited but an open-ended quantity. It doesn’t help with the oil problem.⁵ And it worsens the climate problem, because every dollar spent on

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RMI *in the news*

RMI & Holy Cross Explore Efficient Homes

Last winter, Rocky Mountain Institute partnered with the Institute’s local utility, **Holy Cross Energy** (www.holycross.com), and Aspen’s **Community Office of Resource Efficiency** (CORE; www.aspencore.org) to host two “Resource-Efficient Residential Design Workshops.” The workshops, in Basalt and Eagle, Colo., drew builders, architects, and homeowners, and presented both compelling arguments for energy efficient design as well as practical discussions of low- and no-cost strategies appropriate for homeowners in this region. **Alexis Karolidis**, team leader with RMI’s **Green Development Services**, lectured on whole-system building design (including issues such as daylighting, lighting, and mechanical systems) and Holy Cross and CORE officials spoke about local green building efforts and energy-related programs. “It’s really nice when we can share RMI’s globally applicable ideas as close to home as this,” Alexis noted.



HOLY CROSS ENERGY

A Touchstone Energy® Cooperative 

Creating a Balanced State Energy Policy

By Lena Hansen

Imagine that you've just been elected to the legislature or governorship of your state. As you assess your economy's health, you realize that the 100-plus percent increase in energy prices over the past two years represents the largest single tax increase your state has ever experienced. Billions of dollars are being exported overseas to the Middle East, or into the hands of fossil-fuel companies. You've been told that energy policy is only a federal matter, but you're smart enough not to believe that. You know, too, that the vast diversity and greater grassroots vitality of your state, like most, tend to make its government more creative, dynamic, and accountable than the leadership in Washington. So what can you do?

RMI's work demonstrates that states can deploy three strategies to lower total energy consumption by 20 percent with existing technologies, and nearly double that with technologies that will be available over the next decade. This is the equivalent of giving every individual a \$200 tax refund every year for the next 20 years. The environmental benefits come for free—states could get more than halfway to the carbon dioxide reduction targets envisioned in the Kyoto Protocol at no additional cost.

A combination of peak demand response and efficient technologies (such as high-efficiency buildings) to reduce peak load could dramatically lower U.S. natural-gas demand, thereby lowering the price of gas.

Utility Incentive Structure

Due to historical accidents, all states except Oregon and California currently regulate electric utilities in a way that rewards them for selling more energy and penalizes them for cutting customers' bills. Under the current rate-setting process, a utility makes profit for every kilowatt-hour it sells (say, 2 cents profit on the 12 cents per kilowatt-hour you pay on your power bill), and loses that same 2 cents profit margin for every kilowatt-hour it *doesn't* sell due to more efficient use.

Furthermore, most states have fuel adjustment clauses that make fuel costs the responsibility of the customer, not the utility. Since the utility doesn't pay for increasing fuel costs (such as the high natural gas prices over the past few years), utilities have no incentive to reduce costs or mitigate price risks through efficiency or renewable energy.

Some states, led by California, are starting to correct these perverse incentives. The solution is simple: decouple utilities' profits from their sales volumes, so they're no longer rewarded for selling more energy nor penalized for selling less, and then let utilities keep as extra profit a small part of what they save their customers, thus aligning both parties' interests.

When you conserve electrical energy, you reduce the amount of natural gas that power plants consume, and they consume a lot (18 percent of U.S. gas demand). During the peak electric period, for every 1 percent reduction in nationwide electricity use, the *total* consumption of natural gas decreases by 2 percent, cutting its price 3–4 percent. Thus, a combination of peak demand response and efficient technologies (such as high-efficiency buildings) to reduce peak electric load could lower U.S. gas demand *and price*. This strategy is the most important single way to make natural gas and electricity cheap and abundant again. It could soon cut their costs by over \$50 billion a year.

State financing, typically with revolving funds, can speed investment in efficiency and renewable energy. For example, in 2002 San Francisco voters approved a \$100-million bond issue to fund renewable energy. Honolulu's \$7.85 million revolving fund for installation of solar water heating on low-income households is expected to earn \$2 million net.

Like efficiency, renewable energy has a negligible fuel price risk—sunshine and wind are free. With a corrected incentive structure, utilities should find it prudent and economically sound to diversify their generation portfolios with renewables as a hedge against volatile natural gas prices.

Energy

Transportation Efficiency

A balanced state transportation policy can offset high oil prices, mitigate concerns about security, and minimize the environmental impact of cars and vehicle infrastructure.

The price of a gallon of gasoline in the United States increased by 29.5 cents last year. Increasing vehicle efficiency without sacrificing transportation services and safety could free up significant funds that would then be available for injection into local economies. Increased efficiency will admittedly reduce gasoline tax revenue, but this loss is recouped through the corresponding increase in disposable income generated.

The United States faces serious security risks from its increasing dependence on oil. Although oil is a global commodity, the majority of future supplies and nearly all swing capacity will probably come from the volatile Middle East region, particularly Saudi Arabia and Iraq. While increasing inventories can address short-term disruptions, it is an expensive proposition that does not improve states' long-term security as effectively as reducing the absolute demand for oil through efficiency and biofuel substitution (discussed below).

- High occupancy vehicle lane access to alternative-fuel vehicles and hybrids
 - Pay-at-the-pump insurance
- Incentivized purchase of alternative-fuel vehicles and hybrids
 - State government procurement of efficient vehicles



RMI has identified both short-term and long-term options that can significantly improve vehicle transportation efficiency. Several options could provide immediate benefits at zero or low cost. Others may be more resource-intensive and may face more barriers to implementation, but could provide substantial benefits for years to come.

Biofuels
are a strategic investment
that results in greater energy security
and increased agricultural and ethanol refinery employment.

Allowing alternative-fuel vehicles (AFVs) and hybrids access to existing high occupancy vehicle (HOV) lanes, regardless of passenger numbers, is a simple, low-cost change that can increase vehicle transportation efficiency. State governments can show leadership through the procurement of efficient vehicles. It helps the budget, since the government will save \$8,200 in lower fuel costs during the course of each vehicle's lifetime, versus an incremental cost of \$3,000, a net savings of roughly \$5,000 for every vehicle a state buys. States should also create labeling programs for tires, since low-rolling resistance tires increase efficiency 2–3 percent, but cost nothing more.

One clever method to decrease all the problems associated with transportation fuel use is pay-at-the-pump insurance. Currently, third-party auto collision insurance costs the same regardless of the number of miles driven. Furthermore, many drivers don't buy auto insurance, hoping they won't get caught. These factors put an unequal burden on people who drive less (generally low-income people drive about half as many miles as the well-to-do) or play by the rules.

RMI *save the date*

RMIQ to Feature Amory Lovins in Aspen

Rocky Mountain Institute is currently planning another event in the Institute's RMIQ ("RMI's Quest for Solutions") speaker series for **22 August** in Aspen, Colo., when RMI CEO and cofounder Amory Lovins will discuss energy security.



The now several-year-old lectures are designed to bring exciting, forward-looking solutions to RMI supporters and interested members of the public. The series confronts the world's most pressing issues and brings them into perspective for local residents. Please check RMI's Calendar of Events (www.rmi.org/rmiq) as more details become available.

Biofuels Substitution

This problem can be corrected by mandating that collision insurance be bought at the pump via the existing state fuel-tax system and repaid to each state's insurance issuers. Implementing pay-at-the-pump insurance today would add ~45 cents to each gallon of gas, thereby creating an incentive for people to drive less, but would reduce insurance bills even more, because of the elimination of uninsured drivers and the increase in customer base for insurance companies.

Additionally, states could fund incentives to encourage the purchase of alternative-fuel vehicles (AFVs) and hybrids. Many states offer some tax credits, which help buy down the extra cost of hybrids or AFVs, but they are a drain on the state treasury. A more sophisticated approach is the revenue-neutral feebate. Feebates provide a rebate or levy a fee on each new vehicle depending on its efficiency when compared to a benchmark. They are applied by vehicle size class, so if a consumer wants to buy an SUV, the incentive is to buy the most efficient SUV in that size class.



Rural and small town America can gain enormously in income, jobs, and stability through biofuel production and related revenues—while the state and country gain a stable domestic fuel supply.

Traditional thinking is that U.S. biofuels are yet another in the long line of subsidized crops, representing an agricultural bailout by urban and suburban dwellers. This view is badly outdated. Cellulose-based biofuel technology has the potential to lower the cost of ethanol below the equivalent gasoline price because it uses lower-cost agricultural waste products or dedicated perennial crops as inputs and, with continued technological advancement, will boast much higher ethanol yields. Cellulose-based ethanol is more environmentally sustainable, reducing carbon emissions by over 90 percent compared to gasoline. Surprisingly, corn-based ethanol reduces carbon emissions only by about 20 percent compared to gasoline. Thus, cellulose-based biofuels are a strategic investment that results in greater energy security and increased agricultural and ethanol refinery employment.

Biomass is widely available nationwide, either in agricultural waste streams or dedicated energy crops. Existing agricultural waste streams are readily available, currently unused, and, most importantly, are low- to no-cost. Dedicated energy crops could be grown without replacing food crops simply by utilizing land otherwise unsuitable for or reserved from conventional cropping.

Biofuels production has additional benefits to state economies. The Renewable Fuels Association estimates that a typical 40-million-gallon-per-year ethanol plant adds over 700 jobs across numerous sectors, results in a \$110-million expansion of the local economic base, and increases state and local sales tax revenues by \$1 million. Currently, the biggest impediment to biofuels development is the up-front cost of biorefineries. States could create incentives to lower capital cost, thereby encouraging biofuels producers to locate in the state, bringing with them substantial economic value.

Creating a balanced state energy policy is no mystery. There are many basic programs and steps that states can take to allow sensible energy options to compete in the marketplace, and most of them—once understood by leaders and the public—are embraced as worthy solutions. Smart state energy policy just takes bright, dedicated people considering what's best for everyone and carefully examining all the excellent options.

Lena Hansen is a researcher/consultant with RMI. Much of the underlying analysis is in RMI's Winning the Oil Endgame, at www.oilendgame.com.

Cleaner, Greener Science

GREENHOUSE GAS MANAGEMENT AT THE STANFORD LINEAR ACCELERATOR CENTER

By Cody Taylor

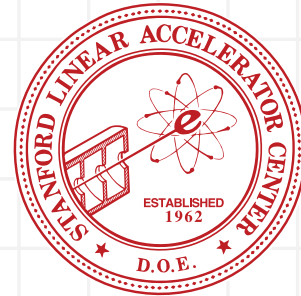
Think it takes a long time to clean your house? How about a two-mile-long building? Containing just such a structure, the Stanford Linear Accelerator Center (SLAC) is determined to pioneer cleaner and lower-impact operations in science. SLAC recently enlisted RMI to evaluate its greenhouse gas (GHG) emissions and identify ways to curb them while enhancing SLAC's scientific mission.

A U.S. Department of Energy national laboratory since 1966, SLAC operates its two-mile-long accelerator and other experimental facilities in Menlo Park,

Calif., where they are perched atop the San Andreas earthquake fault and beneath Interstate 280. With a goal of reducing its GHG emissions to 30 percent below 1990 levels by 2010, SLAC aims to set new standards for responsible science. RMI is helping SLAC to understand its emissions better and identify potential reduction measures.

Saving Energy

Because it is home to many high-energy physics experiments, the Center is a large electricity user, and, obviously, one way that SLAC can reduce its emissions is by reducing its need for electricity. Luckily, many energy efficiency improvements can trim power use (reducing both GHG emissions



and utility bills) without affecting scientific activities. In recent years, dramatic increases in SLAC's electricity costs have shortened the payback on such investments and made additional measures cost-effective. Installing sophisticated energy management and control systems could help SLAC improve the operation of building systems—such as lighting and motors—without compromising critical science needs. Energy management and control systems also bolster efforts to track electricity use, helping

RMI in the news

Winning the Oil Endgame featured in NY Times editorial muster

RMI received considerable attention this spring when the Institute appeared in an important April 19 *New York Times* editorial titled “The Missing Energy Strategy.”

In it, *Times* editors criticized the energy bill that was passed by the House in April, and called on President Bush to “elevate the discussion” regarding the kinds of energy policies needed to cut Mideast oil dependence and address climate change.

“What’s maddening about this is that there is no shortage of ideas about what to do,” the editorial stated. “Step outside the White House and Congress, and one hears a chorus of voices begging for something far more robust and forward-looking than the trivialities of this energy bill. It is a strikingly bipartisan chorus, too, embracing environmentalists, foreign policy hawks, and other unlikely allies. Last month, for instance, a group of military and intelligence experts who cut their teeth on the Cold War—among them **Robert McFarlane**, **James Woolsey**, and **Frank Gaffney Jr.**—implored Mr. Bush as a matter of national security to undertake a crash program to reduce the consumption of oil in the United States.”

Not only is there a chorus of Americans asking for a better strategy, the *Times* noted, several groups have generated such strategies: among them **RMI**, the **Energy Future Coalition**, and the **National Commission on Energy Policy**.

Although RMI's 2004 report *Winning the Oil Endgame* was not mentioned by name, *Times* editors referred to its content, mentioning some of its key tenets, such as advanced-technology vehicles and biofuels. Clearly, it's time to get *WTOE* implemented. RMI is hard at work on that, and we'll keep you posted on progress.



In recent years, dramatic increases in SLAC's electricity costs have shortened the payback on energy efficiency improvements.

staff detect and prevent system malfunctions. Additionally, SLAC can incorporate energy consumption issues into its long-range development plan so that both efficient building designs and the GHG impacts of scientific experiments are considered; meanwhile, old pieces of equipment can be replaced with more efficient models on a continuing basis.

Process Gases

Unlike most businesses that primarily emit carbon dioxide, a large portion of SLAC's emissions are from the release of other GHGs, notably sulfur hexafluoride. A kilogram of sulfur hexafluoride has 22,000 times the "global warming potential" of a kilogram of carbon dioxide. Opportunities exist for replacing these harmful substances with less harmful ones. SLAC is also investigating ways to recycle gases and is considering working with an outside firm to capture used gases and reprocess them. Eventually SLAC may be able to cycle some gases through closed-loop systems. All these efforts contribute to reducing the Center's GHG emissions, boosting energy efficiency, and cutting power bills.

What's Next

As SLAC is setting goals for its emissions reductions and working aggressively to meet them, one of the Center's options is joining a GHG "registry" such as the **California Climate Action Registry** (www.climateregistry.org). A registry of this type brings together diverse groups

Carbon Mitigation at RMI

RMI staff works with clients across the United States and around the world, helping them to profitably reduce their impacts on the environment. We also consistently turn our attention inward, analyzing our own impacts and finding ways to reduce them. For example, RMI has been purchasing green electricity—paying an extra few dollars each month for energy from certified renewable sources—for many years. Additionally, photovoltaic panels on our headquarters building have been providing us with free solar electricity since the building was completed in 1984. Most recently, to cut emissions from driving, RMI leased a **Toyota Prius** (see p. 14)—a hybrid-electric car that, with proper driving technique (p. 15), can get 55 miles per gallon. That's about twice as efficient as the average car on the road today and four times as efficient as many SUVs. To ensure proper driving, RMI took part in a training session held by Ed Rosenberg of Bighorn Toyota, from whom the *Prius* is leased.

While efficient cars and renewable energy make a significant dent in our annual emissions, a recent inventory revealed that approximately 75 percent of our emissions come from the airline flights we take in the course of working with our clients. Videoconferencing systems in all of our offices reduce the need to travel somewhat, but in most cases air travel is necessary for our mission. Overall, despite an aggressive recycling program, the purchasing of 100 percent recycled content paper for office use, and installing efficient water- and energy-using devices, our impact on the environment isn't quite the model of sustainability that we'd like. Still, we're working on it. Last year we began purchasing enough carbon offsets—permanent reductions in emissions realized by



other organizations—through the **Chicago Climate Exchange** (www.chicagoclimatex.com) to make our net annual emissions of carbon dioxide zero. (Gross emissions are low per employee per year.) RMI staff also recently formed an internal task force to champion additional internal efforts. These efforts not only help us practice what we preach, but also increase our own understanding of the perceived barriers to sustainability, and strategies to overcome these barriers, which we can then share with clients, colleagues, and the public.

—Will Clift

all working to increase their efficiency, reduce waste, and save money. These early adopters will learn the most cost-effective ways of reducing their emissions, and be able to help shape future policy. Joining a registry also helps companies and organizations to establish a certified baseline

level of emissions. This is valuable to the facility because it will allow SLAC to receive credit for reductions it has already made.

Cody Taylor is a former Mineral Acquisitions Partners fellow at RMI and regularly contributes to various RMI projects.

RMI Helps Manage the New Business of Climate



By Joel Swisher

On 16 February 2005, the Kyoto Protocol to the 1992 UN Framework Convention on Climate Change went into effect. For the first time, thirty industrialized countries, which account for just under half of global greenhouse gas (GHG) emissions, have accepted binding, quantitative emissions limits. The United States is conspicuously absent from this club, having first signed the treaty in 1998 but then rejected ratification in 2001.

The Kyoto Protocol's enactment is driving government policies to limit emissions and creating demand in emerging carbon markets. These markets are responding to the three "flexibility mechanisms" that were created under the Kyoto Protocol to foster international GHG emissions trading and collaboration in reducing emissions. In the United States, similar

measures and markets are emerging at state and regional levels, despite the rejection of the Kyoto Protocol at the federal level.

For example, Oregon and Washington have set standards for carbon dioxide emissions from new power generation facilities, and California has established standards for emissions from cars, which Oregon is also expected to adopt. Oregon created the **Oregon Climate Trust**, an independent fund that supports GHG reductions on behalf of generators that pay into the fund as a method of complying with emissions standards. The state governments on the West Coast and in the Northeast are considering the formation of regional GHG trading markets. Another private GHG market, the **Chicago Climate Exchange (CCX)**, was established to foster trading of GHG credits based on voluntary emissions reduction commitments by member firms, including RMI.

Carbon limits will shift the economic performance of all energy supply and demand-side technologies, and annual trade on the nascent carbon market is expected to grow to many billions of dollars. In the short term, variations in government responses to the Kyoto Protocol, together with uncertainty over future climate impacts and emissions constraints, will require firms to balance the costs of reductions against the potential benefits. These benefits include the mitigation of potentially large future risks, as well as the exploitation of new product and market opportunities. Firms that achieve this balance will improve their competitive position in a carbon-constrained world.

RMI has developed tools and methods to help companies and institutions design strategies to address the risk of global climate change and the need to reduce GHG emissions. This process builds on the energy and climate work of RMI's **Energy & Resources Services** team, including our 2003 publication

The New Business Climate: A Guide to Lower Carbon Emissions and Better Business Performance.



Our work involves emis-

sions accounting, baseline analysis and screening reduction measures, which lead to technical design, financial strategies, and implementation planning to reduce GHG emissions.

We typically find that profitable, "no-regrets" efficiency improvements are available today, and that longer-term investments in clean energy technology will be increasingly attractive with emissions limits in place. Meanwhile, flexible regulation and careful use of the emerging carbon markets can help manage costs. These and other opportunities can be captured by firms that use the challenge of climate change to stimulate innovation and improve business practices to reconcile environmental and business performance goals.

Thus, success in the New Business Climate will require new business strategies and new capabilities to execute them. Over the next several decades, the business implications for climate winners and losers, both within and between industries, could differ dramatically from conventional

The three Kyoto flexibility mechanisms

- 1. Joint implementation (JI):** reduce emissions, or remove carbon from the atmosphere, in other Annex I Parties (industrialized countries except the U.S., Australia, Monaco, and Liechtenstein), in return for emission reduction units (ERUs)
- 2. Clean development mechanism (CDM):** implement projects that reduce emissions in non-Annex I Parties, or absorb carbon through afforestation or reforestation activities, in return for certified emission reductions (CERs, tCERs, and ICERs)
- 3. Emissions trading:** acquire "units" from other Annex I Parties

Source: UNFCCC, undated, "Kyoto Mechanisms—Background," http://unfccc.int/kyoto_mechanisms/items/2998.php

“The act of measurement alone leads to enormous opportunities to improve productivity.”

Michael Porter
Business scholar

wisdom. A firm’s carbon management strategy influences the value of the firm’s assets and liabilities as the cost of carbon emissions rise. These values depend on the emissions implications of the firm’s capital equipment, land, technology, intellectual property, etc. Carbon constraints will also create

opportunities for new markets, products, and services that drive the relative performance of firms within a given industry or sector.

Some of RMI’s consulting projects that have included GHG management include work with Interface, Shell, Anglo American, and STMicroelectronics. Our energy planning work with such cities as San Francisco and Palo Alto includes GHG reductions planning. We have also designed a carbon-neutral strategy for Oberlin College, and we recently performed a GHG inventory and reduction plan for the Stanford Linear Accelerator

Center (SLAC), which is described in an accompanying article (see p. 8). Finally, RMI is an Associate Member of the CCX, also described in an accompanying article (see box, p. 9).

Carbon reductions need not be the regulatory headache that many executives anticipate. With creativity, attention to details, and a strategic approach to the emerging carbon market, emissions reductions can be profitable and a source of competitive advantage.

Dr. Joel Swisher, PE, principal and team leader of RMI’s Energy & Resources Services, has more than twenty years’ experience in research and consulting on carbon management.

RMI *in the news*

H₂ ahoy! RMI backs The Hydrogen Expedition

RMI rarely endorses other organizations’ activities, but this spring, the Institute agreed to endorse one: The Hydrogen Expedition. The Hydrogen Expedition is the brainchild of **Joseph F. Sahid**, an 18-year-old New York City sailor and self-described “passionate advocate of alternative energy.”



Photo courtesy
Joseph F. Sahid

The lofty ambition of the venture is the first circumnavigation of the globe in a hydrogen-fuel-cell-powered boat. Not only will the boat run on clean hydrogen, but at just under 24 feet, Joseph believes the boat will also be the smallest powerboat to complete a circumnavigation of the globe.

“Hydrogen fuel cells are innovative devices that can silently power everything from boats to businesses, emitting only water in the process,” Joseph noted to RMI in a letter introducing the project. “They have the potential to be the key to clean renewable energy, environmental conservation, and energy independence. Along with the other members of The Hydrogen Expedition team, I hope that the circumnavigation will stimulate the development of an environmentally friendly hydrogen economy. We also hope that, in a more general sense, the expedition will get people talking about the environment and alternative energy.”

Joseph noted that his passion for alternative and renewable energy came after he read *Natural Capitalism*, which he said “changed my life... Similarly, a speech I once heard by Amory Lovins compelled me to dream up The Hydrogen Expedition. Rocky Mountain Institute really is an extraordinary organization staffed by extraordinary people, and I will use The Hydrogen Expedition to publicize the great work that you do.”

Joseph has also recruited a number of young people, mostly students, to help him organize the voyage, and he plans to set sail, so to speak, before the end of the year.

Besides RMI, other supporters in this around-the-world adventure include: the **Bluewater Network**, **4Hydrogen.com**, **Save the Planet USA**, the **Green Guide**, **Environment Colorado**, **Environmental Advocates of New York**, **The Hydrogen Energy Center**, the **Italian Hydrogen and Fuel Cell Association**, and the **National Hydrogen Institute of Australia**.

For more information, visit www.thehydrogenexpedition.com.

The Tsunami Response

A RECONSTRUCTION OPPORTUNITY

By Eric Rasmussen,
MD, MDM, FACP

Ten days after the 26 December 2004 tsunami killed several hundred thousand people around the Bay of Bengal, I led a small team of three (including **Dave Warner, MD, Ph.D.** and **Dan Engle**) into Indonesia under orders from the Office of the Assistant Secretary of Defense. Our task was to lend support to both the U.S. military relief operations and the UN relief agencies working on the devastated beaches of Banda Aceh in northern Sumatra, bridging the civilian and military relief efforts wherever appropriate, encouraging conversation and cooperation. Our efforts were helpful in a few concrete ways, we think, but they were generally indirect, were quite minor within the scope of the overall effort, and were mostly pointed toward future collaboration.

Spanish casualty hospital.



I must stress that our team was a very small part of an enormous emergency response to a world-altering disaster. In the space of a few hours, the coasts of a dozen countries from Thailand to Tanzania had been severely damaged by the combination of a powerful earthquake and an enormous tsunami. At magnitude 9.3, the quake itself was the second-largest ever recorded by a seismograph (after a 9.5 in Chile in 1960). Then, mere minutes after the shattering earthquake, the first of the tsunami waves hit Sumatra and waves up to 80 feet tall crashed over the fishing villages on the coastal plains of Aceh Province. The tsunami propagated across both sides of the Bay of Bengal and led to the death of a quarter of a million people.

My team arrived in Banda Aceh two weeks after the disaster and the damage was the most severe any of us had ever seen. Standing on the beach where the tsunami came ashore our initial impression was of total,

Author's note: The opinions expressed in this article are mine, though they may have been developed in concert with numerous colleagues to whom I'm deeply grateful. I am solely responsible for errors and omissions and I do not speak for the Department of the Navy or the Department of Defense.

irretrievable loss and, to be honest, recovery seemed beyond imagination. That early impression, though, was gradually dispelled as we watched the resilience and determination of the people of Banda Aceh cleaning up, and my initial pessimism later seemed a little embarrassing.

The three of us worked in concert with other relief teams in tents two blocks from the edge of the destruction. Since we had all worked on disaster and reconstruction planning previously, we eventually began discussing methods for sustainable rebuilding in the damaged areas, seeing possibilities in the supplying of water, food, shelter, energy, communications, security, health care, transportation, economics, and more.

The musings in the field were interesting and productive and we each returned from Indonesia near the end of January with a desire to continue the conversation. From my home outside Olympic National Park in Washington state, I expanded our links with the international community using email and Skype,¹ and interested colleagues from around the globe began to chime in.

Resources

www.info-share.org • www.voxiva.com
www.biomimicry.net
www.friendsofgaviotas.org

All photos this story courtesy of Eric Rasmussen



The author (foreground) Skyping for aid.

I had previously hosted two charrettes with Rocky Mountain Institute on sustainability in stricken communities,² and several of us soon recognized that those lessons now offered the potential for real-world application. After a few weeks of discussing the reconstruction possibilities electronically, I represented RMI at a forum in Aspen where I spoke on tsunami relief and reconstruction. A few days after that lecture I received a note about an RMI supporter who had decided to help rebuild Denuwala, a small fishing village of 1,200, at the southern tip of Sri Lanka, that had been badly damaged. He had seen my presentation and, although his rebuilding effort was to be in Sri Lanka and not in Indonesia, he asked if I knew anyone who could help.

Several of us knew others who had worked in the Sri Lankan relief effort so, after brief discussions with a few colleagues, I was able to rapidly prepare a bit of background, a few contacts, and the beginnings of a plan. Such a rebuilding offer is a rare and remarkable opportunity, and it sparked a lively discussion of cultural norms and reasonable possibilities.

The first task, in our view, was gaining a better understanding of the environment to be rebuilt. Who are the Sri Lankan villagers? How were they linked to the world before? What do they know? What do they want? What capabilities were present before? What capabilities were lost? What is the community already rebuilding because a prolonged loss was intolerable? What does the community think is desirable as a longer-term goal, both for local development and for global integration? Most importantly, if, in our discussions with the villagers, our assessment team finds mutually desirable goals, who in the village would be willing to work with us in ways that eventually make the effort wholly theirs?



Survivors' shelter near the airfield in Banda Aceh.

Our early tasks must first include that comprehensive assessment from the locals, followed by our effectively explaining to them the range of the possible. From our perspective, many sectors could be addressed using sustainability principles and practices, but perhaps not all would be wanted. Early challenges outsiders might consider include housing, power, lighting, and potable water, but the priorities of those who live there might be very different.

In our opinion, Gaviotas might be a useful model to describe to anyone needing to start from scratch. Gaviotas is a settlement in the eastern *llanos* of Colombia founded by Paolo Lugari—another friend of RMI's and a man who has developed in Gaviotas a gorgeous example of the possible. Alan Weisman in his book *Gaviotas* records the story of this remarkable village, from its humble start in a remote and empty grassland to its position today as a model community for the entire world. Because the people of this remote village have maintained their courage, cooperation, creativity, and persistence over a quarter-century of development, Gaviotas has become a fount of innovation, optimism, sustainability, and peace.

With Gaviotas described, a sustainable-practices team could talk with the villagers about which locally viable techniques already known to them could help establish Gaviotas-like sustainability and resilience. The team might include principles from the work Janine Benyus did in *Biomimicry*, including rebuilding with low energy flows, sunlight and wind for power where it's feasible, local materials and local construction, closed-loop systems for resource use, and comprehensive recycling.

CONTINUED ON NEXT PAGE



Banda Aceh post-tsunami beachfront.

We'd want to discuss rebuilding using knowledge from Stephen Kellert and E.O. Wilson's *Biophilia Hypothesis*, including principles of natural ventilation, dynamic and diffuse daylight, and local materials (like bamboo) that make sense for local construction. We'd offer communication and public health surveillance opportunities on the simple—and highly effective—Peruvian model developed by Paul

Meyer and Voxiva. We'd want to offer lessons from Cameron Sinclair and *Architecture for Humanity*, particularly their work designing health clinics in sub-Saharan Africa using local knowledge enhanced by international consultation and competition.

We'd want to explain the lessons we've learned from Sanjana Hattotuwa of InfoShare, a Sri Lankan NGO. InfoShare is deeply involved in cul-

tural and political peace-building through collaborative “all-faction conversation” and could help us ensure effective inclusion of all stakeholders within the community. InfoShare's techniques in online dispute resolution, developed with Hannes Seibert of the Nobel Peace Laureates Foundation, have helped combatants in Sri Lanka see areas of potential agreement and compromise in a neutral and anonymous space. Their methods have been shown to defuse tension and encourage an inclusive spirit of personal investment and multi-lateral cooperation.

These options for acutely helping those in urgent need are culturally appropriate for most places by careful design. They also help disconnected populations share in the benefits learned elsewhere so that first efforts have a greater chance of success.

In our view, the ideal opportunity in Denuwala would be to offer the many lessons learned in decades of global sustainability efforts as a synthetic and integrated whole for their rebuilding. Interestingly, the most acute chal-

RMI *in the news*

RMI Drives its Talk with Hybrid Aplomb

You've heard of walking the talk. Now, RMI is taking a step toward *driving* its talk. In early March the Institute leased a Toyota *Prius* to be the new “company car” (our first).

The “RMI blue” *Prius* is expected to be an economical and energy-saving solution for RMI work-related trips.

“We really encourage its use by our staff and, in fact, driving the *Prius* instead of using a staff member's own vehicle is preferred,” said RMI Executive Director **Marty Pickett**.

Immediately upon arrival of the car, RMI CEO Amory Lovins suggested an experiment using the car—tracking miles driven vs. gallons consumed for each driver so that we could understand how mpg depends on behavior when compared to other factors, notably weather (the regenerative storage battery doesn't work as well at low temperatures, and the tires aren't as efficient on snowy or slushy as on dry roads).

Between early March when the car arrived and the publication of this newsletter, RMItes had—mile for mile—already saved hundreds of pounds in carbon dioxide emissions, while saving money to help fund our mission.



Photo courtesy Toyota Motor Sales, USA, Inc.

Even a mile from the beach, wreckage like this was common in Aceh province in Indonesia after the 26 December tsunami. Indonesia and Sri Lanka were the hardest hit of the South Asian nations, and in Aceh province alone it has been estimated that more than 650 villages were affected.



In my view, this effort may be quite important in several ways. We think that with respect and careful attention to collaborative processes, we can help this devastated village in ways those living there find both acceptable and desirable. We think we can do it using sustainability principles, cultural intelligence, political sensitivity, global participation, and local personal energy in a fashion not yet tried elsewhere. And we think we have, in this Sri Lankan fishing village, a chance to establish a remarkable model of post-disaster reconstruction that is well worth our long-term study and iteration. We hope to start within weeks.

Eric Rasmussen, MD, MDM, FACP, is a Navy physician on the critical care faculty of a teaching hospital near Seattle, Wash. He is also an advisor in humanitarian medicine for the United Nations Office of the Coordinator for Humanitarian Assistance (UN-OCHA) and a Senior Fellow at RMI.

allenge, we suspect, may lie with us; in our finding humility as we approach this opportunity. We know very well that we need to incorporate those who already live there in every aspect of the assessment, planning, and

rebuilding process, reducing the inevitable enthusiasm we bring with us to a level that allows dispassionate consideration of their goals. We also know that most of us are not well-conditioned to do that.

¹ Skype: a free Internet-based telephone system; see www.skype.com.

² See www.rmi.org/sitepages/pid244.php.

How to Drive a Hybrid Car

To get a state-of-the-art 4-/5-seat hybrid-electric midsize sedan to perform at ~53–55 mpg (it’s rated at 55) rather than in the low 40s, it needs “pulse driving,” which differs in two ways from our old driving habits:

1. When you see that you’ll need to slow or stop up ahead, start braking gently and as early as possible so you recover the most braking energy back into the battery for later reuse. *Prius* recovers 62–66 percent of braking energy in its regenerative mode, but if you brake too late, hence too hard, the mechanical brakes will override, and they simply turn motion into useless heat.
2. Contrary to what we were all taught in high-school driver’s ed, when you’re accelerating up to cruising speed, do so briskly. The engine is most efficient at high speed and torque, so you’ll use less fuel accelerating aggressively for a short time than gently for a long time.

Note: Many reviewers test hybrids driven in the same way as non-hybrids, then gripe that hybrids fall short of their rated efficiency by more than non-hybrids do. This is incorrect; properly driven hybrids can actually match their EPA-rated mpg more closely than non-hybrids can. (My Honda *Insight* mild hybrid, for example, averages 63 mpg and is rated 64, the difference being more than attributable to snow tires; Toyota’s U.S. Executive Engineer, Dave Hermance, gets 53–55 mpg on his 55-mpg-rated *Prius*.) *Consumer Reports* is a major source of this confusion, having repeatedly refused to print a correction explaining that its standardized test procedure disproportionately reduces the mpg of the hybrids it tests. *CR* also calculates combined city-highway mpg differently than EPA and automakers do.

Consistent with attentive driving, you’ll also find it very instructive, when driving a hybrid, to keep an eye on the real-time mpg display and (like a videogame) use the feedback to improve your driving habits for best mpg.

—ABL

National Solutions Council hits full stride

Rocky Mountain Institute's National Solutions Council has in recent months hit its stride and has been actively involved in numerous RMI events, programs, and promotions. First convened in July 2003, at the home of Council member **Jerry Hosier** (as a result of the efforts of **Kathy Farver** and **Elaine LeBuhn**), the Council focuses on promoting ideas developed at the Institute, and sharing them with like-minded individuals in their communities.

In the past year, the NSC's activities have included:

- **Ecological Design.**

In March 2004, Council Cochair **Kathy Farver** hosted an RMI discussion about the work of **Dr. John Todd**. A biomimetic designer with whom RMI often works, Dr. Todd is a global leader in the field of ecological water purification—the use of natural systems and processes to clean water—and the cofounder of **Ocean Arks International**. His water cleansing systems hold the key to making the world's scarce water more available, especially to populations that suffer shortages and water-borne diseases.

"Elaine and I decided to join the National Solutions Council precisely because of RMI's focus on solutions—achievable, affordable, beneficial solutions to environmental challenges. I continue to believe in the necessity and worth of public policy decisions in achieving thoroughgoing change, but it's clear that progress in that arena will not be forthcoming for the foreseeable future. Thankfully, RMI is there, helping light the way ahead so that our collective next steps are easier to take. That's what is needed right now, and it's worth supporting."

David Henry

- **Winning the Oil Endgame.**

In July 2004, **Doug and Lynda Weiser** hosted an important event at their Snowmass home, where RMI CEO **Amory Lovins** discussed RMI's work in the corporate world, as well as *Winning the Oil Endgame*, RMI's independent, peer-reviewed synthesis for American business and military leaders that charts a roadmap for getting the United States completely, attractively, and profitably off oil.

- **Implementing Oil Endgame.**

In December 2004, **Bud Konheim** and **Nicole Miller** hosted a New York City event which Council members attended; *Winning the Oil Endgame* was again presented by Amory Lovins. Many observers believe that *WTOE's* carefully articulated approach to oil could be replicated for other energy sources, like natural gas and coal.

To learn more about the NSC see p. 24, or contact: Ginni Galicinao, Rocky Mountain Institute, 1739 Snowmass Creek Road, Snowmass, CO 81654-9199; tel: (970) 927-3851; fax: (970) 927-4178. www.rmi.org

Blue Sky presenter Richard Kidd of the U.S. State Department, RMI's Michael Kinsley, and NSC member Chris Smith (l-r).



Photo courtesy of Judy Hill (www.judyhill.com)

RMI *save the date*

National Solutions Council weekend

Mark your calendars for **16–18 July**, when RMI will host in Snowmass a special National Solutions Council weekend that combines the best of RMI and Aspen. NSC members will have the opportunity to participate in a workshop with **Amory Lovins** and RMI's Research & Consulting team, as well as enjoy the nature, beauty, and performing arts that Aspen is famous for. The weekend culminates with an evening salon at the home of **Rita and Irwin Blitt**, where **Alexis Karolidis** will talk about greening our nation's hospitals.



For more information about the Council, please contact Development at **(970) 927-3851** or **develop@rmi.org**.

Change Management



E. Kyle Datta,
Managing
Director, RMI
Research &
Consulting

As an organization, RMI's mission entails changing the world. To do so, we must change ourselves. RMI itself has proven remarkably adaptable and resilient, exhibiting many of the characteristics of a living organism.

We are evolving. RMI entered the consulting arena to influence corporations and apply its research, creating a real-world feedback loop. Research and consulting are carefully integrated to capture the synergies from interaction with business and governments. During its first two decades, RMI built internationally recognized expertise in energy and green buildings. In the process, we also developed the capability to create abundance by design, to think across boundaries, and, through the process of whole-system design, creatively integrate our insights. This year, RMI launched a new practice area, the **Integrative Design Practice**. This group's purpose is to develop and refine RMI's methodologies for whole-system thinking and apply these methodologies across a wide range of industries.

We are renewing ourselves. Some old friends have departed to seek their destinies and carry the genetic code of RMI on to other organizations. The next generation, the ones who will disseminate RMI's DNA into the future, have already arrived. They are remarkable young people—literally the best and brightest, the cadre of the next industrial revolution. Over the next year, a new set of senior practitioners will be joining us to expand our intellectual capabilities and provide the critical mass of intelligence and experience. The best consulting firms are known for developing their people. At RMI, we want to grow leaders.

Our research and consulting practice is more than just thinking up the next big idea. It is about achieving real results, examples that can be emulated by others, spreading globally like a beneficial virus, or simply winning the Darwinian competition. Thus, as agents of change, we ourselves will always be evolving.



Charretteers' helping to manage change.



¹ **Charrette:** an intensive, transdisciplinary, roundtable design workshop. It achieves many months of normal conceptual design in typically a few days. A carefully conceived but flexible process, a typical charrette alternates between plenary sessions and topical working groups (sometimes cross-pollinated by “wandering minstrels”) to yield a magical level of integration. Organizing and leading charrettes is one of RMI's core skills, applied successfully to hundreds of projects across a wide range of sectors, disciplines, and scales.

A charrette is a process of discovery, unlike any conventional workshop format, and thoroughly melds the “home team” with the “visiting team” so that after the visitors have left, the “home team” can consummate the new design. The charrette is meant not only to create a design and to learn together, but also to change how the participants think. Its results are not known in advance and often appear not-quite-impossible. At times its process may seem disorderly. But as we have learned by actually doing many, design charrettes always come together in the end, and abundance by design is the result.

Examining the Connections



Marty Pickett,
Executive
Director

Rocky Mountain Institute recently wrapped up its twenty-third year as an entrepreneurial nonprofit organization whose mission is to foster the efficient and restorative use of resources to make the world secure, just, prosperous, and life-sustaining. Although our mission is rather straightforward, and our notions about energy and resources lead to good results, there are often questions about how and why we choose to have an ongoing loop between our research and “applied research,” or consulting.

Approximately half of RMI’s revenue comes from individuals, corporations, and foundations that support the Institute’s research projects and the development of new intellectual capital—that is, the great ideas and solutions you see written about in this and

other RMI publications. RMI derives roughly the other half of its support from applying that research and consulting with private firms, the military, and communities (a sign of our entrepreneurship). This real-world application of research does three things: it confirms the validity of the Institute’s ideas; it refines the ideas themselves, so they’re easier and cheaper to implement, and yield greater rewards; and real-world application fulfills the Institute’s mission, creates vivid case-studies, and increases competitive pressure for wider adoption.

However, RMI’s role as a change agent is no simple given fact. Our ability to get our principles and practices adopted depends on our ability to inspire, inform, and collaborate with decision-makers in corporate, academic, military, and government settings. The people we seek to work with in these settings—typically “early adopters”—don’t necessarily accept everything we present; there’s a world of ideas competing for attention. So RMI must continually under-

take cutting-edge research that produces revolutionary hypotheses about how energy and resource efficiency can, especially when presented in whole-system thinking and integrative design practice, provide win-win solutions that reconcile otherwise-intractable economic, environmental, and security challenges.

RMI’s research and its real-world application have broken new ground in several major sectors: energy, utilities, vehicles, buildings, and industrial processes. But what is more important is that RMI’s insights in these areas come from the Institute’s rigorous examination of issues that cross boundaries—indeed, in many instances, it’s at the very intersection of often unrelated fields that RMI’s Research & Consulting staff make the most important findings. Sure, a green building is a great achievement, but exploring the relationship of a green building to its land is just as important, as are the land and the community, the community and transportation networks, the

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Editor’s Notes

Harping on “Tarping”



Cam Burns,
Editor

In early May, workers at a Swiss ski resort covered a section of the Gurschen glacier in Switzerland in thin foil, to reflect the warm sun’s rays and slow the ice sheet’s melting. The glacier sits at about 10,000 feet above sea level, and like many everywhere, it is disappearing rapidly. To protect a strategic ramp that gives skiers access to the glacier from a chairlift off-loading

station, officials at the Gemsstock resort put down about 3,000 square meters of a 4-millimeter-thick white synthetic-fiber sheet, covering the ramp and the upper part of the glacier. Various environmental groups—including the WWF and Greenpeace—protested as the cover was placed upon the ice, “saying a fundamental change in climate policy—not short-term measures—was required,” the British Broadcasting Corporation reported on 10 May.

Global climate change is today the single biggest environmental issue for this planet, period, and Rocky Moun-

tain Institute has been publishing profitable solutions to it since the Institute was founded. In recent years our work in carbon dioxide and other greenhouse gas emissions management has ramped up, and in this and future editions of *RMI Solutions*, you’ll read more and more about this timely work. RMI’s work on global climate change includes both long- and short-term recommendations, and both have their places. And while we understand why “tarping” glaciers has its critics, the activity still has a vital role: it draws attention to one of the world’s most pressing issues.

Will Clift, RMI Research & Consulting



It is your money
or your life.

Businesses pick
higher environ-
mental standards
or fast, cheap
production.

Schools choose arts *or* sciences.

But this “tyranny of the ‘or,’” to quote Jim Collins in his book *Built to Last*, never resonated for Will Clift. Throughout his life and in his work with RMI’s Energy & Resources Services team, Will shuns this exclusionary model of thinking and decision-making.

“Both the education system and the business world tend to push people to define themselves very narrowly,” he said. “I’ve slowly come to understand that this is not the only way to find fulfillment or add value, nor is it what I am best at. The times that I have chosen the confluence of two or more paths or ideas instead of taking one have been far more memorable and rewarding.”

Will’s professional and personal achievements are testaments to the idea that there is a sweet spot in the confluence of the right and left sides of the brain. Thus, he uses both.

Will was drawn to sculpture at an early age, assembling structures out of wooden blocks at the age of four. This creativity evolved into a mature interest in furniture design—Will was designing and building tables and chairs from age sixteen and selling commissioned pieces by eighteen.

The functionality of furniture limited the degree to which Will could explore form, so after leaving home



“Four Pieces, Waving”

for college, he shifted his attention to pure sculpture. He turned an artistic eye toward intersecting lithe pieces of wood, making gallery-quality sculptures that delicately balance without the use of glue or nails. He is self-taught in both sculpture and furniture-making, having never taken a formal class on either. “Art is a very personal thing for me,” he noted, “I didn’t want to get stuck with the baggage of history and theory by studying it.”

In Will’s research and consulting work at RMI, however, it’s imperative that he study both theory—so he can help craft smarter energy practices for our clients—and history, so he can understand what has and hasn’t worked in the past. One of Will’s current projects is the development of a resource plan for the City of Palo Alto Utilities. Will points out, once again, that seeing the world as a series of “either-or” options is an unnaturally binary way of making choices, yet for many companies it is standard procedure. Instead, Will finds a balance in achieving clients’ ultimate goals that hinges on elegant design and creative problem-solving. “The opportunity to work integratively, across disciplines, is what brought me to RMI. And I’m slowly learning that to be a “generalist” *and* an “expert” is not mutually exclusive; as I learn about a topic—distributed generation, for example—in greater depth, I start to see potential applications of related ideas all around me.”

Will graduated from Stanford with a BS in integrative design (a focus of study he helped develop, combining various engineering disciplines, psychology, and business strategy and entrepreneurship). He earned his master’s degree, also from Stanford, in management science and engineering. This program pairs engineering analytics with business acumen. In February he was involved with a charrette for a major renovation and addition to the Boston Museum of Science. He is also involved in a partnership with the **Sustainability Institute** in Vermont, to develop a model to help utilities understand risks and opportunities associated with their carbon dioxide emissions and climate change.

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James E. “Jay” Hughes, Jr.



One of the principles that Rocky Mountain Institute constantly promotes in all its work is the notion that everything is part of a system and that systems—no matter how big or small, how resilient or fragile—can be wholly altered by actions or accidents at any point in the system. While the Institute has applied its understanding of systems to a variety of complex entities, RMI Board member James E. “Jay” Hughes does the same thing—but with families.

Jay works with families to examine ways to preserve family structure, integrity, resources, and wealth, by exploring aspects of a family’s situation, personalities, and dynamics.

“When you find those connecting dots that reframe an issue, you repeatedly open up ways of resolving problems,” he said.

Jay didn’t start out applying what is essentially a form of whole-system thinking to families. For most of his distinguished legal career, Jay’s primary interest in law revolved around more straightforward fiscal issues—taxes, investments, etc.—and how to preserve financial capital. But as Jay’s experience grew and he saw families both achieving greatness and declining, he became much more interested in the challenge of building families into long-lasting, high-quality organizations—“much longer-distance runners,” he calls them.

His notions are probably best couched in the multi-generational example he describes as the “shirtsleeves-to-shirtsleeves in three generations” phenom-

non. In it, the first generation starts out with few resources and no wealth and works extremely hard to make a life for itself. During the second generation, the resources and wealth “plateau”; during the third generation, the resources are depleted; and the fourth generation returns to hard work.

Jay’s ideas are not simply about the preservation of *money*; rather, as he explains in his book *Family Wealth: Keeping it in the Family*, money is a tool that supports family growth and development and the actual *wealth* of a family is its members and their intellectual capital. In the book, Jay describes the challenge of retaining wealth for more than three generations, then systematically outlines ways for families to achieve that.

Some of the strategies are eye-opening. They range from the proper management of complex personal relationships (one example being the father who has to fire his son for incompetence, then takes off his “boss” hat, replaces it with his “dad” hat, and consoles the son) to governance and financial systems to mentoring to family mission statements—even the evaluation of the next generation is described.

“The book was written at the urging of a number of friends and acquaintances to put all I’d learned over the years into words,” Jay said.

Jay attributes a lot of his interests in life to his early years, notably to his education. Jay, his brother and two sisters were born and raised in New Jersey. When Jay was six, he began attending the Far Brook School (www.farbrook.org), in Short Hills, N.J., which he quickly found out—and is fast to note—was a “life-changer.”

“It teaches through the arts,” Jay explained. “Everyday, from nursery school through the eighth grade, every student does some kind of performing or fine art. The academic curriculum is designed around that.”

This creative way of looking at things and solving problems, Jay said, helped him see that so-called linear thinking is not always the most appropriate approach to problems. “I really felt I was educated at Far Brook,” he said.

After Far Brook, Jay attended the Pingry School, studied history and European civilization at Princeton, and then earned his *Juris Doctor* at Columbia in 1967. Jay went into law, and spent his career with three distinguished Manhattan firms: Coudert Brothers, Jones Day, and his own firm, formed in 1994, Hughes & Whitaker.

Jay retired in 2001 and moved to Aspen, Colo. and began what might be described as a new chapter with Jackie Merrill, his “life partner” of 12 years.

Unlike most Board members, who have joined the Institute’s governing body as a result of interest in energy and/or resource issues, Jay joined the Board in 2004 as a result of his knowledge of organizational structures and their durability and feeling he could help the Institute chart a healthy future. A local friend, RMI Board member Elaine LeBuhn, suggested Jay for the post.

“I was in a transition to a new life, and looking to see how I could give back,” he said. “Amory and I are in different fields but I think we’re both pioneers—not necessarily in the seeking of new ideas, but in reconnecting old ideas.”

—Cameron M. Burns

Carol Rothschild Noyes, Longtime RMI Board Member, Supporter, Passes

Carol Rothschild Noyes, a longtime friend and supporter of RMI, passed away 18 April at her home in Laurel Hollow, N.Y. She was 88.

Carol was a nationally renowned supporter of civic and environmental causes, and had been associated with RMI for more than two decades, serving as both a Board member and in various capacities with RMI's Development Department. She was also a regular financial supporter of the Institute.

Born 13 March 1917 in New York City, Carol Warburg Rothschild was brought up in one of New York's well-to-do families involved in banking and commerce, and there were few material possessions lacking in young Carol's life.

"She grew up in what to us would look like another world," said Deborah Bradford, Carol's Aspen, Colo.-based daughter. "In huge houses with servants' quarters and gardeners and grooms and all that sort of stuff. But she never wanted to live like that. Her approach to life was much more modest. The thing she did take from that lifestyle as a legacy, I think, was the philanthropy. That became a real passion of hers."

Horses, sailing, and various outdoor activities were also big passions, as was art—which she studied at Vassar—and she was a consummate collector and an integral part of the New York cultural scene.

After college, she and a friend, Dottie Noyes, ran a furniture store in New York ("New Design") that sold contemporary furniture designed by Ray and Charles Eames, Eero Saarinen, and Alvar Aalto.

But it was the philanthropic aspects of Carol's life that were to rule her existence from early on, and she became well-known for her role with the New York City office of Planned

Parenthood, where she won a reputation for tireless work on behalf of others.

"I continue to be amazed and delighted to be part of such an extraordinary Institution."

Carol Noyes, 15 October 1994

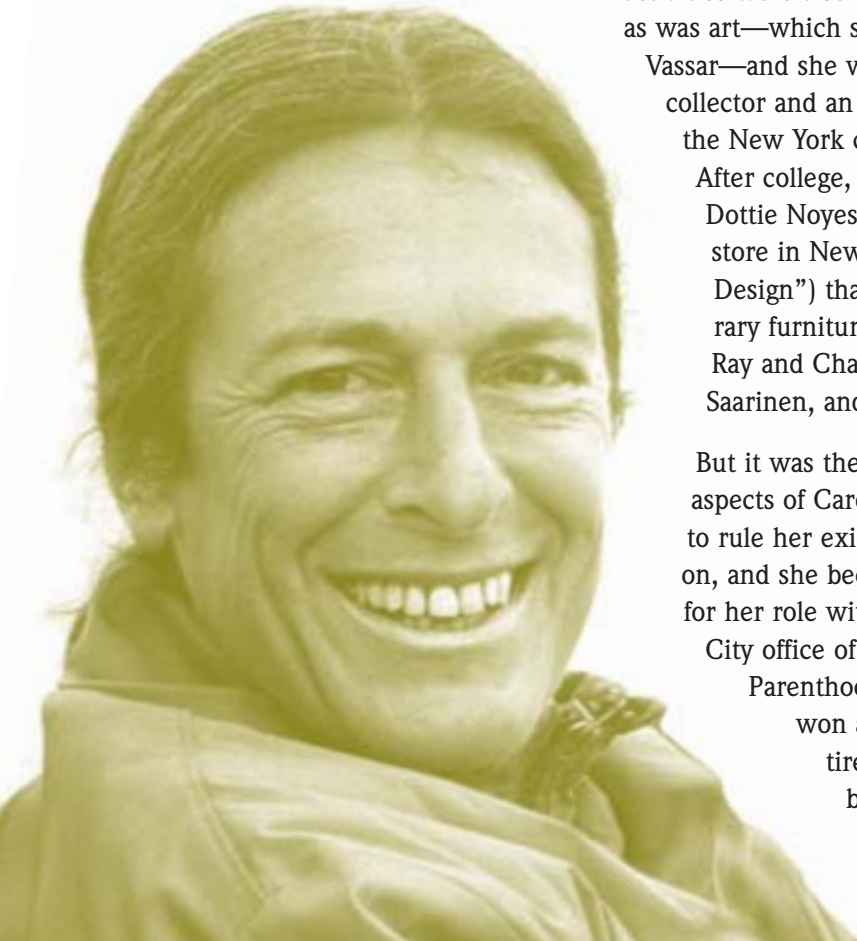
"What inspired me to join Planned Parenthood?" Carol asked in the 1996 book *Choices: Nine Leaders of Planned Parenthood of New York City Tell Their Stories*. "I was kind of a captive. My mother, Carola Rothschild, had been part of the movement ever since I can remember. She was always interested in things medical and during the war she became a medical technician; she took blood counts and things like that, and was on the boards of various hospitals. I can't remember any particular aspect of Planned Parenthood that she talked to me about, but I can remember one thing she said about children: "They're just like puppies; 'you gotta love 'em *and* feed 'em.'"

Not surprisingly, perhaps, Carol and first husband Amory Bradford had a large family, and produced five children: Peter, Deborah, Carola, David, and Madhavi.

Deborah recalls the most important principles that Carol instilled in her children were individualism and responsibility: "She really taught us all to be our own people. She modeled it and she loved it. That whole thing about giving you roots and wings—she created a very stable solid world, and also really inspired us and taught us how to leave it."

The environmental movement in the United States reached maturity about the same time Carol's children reached adulthood, and the notion of caring for the earth became a theme in the Bradford residence.

CONTINUED ON NEXT PAGE



Carol Rothschild Noyes

CONT. FROM PREVIOUS PAGE

Indeed, Peter went on to become an energy policy expert—a contemporary of RMI CEO Amory Lovins and one of Ralph Nader’s “Raiders”—and a strong environmental ethic runs through all the Bradford children.



“It was so supported at home,” Deborah observed. “He [Peter] probably would’ve found his own way, but it wasn’t a strange avenue for him to go down. We were all, more or less, brought up with those values.”

While Carol was still involved with Planned Parenthood, demand for her to join various environmental organizations grew, and she eventually was elected to the Board of Natural Resources Defense Council (NRDC), where she served in various capacities for parts of three decades. “The two just have a symbiotic relationship,” Carol noted in *Choices*. “You can’t consider the environment without considering population.”

In the early 1980s, she also met and got to know Amory Lovins, through her friendship with Mary and William P. Bundy, the latter being the editor of *Foreign Affairs* who published Amory’s controversial 1976 article “Energy Strategy: The Road Not Taken?”

They became close friends, and eventually, in 1985, Carol joined RMI in an official capacity, as a Board member.

Deborah noted that one outstanding aspect of Carol’s personality was her wide creative and rebellious streak, and the early years on RMI’s Board held great appeal for Carol.

“She loved those early Board meetings at RMI,” Deborah said. “It was such a cast of characters. This was not your typical board, and it was her kind of thing. They did not stand on ceremony, they were all really brilliant, and they were doing a lot of really important work. She really did care a lot about the environment and she saw the things RMI was doing as being some of the most important of any of her work.”

Indeed, Carol’s support of RMI included hundreds of hours of fundraising work with RMI’s then-Development Director Farley Sheldon.

Carol’s marriage to Amory Bradford ended in divorce in 1965; she later remarried, to Charles P. Noyes, brother of her friend Dottie, who died in 1994.

During her life, Carol served in various capacities with a raft of organizations, including: NRDC, the Woods Hole Oceanographic Center, Planned Parenthood, the Brearley School, the Concord Academy, Vassar College, Inform, and, of course RMI, where in 2001 she became an emerita member of RMI’s Board. Her son, Peter Bradford, remains a special advisor to the Institute.

Carol is survived by three daughters, Deborah, Carola Lea of Lyme, N.H., and Madhavi Bradford of Darlington, Idaho; and two sons, Peter Bradford of Peru, Vt., and David Bradford of Guilford, Vt.; a sister, Phyllis Farley of Manhattan; two stepsons, Charles P. Noyes III of Spencertown, N.Y., and James Noyes of Hood River, Ore.; and eight grandchildren.

Carol’s many years of service and support will be well remembered, and her broad, warm smile remains in our hearts. Thank you, Carol. You helped make saving the world a lot more fun.

—Cameron M. Burns

RMI *letter of the month*

Dear Art Director,

As you are well aware, working with Rocky Mountain Institute has opened our eyes to possibilities in both papers and inks that we may not have been as aggressively exploring without our relationship with your organization. We value our partnership with Rocky Mountain Institute and are very excited about the path it has headed us on.

For your information and gratification, we just received word last week from a very substantial account that we will be doing their printing in the future. Their decision to use Gran Farnum Printing was primarily based on the fact that we offer a stocking program of **100 percent PCW, PCF*** papers to produce their jobs on.

Thank you for being our partner in this journey.

Jim Anderson
Gran Farnum Printing



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Below is suggested wording for including RMI in your will. But we also suggest you consult your attorney.

“I hereby leave _____ percent of my estate (or a fixed amount, specific property, or the remainder of my estate) to Rocky Mountain Institute, a Colorado nonprofit corporation, whose purpose is to foster the efficient and restorative use of resources to make the world secure, just, prosperous, and life-sustaining.”

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Members of the National Solutions Council are:

- **invited to participate** in various discussions with RMI staff and/or Board of Directors about global issues. Several members attended our 22 April Blue Sky Session, hosted by Richard Kidd of the U.S. State Department. Mr. Kidd shared news of the State Department's work ridding certain war-torn regions of landmines, as well as America's role in the post-9/11, energy-precious world.

- **special invitees** to RMIQs (RMI's Quest for Solutions presentations) and other RMI events. Environmental writer, designer, educator and RMI Board member David Orr spoke in April at an RMIQ co-hosted with the Aspen Center for Environmental Studies.

- **sponsors** of regional RMIQ lectures or series.

NSC member Bud Konheim hosted an event in New York on 2 December that featured Amory Lovins and a discussion of the most recent outcomes of *Winning the Oil Endgame*.

- **recipients** of advance notification of key upcoming RMI publications.

Mark your calendars for 16–18 July when RMI will host in Snowmass a special National Solutions Council weekend that combines the best of RMI and Aspen. NSC members will have the opportunity to participate in a workshop with Amory Lovins and RMI's Research & Consulting team, as well as enjoy the nature, beauty, and performing arts that Aspen is famous for. The weekend culminates with an evening salon at the home of Rita and Irwin Blitt, where Alexis Karolides will talk about greening our nation's hospitals.

The NSC extends an invitation to all RMI donors of \$1,500+ annually to join. Watch your mailbox for upcoming NSC events!

For more information about the Council, please contact Development at (970)927-3851 or develop@rmi.org.

Life at RMI

Examining the Connections

(continued from p. 18)

transportation networks and energy sources and systems...and so on. It's this exploration of interstices that makes RMI's inquiry unique. And, admittedly, often this kind of examination of problems is more subtle and unpredictable than, say, tackling one big issue at a time or coming up with the research and hoping it will be utilized.

As you'll see in this edition of *RMI Solutions*, we have included articles about influencing states' energy policies (the federal government isn't the only or even the most important energy player), about improving communications and cooperation in rebuilding a tsunami-struck village (not drawing up monumental building plans), and about mitigating carbon dioxide (not shutting down industry, but helping the efficient flourish at the expense of the inefficient). It's this subtle exploration of connections that, we think, often leads to sweeping and deeper changes. We hope you agree.

Staff Spotlight

Will Clift

(continued from p. 19)

Energy and Resources principal Joel Swisher commends Will, saying, "Will is our Renaissance Man. He is skilled at number-crunching spreadsheets, writing up charrette reports, and working with clients one-on-one. Unlike the rest of us engineers, Will enjoys dividing his time among a number of diverse projects."

Will's sculptures sell in galleries in Washington DC, Denver, Santa Fe, and San Francisco. "Making sculpture has never been in competition with being a consultant at RMI, nor vice versa—neither for time, nor in terms of which one I am more serious about," he explains. "While there is no explicit connection between my sculpture and my work at RMI, the two are very complementary for me. They give me a balance between my physical, emotional, and intellectual sides, and between my need to be both social and solitary. I've felt pressure on both sides to give up the other, but I don't see that happening. If I did, the quality with which I do the other would suffer, and so would I."

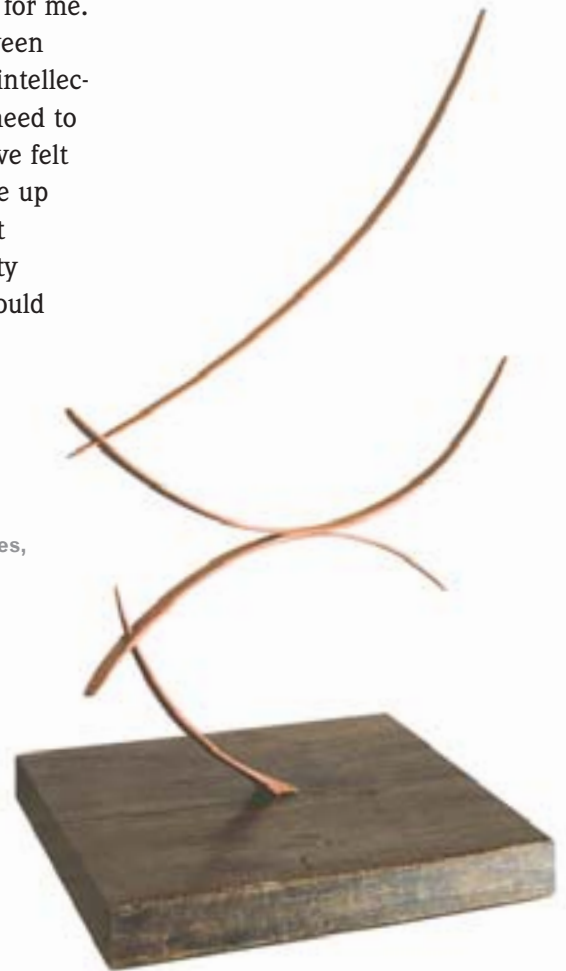
Will defines opportunity in life differently than most. He has proven that the confluence of interests and skills, which initially pull one in opposite directions, can actually create unique opportunities and yield a high degree of satisfaction. Whether he is constructing sculptures or evaluating energy-efficient technologies, he looks to outsmart the "tyranny of the 'or.'" His intuitive draw to this perspective aligns well with RMI's focus on whole-system thinking, illustrating that when the whole system is integrated, the opposing pulls provide a chance for discovery, exploration, and success.

—Piper Foster

Piper Foster recently interned with the Development Department.

"My sculpture and my work at RMI are very complementary for me. They give me a balance between my physical, emotional, and intellectual sides, and between my need to be both social and solitary."

"Two Pairs,
One Resting on the Other,"
by Will Clift



Competitors To Nuclear: Eat My Dust

In a market economy, private investors are the ultimate arbiter of what energy technologies can compete and yield reliable profits, so to understand nuclear power's prospects, just follow the money. Private investors have flatly rejected nuclear power but enthusiastically bought its main supply-side competitors—decentralized cogeneration and renewables.

Worldwide, by the end of 2004, these supposedly inadequate alternatives (see graph, p. 1) had more installed capacity than nuclear, produced 92% as much electricity, and were growing 5.9 times faster and accelerating, while nuclear was fading.

The world's nuclear plant vendors have never made money, and their few billion dollars' dwindling annual revenue hardly qualifies them any more as a serious global business. In contrast, the renewable power industry earns ~\$23 billion a year by adding ~12 GW of capacity every year: in 2004, 8 GW of wind, 3 GW of geothermal/small hydro/biomass/wastes, and 1 GW of photovoltaics (69% of nuclear's 2004 new construction starts, which PVs should surpass this year). PV and windpower markets, respectively doubling about every two and three years, are expected to make renewable power a \$35-billion business within eight years. And distributed fossil-fueled cogeneration of heat and power added a further 15 GW in 2004; it does release carbon, but ~30% less than the separate boilers and power plants it replaces, or up to ~80% less with fuel-switching.

Windpower's 50+ gigawatts of global capacity, half of U.S. nuclear power capacity, paused in 2004 due to Congressional wrangling, but is expected to triple in the next four years, mainly in Europe, which aims to get 22% of its electricity from renewables by 2010. One-fifth of Denmark's power now comes from wind; German and Spanish windpower are each adding as much capacity *each year* (2 GW) as the global nuclear industry is annually adding on average during 2000–10. No country has had or expects economic or technical obstacles to further major wind expansion. The International Energy Agency forecast in 2003 that in 2010, wind could add nine times as much capacity as nuclear added in 2004, or 84 times its planned 2010 addition. Eight years hence, just wind plus industry-forecast PVs could surpass installed global nuclear capacity. The market increasingly resembles a 1995 Shell scenario with half of global energy, and virtually all growth, coming from renewables by mid-century—about what it would take, with conservative efficiency gains, to stabilize atmospheric carbon.

Whenever nuclear power's competitors (even just on the supply side) were allowed to compete fairly, they've far outpaced central stations. Just in 1982–85, California utilities acquired and or were firmly offered enough cost-effective savings and decentralized supplies to meet all demand with no central fossil-fueled or nuclear plants. (Alas, before the cheaper alternatives could displace all those plants—and thus avert the 2000 power crisis—state regulators, spooked by success, halted the bidding.)

Today's nonnuclear technologies are far better and cheaper. They're batting 1.000 in the more competitive and transparent processes that have swept most market economies' electricity sectors and are emerging even in China and Russia. A few Stalinist economies like North Korea, Zimbabwe, and Belarus still offer ideal conditions for nuclear sales, but they won't order much, and you wouldn't want to live there.

No wonder the world's universities have dissolved or reorganized nearly all of their departments of nuclear engineering, and none still attracts top students—another portent that the business will continue to fall, as Nobel physicist Hannes Alfvén warned, “into ever less competent hands,” buying ever less solution to any unresolved problem than in the days of the pioneers. Their intentions were worthy, their efforts immense, but their hopes of abundant and affordable nuclear energy failed in the marketplace.

—Amory B. Lovins

Private investors have flatly rejected nuclear power but enthusiastically bought its main supply-side competitors—decentralized cogeneration and renewables.

costly nuclear power instead of cheaper options buys less coal displacement. For example, if a new nuclear plant delivered a kWh for only three times the cost of saving a kWh (the actual difference is typically much larger), then for the cost of your one nuclear kWh, you could have saved three kWh, tripling your carbon reduction.

These realities have only strengthened since RMI first detailed them in the late 1980s.⁶ Yet all were ignored then because they collided with dominant nuclear theology. Hence today's supposed Hobson's choice between frying slowly from climate change or instantly in a nuclear fireball—when in fact neither is necessary nor economic.

Peter Schwartz and a few other long-time friends have become so enchanted with nuclear theology that they now suggest, in a bizarre kind of reverse projection, that market-oriented analysts like RMI are somehow in thrall to quaint and impractical notions. They claim that we economic rationalists, not they, are misled by a false anti-nuclear theology that blinds us to the manifest superiority of the nuclear god.

Get a grip, guys. As a student of this subject since the early 1960s, when I thought nuclear power sounded like a good idea, I've always been, and am today, open-minded about the possibility that it may have hidden merits. But based on the literature and on deep practical experience of electric

efficiency and production in scores of countries, I see no evidence that nuclear power, using any technology, under any political system (let alone an attractive one), is or promises to become an economically, technically, or socially sound energy solution.

I read many slick nuclear polemics and sweeping qualitative claims, but see no analysis backing up their key assertions, such as alternatives' being small and slow, which the market contradicts. It's no good claiming we need *all* options. We have only so much money. The more urgent you think it is to protect the climate, the more important it is to spend each dollar to best effect by choosing the fastest and cheapest options—those that will displace most carbon soonest.

In short, I'm unmoved by nuclear theology. In God we trust; all others bring data. Show me the numbers.

Amory B. Lovins is cofounder and CEO of RMI.

This is a greatly condensed and popularized summary of the nuclear section of "Energy Policy for National Insecurity," posted at www.rmi.org/sitepages/pid171.php#E05-04, which provides details and documentation.

Thanks to the authors of two incisive analyses: Peter Bradford "Nuclear Power's Prospects in the Power Markets of the 21st Century," for the Nonproliferation Policy Education Center (www.npec-web.org), and Doug Koplou, "NuSubsidies Nuclear Consortium" (www.earthtrack.net/earthtrack/library/NNC_Overview.ppt); to RMI colleagues Ken Davies, Nathan Glasgow, Kyle Datta, and Dr. Joel Swisher PE for research and review; and to Navigant Consulting and World Alliance for Decentralized Energy for data.

- 1 Spring 2001 *RMI Solutions* (www.rmi.org/sitepages/pid238.php) and annotated *Foreign Affairs* article (www.rmi.org/images/other/Energy/E01-04_FoolsGoldAnnot.pdf).
- 2 See RMI Publ. #E05-04 (above) for details. The 207 "distributed benefits" detailed in RMI's *Economist* Book of the Year, *Small Is Profitable* (www.smallisprofitable.org), would disadvantage nuclear power by about another tenfold, but aren't counted here. The decentralized options are also improving quickest.
- 3 See my 28 Feb. 1980 *Nature* review article "Nuclear Power and Nuclear Bombs" (RMI Pub. #S80-1, www.rmi.org/sitepages/pid618.php) and the Nonproliferation Education Center's 2005 paper "A Fresh Examination of the Proliferation Dangers of Light Water Reactors," www.npec-web.org/projects/NPECLWRREPORTFINAL110-22-2004.pdf, by V. Gilinsky, H.W. Hubbard, & M. Miller.
- 4 "Nuclear Power and Nuclear Bombs," RMI Pub. #S80-2 or www.foreignaffairs.org/19800601faessay8147/amory-b-lovins-l-hunter-lovins-leonard-ross/nuclear-power-and-nuclear-bombs.html, and three out-of-print books, notably *Energy/War: Breaking the Nuclear Link* (1979).
- 5 *Winning the Oil Endgame*, www.oilendgame.com, pp. 98 and 258–260.
- 6 RMI Publs. #E88-28, -29, -31, E89-2, -3, all at www.rmi.org/sitepages/pid171.php#LibNucEnergy or in hardcopy.

RMI Solutions

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LETTERS TO THE EDITOR

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

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

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



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RMI Solutions

NEWSLETTER

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