10TH ANNIVERSARY EDITION

with a new Introduction by Amory B. Lovins *and* Paul Hawken

'This is a huge deal' BILL CLINTON

Natural Capitalism

THE NEXT INDUSTRIAL REVOLUTION

PAUL HAWKEN • AMORY B. LOVINS
& L. HUNTER LOVINS

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Paul Hawken, Amory B. Lovins and L. Hunter Lovins

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To Dana, David, Herman, and Ray

LOAVES AND FISHES

This is not the age of information.
This is *not*
the age of information.

Forget the news,
and the radio,
and the blurred screen.

This is the time
of loaves
and fishes.

People are hungry,
and one good word is bread
for a thousand.

— *David Whyte*

Introduction

to the 10th Anniversary Edition

Ten years ago, we wrote this unusual and increasingly influential book. Its ambition was nothing less than to redefine business for the 21st Century: to set out a new way of doing business wherein nature and people are fully valued, but without needing to monetize their value. We pointed out that the market feedback loops that supposedly keep capitalism on a self-correcting course do not. We acknowledged the orthodox definition — the productive use of and reinvestment in capital — but broadened it to include not just physical and financial capital (goods and money) but also natural and human capital (nature and people, including individuals, communities, and cultures). Productively using and reinvesting in all four forms of capital, not just two, could reverse the centuries-long destruction of the environment and create a policy and business model for social and ecological restoration *and* economic prosperity.

What debaters of globalization call environmental and labor problems reflect the absence of natural and human capital from the balance sheet of economic globalization. These forms of capital have different attributes: Nature is rooted in biomes and people are rooted in communities; they cannot be shipped and traded like money or goods without damaging them.

The four principles of what Paul Hawken dubbed natural capitalism are simple: Principle one, radical resource productivity, wrings more work out of less stuff, from extraction to end use. It uses fuels, minerals, water, and other resources with elegant frugality, dematerializes products, and makes them last longer. It comprehensively reduces the extractive flow needed to maintain the stock of physical goods and the flow of services. Principle two, biomimetic production, closes the loops in extraction and manufacturing, and turns waste into value. It designs out toxicity, so the flow of materials back into nature that do not produce value do not do harm. Principle three, the solutions economy, rewards both these shifts: the less stuff a provider needs to

deliver a service or the service a good is designed to provide, the more money producers and customers make. This can come about because the manufacturer is leasing the service of a product, not selling the product, providing powerful incentives for durability, quality, and reuse. Principle four, reinvestment in nature, restores and enhances nature's fecundity, boosting ecosystems' ability to provide even more food, fiber, and free ecological services, and hence to enhance life for all beings.

Although the first principle has received the widest attention and adoption, all four are vital and interlinked. Consider the flow of materials in, say, the U.S. economy in the mid-1990s (other industrial economies differ but by less than one might expect):

- We mine or grow or harvest materials whose daily flow per person averages 20 times that person's weight — counting only water returned dirty, not water returned clean.
- At least ninety-three percent of this massflow is lost in extraction and manufacturing; at most 7 percent gets into products.
- Six-sevenths of those products, by mass, are consumer goods that are thrown away after one use or no uses. Thus only 1 percent of the original mass is retained in durable products.
- Of the material in those durable products, only about one-fiftieth later returns to produce more value, either as compost or from recycling and remanufacturing.
- Thus the flow of molecules in the U.S. economy is about 99.98 percent pure waste. Correcting this is the biggest business opportunity in the history of the global economy.
- Moreover, much of the waste is toxic. Its disposal erodes nature's ability to maintain production of the food, fiber, and ecological services we cannot live without.

Natural capitalism systematically addresses this poor design. Together, its four interlinked principles, applied to an enterprise, reduce costs and increase customer satisfaction and loyalty. They yield practices and economies that can surpass conventional business norms while also fulfilling Interface founder Ray Anderson's business goal to take nothing, waste nothing, do no harm, and do well by doing good, at the expense not of the planet but of less alert competitors.

Many industries, nations, and firms have barely begun this journey. Increasingly, that lag is compromising not just their environment but their prosperity and security. Climate change, for example, is widely considered by military leaders to be a grave and self-inflicted threat to global stability. As more companies achieve success in the

area of energy and the environment, their competitive pressure on rivals is shifting business strategy, public policy, and the demands of civil society.

Co-author Paul Hawken described in his 2007 book *Blessed Unrest* (www.blessedunrest.com) how civil society worldwide is rapidly organizing itself in millions of citizen groups, often linked by the emerging global nervous system that can share good ideas and turn them into customer and voter pressure far faster. Governments are starting to move too, first at a local and sub-national level, then nationally (as in European climate leadership, the 2008 United States elections, and emerging Chinese energy and environmental leadership). Most of all, underpinning these growing successes, a myriad companies, large and small, North and South, are shifting their own practices, strategies, cultures, and values to remove the seeming contradiction between rewarding investors and saving the world. Often they eliminate the seeming conflict between these worthy goals by applying some, occasionally all, precepts of natural capitalism. An experience shared by Amory and Paul in their consulting work is the astonishing rise in ecological literacy in the executive ranks of leading companies. We are no longer dealing with an informed scientific and NGO community addressing a distracted and uninterested business community.

Of course, not everyone understands the scope or urgency of various crises we face. You still hear and read daily of business and political leaders who complain about the supposedly high cost of protecting the climate, the harsh choice between jobs and the environment, the trade-off between short- and long-term benefits, the inevitably high cost of green practices, the diminishing returns to investment in resource efficiency.

All these theoretical assumptions are false — flatly contradicted by experience, economics, and rigorous analysis. Protecting the climate is not costly but profitable, because saving energy costs less than buying it: efficiency is cheaper than fuel. Every practitioner of energy efficiency proves this daily; many major firms are making billions of dollars by radically improving their efficiency. (Dow, for example, has already saved $9 billion worth of energy by investing $1 billion in efficient use.)

Environmentally sound practices, intelligently done, typically cost less and return higher profits than destructive ones; firms that under-

stand this are prospering, those that don't are often struggling. Integrative design for radical energy and resource efficiency has now been shown — in thousands of buildings, diverse vehicle designs, and scores of factories — to reduce *capital* costs too, eliminating or reversing the supposed extra up-front investments needed for long-term savings. Integrative design experience has clearly established, as Chapter 6 of this book proposed in 1999, that optimizing whole systems for multiple benefits — not isolated components for single benefits — can often make very large energy and resource savings cost less than small or no savings, yielding not diminishing but expanding returns to investments in resource productivity.

A few examples illustrate these opportunities:

- Big new buildings that save around 80–90 percent of their energy typically cost *less* to build than today's inefficient buildings, because they downsize, simplify, even eliminate the costly mechanical equipment normally needed to heat, cool, and ventilate them. For example, more than 20,000 passive houses in Europe require no heat, yet nowadays cost the same or less to build, because their investment in superinsulation, ventilation heat recovery, et cetera is offset by the avoided cost of the eliminated heating system. Such net-zero buildings are now an official goal in places ranging from California to the U.S. military. The latest designs for big buildings can even produce *more* renewable energy than they use, yet still have attractive economics.
- Rocky Mountain Institute's latest data-center design, which EDS (now part of Hewlett-Packard) completed in the United Kingdom in late 2009, is expected to use one-fourth the normal amount of electricity to provide four times the normal amount of computing, yet cost no more to build. Future designs could be four times more efficient still, and increase the capital savings to about 50 percent.

RMI's $30 billion worth of factory redesigns in 29 sectors of industry are finding energy savings of about 30 to 60 percent on retrofit (fixing up old plants), repaying their cost in about 2 to 3 years, whilst in new factories the savings are more like 40 to 90 percent and the capital cost almost always goes *down*. The principles of how to achieve this in buildings, factories, and vehicles are set out in 2007 Stanford Engineering School lectures at www.rmi.org/stanford. Of course, one couldn't achieve such results if the original designs had been done properly, so RMI is also hatching a plot for the nonviolent overthrow of bad engineering — a project called 10xE (Factor Ten Engineering, www.10xE.org) — to reform how design is taught and done.

SUPEREFFICIENT CARS

Nothing better illustrates the past decade's progress in *Natural Capitalism*'s design principles, growing application, and occasional frustrations than advances in car efficiency. In 1999 when we wrote Chapter 2 "Reinventing the wheels: Hypercars and neighborhoods", nine years of analyses had convinced us that trebled-efficiency but uncompromised cars were feasible and competitively manufacturable. As this book was going to press in 1999, Rocky Mountain Institute was spinning out its Hypercar Center as a freestanding for-profit design firm, Hypercar, Inc. (which, to declare an interest, Amory chaired until 2007, still helps to guide, and is a small shareholder in). Here's what happened next:

- In 2000, the Hypercar team and two automotive firms designed a concept car called *Revolution* (www.rmi.org/rmi/Library/T04-01_HypercarsHydrogenAutomotiveTransition). This uncompromised midsized crossover sport-utility vehicle would be 6.3-fold more efficient than its steel equivalent if powered by a hydrogen fuel cell, or 3.6-fold using petrol. It would weigh 53 percent less and accelerate more briskly but be safer.
- The spinoff firm sought production capital just as the capital market collapsed in November 2000. However, many automakers were interested not just in the car's breakthrough attributes but also in how its manufacturing methods could save ~99 percent of the tooling cost, virtually the entire cost of the body shop and optionally of the paint shop too (the two hardest and costliest steps in automaking), and two-thirds of the size of the car's powertrain. RMI hypothesized in 2000 and proved in 2004 that these savings could offset the costlier carbon-fiber composite materials, making ultralighting free.
- At automakers' request, the Hypercar team validated its conceptual process for manufacturing structures from ultralight composite materials. It worked so well that the team shifted its focus to commercializing its novel manufacturing process, ultimately changing the firm's name to Fiberforge Corporation (www.fiberforge.com). By 2009, it was growing rapidly and had a distinguished array of automotive, aerospace, IT, military, safety-products, medical, sporting-goods, and other customers, and its process was producing marketed products in industrial environments.
- Meanwhile, closer study confirmed that ultralight cars could be as safe as or safer than heavy ones — size not weight was critical, and better design and materials could more than compensate for lighter weight amidst a mainly heavy fleet. Automakers, too, became more comfortable with ultralighting. In 2007, Toyota showed a *1/X* concept car with the interior volume of a *Prius* hybrid, half its fuel use, and one-third its weight. Few concept cars get to market, but this one wasn't just boasting: the previous day, the world's largest carbon-fiber producer, Toray, announced a factory to mass-produce carbon-fiber car parts for Toyota. This juxtaposition clearly signaled strategic intent. Now Honda and Nissan have similar deals with Toray: the next automotive leapfrog is off and running. A parallel light-weighting revolution using light metals like aluminum is also being led by Ford, Nissan, Audi, and the Chinese car industry.

- In 2008–09, as we'd been warning since the mid-1990s, the combination of uninspired leadership, poor strategy, volatile oil prices, and a foundered capital market caught up with General Motors and Chrysler. Both went bankrupt and were rescued by American taxpayers, now their main shareholder. The industry is now in its most turbulent and potentially creative period for a century, with dozens of startups emerging. One of those, RMI's fifth for-profit spinoff Bright Automotive (www.brightautomotive.com), showed in spring 2009 a driving prototype of its *IDEA* one-ton fleet van, which can carry five cubic meters of cargo using about one-third to one-twelfth the normal urban fuel. Unlike other plug-in hybrid-electric vehicles, it makes a compelling business case with no customer subsidy, because its reduced weight and drag eliminate most of the costly batteries. (The best way to make batteries, or fuel cells, affordable is to need fewer of them — a 1991 RMI notion that Audi in 2009 put at the core of its electrification strategy.)
- Another notion RMI hatched in 1991, now called 'vehicle-to-grid', is moving into the mainstream: using electrified vehicles as little power stations on wheels, able to charge with (say) surplus windpower at night, then resell spare power to the utility downtown on hot afternoons when and where it's most valuable. RMI's 2008 multi-industry workshop on the 'Smart Garage' accelerated its evolution by clarifying an orderly evolutionary path that will let vehicles exchange electricity and information with the grid via buildings, all to mutual advantage. Most automakers now appreciate the advantages of electric traction (augmented by hybrid engines, fuel cells, or nothing) and are aggressively bringing such products to market. Many cities are starting to ready their infrastructure for linking to the grid this new mobile power source — an order of magnitude larger than all existing generating capacity.
- As top automakers struggle to survive or rebuild, and startups nip at their heels, the public-policy landscape is in rapid flux too. Many countries are subsidizing premature scrappage of inefficient old cars to try to stimulate their car industries. The most powerful way to speed superefficient cars from drawing-board to street — "feebates" (p. 38) — was tried in 2008 in France: in the first year, sales of inefficient cars fell 42 percent whilst sales of efficient cars rose 50 percent. In 2009, a feebate bill was introduced in the U.S. Senate.

The automotive revolution now looks like this: Start with a standard car (8 L/100 km or 29 miles per US gallon). Substitute a *Prius*-like hybrid and save half its fuel per km. Next make the car light and slippery, saving half the remaining fuel. Next fuel it with 85 percent sustainably grown ethanol or other biofuel unrelated to the food system, saving three-fourths of the remaining fuel; now you're down to 6 percent of the original fossil fuel per km. Next, make it a plug-in hybrid, using only 3 percent of the original fuel. Finally, if you want to eliminate that 3 percent and perhaps the biofuel, switch to hydrogen or battery-electric cars — both of which, like the plug-in hybrids, can make sense and make money if the car is properly efficient.

OTHER VEHICLES — AND THE JOURNEY BEYOND OIL

The flowering of the design revolution presaged in Chapter 2 goes far beyond cars. In 2002–04, RMI produced a detailed roadmap for getting the United States completely off oil by the 2040s, led by business (www.oilendgame.com). Half the oil could be saved at an average cost of $12 per barrel by redoubling the efficiency of using oil, chiefly through trebled-efficiency cars, heavy lorries, and planes. The other half could be displaced by a mix of saved natural gas and advanced biofuels at an average cost of $18 per barrel. The average cost of getting off oil: $15 per barrel, a fraction of its price.

This comprehensive off-oil strategy could probably be adapted and adopted in any other country too, including the United Kingdom. Indeed, U.S. implementation is already under way (www.rmi.org/rmi/Library/E08-02_GettingOffOilRecentLeaps). Of the six sectors that must be transformed — cars, heavy lorries, planes, fuels, finance, and military — three or four are already at or past their tipping point beyond which effort becomes easier, though there's still much hard work ahead. In 2009, *The Wall Street Journal* reported ExxonMobil's concurrence that U.S. petrol demand was already in long-term decline, and Deutsche Bank forecast world oil demand would peak in 2016, then fall dramatically. Oil might indeed become — as Amory predicted two decades ago — uncompetitive at low prices before it becomes unavailable at high prices.

The Pentagon is now leading the effort within the U.S. government in getting that nation off oil. By valuing saved fuel about 10–100-fold higher than previously, to reflect its huge but previously ignored cost of delivery (measured in both blood and logistical cost), the Pentagon's new policies promise a flood of innovations that will speed civilian vehicles' efficiency gains — much as past military R&D gave us the Internet, GPS, the jet engine, and the microchip (www.rmi.org/rmi/Library/2010-05_DODsEnergyChallenge).

Similarly, Wal-Mart in 2005 demanded doubled-efficiency heavy lorries from its suppliers. Their collaboration will raise the fuel savings in Wal-Mart's fleet — the largest civilian fleet on earth — from the 38 percent achieved through 2008 to 50 percent by 2015. Wal-Mart's immense "demand pull" will make those doubled-efficiency lorries available to all companies in the market, a potential saving of 6 percent of U.S. oil. RMI has shown that lorry efficiency can even be trebled.

One of the most dramatic shifts has been in airplanes. Boeing was slipping behind Airbus in 2004, but then announced the *787 Dreamliner* — a midsized plane that integrates ultralighting (it's half carbon-fiber composites by weight), better engines and aerodynamics, and other innovations to save 20 percent of the fuel at no additional cost. Despite production delays, it's sold out into 2018 with 866 firm orders, the fastest order takeoff of any jet in history. Boeing is turning that efficiency leapfrog into a breakthrough competitive strategy by rolling the 787's suite of innovations into every plane it makes, before Airbus can correct its current problems. Boeing's innovations have transformed the aviation sector, reminding us that transformation not incrementalism is the low-risk strategy. Now Ford Motor Company, which in 2006 hired Boeing Commercial Airplanes' chief executive as its own, seems to be emulating Boeing's strategy much as *Winning the Oil Endgame* had suggested: It's pulling ahead of the failed GM and Chrysler and leading innovation in lightweighting and electric traction.

These shifts are facilitated by a new political truth. Whether one is most concerned about prosperity and jobs, or about national security, or about climate and environment, one should do exactly the same things about energy and many other issues. Thus focusing on the attributes and outcomes of our actions, not the motives behind them, offers scope for building consensus, no matter how fractured the polity.

TWO ELECTRICITY REVOLUTIONS

A transformation is now under way in electricity, the other big part of the climate problem. (Burning oil and making electricity respectively account for about 43 percent and 41 percent of U.S. carbon released by burning fossil fuel; the latter figure is about 30 percent in the United Kingdom.) This plus the journey beyond oil combine to create what Rocky Mountain Institute calls its strategic focus — "Reinventing Fire." The electricity part looks a bit harder but not as hard as one might have thought, thanks to two distinct but mutually reinforcing electricity revolutions now in rapid progress.

The first revolution is in how much work we wring from each kilowatt-hour. New technologies for end-use efficiency are better and cheaper than they were a decade ago and are improving with innovation and scale: They progress faster than we apply them, so the

"negawatt" (saved-electricity) resource becomes ever bigger and cheaper, especially when combined with the integrative design techniques mentioned earlier.

The negawatt revolution is only dimly reflected in current government and academic analyses, so policymakers continue to suppose that saving electricity will do less, take longer, and cost more than it will actually do. But some electricity providers are starting to realize that they can turn efficiency into a business opportunity. Customers are figuring out that they can save electricity far more cheaply than they can buy it. The only question is from whom they will buy the efficiency. The main obstacle is that a European Union policy, modeled on Britain's, rewards utilities for selling more energy and penalizes them for cutting your bill. About 48 of the 50 United States had such a policy too, but half of them have lately adopted or are considering a reform that instead aligns electricity providers' with customers' incentives, so they're both better off doing the cheapest thing first — typically efficiency not supply. So long as the United Kingdom and EU lag behind in this reform, their efficiency and hence their competitiveness will continue to suffer.

A more visible revolution, in which countries like Germany, Spain, and China lead and the United States and United Kingdom must struggle to catch up, is in how electricity is produced. For decades Amory was heavily criticized for suggesting that power plants would stop getting bigger and start getting smaller, but the logic was clear. For the first century of the electricity industry, power stations were cheaper and more reliable than the grid, so it made sense to build many power stations and let them back each other up through the grid. Yet in the past few decades, power stations quietly because cheaper and more reliable than the grid, so 98 or 99 percent of U.S. power failures now originate *in* the grid. To make power reliable and affordable, therefore, it should now be produced at or near the users.

At the same time, conventional steam-raising power stations ran out of economies of scale. Smaller units offered greater economies through mass production than big units through size. Further, investors have begun to realize that small, fast, modular units carry less financial risk than big, slow, lumpy ones (www.smallisprofitable.org). Security experts have found the grid alarmingly vulnerable to physical or cyber disruption. In the United States the Pentagon's Defense Science Board has advised all military bases to make their own power

on-site (preferably from renewables) in a way that can run gracefully without the grid. Thus as with getting off oil, economic and security imperatives are driving new choices faster than environmental needs alone could do.

Decentralized, often renewable, generators have begun to gain the technical maturity and production scale that makes them serious competitors. The supposed obstacle of their variability (the sun doesn't always shine and the wind doesn't always blow) dissolved under closer scrutiny: every kind of electricity generator is variable or intermittent to some degree, differing only in how massively, how often, how long, how predictably, and for what reasons they fail. As grids in Europe and elsewhere gain experience (four German states and parts of Spain and Denmark are already about 30 to 47 percent windpowered on an annual basis — over 100 percent at windy times), we're discovering that a mostly- or all-renewable grid may need less storage and backup than has already been installed to cope with the intermittence of large thermal stations. Ireland, a small and isolated grid, plans to get 40 percent of its electricity from renewables (chiefly wind) by 2020 and an impressive 100 percent by 2035. The Danish utility Dong, now about 85 percent fossil-fueled (mainly coal) and 15 percent renewable, plans to reverse that ratio within a generation.

These convergent forces have transformed micropower — *The Economist*'s term for renewables (other than big hydro dams) plus combined heat and power — from a boutique offering into a powerful force sweeping the global power marketplace. By 2006, micropower was producing one-sixth of the world's total electricity (slightly more than nuclear power), one-third of the new electricity, and from one-sixth to more than half of all electricity in a dozen industrial countries, not including the badly lagging United Kingdom or United States. Consider these data points:

- In 2006, nuclear power worldwide added 1.44 billion watts (about one big reactor's worth) of capacity — more than all of it from uprating old units, since retirements exceeded additions. But photovoltaics (solar cells) added more capacity than that in 2006; windpower, ten times more; micropower, 30–41 times more. Micropower plus negawatts probably provided over half the world's new electrical services.
- In 2007, the U.S., Spain, and China each added more wind capacity than the world added nuclear capacity, and the U.S. added more wind capacity than it added coal-fired capacity during 2003–07 combined.

- In 2008, China doubled its windpower installations for the fourth year in a row and looked set to beat its 2020 windpower target in 2010. Windpower pulled ahead of gas-fired capacity additions for the first year in the United States and the second year in the EU. For the first time in the nuclear era, no new nuclear plants came online worldwide: Nuclear net capacity decreased by 1.6 billion watts, nuclear output fell, and nuclear power continued to be unable to attract equity investment (it's bought only in centrally planned systems). Meanwhile, micropower worldwide added 40 billion watts and got $100 billion of new investment. That plus another ~$40 billion for big hydro dams brought renewable power production, for the first time in about a century, more total investment than the $110 billion put into fossil-fueled stations.

Many, even most, new generating units in market economies where private investors not governments make such choices have already shifted from the million-kilowatt scale of the 1980s to the hundred-fold-smaller scale that prevailed in the 1940s. Even more radical decentralization, even to customers' kilowatt scale (prevalent up to the 1920s), is emerging and may prove still more beneficial, especially if its control intelligence becomes distributed too.

The electricity revolution is of course good news for climate protection, because micropower and negawatts now offer the world's most realistic, prompt, and affordable climate solutions. The actual price of new U.S. windpower, for example, is about one-third that of new nuclear power or half that of new coal power (if carbon isn't priced). Virtually everyone now agrees that climate change is a serious problem, so the world obviously needs the most solution per £, €, $, ¥, or RMB, and also the most solution per year. New nuclear power is a counterproductive way to protect the climate: Based on observed market performance, it saves about 2–20 times less carbon per unit of investment, roughly 20–40 times slower, than investing in micropower or negawatts would do.

The British government's latest attempt to re-nuclearize by outsourcing the supply and financing to the French government and (of necessity, as will become apparent) also adopting French siting and transparency policies, is likely in due course to meet with the same financial, economic, political, and logistical failure as its previous nuclear revival efforts. Perhaps the October 2009 revelation that French reactor-building, after factoring out inflation, got 3.5-fold costlier per kilowatt during 1970–2000 (www.iiasa.ac.at/Admin/PUB/Documents/IR-09-036.pdf) might spur reflection. The power of governments is great to block competitors and coddle favorites, but ultimately, the best buys do tend to win.

MUCH MORE TO DO

Energy supply and demand have progressed enormously since we wrote this book a decade ago. More quietly, so too have manufacturing, water, agriculture, and forestry. To be sure, what H. G. Wells called the "race between education and catastrophe" continues. Fisheries continue to collapse round the world even as effective ways are found to protect them and even bring some back from the brink. Deforestation rampages even as a few logged-and-burned rainforests are rapidly and successfully restored to ecological and economic health (an astonishing new development nobody knew was possible). Water continues to be squandered and wasteful projects built even as ever greater opportunities to save it are discovered: even small savings in the efficiency of retaining rainwater, so it soaks into the soil, can outweigh large savings in the efficiency of using water already captured in pipes. Green buildings, once an oddity, are now the market norm in many places and are gaining ground rapidly in such huge markets as China and India, simply because they provide superior value. And in the United States in 2006, leaders of the building and design communities adopted the 2030 Challenge to cut greenhouse gas emissions from new buildings by 50 percent immediately, rising steadily to 100 percent by 2030. By 2009, who do you suppose had a group figuring out how to build zero-net-energy or energy-positive buildings for the military? It was the U.S. Army Corps of Engineers.

We are impressed with the potential that the baton of climate leadership may be passing to China, driven by many motives including strong economic self-interest. Three years ago Amory startled the Chinese delegation to a China–U.S. climate summit by addressing them on these lines:

> Your society has five millennia more experience than mine. Your country has five times as many brains as mine, quite possibly better ones. About 90 percent of the technologies that underlay the Western industrial revolution were invented in China. Your country is the only one that has cut its energy intensity more than 5 percent a year for a quarter-century [through 2001, then lately resuming]. Your country is the only one to have made energy efficiency its top strategic priority for national development. You have better car-efficiency and renewable-energy standards than we do. Your country is #1 in three renewable energy technologies, #2 or #3 in all the rest, and aims soon to be #1 in all of them [five by the end