

Mrs. C. Edwin Carlson, National Chairman

REAL Security

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*The Lovinses, a physicist and a lawyer respectively, are consultants active in energy policy in over 15 countries; authors of a dozen books; and principals of Rocky Mountain Institute (Drawer 248, Old Snowmass, Colorado 81654), a new nonprofit foundation exploring links between energy, agriculture, security, and economics. This article is based on their book *Brittle Power: Energy Strategy for National Security*, published in 1982 by Brick House (Andover, Mass.) with a Foreword by Adm. Thomas H. Moorer, former Chairman of the Joint Chiefs of Staff, and Hon. R. James Woolsey, former Undersecretary of the Navy. *Brittle Power* is based on the Lovinses' 1981 analysis commissioned by the civil-defense arm of the Pentagon: It is rich in technical detail, and cites more than 1200 references, but is easily understandable by the general reader.*

America's security faces many serious threats. Strategic planners, however, have tended to focus almost exclusively on the military threat. They have largely ignored equally grave vulnerabilities in America's life-support systems. Such vital services as energy, water, food, data processing, and telecommunications are very easy to disrupt. Their failure would leave our Nation helpless.

A handful of people, for example, could turn off three-quarters of the oil and gas supplies to the eastern States, for upwards of a year, in one evening's work without leaving Louisiana. A few people could black out a city, a region, or even the whole country for months—perhaps for years. Attacks on certain natural-gas systems could incinerate a city. Sabotage of a nuclear facility could make vast areas uninhabitable. All these could be accomplished by simple, low-technology attacks. And because terrorist attacks on the energy system are so devastating—yet cheap, safe, deniable, and even anonymous—they may become the most attractive form of military attack (as Libya and other countries have already threatened). Yet a free society has no direct means of defense against such surrogate warfare.

In 1979, the Defense Civil Preparedness Agency commissioned us to survey the vulnerabilities of the U. S. energy system, and what could be done about them. We were shocked to find how far

misapplied technology had already jeopardized national security. In effect, Federal energy policy was undermining the mission of our Armed Forces. Nor has this improved. Present policy subsidizes the most vulnerable energy technologies, to the tune of more than \$10 billion per year. Thus it is our own Government which is making our Nation's energy supplies ever easier to turn off.

America's energy vulnerability comes from excessive centralization and complexity. Most of our energy now comes from dense clusters of billion-dollar devices which take a decade to build. Most are computer-controlled with split-second timing. They deliver power or fuel over distances of hundreds or even thousands of miles, through networks that are elaborate, inflexible, tightly coupled, and hooked up so that they cannot work without each other. Electric grids depend on many large, precise machines rotating in exact synchrony, strung together by a continental web of frail aerial arteries. Without this synchrony, the grid cascades towards collapse. Gas grids, too, collapse if their pressure is not continuously maintained. Spare parts for the complex machines are often special-order items which cost too much to stockpile, yet take months or years (and unique, scarce skills) to make and install.

It would be hard to devise a better re-

cipe for easy disruption; massive, catastrophic failures; and slow, difficult recovery. But the stakes are high. The most obvious risks are to our lives and liberties. A well-planned attack on the energy system could cause abrupt lurches backwards, by decades if not centuries, in our economic progress and standard of living. Energy vulnerability has also allowed a major shift in the power balance between large and small groups in society. This, in turn, threatens to erode the freedoms and the trust which underpin Constitutional government.

These risks are frighteningly real: so real that we deeply questioned whether they should be publicly exposed. Might it not be better to hope that they will pass unnoticed? However, it is already too late for that. Incidents ranging from the New York City blackout to the recent bomb-extortion incident at the giant Baytown petrochemical plant are part of a larger pattern of technical accidents, natural disasters, and deliberate attacks on energy systems around the world. *Brittle Power* documents such attacks in 26 of the United States and in 40 foreign countries. These attacks are now occurring about once every ten days (especially in campaigns by Soviet-trained guerrillas). They are becoming more frequent, intense, and sophisticated. The United States has so far been very lucky.

Yet, leading experts on world terrorism doubt this luck will hold.

In outlining these vulnerabilities, we took great care. We subjected the manuscript to thorough internal and peer review, and to formal government classification review, to be sure we were not providing a cookbook for the malicious. Yet we felt that the only thing more dangerous than publicly discussing America's energy vulnerabilities was *not* discussing them; for if vulnerability is allowed to increase while remedies languish unused, only the enemies of freedom will benefit. The antidote is informed public participation in building a genuinely secure Nation.

Currently, however, Federal policies are systematically making the energy system *more* vulnerable. The devices being promoted as the backbone of America's energy supply for the 21st Century are precisely the most vulnerable ones: offshore and Arctic oil and gas, big pipelines, and huge power plants (especially nuclear ones) linked by long transmission lines. Twenty billion dollars in subsidies are being offered to build uncompetitive synthetic-fuel plants—a technology so fragile that both times it has been tried (in Nazi Germany and contemporary South Africa) the plants were promptly and successfully blown up.

These policies of Strength Through Exhaustion are said to be driven by the need to stop importing oil. To be sure, that *is* an urgent problem. One saboteur in a dinghy could cut off 85% of Saudi Arabia's exports for three years or more (the time needed to manufacture some key parts of the oil terminals), then repeat the attack. But we have the means to solve the problem of imported oil. Technologies now exist to make cars and buildings far more efficient. Just those two measures could save more than enough energy to eliminate U. S. oil imports within this decade. This is faster than a power plant or synfuel plant commissioned now could deliver any energy whatever. An energy-saving program, too, would cost only a tenth of the money required to build the power or synfuel plants. But reducing oil imports—now less than 10% of America's energy—wouldn't buy much security if our domestic energy supplies remained highly vulnerable.

Such "solutions" as the Strategic Petroleum Reserve may offer a false sense of security, but actually are part of the problem. One person in three nights could knock out the three pipelines

needed to deliver the Reserve's oil to refineries. The loss of three of the biggest domestic pipelines could indeed be more serious than a complete cutoff of oil imports. Winter damage to the Trans-Alaska Pipeline (it has already been lightly bombed twice) could even turn it into the world's largest Chapstick™ as 800 miles of hot oil congealed inside.

The general public, however, isn't yet aware of how fragile our energy supplies have become. True, a relay failure in Oregon can cause blackouts in Arizona (as occurred in 1981). In 1978, local facilities of American utilities were being bombed every twelve days. In a single week in late 1982, oil depots in Venezuela and Kenya went up in smoke, a nuclear plant under construction in South Africa suffered four bomb blasts, and saboteurs blacked out eastern El Salvador again. But because everyday American energy supplies are ordinarily so reliable—a great tribute to the industry's skill and dedication—we tend to assume that the experts have everything under control.

Unfortunately, modern energy systems are so complex that nobody can predict how they might fail, even accidentally. Worse still, designing them to be reliable in the face of predictable kinds of technical failures does not provide, and may even reduce, an even more vital quality—resilience in the face of *incalculable* failures (such as sabotage). Few energy engineers today have this quality in mind. They therefore design centralized, monolithic systems which don't fail often (at least without help), but when they do fail, they fail big.

Someone who hasn't read *Brittle Power's* hundreds of examples of actual failures could be excused for supposing that "it can't happen here"—just as regional power failures seemed implausible until 1965, or the hijacking of three jumbo jets in a day until 1970, or the takeover of more than 50 embassies until the 1970s, or the aerial bombing of a nuclear reactor until 1981. But given the stakes, no one would want to be in the position of the British intelligence officer who, on retiring in 1950 after 47 years' service, reminisced: "Year after year the worriers and fretters would come to me with awful predictions of the outbreak of war. I denied it each time. I was only wrong twice."

How, then, can the American energy system evolve toward greater resilience rather than less? How can we prepare for a surprise-full future—one that may hold increasing uncertainty, unrest, and even

violence? The answer may be found by examining many kinds of engineering—and above all biology, with its billions of years' experience in coping with surprises—to see how systems can be designed for inherent resilience. Our research yielded 20-odd design principles which could be applied to the energy system so as to make major failures of energy supply *impossible*.

Such a system would be far more efficient, diverse, dispersed, and renewable than today's. It would, indeed, closely resemble the recommendations of the DAR-sponsored school program *Streamline America*. The things we should do to save energy and money also turn out to be virtually the same as those needed for real energy security.

The most resilience per dollar invested—the "most bounce per buck"—comes from using energy very efficiently. Wringing more work from our energy can not only eliminate dependence on the most vulnerable sources (such as oil from the Persian Gulf), but can also make failures of other sources milder, slower, more graceful, and easier to fix.

For example, suppose you live in a superinsulated house in Minnesota. If the heating system fails in midwinter, you won't know it for weeks. The clue will be a slow drop in indoor temperature, from 72° to at worst 55°—but no lower, because of the heat from windows, people, lights, and appliances, so neither you nor your pipes will freeze. If a few neighbors come in to take refuge from their sieve-like house, their body heat will restore your house to 72°. A few extra children will make it overheat if you don't open the windows. Alternatively, any little source of heat will heat your whole house evenly—like burning junk mail in a #10 can. (The house we are now building in the Colorado Rockies won't even need a heating system in the first place.)

Suppose we had a car fleet getting 65 miles per gallon (15 worse than the "city" rating of an advanced Rabbit™ prototype tested two years ago). The half-full gas tanks of such cars would run them for a month without filling up at all. The oil "in the pipeline" between well-head and gas-pump would run the whole fleet for about a year—whereas now, if the pipeline feeding a refinery is cut, it must shut down in a few *days*. Thus using energy more efficiently uses up stocks more slowly, and buys precious time to fix what's broken or to improvise new supplies.

Another key to resilience is gradually to replace centralized energy sources with many dispersed ones, richly interconnected—the strategy of a tree which has many leaves, each with many veins, so that insects' random nibbles won't disrupt the vital flow of nutrients. The value of such dispersion was re-proven in the Northeast Blackout of 1965, when the power engineer in Holyoke, Massachusetts was able to unhook the city from the collapsing grid and hook up instead to a local gas turbine. The money saved by not having to black out Holyoke paid off the cost of building that power plant in four hours.

Renewable energy sources can enjoy the benefits of interconnection when you wish but can also stand alone when you need to. Thus, Department of Energy officials in 1980 had just cut the ribbon on a West Chicago gas station, powered by solar cells, when a thunderstorm blacked out the city. That was the only station pumping gas that afternoon. Likewise, a Great Plains farmer who uses windpower recently saw on the TV evening news a report that his whole area was blacked out. He went outside and looked. Sure enough, all his neighbors' lights were off. So he came back in and watched his wind-powered TV some more to see when his neighbors' lights would come back on.

Many people would like to be in that position. Rapidly emerging technologies now make this not only possible but a way to save money too. By a happy coincidence, the efficiency gains and the many kinds of renewable energy sources which, together, are enough to meet essentially all the long-term needs of an advanced industrial economy are also the cheapest energy options. Thus the "insurance premium" we must pay for energy security actually *pays us back*. A "least-cost energy strategy" combining efficiency with appropriate renewable sources (as the Harvard Business School's energy study recommended) could save Americans more than two trillion dollars in the next two decades, provide more than a million new jobs, and solve many environmental and social problems. Indeed, such economically efficient investment is the only way we will be able to maintain a dynamic economy.

Many careful, up-to-date analyses confirm that efficiency and renewables can already provide more energy, faster, cheaper, than additional centralized, vulnerable sources. (Well-designed renewables are also more reliable, despite

fluctuations with time and weather: one can predict sun, wind, and rain better than one can predict terrorism, reactor accidents, or Saudi politics.)

This theoretical finding is being confirmed by actions in the marketplace. Just in 1980, Americans invested about \$15 billion in efficiency and renewables. Since 1979, the United States has gotten more than a hundred times as much new energy from savings as from all expansions of supply combined. That is, weatherization, plugging steam leaks, buying more efficient cars, and millions of other individual decisions in the market have outpaced by better than a hundred to one all of the new oil and gas wells, coal mines, and power plants built in the same period—even though the centralized technologies got about six times as much investment and ten to twenty times as much government subsidy.

Moreover, the U. S. since 1979 has gotten more new energy from sun, wind, water, and wood than from oil, gas, coal, and uranium, or any of them. Thus renewable energy is already over 7% of our total supplies, and the fastest-growing part. America will soon have its millionth solar building. Woodburning in homes and factories, developed mainly in the past five years with no subsidies, now delivers about twice as much energy as nuclear power, which had a head start of 30 years and \$40 billion in Federal subsidies. Since 1979, more new megawatts of generating capacity have been ordered from small hydroelectric plants and windpower than from coal or nuclear plants or both. A quiet energy revolution, all but unnoticed, is well underway.

In short, the problem of secure and affordable energy supplies is being solved—but from the bottom up, not from the top down. Washington will be the last to know. The solutions that individuals are finding (with important help from the innovative community programs described in *Brittle Power*) don't need and probably can't even tolerate the mandates of Soviet-style central planning. They rely instead on a truth familiar to both Jeffersonians and free-marketters: that most people are pretty smart and, given incentive and opportunity, can go a long way towards solving their own problems. Best-buy, accessible energy investments can simultaneously enhance America's military preparedness and protect the individual choice and civil liberties that are central to the vision of our Republic. Thus a decentralized process, based on accessible

tools as simple as the caulking gun, can—given a few decades' steady implementation—remove a major threat to national security.

Thoughtful military leaders know from the lessons of history that such a process is vital to the Nation. Goering and Speer remarked after World War II that the Allies could have saved two years by bombing Nazi power stations early. (Japan, in contrast, got 78% of its electricity from decentralized small-hydro dams, which were so nearly invulnerable that they sustained only 0.3% of the bombing damage. The central power plants, with only 22% of the output, suffered 99.7% of the damage.) The near-total accidental blackouts of France (1978), Israel (1979), and southern Britain (1981) underscored the danger of overdependence on centralized power grids. Such thinking has already led Sweden, Israel, and China to base much of their preparedness planning on energy decentralization. Indeed, the Red Army reportedly wants to decentralize the Soviet energy system (which is even more centralized than ours) as a national security measure—but the Politburo forbids this because it would reduce the Communist Party's political control!

The importance of energy resilience to national security may hold wider lessons. First, focusing exclusively on centralized military planning to counter overt military threats may build costly Maginot Lines while the back door stands ajar. Indeed, there are many back doors: energy is not the only hidden vulnerability of our interdependent industrial society. The average molecule of food is shipped some 1300 miles before an American eats it. Drop a few bridges across the Mississippi and Easterners will soon starve. New York City's water arrives via two antique tunnels, each too small to permit either to be shut down for inspection or repair. A smart computer criminal could probably crash the whole financial system. There are doubtless other key vulnerabilities not yet discovered, and someone had better start finding out how to reduce them.

Second, better security may not cost more money. At least in the case of energy—and probably of water, food, and data processing too—real security is the best buy. It is what a genuinely free market would produce if we had one.

Third, better security doesn't necessarily come from Washington. It may indeed come best from the village square or the block association, rather as the Founding Fathers envisioned the local

militia. The parable of energy security reminds us that real security in its widest sense begins at home. It includes a reliable and affordable supply of energy, water, and food; a healthful environment; a vibrant and sustainable system of production; a legitimate system of self-government; and a polity that preserves and refines our most cherished values. Most people who thus enjoy "Life, Liberty, and the Pursuit of Happiness" will simply want to be left alone to enjoy them—not to fight anyone else. But such assets can only be safeguarded by protecting our neighbors' similar assets lest, deprived, they seek to take what we have. Perhaps real security, then, comes not from reducing our neighbors' security but from increasing it, whether on the scale of the village or the globe.

Untold treasure has been devoted to a different theory of providing strategic security, by the actions of a central government and the greatest concentration of technical genius the world has ever known. This effort is currently costing our Nation more than ten thousand dollars a second. Yet in 1944 the United States was militarily invulnerable, while today, thirty thousand nuclear bombs later, it lies entirely exposed to devastation. Those bombs are said to have deterred nuclear attack, and perhaps they

have so far. Yet in an era when the explosive power of a World War II can be packaged to fit neatly under your bed, bombs can arrive not only by missiles (whose radar tracks mark their origin for retaliation) but also by Liberian freighter, rental van, or United Parcel Service. If Washington disappeared in a bright flash tomorrow morning, but nobody said, "We did it," against whom are our strategic forces to retaliate? Anonymous attacks, whether nuclear or via a vulnerable energy system, cannot be deterred.

Whatever military might has accomplished, then, it has not yet made us truly secure. Perhaps it never will. The roots of real security go deeper; they need greater nourishment than armies and missiles alone. One vital element of defense, for example, is a political system so firmly based on shared and durable values that it can never be subverted or taken over. Some Scandinavian strategists even suggest that military security comes foremost from organizing on such patriotic foundations a standing Resistance that will make one's national territory impossibly disagreeable for anyone else to occupy.

The nuclear threat *is* terribly important. So is countering it as best we can (since it cannot really be defended against). But the complexities of that

task must not obscure our understanding of our Nation's basic strategic assets. These include a geography that shields us against physical invasion from overseas; a freedom of expression that shields us from ideological invasion by exposing concepts to the critical scrutiny of an informed public; an ecosystem much of whose once unique fertility can still be rescued from degradation; a diverse, ingenious, and independent people; and a richly inspiring body of political and spiritual values. To mature within these outward strengths—strengths more fundamental and lasting than any inventory of weaponry—will require us to remain inwardly strong, confident in our lives and liberties no matter what surprises may occur. This in turn will demand, in the spirit of our political traditions, a continuing American Revolution which expresses in works a sincere faith in individual and community effort. It was that faith which inspired our Republic, long before strategists became preoccupied with the narrower and more evanescent kinds of security that only a faraway government could provide. It is that faith today, the very marrow of our political system, which alone can give us *real* security.

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The National Society Regrets to Report the Death of:

DOROTHY BERRYMAN SHREWDER (MRS. ROY V.) on May 12, 1982 in Ashland, Kansas. Mrs. Shrewder served as State Vice Regent of Kansas 1940-44, as State Regent 1944-48 and as Vice President General 1954-57. She was a member of the Fort Supply Trail Chapter.

VIVIAN I. TORKELSON (MRS. ALEXANDER) on November 1, 1982 in Glasgow, Montana. A member of the Milk River Chapter, Mrs. Torkelson served as Montana State Regent 1966-68.

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