EXCERPT FROM

IN SEARCH OF ENVIRONMENTAL EXCELLENCE

MOVING BEYOND BLAME

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FOREWORD BY JEAN-MICHEL COUSTEAU

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EXCERPT—CHAPTER THREE

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Chapter 3

A Global Greenhouse: Framing the Debate

A person would be an economic fool to put money into a redwood seedling when so many more profitable opportunities are at hand.

—Garrett Hardin,
Professor of Ecology, University of California–Santa Barbara

Six of the hottest years on record occurred in the 1980s.

As much energy leaks through American windows every year as flows through the Alaskan pipeline.

Tropical rain forests the size of the city of Philadelphia disappear every week.

These facts are linked by a common thread: global warming.[1] This issue has captured the attention of government, industry, and private citizens alike, for the threat appears as dire and dramatic as the warnings of the Old Testament prophets. The record heat and drought of 1988 was the critical turning point in capturing the general public's attention; it forced some business leaders to recognize that the industrial world's long-standing dependence on fossil fuels and the consequent production of carbon dioxide, are changing the world's ability to regulate temperatures and sustain life. Industrial activity is indeed altering the face of the earth in ways far more consequential than most radical environmentalists dreamt possible in the 1960s and 1970s.[2]

The National Academy of Sciences in 1979 estimated that a doubling of carbon dioxide concentrations above preindustrial levels would raise the earth's temperature between 2.1° and 8.1° F.[3] Within

six years of this prediction, three major worldwide associations of scientists reconfirmed the seriousness of these estimates, including the International Council of Scientific Unions, the United Nations Environmental Program, and the prestigious World Meteorological Organization.

These groups all cautioned that such increases in temperature would alter the global availability of water, which could cause widespread disruptions along coastal shorelines and in international agricultural yields. The Environmental Protection Agency further cautions that if present trends continue, the climate may change as fast in the next century as it has over the eighteen thousand years since the last ice age. Here in the United States, global warming could drastically change lives, transforming lush fields of grain into deserts while causing widespread flooding elsewhere. America, and the rest of the world, may be forced by these changes to spawn a revolution in energy generation and consumption, as well as in product design and manufacturing.

The global-warming crisis underscores the delicate balance that exists between industrial growth and environmental health. In order for society to be sustained, significant reductions in emissions of greenhouse gases—primarily carbon dioxide (CO_2) but also chlorofluorocarbons (CFCs) and methane—must occur. The least disruptive way to do this is through greater energy efficiency.

If we don't respond, what might tomorrow feel like? The answer lies in any greenhouse when all of its windows and vents are shut. Transparent windows allow the sun's rays to enter and warm the surroundings, but do not allow the hot air to escape. (Heat is a form of infrared radiation, invisible but felt by the skin. The same window that lets visible light enter, also prevents infrared radiation from escaping. Thus, the temperature rises.) The earth's atmosphere is similar to that of a greenhouse. The atmosphere allows visible light to enter, but blocks infrared rays. Overall, this is beneficial: gases and vapors surround the earth like a blanket, maintaining a warm, inviting atmosphere in which life can flourish. This blanket separates the earth from its cold, empty surroundings. Without a greenhouse blanket, the surface of the earth would be 70° F colder, and the oceans would freeze.

The new problem is "runaway greenhouse," a kind of smothering in our own blanket. A trend toward warming on a worldwide basis cannot easily be halted once it has started. To reverse this is as difficult as warming an ocean, or changing a season. We can only slow the trend down, and hope that the earth's plants and animals adapt to such temperature changes on a grand but gradual basis. This, without a doubt, will demand massive changes in the daily life of humankind.

War Without Borders

In Shakespeare's *Macbeth*, the witches claim that Macbeth's ambitions and pride will continue to rule until the forests move. Macbeth's downfall occurs when an approaching army cuts down the trees of a nearby forest and, using them as camouflage, moves the forest closer and closer to Macbeth's castle. They take the arrogant Macbeth by surprise when they emerge to strike from close range.

In a sense, the modern industrial world has been reliving Macbeth's tragic blindness. Forests are moving. A recent EPA report on global warming shows how this accelerated relocation of resources does not respect man-made political boundaries or ambitions.

After the last ice age, oak trees migrated northward from the southeastern United States as glaciers receded. Temperatures rose slowly enough that forests could adapt to climate changes (forests in these regions have historically moved only sixty miles in a century). The EPA warns, however, that hemlock and sugar maple ranges could move as much as four hundred miles north by the year 2050, most likely causing these classic trees to be pushed to near-extinction in the United States. The financial effects of this forecast are critical: many agricultural and forest products of America's fertile crescent—the Great Plains corridor—may move north to Canada, perhaps carrying billions of dollars in economic dislocation with it.

In California, the sea-level rise induced by high temperatures and melting glaciers would flood much of the Central Valley. Thousands of acres of the world's most prized farmland would be reduced to nonproductive shallow ponds and spillways. The increased salinity of the water would greatly reduce the populations of magnificent white

egrets, trumpeter swans, and great blue herons, which depend on freshwater marshes. Regional harvests of crops such as sugar beets and corn, according to EPA models, could be reduced by twenty to forty percent.

Global warming's worsening of air quality would be dramatic. Ozone levels in the San Francisco Bay would triple those of today, which are already in excess of EPA standards.

In Greater Miami, climate change could require at least a half-billion-dollar investment for retrofits and dikes to protect the area's freshwater drinking supplies, roads, airports, and waste-treatment systems from the potential sea rise. The nearby Everglades National Park would be severely threatened, also.

Global warming would aggravate existing beach erosion in Florida and throughout the East Coast. The U.S. Army Corps of Engineers already considers two thousand miles of beach to be in critical condition, at a time when half of the ten thousand miles of shoreline in the lower forty-eight states is under some sort of proposed development. These shoreline investments may suffer serious declines in value if global warming strips away our beaches.[4]

In the Tennessee Valley and lands located within the river basins of the Chattahoochee and Apalachicola rivers, the EPA predicts that between ten and fifty percent of agricultural acreage could become unusable. In many cases, such declines will create economic dislocation in already depressed areas. In the Southeast, for instance, which presently supplies roughly half of America s softwood and hardwood, significant dieback in timber could occur as early as 2020, wrecking local economies.

Studies also note a likely increase in U.S. human mortality. The cities most affected would be New York City, Chicago, and Philadelphia. The EPA global-warming report states: "In the absence of any acclimatization, total summertime mortality in the United States under conditions of doubled carbon dioxide is estimated to rise from an estimated current 1,156 deaths to 7,402 deaths, with deaths in the elderly (aged 65 or over) subset contributing about 70 percent of each figure (727 and 4,605 respectively). Currently, the percentage of elderly in the U.S. is increasing. Thus, the number of mortalities estimated to result from climate change may be larger."[5]

COST OF PLACING SAND ON U.S. RECREATIONAL BEACHES AND COASTAL BARRIER ISLANDS AND SPITS (IN MILLIONS OF DOLLARS)

	Sea Level Rise by 2100			
State	Baseline	50 cm	100 cm	200 cm
Maine	22.8	119.4	216.8	412.2
New Hampshire	8.1	38.9	73.4	142.0
Massachusetts	168.4	489.5	841.6	1545.8
Rhode Island	16.3	92.0	160.6	298.2
Connecticut	101.7	516.4	944.1	1799.5
New York	143.6	769.6	1373.6	2581.4
New Jersey	157.6	902.1	1733.3	3492.5
Delaware	4.8	33.6	71.1	161.8
Maryland	5.7	34.5	83.3	212.8
Virginia	30.4	200.8	386.5	798.0
North Carolina	137.4	655.7	1271.2	3240.4
South Carolina	183.5	1157.9	2147.7	4347.7
Georgia	25.9	153.6	262.6	640.3
Florida (Atlantic coast)	120.1	786.6	1791.0	7745.5
Florida (Gulf coast)	149.4	904.3	1688.4	4091.6
Alabama	11.0	59.0	105.3	259.6
Mississippi	13.4	71.9	128.3	369.5
Louisiana	1955.8	2623.1	3492.7	5231.7
Texas	349.6	4188.3	8489.7	17608.3
California	35.7	174.1	324.3	625.7
Oregon	21.9	60.5	152.5	336.3
Washington	51.6	143.0	360.1	794.4
Hawaii	73.5	337.6	646.9	1267.5
Nation	3788.0	14512.0	26745.0	58002.0

Source: Leatherman for U.S. Environmental Protection Agency

The sensible response to the challenge is clear. To avoid the losses, America must get off its petrochemical treadmill.[6] This means less oil, less coal, less waste.

Perhaps one of the most dramatic symbols of human arrogance toward the world's resources and a modern nation's need for energy security is Exxon's Epcot Pavilion in Orlando, Florida. A favorite tourist attraction for millions of people all over the world, Exxon's impressive display actually damns the human race.

Tourists are channeled into carriages "driven through time," starting with panoramic views of our favorite family dinosaurs. To add authenticity, visitors are informed that the smell of the prehistoric swamp that pervades the setting is a petrochemical developed by Exxon and manufactured exclusively for this special effect. The plants and dinosaurs, over time, decayed into the oil and coal that are the resources Exxon now utilizes.

As the visitors are shuffled along, they see a tiger—the corporate icon of Exxon—spinning the world by its paw. The subliminal message of the show, *The Universe of Energy*, is that through its clever capture of fossil fuels, Exxon has placed itself above the world. The cynical message of the program is underlined by the firm's breezy appropriation of nonpetrochemical-based fuels. The millions of tourists who view the slick presentation are told that they have been conveyed through this history of hydrocarbons by solar-powered carriages. Ironically, Exxon was the first oil company to abandon solar research in 1982.

Exxon has captured the history of the world as seen through a hydrocarbon lens, a narrow view that needs to be reexamined. Recent estimates show that global warming will not be stabilized until the year 2050, and that even this stabilization will require a fifty-percent reduction in current fossil fuel use.

A more familiar reminder of what we can no longer afford is Exxon's *Valdez* oil spill off the once-pristine Alaskan coast. This event dramatizes the blind trust in nature which still guides energy policies. Whether or not Joe Hazelwood, captain of the *Valdez*, was drunk when his ship crashed into Bligh Reef is not the real issue. The real issue is affordability.

On Friday, March 24, 1989, only four minutes after midnight, the Exxon *Valdez*, having strayed a mile and a half off course, ground

its solid bottom over jagged rocks, and ripped multiple holes in its hull. Over 11 million gallons of crude hit the scenic Prince William Sound, just below Valdez, Alaska. This event continues to exact a toll from all of us. Twenty thousand birds—from thirty different species—were lost, including many of the once-familiar yellow-billed loons, which turned nightmarishly black. At least seven hundred Pacific sea otters and dozens of bald eagles also perished. Some wildlife biologists claim the actual fatality numbers may be five times higher. To say that ninety percent of the Kenai Fjords National Park Shoreland has been hit is only to recite a number; the true cost can only be appreciated when one sees the damage along the 240-mile coastline.

Captain Joseph Hazelwood's career has been marked by a stubborn streak which echoes the world's faith in fossil fuels. In his college yearbook he inscribed the motto: "It can't happen to me." This statement sums up the blind trust in nature that has governed the oil industry for far too long. The firm's simple arrogance, however disarming, is not new.

During the peak of the oil crisis in 1979, when Exxon posted the largest quarterly profit margin in corporate history—a 248-percent increase—Walter Kaufman, then president of Exxon, visited Cornell University. One individual in the crowd of demonstrators asked Kaufman, "What do you think about the fact that my grandmother in the Bronx can't afford your oil prices?" Kaufman responded: "I see no correlation between what I decide in the corporate boardroom and the fate of your grandmother."

Kaufman was wrong. Global warming shows that corporate decisions are inescapably intertwined with the fate of relatives, of neighboring nations, and of the global greenhouse we all share.[7]

The United States has played the major role in building the greenhouse effect. The reason is indisputable: we consume one-fourth of the world's energy. "People born in the U.S. between now and the year 2000 will give off more carbon dioxide from burning fossil fuels than everyone born in the same time period in Latin America and Africa," notes Michael Totten, an aide to Representative Claudine Schneider. In a sense, our extravagant use of energy *requires* the tragedy of such events as the Exxon *Valdez* oil spill.

Though the energy crisis of the seventies fostered a new conservation ethic that allowed the U.S. economy to grow forty percent without any accompanying increase in energy use, the ratio of energy consumption began to climb again in the first part of 1988. One of the most haunting features of a treadmill is its mesmerizing returns onto itself. We know better, yet we forget, returning again and again to the urge to consume rather than conserve. It's easier to waste and takes a lot less planning. But global warming demands that we move the nation as far off the petrochemical treadmill as technically possible, as soon as possible.

Nonetheless, the federal government slashed conservation budgets throughout the eighties. U.S. efforts pale next to those of our foreign competition. Though the United States consumes seventy-five percent more energy per dollar of gross national product than competitors such as France and Japan, American research-and-development funding for new conservation measures lags behind funding levels in France and Japan, as well as in the United Kingdom and West Germany.[8]

How do we get off the treadmill?[9] The answer is known, yet its recognition will be resisted and delayed.

The age of cheap, clean, and abundant energy supplies is over. Domestic oil production has been on the decline since 1970. The nuclear power industry is nearly at a standstill. New energy possibilities in coal and other fossil fuels promise high prices, delayed deliveries, and considerable environmental risks. If America is to assert a leadership role in developing a new approach to both securing clean energy supplies and mitigating the devastating consequences of global warming, then now is the time to explore new alternatives.

A Great Equalizer

The global warming issue touches everyone and everything on the planet. It has forced people to view the earth in a new light, recognizing that what one does in one's own backyard bears consequences for the rest of society. Both rich and poor feel it.

Ironically, it is the wealthy who may suffer the most. As the earth warms, glaciers will melt, causing sea levels to rise, threatening

some of the nation's most coveted coastlines. The EPA estimates that the cumulative costs for protecting our coasts, often home for the wealthy, would reach between $73 billion and $111 billion in 1988 dollars for a one-meter rise by the year 2100. Even with this investment, an area the size of Massachusetts would be lost forever, and our dwindling wetlands would be further reduced by fifty to eighty-two percent.

Of course, dramatic changes in global climate could ruin the fragile, less flexible economies of poorer, less mobile developing countries too. Further draining of world resources may contribute to what economist Robert Heilbroner calls the twenty-first century's special kind of "resource wars."

> I do not raise the specter of international blackmail merely to indulge in the dubious sport of shocking the reader. It must be evident that competition for resources may also lead to aggression in the other "normal" direction—that is, aggression by the rich nations against the poor. Yet two considerations give new credibility to nuclear terrorism: nuclear weaponry for the first time makes such actions possible; and "wars of redistribution" may be the only way by which the poor nations can hope to remedy their condition.[10]

Since global warming could actually help some countries by improving regional climates for food production, such "resource wars" could disrupt any coordinated international strategy to combat the larger costs of climatic change. Nevertheless, this issue clearly requires international cooperation. To appreciate the international sensitivities of this issue, consider the following figures.

A study prepared by the Palo Alto-based Electric Power Research Institute notes that twenty-five percent of the world's population resides within industrial societies which consume about seventy-five percent of the world's electricity. Average use of a refrigerator, air conditioner, and heater already has the typical Westerner using nine times as much electricity as the typical resident of the developing world.

The implications of these simple statistics are intertwined with another key factor contributing to the greenhouse effect: the massive destruction of rain forests. The photosynthetic process of trees

and all living plants absorbs the carbon dioxide that is released into the air with the burning of fossil fuels. This natural recycling process is being disrupted by countries such as Brazil, current home to a third of the world's rain forest. Burdened with huge debts to world banks, Brazil is converting vast stretches of their forest into instant moneymaking ventures such as short-term cattle farms for American-based fast-food restaurants. The land proves useless after several grazing seasons, and the cattle farmers move on.

In their wake lies the destruction of countless sensitive ecosystems. Although the world's rain forests cover only two percent of the earth's surface, these rich forests contain half of all species of life on the planet. At present, forty-eight species of plant and animal life become extinct every day.

It is estimated that worldwide net tree loss accounts for twenty-five percent of global CO_2 emissions. (Trees that are burned not only no longer absorb carbon dioxide; in the process of burning, they release more of it into the atmosphere.) Adding to the dilemma is the fact that almost half of the world's population depends on firewood for cooking and home heating. As areas around the globe become developed, they will switch to electricity, which will partially arrest the deterioration of this element in the current global-warming equation. But this is likely to increase the use of fossil fuels to produce electricity. If the entire world used as much electricity per capita as the industrial world uses now, worldwide use of electricity would be at least three times as great. Such catch-22 scenarios help show why the fossil-fuel addiction seems impossible to break: the more dependent we become on oil, the harder it is to secure an alternative route.

Deforestation is hardly an issue confined to foreign borders. High demand from other countries for U.S. timber, and the notoriously weakened dollar, have created a domestic timber industry boom at the expense of regal old-growth giants in Oregon. Critics claim the U.S. Forest Service is caving in to the Pacific Northwest's logging industry, which sells massive stretches of American forest to Japanese consumers.

Coupled with increases in the use of fossil fuels over the last one hundred years, global deforestation has already led to a doubling of

carbon dioxide in our atmosphere. In light of this, we must face the question: How can we balance our world's need for energy with these urgent environmental concerns? To date, this question has not been adequately addressed by any government.

A December 1988 report by the Electric Power Research Institute predicts that, because of its abundance, coal will supply about two-thirds of the additional energy needed worldwide over the next fifty years. This report advocates the development of an innovative clean coal technology program, and asserts that the domestic electric utility industry will invest more than $3 billion to make this program a reality. This program received a push from the federal government back in 1986 in light of Canada's concerns about acid rain resulting from U.S.-burned coal.[11]

This move toward less coal emissions is welcome, but America and its neighbors—as well as coal advocates in China and India—have to move beyond coal, and beyond other fossil fuels. To continue to rely on coal consumption, without seeking safer replacements, is like tap-dancing on thin ice. Consider the following observations by Dean Abrahamson, from a speech he gave at the Hubert H. Humphrey Institute of Public Affairs at the University of Minnesota:

> There is little hope for slowing climatic change if new commitments continue to be made to coal and the other hydrocarbons. Yet coal is expected to surpass petroleum as the world's most utilized fuel between now and the middle of the next century. So-called clean coal technology, the deployment of which would increase greenhouse gas emissions, is now slated to receive a public dole of over $500 million of federal funds for the 1990 fiscal year. Continued subsidies of coal, the most environmentally noxious of the fossil fuels, and of the destruction of old-growth forests are among the considerations which led to the following observation by D.A. Wirth in *Foreign Policy*: "the implications of the greenhouse phenomenon have not played the slightest role in long-term strategic planning by the U.S. government."

This shift away from coal and oil won't be easy. Projections by the World Energy Conference's Conservation Commission say that the amount of fossil fuels used in the year 2060 will be 1.64 times the

present volume.[12] Since this assumes that hydropower increases by five times and nuclear by eighteen times—the latter assumption being quite debatable—the reliance on fossil fuels could even be greater. Our search for safer and more cost-effective energy substitutes will be hampered.

In addition, the forecasted increase in the use of coal has fostered bizarre and costly options to treat the resulting gases. Many options rely on technologies that profitably exploit one part of the environment to save another. For instance, one proposal calls for the pumping of carbon dioxide into pipelines leading to reservoirs deep in the ocean. Though this option—cross-stitching both American coasts with miles of heavy-duty piping in corrosive salt waters—may be technically possible, it means spending billions of dollars pursuing high-tech glamour instead of reasonable and appropriate answers. Such an effort is the equivalent to our misplaced faith in the one-time promise of "too-cheap-to-meter" nuclear power. America can no longer afford to be distracted by the lure of unneeded[13] or damaging[14] energy technologies.

The hard-won path toward greater energy efficiency and environmentally sound policies will have greatest impact on the developing nations. With far fewer financial resources than the United States, they are going to have to upgrade their practices faster than the industrialized world.

Promising steps in the recognition of the need for international cooperation is the Declaration of the Hague, which the World Watch Institute has described as "an environmental security council." Countries as diverse as West Germany, Pakistan, and Hungary had signed an agreement by 1990 to finance the transfer of energy-efficient technologies and CFC substitutes to the developing world in exchange for the recipients' reducing carbon dioxide and CFC emissions.

Ironically, the three largest emitters of carbon dioxide—China, the United States, and the Soviet Union—were not invited because of their known reluctance to sign such agreements. Nevertheless, China has, despite some formidable challenges ahead, demonstrated the potential for reducing energy intensity. (Energy intensity is a measurement of the amount of energy consumed per unit of economic output.) Since 1979, China has cut its energy intensity by four

percent per year. Another glimmer of hope is that the Soviet Union, by improving efficiency, and by pursuing structural reforms through perestroika, could limit its greenhouse-gas emissions at no extra cost to the Soviet economy.[15]

Japan could take the lead in helping developing nations tackle environmental problems. While America played the role of the great provider in the twentieth century, Japan, together with the "little dragons" along the Pacific Rim, is today a logical leader in dispersing foreign aid and reaping the benefits of such investments.

Within this larger context of a world market working to promote environmental restoration, the expense of efficiency controls takes on a new aspect—that of a timely, diplomatic investment to improve national and global security.

Who Are the Economic Fools?

Walt Whitman celebrates the cutting down of redwood trees in his poem "Song of the Redwood Tree," and the glory he finds in the sound of saws once again reminds us what is wrong with America's estimate of nature.[16] Garrett Hardin takes this point further, sardonically arguing that one would be an economic fool to plant a redwood tree because it takes so long—some two thousand years—for a redwood to reach its full value under today's standard assumptions.

But this belief that "nature is nothing in itself until divinely serviceable by man" makes Whitman's generation the ultimate economic fools. Regrettably, most political and business leaders still glorify the chopping down of natural resources for conversion into quick and easy profits. To level forests is not an adequate celebration of what Whitman called "the rising, teeming stature of humanity," because disappearing forests are now costing all of us. Hardin's calculation of the $14,000 value of a redwood tree after two thousand years also fails to include the environmental benefits inherent in one tree's contribution to mitigating the greenhouse effect.

U.S. AID forester Michael Benge has been trying to prove the value of another particular tree—the wild tamarind—in order to save rain forests. A fast-growing member of the legume family, this tree is nitrogen-fixing, so it enriches soil as it also serves as fence, firewood,

and food for livestock. This tree can help replenish the soil while serving other commercial uses because of its fast rate of growth. The world could invest in these safer alternatives. It is the international banks, dictating development policies for most of the world, that should prove the most critical player in halting this maddening pace of deforestation.[17]

How much are environmental benefits, such as those provided by trees, actually worth? Throughout the world, experts are now scrambling to quantify the real environmental economic costs associated with energy production and greater efficiency in order to move the nation beyond the "time discount" preoccupation of modern economic thinking. This concept postulates that present consumption reaps greater value than preservation of resources for future use. This assumption, which has guided thinkers from Adam Smith and John Locke to most modern-day supply-side economists, is one cause of today's environmental crisis.

Businesspeople such as Roger Sant of Applied Energy Services, Inc., have taken it upon themselves to prove the economic value of forests. Because Sant—an independent power generator—is now constructing a coal-fired plant in Uncasville, Connecticut, he is paying to help plant 52 million trees in Guatemala. These trees are expected to absorb 15 million tons of carbon dioxide over forty years, the same amount expected to be emitted by his power plant.

Sant, who is also chair of the Washington, D.C.-based Environmental and Energy Institute, claims that he will include reforestation projects for every new coal plant his firm constructs. "Energy policy ought to be seen through a greenhouse lens. That ought to be a principal focus," says Sant, adding that utilities and independent power producers should take a leadership role on global warming by stressing energy efficiency and conservation in every move they make.

Reforestation efforts are also building on several fronts. A plan by the World Resources Institute, also backed by the World Bank and the United Nations, promises to invest $8 billion over five years to plant trees. In Thailand and India, Buddhists are recognizing ecological values in their beliefs, and promoting sizable tree planting campaigns. In the United States, researchers at Lawrence Berkeley

Laboratory have discovered a way to utilize trees, along with white paint, to help mitigate the magnification of temperatures in urban centers, known as "the heat-island effect." (For example, since 1940, Los Angeles temperatures have increased by 5° F.)

Long before homes were cooled by air conditioners, trees were planted and outside walls painted white to achieve the same effect. Computer models verify that a return to this approach is a most economical way to combat global warming. What is so satisfying about urban trees is that their aesthetic value is matched by their practical value. They improve the local climate and, by serving as shade and windbreak, reduce the loss of moisture from soil. Trees are remarkably effective in cooling buildings in summer, at around one one-hundredth of what it would cost to get an equivalent amount of cooling from power plants and air-conditioning equipment. On hot summer days, a tree can act as a natural "evaporative cooler" using up to one hundred gallons of water a day, thus lowering the ambient temperature of otherwise scorching city streets. Anyone who has sweated out an August in Manhattan or a summer in Phoenix may now ask: Would we not be economic fools if we keep our cities treeless?

In addition to saving energy, urban trees and light-colored surfaces are probably the least expensive way to decrease carbon dioxide emissions. By reducing the need to burn fossil fuels for power, these old-fashioned tools carry many indirect benefits that the last several generations seem to have forgotten.

Here is the global warming reduction recipe the Lawrence Berkeley Lab (LBL) now suggests for each citizen: Pay $15 to $50 to plant and water three trees around a house, wait ten years for the trees to grow, and then save about 1 or 2 kilowatts of peak power and about 750 to 2000 kilowatt-hours per year in air-conditioning energy per house—a value of $50 to $150 each year. Similarly, when asphalt streets or parking lots need resurfacing, they should be finished off with a thin surface of white sand, and any reroofing jobs should be done in white.

Trees can also reduce heating bills by thirty percent. And LBL's supply-curve models have shown that trees could help eliminate much of Los Angeles's smog problem.

The Lawrence Berkeley Lab, led by conservation guru Art Rosenfeld, thinks big, and their goals are quite honorable: to reduce energy intensity by 3.5 percent over the next twenty years. If we followed their route, America could keep its energy usage at current levels and save from $1.3 to 2.2 trillion (in 1987 dollars).[18] The fundamental message is clear. We can tackle the challenge of global warming, and improve America's industrial edge in the process.

This is how LBL summarizes the benefits of its recommendations: "Investments in improved efficiency would provide U.S. industry with a better competitive position in world markets, and free up more than $100 billion annually for capital investments in other U.S. industries. The poor would benefit from lower energy costs and additional jobs. Reduced emissions of carbon dioxide and other pollutants would lessen environmental damage and reduce the impact of global warming."

Steven Schneider, a climate expert at the National Center for Atmospheric Research, calls this approach a "tie-in strategy," since it would enable Americans to reduce the trade deficit, enhance competitiveness, free up capital for research, and reduce greenhouse gases all at once.

A recent U.S. Department of Energy report echoes many of LBL's findings, noting that through energy conservation measures, the United States could stave off a projected thirty-eight-percent rise in carbon dioxide emissions by the year 2010. This same DOE report underscores the fact that what is needed is a global response to the greenhouse effect, one that entices multinationals to get off the petrochemical treadmill as much as possible.[19] Even if the United States reduces its emissions of carbon dioxide to 1985 levels, however, global levels would only decrease seven percent, without similar efforts by other nations.

At present, the tilted playing field that favors the production of more fossil-fuel–based energy over conservation is common around the globe. In many planned economies and the developing world, it is business as usual to subsidize fossil-fuel supply and dismiss efficiency demands. A striking image of the inadequacy of some nations' energy policies, in spite of China's overall gains in reducing energy use, comes from Beijing. Even though winters in Beijing are

as cold as in Boston, brand-new buildings are uninsulated and are heated by heavily subsidized coal burning.

Less Is More

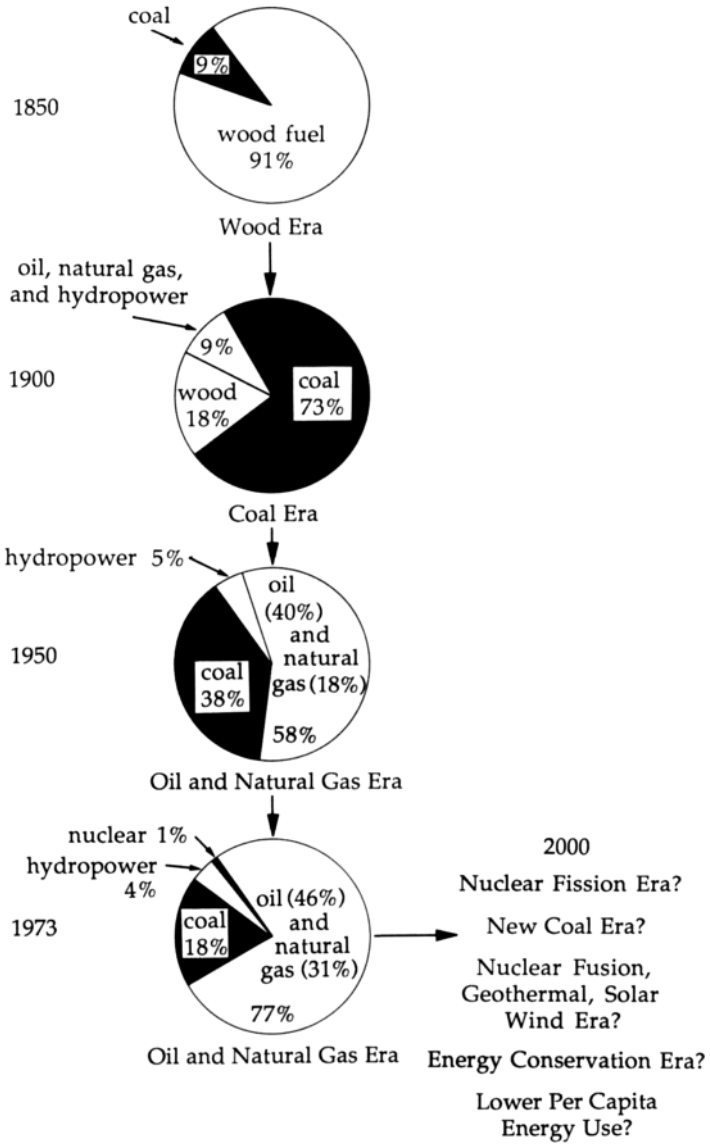
The discovery that conservation is a resource is a clear demonstration of the principle of "Less is more." The oil crisis of the seventies began this revolution, spurring the first generation of efficiency reforms and product-design innovations. The second wave of innovations, propelled by what might be called the second oil crisis—the *Valdez* spill—will need the helping hand of government to further sharpen the tools we already have.

Consider the following facts: Any person can "produce" energy by using light bulbs that use one-fourth as much energy as standard bulbs. Houses, through use of new insulations, can cut energy use by nine-tenths.

Ironically, in the absence of strong federal leadership on energy, states have played the critical roles in implementing energy conservation and efficiency programs. The New England Power Service Company has a remarkably advanced state conservation program. In 1989, the company spent $40 million to install energy-efficient lights, insulate water heaters, and improve industrial efficiency throughout its service area. By 1991, the utility hopes to displace 100,000 tons of coal by way of this program. Over the fifteen-year planning horizon, the savings will equate to one-third of the utility's energy requirements.

Another forward-looking state effort comes from the New York State Energy Research and Development Authority, which was formed in 1975 as a public-benefit corporation mandated to fund alternative energy concepts. A good example is NYSERDA's many district heating and cooling programs. Many of the older heating systems in American cities are extremely inefficient and waste vast quantities of energy. Comparing the old systems to the new is a little like comparing a Model T to a 1990 Celica. Jamestown, Rochester, and Buffalo are current success stories, as these communities now save between twenty and forty-five percent of past energy bills. Not only do these upgrades improve air quality, they also serve as economic-development boons.[20]

CHANGING PATTERNS IN THE USE OF ENERGY RESOURCES IN THE UNITED STATES



Source: U.S. Bureau of Census and Resources for the Future

New York was also one of the first states to recognize that capturing heat produced in industrial processes for reuse as energy was a sensible idea. In doing so, New York and other states proved many old-school planners wrong: developing more centralized energy generation is not always incompatible with the soft energy path of increased efficiency and recycling.[21]

"Less is more" programs have also been developed on the West Coast. California's adoption of standards for the single largest user of electricity in the home—the refrigerator—forced national manufacturers to create greater efficiencies, which in turn became de facto industry benchmarks. Such refrigerator standards could allow the United States to avoid doubling its nuclear power-plant fleet. California has also been a leader in developing renewable energy supplies, cutting its reliance on fossil-fueled power plants from eighty percent in the midseventies to almost half of that today.

States took the lead in innovative energy programs because of the lack of any high-visibility energy policy being staked out at the White House. The emerging environmental consequences attendant upon future energy choices, however, will command a revival of federal responsibility in the 1990s. A replacement for the petrochemical treadmill cannot be built by states alone.

One federal agency that has played a leadership role in promoting a more efficient use of existing resources is the Bonneville Power Administration (BPA), which was created in 1937 to provide cheap power throughout the Pacific Northwest by marketing the tremendous energy potential of the magnificent Columbia River. Thirty different federal dams are part of the system.

A sample accomplishment of the BPA is its promotion of the idea of "least-cost" energy planning. By initiating innovative conservation efforts, such as the investing of $21 million to retrofit more than ninety percent of the entire community of Hood River, BPA is breaking new ground. They not only quantify what energy savings can be achieved, but also analyze how their approach can be marketed to other communities across the United States.

By better coordinating its activities with Canada's B.C. Hydro—which built U.S.-financed dams under a special treaty in the 1960s—BPA has captured an additional 600 megawatts of power, some of

which is now being marketed to California on an experimental basis. This is the equivalent of one nuclear reactor's worth of power, but it did not require one bucketful of cement. Furthermore, BPA has negotiated a trend-setting contract with Southern California Edison, which serves the Los Angeles basin, whereby the two parties exchange power to take advantage of each other's energy peaks and demands without contributing to "the air quality problems of Southern California or the greenhouse effect," notes BPA's deputy administrator, Jack Robertson.

"If the West Coast was better able to integrate utility systems, there could be 5,000 to 6,000 megawatts of additional power that could be achieved by squeezing the existing systems and using integration and interregional energy transfers as resources," Robertson added. Instead of building more nuclear and coal plants, we should build much less costly reinforcement of transmission links, allowing for transfers of energy back and forth. This upgrade should be part of our national energy plan.

One way to entice the entire United States to become more energy-efficient would be to establish a "golf score" for utilities. Under a system proposed by David Moskovitz, former utility commissioner of the state of Maine, a utility's score would equal the cost of serving its average residential or commercial customer. As in the game of golf—where the lower score is better—utilities would compete with one another on the basis of efficiency, not power generation. Tying profits to an index of average regional customer bills would provide incentives for supply-side efficiency improvements and would reduce pollution. Under these rewritten profit rules, utilities could increase revenues by selling energy services—such as better windows and light bulbs.

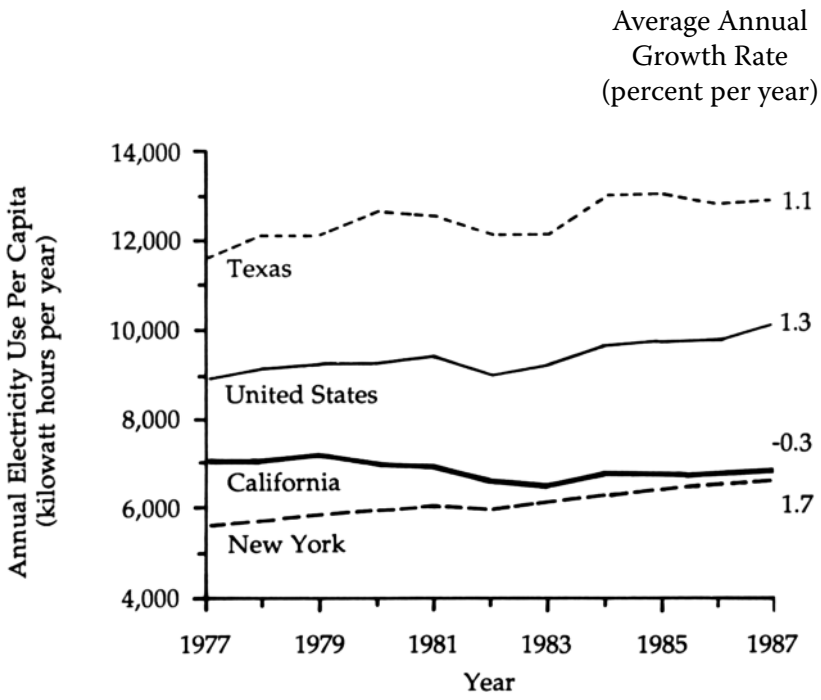
All eyes are on America to determine how far it can go with a second generation of efficiency enhancements. All told, Americans already save $150 billion per year because of reduced oil consumption fostered by improvements in cars, buildings, and manufactories since 1973. Without the first generation of these improvements, the carbon dioxide feeding global warming would be fifty percent worse. Moreover, our trade deficit would have slipped another $50 billion into the red.[22]

Winning the War

The Global End-Use Oriented Energy Project asserts that it is indeed possible to hold energy use constant while reducing carbon dioxide over the next fifty years, even as the world population doubles and gross world product quadruples.

Meeting these goals will require a national energy policy. Will President Bush, a former Texas oilman, take the responsible path toward national security by following the lead of such states as California or New York, or will he follow the path of least resistance and continue to blindly embrace our past mistakes?

PER CAPITA ELECTRICITY USE IN CALIFORNIA, NEW YORK, TEXAS, AND THE UNITED STATES, 1977–1987



Source: Robert J. Mowris, Lawrence Berkeley Laboratory; U.S. Energy Information Agency, *Electric Power Annual* (1982, 1987), U.S. Department of Commerce, *U.S. Statistical Abstract of the United States* (1985, 1989).

If Texas is any indication, we have reason for deep concern. Texas represents the ultimate in Big Oil mentality. It is the only state in the lower forty-eight that restricts sales of excess energy to its neighboring states, and instead blindly plans for more and more generation and consumption. In fact, utilities actively market excessive consumption from unneeded new nuclear power units. Texas's energy use is projected to rise for the next ten years, while most states strive for gains in efficiency.[23]

Congress can help, by dragging reluctant states into the age of efficiency. Already leaders from both parties have announced new federal initiatives on energy policy. Senator Tim Wirth of Colorado and Congresswoman Claudine Schneider of Rhode Island have both introduced bills calling for three-year increases of research and development funding in the area of energy efficiency and renewable energy. The Wirth bill would also establish a "Least-Cost National Energy Plan" which would mandate a twenty-percent carbon dioxide reduction by the year 2000. The legislation stipulates that the top two R&D priorities of the federal Department of Energy should be a reduction in greenhouse gases and greater energy efficiency. Additionally, it calls for the establishment of regional centers for industrial efficiency, important links in revitalizing American manufacturing.

But government does not have all the resources to do the job. Therefore, partnerships between business and government will be necessary. The government's response to global warming has to move toward policies that encourage such partnerships to improve American industry. Marc Ross, a University of Michigan physicist who serves as a consultant to the Department of Energy, highlights the challenge: "It will take government intervention because there are so many players here. You have over 80 million households using appliances. You have 100,000 to 200,000 contractors who have to learn how to better insulate houses."

Ross has identified five areas where government initiative can help ease global warming over the next two decades: conservation; process changes; fuel switching to natural gas; greater reliance on electricity and biomass; and recycling. The good news is that these goals can be achieved without much government money.

Efforts to reverse deforestation and improve efficiency, as well as manufacturing reforms, are just a few links in a long list of new measures that have to be adopted and reinforced on a worldwide basis to combat global warming. The critical player in securing environmental excellence is government. Luckily, joint ventures between governments, private industry, and utilities are financing ways to discover energy answers. The chief challenge before us now is how to shorten the time it takes to discover an answer, and then make it readily available in the marketplace. This lesson applies not only to efficiency innovations, but to the next step as well: new technologies.

In the development of new power-generation hardware such as a better gas turbine, a site-specific demonstration is typically cofunded by a governmental financing authority and perhaps another utility or entrepreneur. If the product demonstration is a success and generates sufficient interest, it is followed by the dispersal of the product within an industrial group.

The typical time for the completion of this cycle in the United States is fifteen years: roughly five years of design, five of development, and five of dissemination. (In Japan, due to the long-term focus of government-industry R&D efforts, this time frame has been shortened on the average to a total of five years.) In light of the current environmental crisis and increasing foreign competition, America needs to speed up this cycle by linking energy goals with environmental needs and economy savings from the start.

According to Robert Williams of Princeton's Center for Energy and Environmental Studies, developing countries could benefit from extensive military R&D on jet turbines with a series of added innovations to adapt such engines for power generation. From a global warming perspective, these turbines are particularly beneficial if they are wedded to biomass energy supplies.[24]

The use of organic matter such as trees and plants—referred to as "biomass fuel"—combats the greenhouse effect. This is achieved in three important ways: by replacing fossil fuel with biofuels; by sequestering carbon dioxide already in the atmosphere in tree plantations; and by reducing deforestation and the resulting release of carbon dioxide by giving nations reasons to recognize the value of properly managed tree plantations.

Biomass currently accounts for thirty-six percent of the world's energy, but is used very inefficiently. Its use makes inherent sense in the developing world, especially in conjunction with new efficient turbines. New innovations that recycle steam and thus recapture energy previously lost make these machines adaptable to the modest economies of many developing countries. These modified jet turbines are not yet commercially available, but, in a strange twist of fate, coal R&D may provide the needed final push. Hundreds of millions of public and private expenditures in the United States, Western Europe, and Japan have resulted in major advances in the technology of firing high-efficiency, low-cost gas turbines with gas derived from coal. Much of this coal-gasification turbine research and development is directly relevant to biomass, notes Williams. Because biomass does not have the sulfur problem associated with coal use, running such turbines on biomass is cleaner and cheaper. This is an important ground for hope. The developing world can avoid the treadmill, with a little help from friends in the research community.

There are a few cases where government and private industry working together have achieved R&D successes that promise an easing of the global-warming phenomenon. One of these is the giant LUZ International solar thermal farm in California's desolate Mojave Desert, where 650,000 parabolic mirrors stretch over one thousand acres, producing ninety-five percent of the world's solar electricity.

By mid-decade, farms like these will be generating a total of 600 megawatts. That is enough power to supply more than 300,000 homes. In addition, each 80-megawatt solar plant saves 325 million pounds of carbon dioxide emissions which would be given off by any fossil-fuel plant producing the same amount of energy.

LUZ, an Israeli–U.S. joint venture, moved to California in 1983 to take advantage of federal and state solar tax credits and independent power contracts.[25] The credits and contracts provided a subsidy sufficient to help get LUZ's fledgling "parabolic trough" technology out of the laboratory and into the steady sun of southeastern California.

LUZ's technology tracks the sun with microprocessors as it moves from horizon to horizon, capturing heat to raise the temperature of the generating fluids. A heat exchanger then transmits this heat to turn a traditional turbine (which also runs on natural gas when sun-

light is insufficient), allowing the farms to generate electricity to sell to utilities. LUZ is currently working on a research project with the California Energy Commission to increase the efficiency of the "parabolic trough" by eliminating a transfer loop from the process. This would eliminate a potential waste problem, as water would replace oil as the heat-transfer fluid.

In every solution to the energy dilemma, whether it is new efficient turbines, parabolic troughs, least-cost plans, or centers for industrial efficiency, government has a role. Its key role, beneath all the contracting details, is as an enabler, helping industry to develop its alternatives. By 1986, states as diverse as California, Idaho, and Maine had been able to defer their needs for new coal and nuclear plants by acquiring 1,424 independent power projects utilizing alternate resources such as solar, wind, and hydro energy. These alternative projects average a capacity of just 12 megawatts, but demonstrate how public–private partnerships are helping to solve environmental dilemmas. In the overall scheme of things, such small incremental power additions make more sense than massive new plants. Dozens of unfinished nuclear power plants across America stand as unfortunate reminders of this fact.

Small, independent applications of alternative energy sources are universally acknowledged by the research community to be influential and eminently productive in mitigating global warming. We can no longer afford to consider these operating alternatives the gadgets of hippies and technocrats. In light of government's tight pocketbook, these new power projects represent the vanguard of a society more in tune with the limits and organic rhythms of the earth. They are the machines by which we can build more affordable beliefs, more sustaining lifestyles.

NOTES

Chapter 3

1. It is too early to gain any firm factual hold on the changes now called global warming, since most of these changes, even the experts admit, may never be fully known in advance. Four factors—clouds, oceans, solar cycles, and volcanoes—may serve to illustrate the remarkable complexity of global warming. "Clouds," admits expert V. Ramanathan of the University of Chicago, "are one of the largest sources of uncertainty." A warmer earth should mean more humidity, and thereby more clouds. But it is also thought that clouds could cool things off by increasing the reflection of solar energy. So it is hard to predict which effect might dominate a cloudier world.

   Oceans are massive heat absorbers, but just how long they can delay the full onset of global warming is still hotly debated. Volcanoes cool the earth's overall surface, but no one can predict when the big ones will erupt. And solar cycles show that, while many believe the sun's output is constant, it's not. Brightness, for instance, diminished about 0.1 percent from 1979 to 1984.

   How clouds, oceans, volcanoes, and sun cycles interact is still an untold story, more like a Brahms symphony than a science.

   Most experts agree, however, that the policies being pursued to combat global warming—the saving of the rain forest, greater energy efficiency, and less fossil-fuel use—are useful and needed policy initiatives regardless of whether the world is cooling or warming. These policies should be viewed as an insurance policy for future generations.

2. The record heat of 1988 simply replaced the previous record set in 1987. The years 1981 and 1983 tied for third-warmest, with 1980 and 1986 in fifth and six places, respectively. These records hold for all recorded weathers in history.

3. "The combined atmospheric buildup of carbon dioxide and other greenhouse gases since 1860," notes Irving M. Mintzer of the World Resources Institute, "are believed to have already committed the earth's surface to warm approximately 0.5° to 1.5° C. above the average global temperature of the pre-industrial period." This doesn't sound like much, but actually represents an astonishing amount of released heat. A change in average global temperature of only 1° C. separates today's climate regime from that of the "little ice age" period of the thirteenth through seventeenth centuries in Europe and North America. So the increase of 2.1° to 8.1° F. (which is 1.5° to 4.5° C.) represents a massive increase atop the already noted changes.

4. These round figures come from research performed by Skidaway Institute of Oceanography for a position paper entitled *Saving the American Beach*, presented by the

Concerned Coastal Geologists at Savannah, Georgia, in 1981. These figures, therefore, understate the extent of the damage. Orrin H. Pilkey, Jr., of Duke University, along with William J. Neal of Grand Valley State College, have edited a series of reports sponsored by the National Audubon Society, entitled *Living with the Shore*. This series goes into great detail on the numerous restoration projects now underway on all American coastlines.

5. U.S. Environmental Protection Agency, *The Potential Effects of Global Climate Change on the United States*, draft report (vol. 2), Oct. 1988, pp. 12–14.

6. Getting off the petrochemical treadmill means a sustained and concentrated effort—a process of withdrawal, not a drunk man's dive. The change will not happen overnight. As California's efforts show, the trick is increasing the use of alternatives to fossil fuels. The state was once dependent upon fossil fuels for about eighty percent of its energy needs, but that percentage has almost been sliced in half, as safer substitutes have been found for about a third of the state's energy needs.

   For more specific and technically detailed information about California and other states' efforts, see "State Energy Policies and Global Warming," by Peter Asmus and Bruce Piasecki, *California Policy Choices* (vol. 5) (Sacramento, Calif.: University of Southern California School of Public Administration, 1989).

7. Despite our characterization of Exxon and other multi-national oil companies as preoccupied with a fossil-fuel future, the world's biggest oil company—Royal Dutch Shell—is a model of long-range planning, with a growing emphasis on incorporating environmental concerns into the picture. Royal Dutch Shell was the first to push unleaded gas and is experimenting with greater use of less polluting natural gas.

   Unlike many of the oil companies who abandoned solar development in the 1980s, Mobil is still aggressively researching the use of photovoltaics for future utility use. At present, the firm produces the largest, most powerful flat-plate module in the world. Despite its finely honed green image, however, environmentalists have criticized the company for its involvement with an aluminum smelter and bauxite mine in the Amazon rain forest.

8. Claudine Schneider, "Least-Cost Utility Planning: Providing a Competitive Edge," *Public Utilities Fortnightly*, Apr. 17, 1986, p. 15.

9. In *The Control of Oil* (New York: Vintage Books, 1976), John Blair argues that institutional barriers are the prime impediment preventing us from ending our almost sentimental love of oil. His prescription is to sever the cozy relationships between regulator and regulated. He calls for the vigorous enforcement of antitrust laws to allow market forces to break up the big oil companies and to shape public policy. An end to depletion allowances and tax breaks would do the same.

   His view, from over a decade ago, still rings with some truth: "In mutual dislike, rather than in mutual understanding, there is strength. Moreover, by making an industry's behavior depend on the judgment and actions of many buyers and sellers, the competitive approach minimizes the harm that can be done by any small groups of individuals, thereby making influence and corruption more cumbersome, expensive, and of most importance, ineffective."

The new concerns about greenhouse gases, however, change the agenda for the oil lobby, and require a quicker resolution than Blair's "mutual dislike." No matter how entrenched the petrochemical treadmill may be in society, the more efficient use of fossil fuels will be mandated by political reality. This is the first step to be taken in response to environmental concerns, because it is the easiest and most cost-effective.

10. Robert Heilbroner, *An Inquiry into the Human Prospect*, 3rd ed. (New York: W.W. Norton, 1980), p. 43.
11. Two articles, appearing in the Mar. 17, 1989, *Christian Science Monitor*, highlight the market opportunities that will open up because of retrofits required by acid rain: Richard Wentworth, "Cost and Profit in Cutting Acid Rain," and John Borley, "Canadian Smelter to Spend $500 Million to Cut Emissions," both on p. 9.
12. See the Electric Power Research Institute's *Global Climate Change and the Electric Power Industry* (presented at the Jan. 5, 1988, National Climate Program Office's Strategic Planning Seminar), pp. 8–13.
13. An example of "unneeded" high-tech investments of government research dollars is the Tokomak project at Princeton University. This project studies the principles of magnetic fusion to create little stars on earth. At best, the commercial application of superconducting magnets to create some glow in every basement is decades off. Lavishly funded research projects such as Tokomak are full-employment acts for academia's brightest and best. But we must resist, at times, chasing esoteric dreams and developing research toys that may never leave the laboratory. If Tokomak received only twenty percent less funding, thousands of homes could be made more energy-efficient for seventy years. The choice is tough. Obviously, big science cannot be the only path of reform.
14. An example of a "damaging" use of federal research dollars is our large investments in enhanced oil-recovery techniques, since their success only keeps us on the petrochemical treadmill. Back in 1905, America's discovery of abundant oil at Spindletop made its extraction simple and cost-effective. After World War II, the nation's emphasis shifted to "secondary" oil recovery, whereby steam helped isolate remnant oil in known reserve areas. At present, enhanced or "tertiary" oil recovery entails going back to spent oil-recovery sites and, through the use of surfactants that wash out oil like soap removes grease from dishes, removing the last drips. After this oil is pumped up using steam pressure, another process separates usable oil from surfactants. Some critics, like E.F. Schumacher, claim that the resultant unit of energy is less than the energy consumed to produce, pump, and refine it for commercial applications. In short, another treadmill.
15. See William Chandler, "Views of OECD, The Soviet Union and China." Chandler, a senior scientist for Battelle Memorial Institute, Pacific Northwest Laboratories, prepared this study for submission to the University of California–Davis Panel on Prospects for International Action on Global Climate Change, Sept. 6, 1989. He points out that the most effective method to combat global warming may be to set specified energy-efficient improvement rates, or establish goals for carbon dioxide–release reductions based on a nation's gross national product per-unit ratios.

This would be a positive way to go about achieving reforms, since these measures would be perceived as being fair to everybody as they would increase rather than retard economic development.

16. Walt Whitman was one of a number of writers on both sides of the Atlantic who advocated extreme reshaping of the environment during the second half of the nineteenth century. His works present "a new race dominating previous ones," which should, in time, inhabit the entire globe and transform nature into "a new earth." He celebrated his century's great changes—the proliferation of railroads, steamships, cotton gins, and telegraph lines in "Passage to India," and the felling of California's redwoods in "Song of the Redwood Tree"—as symbols of an irresistible and impending succession to a "new earth," and as icons of a longing in modern man for complete transformation of the environment.

17. The banking policies of the World Bank affect two-thirds of the world's ecological wonders. Typical of the misguided sort of project that the bank has funded in the past is a recent proposal to loan Brazil over $1 billion for huge hydroelectric projects that would flood hundreds of miles of dense tropical rain forests and displace another population of indigenous people. The bank has been urged by environmentalists to turn to smaller-scale projects that allow the existing human, animal and plant natives some dignity. Instead of monster dams to produce electricity that may never be needed, the banks should promote a range of environmentally benign energy alternatives such as simple solar heat pumps.

    Progress was beginning to show in Brazil in 1988. Ironically, economic difficulties, which have hampered environmental protection, are reducing damaging public-works projects as well. Utilities in Brazil are now trying to factor in environmental costs in their decisions, at least temporarily stalling previously planned dams. On top of that, a broad policy initiative entitled Nossa Natureza ("Our Nature") has obtained the support of the country's military and is coordinating the activities of Brazil's four environmental-protection bodies.

    Perhaps the most promising tool to save rain forests is debt-for-nature swaps. Such swaps involve the purchase of a developing country's debt at a discounted value in the secondary market, and cancellation of that debt in return for environment-related action on the part of the debtor nation. Such swaps have already occurred, or are being contemplated, in Brazil, Bolivia, Costa Rica, Ecuador, Chile, Mexico, Argentina, and the Philippines.

18. The required retrofits would cost $300 million to $500 million, yet they would also reduce the trade deficit by $20 billion to $40 billion annually because of the ability to reduce oil imports by 2 million to 3.5 million barrels per day.

    LBL proposes a number of innovative policies to accomplish these goals. One of the more fascinating is a "gas guzzler/sipper fee/rebate program" for automobiles. This revenue neutral fee/rebate scheme would propose a fee on new cars based on their fuel efficiency. Efficient cars such as the Honda Civic American would receive, based on 1987 calculations, a rebate of $1,250, whereas gas guzzlers like the Ferrari Testarossa would pay large fees. During a transition phase, the rebates would be paid in proportion to American-made content and labor, in order not to alienate the

American auto manufacturers, allowing them to gradually shift production away from the less efficient cars that currently dominate their sales. Additional registration fee incentives, along with a modest ten-cents-per-year gas tax, would, according to LBL's Rosenfeld, allow the marketplace to promote better efficiency without severe economic dislocation.

Other proposals include sliding-scale hookup fees and rebates for new commercial and residential buildings, and developing a carbon dioxide tax for all fifty states, with rebates given to those utilities who shift away from the petrochemical treadmill fastest. It is these kinds of specific adjustments, once freed from this age of environmental blame, that will bring substantive reforms into the world.

19. It is ironic, considering how closely allied DOE is with oil interests, that their own reports encourage getting off the petrochemical treadmill. DOE has drawn most of its leaders, appointed by the president, from among oil people. It wasn't until the Hanford and Savannah problems described in Chapter 2 became so large that James Watkins, an ex-nuclear navy official, became the first secretary of energy with a background outside the oil industry.

20. New York's efforts are impressive, but in the Soviet Union, seventy percent of residential users participate in district heating and cooling programs, while the U.S. overall percentage is infinitesimal. Nevertheless, much of this coordination in the Soviet Union is wasted because of a lack of temperature controls. The most common method of interior temperature control is opening windows, even in winter.

21. Another emerging trend is the notion of "hard solar," whereby huge photovoltaic farms would be stationed in the Southwest to generate electricity for different parts of the nation. The problem with solar energy has always been finding enough insolation in enough parts of the country to enable widespread applications, and the ability to store the energy, once it has been created, for use when the sun is down. However, when the energy produced by photovoltaics is converted into liquid hydrogen fuel, it could theoretically be stored and transported to less sunny parts of the country for use. With certain policy changes, researchers such as Robert Williams of Princeton predict, such technological breakthroughs could occur as early as the beginning of the next century.

    It is projected that thirty to forty percent of New Mexico would need to be utilized in order to displace current fossil-fuel consumption. From an international perspective, it would take 1.7 percent of the land mass of our deserts, or 3.6 percent of the world's agricultural land, to displace world fossil-fuel use.

22. These statistics, as well as others scattered throughout this chapter, were presented by Claudine Schneider, Republican Representative from Rhode Island, in an article entitled "Preventing Climatic Change," in the Summer 1989 edition of *Issues in Science and Technology*. Schneider writes: "The slow pace of climate change breeds complacency, but we must remember that the climate will also be slow to respond to after-the-fact solutions. We must begin now to adopt the good stewardship practices that will reduce the likelihood of human-induced climate disruption." She also notes: "A fifty percent cut since 1980 in the federal energy efficiency R&D budget has meant that there have been no new research projects begun this decade. These

budget cuts seem particularly shortsighted in light of the spectacular success of federal energy-efficiency R&D. According to a 1987 analysis by the American Council for an Energy Efficient Economy, the $16 million that DOE spent on cooperative projects with industry to develop heat pumps, more efficient refrigerators, new ballasts to improve the efficiency of fluorescent lights, and glass coatings that control heat loss and gain through windows will help save the country billions of dollars through energy savings."

23. There is a ray of hope from Texas in the form of an ambitious $100 million building retrofit program, most of it earmarked for state-owned institutions. This program is funded, appropriately enough, by Exxon funds obtained by way of a settlement regarding petroleum price-control violations between 1973 and 1981. Texas owns more state buildings than any other state, and therefore is the perfect testing ground for such new conservation technologies. The most promising aspect of the program, however, is that the program will institutionalize a series of incentives—in the form of savings and bonuses—for new energy-audit managers to exceed efficiency targets. The eight-year program began in July 1988. It will provide a critical data base from which the nation can shape a national strategy.

24. Much of the information from Robert Williams is included in a paper entitled: "Biomass Gasifier/Gas Turbine Power and the Greenhouse Warming," and was presented at the International Energy Administration/Organization for Economic Competition and Development Seminar on Energy Technologies for Reducing Emissions of Greenhouse Gases in April 1989 in Paris. For more information, contact Director, Center for Energy and Environmental Studies, Princeton University, Princeton, NJ 08544.

25. Tax credits and long-term, fixed-price contracts have been maligned by critics, but they provided important help to the infant renewable-energy industry. Tax credits, which were repealed at the end of 1988, eventually became unpopular because some opportunists abused bogus wind and solar projects for tax-credit write-off purposes.

    Even more valuable as a helping hand to LUZ and other independent power producers were California's Standard Offer 4 contracts. These contracts, developed by the California Public Utilities Commission, were initially based on projected prices for future oil. Averaging about seven cents per kilowatt-hour, some contracts extended fifteen to thirty years. These contracts attracted much-needed financing for innovative solar, wind, and geothermal projects.

    An unexpected large response from applicants, coupled with the rapid fall in oil prices, led to the suspension of SO 4 contracts in April 1985. Numerous paper projects"—projects which may never exist in reality—contracts were approved before the SO 4 deadline, and forecasting how many of these will actually come on-line has become a convoluted shell game that has, unfortunately, undermined the credibility of renewable energy resources.

    In 1989, the California Legislature reinstated a solar tax credit, but limited it to electricity generating systems. This is yet another example of how governments are realizing the benefits of innovation.