4

Efficiency: The Fat of the Land

The *Titanic* weighed 46,000 tons. It burned 825 tons of a coal a day, in 159 furnaces, to heat 29 boilers, which powered its huge reciprocating steam engines. Smoke from the coal poured out from three of its proudly raked funnels. The fourth (closest to the stern) was a dummy, added for grandeur alone. One surmises that the Astors and the Guggenheims had a taste for profligate excess.

Don't we all. In close, most of us are rotten environmentalists. We eat, drink, and smoke the wrong things, and in the wrong amounts, have sex with the wrong lovers, then dose ourselves with the wrong medicines. We breathe, suck, chew, swallow, and inject: incense, perfume, tobacco smoke, silicone, and a rich variety of sexual emissions. We are, perhaps, no longer quite as proud of all this as the Astors and Guggenheims once were. But we do it anyway. The Softs weep. As they see it, it all comes down to fat: fat families, fat cars, fat refrigerators, fat toilet cisterns, and yes, fat diets. We take in too much at one end, emit too much at the other, as we make our elephantine progress across the Serengeti plane of life.

Thomas Samaras, author of *The Truth About Your Height*, pushes the argument to its perfectly logical limit.[1] People are growing steadily taller with each generation. A 20 percent increase in height implies a 73 percent increase in weight. Big people eat and drink more, drive bigger cars, use more fabric and leather for clothes, more gold for rings, and more soap to wash. People are growing taller around the world because,

Malthus notwithstanding, they have learned to supply themselves with a calorie-rich, Western-style diet. Samaras advises feeding children less—a healthy diet but not one that entails "excessive" growth.

We didn't used to call such seemingly private matters "environmental," but as the Softs have been saying all along, the walls between public and private spaces are permeable. Factory, power plant, and ocean liner consume and emit; so do man, woman, and child. Individuals affect the environment by their habits and their numbers. Malthus said populations grow geometrically, and "Malthus was right" declares a man who has proved it himself, Al Gore, father of four.*

To be green we must be pure and thin. Eat organic, not synthetic. Dress in cotton, not plastic. Find fertilizers in the barnyard, not the oil refinery. Split wood, not atoms. Green is pure. Green is efficient. Conserve water, food, and energy. Set things environmentally right close to home and the good effects will surely trickle up the supply chain, trickle up from refrigerator to power plant to minehead, from gas tank to refinery to oil well, from compost heap to the Kansas cornfield, from Sunday newspaper to old-growth forest.

Except that they won't. Not with food, wood pulp, oil, or anything. Purity is not green. Efficiency is not green. However attractive or enriching they may be, purity and efficiency don't directly advance green objectives at all, at least not as prescribed by the Softs. Most of the time, they do just the opposite.

PURITY

Let us start by following our Soft friends on a delightful excursion, to a farmer's market in Paris. The produce is piled fresh and high on rough wooden tables. It has come straight from fields fertilized the old-fashioned way. We pick and choose, only the best, all pesticide-free, the farmer assures us. He wraps it in yesterday's newspaper and we slip it in our string bag. The cheese is unpasteurized; it tastes better that way. The smell of fresh bread drifts from the open-hearth ovens of a nearby bakery. There are meat and poultry stalls nearby, too, and we know the livestock was raised in a pasture, not a factory. And there's not a shred of plastic or preservative in sight.

*I owe this crack to P. J. O'Rourke, *All the Trouble in the World* (New York: Atlantic Monthly Press, 1994), 25.

Insist on unadulterated ingredients, go for variety, purity, taste, and the diet will take care of itself. Any Frenchman will tell us that. And though he is completely wrong about everything else, he is right about the most important thing. Getting our food this way is delightful. Immeasurably more so than a concoction of olestra, aspartame, and antioxidant, pre-sliced and packed by machine in a plastic bag.

On such matters, the Soft Green sees eye to eye with our epicurean Frenchman. All these choices are not only healthier, they are greener, too. More frugal. More efficient. And cleaner, of course, by definition. The packaging, fertilizers, and food factories poison the landscape, just as the chemical concoctions poison the body. The genetically altered strawberries most likely corrupt both, displacing natural varieties in the fields and disrupting human biochemistry when we eat them. The whole green revolution, chemically and genetically manipulative as it is, corrupts land and body alike.

So much for food, our oldest form of energy. How about all the others? Gasoline, coal, oil, natural gas, and uranium? Or, if you prefer, solar and wind energy, biomass conversion, and cogeneration. Soft Greens *do* prefer the latter, of course, "soft" sources of energy over the "hard." This was the second, seductive strand of the Soft Energy prescription set out by Amory Lovins in his 1976 article in *Foreign Affairs*.

For Lovins, big electric power plants are the hardest of the hard. About one thousand operate in the United States today, and the environmental case against them seems too obvious to require much in the way of elaboration. They are the environmental equivalent of the factory farm and the chemical-doused field, a green disaster. The huge coal-fired power plant belches smoke, produces millions of tons of sludge, and burns fuel at such copious rates it must be fed by train convoys hundreds of cars long. Huge dams for hydroelectric plants flood vast expanses of land and disrupt the flow of great rivers. Nuclear plants risk meltdown, and nobody wants their spent fuel. "Massive electrification," the entire hydro-nuclear-coal-electric grid, is dirty and dangerous.

Uneconomical, too. Such massive systems entail tremendous waste. The nuke uses the white heat of uranium fission, the technology of the atom bomb, to brown toast a hundred miles away. Using flame temperatures of thousands of degrees, or nuclear temperatures in the millions, for such purposes is "like cutting butter with a chainsaw," declares Lovins. And in between the nuke and the toast, high-voltage power lines slice across the landscape, dissipating power mile by mile.

A policy of relying on such fuels is one of "strength through exhaustion," argues Lovins. It can't be sustained, and it shouldn't be. Nuclear power should be abandoned immediately. Synthetic fuels such as coal gas shouldn't be developed. Other fossil fuels should be used only to complete a reasonably short period of transition. To what? "Soft" forms of energy. To "natural," "organic," "free range" fuel, one might say: Solar and wind energy, biomass conversion (producing liquid fuels from farm and forestry wastes), and cogeneration. Why not warm our homes once again with wood, the simple fuel of old, in a wrought iron stove, the simple furnace that warmed our grandparents so adequately and so well? Lovins's Soft Path will vary from place to place: It may be wind power in Southern California and a small dam in rural Kentucky. The Soft Path uses renewable sources, the hard, depletable ones. The Soft Path spends "energy income," the hard dissipates "energy capital." The Soft Path takes "advantage of the free distribution of most natural energy flows." The Hard is profligately wasteful in hauling energy from place to place. Soft technologies, Lovins argues, are diverse, flexible, resilient, sustainable, and benign. Nuclear power is the hardest of the hard. It is impractical always, everywhere.

A great number of people believed Lovins, perhaps more in Britain, where Lovins spent his intellectually formative years, than anywhere else. Many still do. But the 1970s, the timorous decade of oil embargo and political malaise, were the triumphant years for thinking of this kind. As one 1998 retrospective observed, "[w]e were eager to burn anything back then: wood, methane from garbage dumps, bacterial mats, sunflower oil, buffalo gourd, peanut shells and countless other 'natural' substances."[2] A British company made detailed plans for an electric plant to be built in Denmark, fueled mainly by chicken droppings. An American company undertook the design of a plant to convert sewage into oil. New Zealanders planned to extract tallow from slaughtered lambs and use it as car fuel. A Nobel-prize-winning chemist persuaded Congress to subsidize plantations of guayule, a hydrocarbon rich plant that he was certain would substitute for oil. Norway and India built machines to capture energy from wave power; Britain finally launched a commercial wave-power station off the Scottish coast in 1995. Elaborate plans were formed to build huge floating pistons to capture the energy of the tides and a seagoing generator to extract energy from the thermal gradient between warm surface water and cold bottom water. "Wind farms," heavily subsidized by the government, were built in California, Hawaii, and elsewhere. Sunlight was going to be used to split water molecules in catalytic cells into hydrogen and oxygen; the hydrogen could be used as fuel for power plants or even for vehicles.

EFFICIENCY

Purity is half the Soft Green battle; efficiency is the other half. How much more efficient it must be to eat soft. How much less energy and material it must take to live simply, naturally, and close to the earth. How much more efficient it must be to grow crops without the vast, costly, ruinous, destructive excesses of fertilizer and pesticide.

Efficiency figures even more prominently on the Soft agenda for energy. Most important for Lovins, more important than all the organic fuel, is conservation. "Technical fixes," Lovins insists, can cut energy "waste" in half. "Negawatts" are cheaper, safer, better in every respect than Megawatts. Making cars more efficient is soft, drilling for more offshore oil is hard. Roof insulation is soft, arctic gas, hard. Even better than solar in Arizona or a windmill in California is utility-sponsored home weatherization in New York.

The best thing of all about efficiency is that it entails no pain. Accused of peddling a policy of painful privation, Lovins responds that he "explicitly assume(s) no significant change in where we live, how we live or how we run our society," and that he "goes to a hell of a lot of trouble to make the phrasing accurate."

It is in the promotion of efficiency that Soft energy pundits claim to have achieved the most, the fastest. The drive for efficiency succeeded beyond all expectation. Our ceilings today are insulated twice as well, our walls 40 percent better, our floors four times as well. New furnaces, air-conditioning units, heat pumps, refrigerators, water heaters, washers, and dishwashers all use much less energy than their predecessors. Gas furnaces are 20 percent more efficient, mainly because pilot lights have been replaced with electronic starters. The efficiency of refrigerators has more than doubled; washing machines and dishwashers are 60 percent more efficient. Cars averaged 13.5 miles per gallon in 1975, 22.5 mpg in 1995. Extremely efficient fluorescent lights are proliferating. And almost all of these excellent numbers continue to rise steadily.

In other words, billions upon billions of barrels and watts have been saved by technology that simply made them unnecessary. The Softs quote these statistics all the time. It is easy to convert such numbers into

equivalent numbers of oil tankers unfilled and power plants unbuilt. The Softs often do.

Come to think of it, we made comparable improvements in the efficiency of our diets during this same period, too. We zealously "conserved" calories. We favored "efficient" foods, foods that deliver extra miles of repletion on fewer gallons of calories: low-fat milk, diet sodas, and fat-free potato chips. Between 1970 and 1990 the average American has added the sugar equivalent of about a pound a year of artificial sweetener to his diet. We recently added the marvelous olestra to our larder of caloric efficiency. It has the "mouth feel" of pure oil yet is indigestible by the human gut.

Yes indeed, we have certainly grown very smart at conserving calories. Yet our contumacious scale refuses to acknowledge the fact. Could it be broken? We know in our hearts that it isn't. Wardrobes full of clothes that are now several sizes too small tell us the same. The scale is not broken. Despite all those calories conserved, we have just grown fatter.

The Softs were wrong. Completely, laughably, ridiculously, preposterously wrong. For what it's worth, Hard is far more efficient than Soft. But it's not worth what the Softs say it's worth, for the simple reason that "efficient" has almost nothing at all to do with "frugal." This is true for food, and it is true for energy. The whole gigantic myth to the contrary is no more or less than a case study in wishful, credulous, anti-scientific propaganda.

THE BIONIC COW

To begin with, "purity" and "efficiency" are quite different—and for the most part, antagonistic—ends. Efficient things are not pure. Nature, which is "pure" by definition, doesn't care a fig for efficiency, and it isn't efficient at all. Why should it be? The workings of nature were not designed for the satisfaction of some Soft Green efficiency maven in the sky. A mouse has good reason to forage efficiently, but it has no reason to make itself efficiently digestible to a fox or hawk. A tree has excellent reason to transform sunlight and carbon dioxide efficiently into wood and oxygen; a fungus has excellent reason to transform the wood right back into water and carbon dioxide, efficiently, too. This is all about as efficient as two huge diesel engines guzzling fuel and going nowhere in the tractor pull contest at a county fair in Kansas.

Impurity—technological, chemical, biochemical, and genetic—is what gets the engines moving more efficiently our way. Consider the case of a

familiar ruminant quadruped. "The cow is of the bovine ilk," Ogden Nash fondly observed, "One end is moo, the other milk." If we think about the cow any more deeply than that, we probably think of it as a natural, greenish sort of beast, and its farm as clean, in an earthy sort of way. Yet as an engine for converting grass to our kind of food, our cow starts out dreadfully inefficient and not clean in the least. Her several ends emit not only moo and milk, but also fats and cowpats, marble and methane.

Soft Greens will certainly agree with that. There are far too many ends because there are far too many cows, the Soft Green declares. Pound for pound, livestock outweighs humans four to one in the United States. Worldwide, there are almost as many domesticated cattle, sheep, goats, buffalo, and camels (an estimated 3.3 billion) as there are humans. Outside of Gary Larson cartoons the cows don't drive around in the family car, but they are powerful polluters nonetheless.

Indelicate though the subject may be, cows are major, unregulated emitters of methane. As a greenhouse gas, methane is much worse than carbon dioxide; cows, it turns out, are thus significant contributors to whatever global warming problems we may face. At one point in a clean air debate, the Senate went so far as to consider methane control options. Scholars pondered the relative advantages of corks (to be placed, with suitable filters, in cows' rear ends), collection bags, catalytic converters, and a brand new gas tax. Moreover, millions of acres of forest are cleared for cattle grazing every year, and cattle contribute significantly to topsoil erosion and water pollution from agricultural runoff.

What the cow emits in other ways, sometimes by way of daily liquid contribution, sometimes by way of the ultimate sacrifice, is fat. As study after dreary study confirms, we should all be consuming less of it, whether it issues from the udder or the flank. Fewer cows would be healthier for us and greener for the planet, too.

Bovine anabolic steroids (growth hormones) do for cows pretty much what human equivalents do for Olympic sprinters: stimulate faster, leaner growth. Bovine somatotropin (BST), the first major agricultural product of biotechnology, can boost milk production by 25 percent. But these chemicals violate the first principle of Soft Green: They are not Pure. We will not find them in the French farmer's market. Some trace of what goes into a cow comes out and might conceivably be harmful. Even if it isn't, we have too much milk anyway, so who needs more efficient cows? Terminally trendy Ben and Jerry's has denounced BST on its ice cream cartons.

There was a day when the farmer's market was about as green and healthy as you could get. When the United States passed its first federal pure food law in 1906, purity and safety were pretty much the same thing. Beyond salt, sugar, and vinegar, most forms of food "adulteration" were bad, almost by definition. That is no longer true today, not even on the health side of the picture.

So far as health goes, eating two all-beef patties ground from a cow that grows lean and mean is much healthier (though less savory) than downing a quarter-pound of bovine Mae West. The health benefits of eating less fat far outweigh any imaginable risks that hormone residues in the meat might cause, especially since the best scientific opinion holds that these minuscule residues are harmless. Use of artificial pesticides permits the cultivation of crop varieties that contain lower levels of carcinogens than those produced with "natural pesticides": those produced by plants themselves to ward off the bacteria, fungi, insects, and animals that would eat them.

The environmental case for the impure cow is clearer still. Growth hormones make cows substantially more efficient at converting grass to human grub. In other words, you can produce the same amount of milk with perhaps 20 percent fewer cows and a concomitant reduction in methane emissions. Gorging on Ben and Jerry's fat-clogged but BST-free ice cream means tying up as cow pasture some land that might otherwise revert to beautiful woods.

Surely, then, the world can use a more efficient, better-tuned cow. One that spends less time ruminating and belching, one that produces more milk for the methane, more meat for the marble. This is precisely what growth-enhancing products provide. We favor more efficient cars, why not more efficient cows? We have the technology at hand to run SUV cows with econo-box emissions. Hard Greens are all in favor of using it.

Hard agriculture is invariably more efficient than Soft. Livestock allowed to wander freely on the open range impose a far greater burden on nature than livestock raised in a pen and fattened on corn. Plucking salmon from a river does far more environmental harm than raising them in cages anchored in a small patch of ocean. As Dennis Avery has pointed out, "Today's typical environmentalist worries about how many spiders and pigweeds survive in an acre of monoculture corn without giving environmental credit for the millions of organisms thriving on the 2 acres that didn't have to be plowed because we tripled crop yields." The bionic cow requires less pasture.

Preservatives and packaging have much the same impact because they reduce spoilage. Hauling produce in the back of the farmer's pick-up, then inviting the epicure to pick out only the best from the stall, makes for the best cuisine and the most wasteful, too. Poor packaging that allows spoilage is as wasteful as a dripping faucet or a leaking gas tank. Irradiating chicken, meat, and spices kills salmonella and extends shelf life. Because almost all food is transported great distances, cutting spoilage in any of these ways is as environmentally useful as improving the gas mileage of the truck. Either way, less gas delivers more food to the intended consumers, to people rather than bacteria and fungi.

Or, to put it another way, fertilizers, pesticides, packaging, and preservatives are the chemical keys to the best solar-power systems in widespread use today. They permit us to capture far more energy from the sun, far more efficiently, using less land. In return for the modest amounts of oil required to make them, they substantially boost the performance of the best solar-power engines yet invented, green plants.

End to end, Hard agriculture transforms earth, sun, chicken, and cow into edible calories much more efficiently than Soft alternatives. Does it also impel us to eat less? Of course it doesn't. "Efficient," as I argue further a few pages hence, is not synonymous with parsimonious or frugal. In fact, they have nothing to do with each other at all.

CUTTING BUTTER WITH A CHAINSAW

Difficult though it may be to believe, Hard is far more efficient than Soft in meeting the rest of our energy requirements, too.

It is, indeed, difficult to believe. Big central power plants seem so obviously dirty and inefficient that Softs almost never bother even to check the numbers. The Sierra Club repeatedly urges the nation to "stabilize national electricity demand," and fancy charities give big grants to promote that end. When General Motors announced its first plans to develop an electric car, the Natural Resources Defense Council dismissed the idea with a sour wave at power plants. "We have to generate the electricity somewhere," grumbled a spokesman, "and that would create a great deal more pollution."

Yet the engineering facts are beyond serious dispute. It is more efficient, and a whole lot cleaner, to burn fuel and distribute electricity than to refine fuel and distribute gas or gasoline. This is true whatever fuel you're using, including the ones Lovins favors—wood, trash, agricultural

waste, and hydroelectric power. If you're going to use such fuels at all, big and central is much more efficient. Contrary to all small-is-beautiful intuition, it's better to burn fuel in the external-combustion engine of an electric power plant than in the internal-combustion engine of your average car.

A good electric power plant converts about 35 percent of its thermal energy into electricity, and the best ones approach 50 percent. Subsequent losses in the transmission grid are small. The best car engine can convert barely 20 percent of its heat to torque. Transmitting electricity, charging a battery, and running an electric motor entail some energy loss, but refining oil for cars entails even more. Going electric means lower pollution right off the bat.

So if you have to cut grass two hours a month, use an electric rather than a gasoline lawn mower; leaving it to the central power plant to turn the blade will generate less pollution, not more. Cook a two-pound meatloaf in a microwave rather than a gas oven, for the same reason. Dry the paint on a new car with ultraviolet light rather than gas heat. Produce one pound of steel in an electric mill rather than a blast furnace. Or drive nine miles to work in a car powered with electricity rather than gasoline. Each of these choices redirects fuel consumption from a small, wasteful, dirty, end-of-the-line burner to a large, efficient, comparatively clean one. Each will save about a pint of gasoline or the equivalent and thus avoid emission of about two pounds of carbon dioxide. Emissions of nitrogen oxides, unburned hydrocarbons, and carbon monoxide will be reduced by 90 percent or more. Using electrically produced microwaves or ultraviolet light to dry paint, newsprint, or wet clothes can be still more efficient, because the radiation is tuned or aimed to heat just the right thing. The green who prefers real numbers to metaphor clamors for more centrally generated electricity, not less, whatever the fuel used to generate it.

Harder fuels have a second big advantage: They invariably burn cleaner. However lovely it may look in the rich man's fireplace, wood—biomass—is a filthy fuel. Far worse than coal—which is high-grade, deoxidized wood—because biomass hasn't been compressed and dried as coal has and because it is usually burned inefficiently. Natural gas is largely methane, a far worse greenhouse gas than carbon dioxide.* Beyond gas, the rest of the Soft biases end up, for all practical purposes,

*Natural gas contains traces of radon, too, so a gas turbine releases more radiation to the atmosphere than a nuke.

pushing things toward coal—not scarce, not sandpile scary, populist in fact, as it employs honest proletarian miners—and is also the dirtiest option among hard fuels.*

Where it really pays to be efficient, where minimizing consumption of materials and maximizing output of energy is essential, you don't find much that is Soft. Aircraft and military ships use fossil fuel, or better still, nuclear. Solar panels are used effectively (though by no means cheaply) on satellites in Earth's orbit, but they operate in a unique environment of intense sunlight and no gravity. On its Cassini probe to Saturn, NASA used 72 lbs of plutonium-238 to produce electricity for the probe's instruments.

Burning uranium is not easy at all; it takes enormous investment in advanced technology to make it happen. But when you finally succeed, you have a system that extracts the most energy from the least amount of raw material. Hard technology is efficient insofar as smart investment in capital substitutes directly for expenditure on fuel. The whole history of the Hard power industry is one of moving from lower- to higher-grade fuel, from higher-bulk fuel to lower, from less capital to more. It takes more capital to extract higher-grade fuel, more to make it burn, more to contain it while it burns. Anyone can gather wood and burn it; man has been doing that successfully for tens of thousands of year. But you need to gather and burn a great deal of it to roast even a single pig. Gathering and burning uranium is very much harder, but a tiny volume of it, prepared just so, can heat and light an entire city. From wood to coal to oil to uranium, the harder the fuel the less natural resource you need, the more capital it requires to burn, and the more efficiently you can transform stored energy into power. The equation is really as simple as that.

As for Lovins's scorn about cutting butter with nuclear chainsaws, he has the thermodynamics exactly backward—He is just plain wrong about the basic physics. High temperature indicates only that a lot of energy has been released fast, in a small space. How efficiently or otherwise that energy gets transformed into what we ultimately want is a completely separate matter. Thermodynamically speaking, however, high temperature is a sign of *low* entropy, the closest heat itself can come to what you are trying to extract from it, which is useful work. Very high temperatures, in other words, are the one sure indication we have of *high* efficiency, not of low!

*Dirtiest for the proletarian miners, too, as countless cases of black lung disease attest.

With today's technology at least, "hard" is in fact thin. "Soft" is in fact fat.* That might change; technology does sometimes change such equations. Mainframe computers were once far more efficient than PCs, but they no longer are today. Energy systems might go through a similar transition. Internal combustion engines, for example, might improve to the point where they beat mass transit, and if they do we will be sorry to have invested wastefully and destructively in things like roadbeds for trains. A fully loaded minivan is already a lot more efficient, per passenger, than a half-full train, especially when you take into account all the extra effort and energy wasted getting to and from the train. But for now, at least, bigger is generally more efficient.

The big, central systems are, for the most part, much more responsible in the handling of their pollution, too. An electric power plant is sited miles from urban areas. Its high-temperature, well-maintained combustors burn much cleaner, and they can be sanitized with scrubbers and such. Small internal combustion engines, by contrast, stick close to people, as we find out quickly enough when stuck in traffic behind a bus or truck. And when it's up to millions of individuals to tune the engine and maintain the catalytic converter, millions won't. Finally, the big plants can use much cleaner fuels; if the public will let them. So long as it remains contained, uranium is a zero-emission fuel.

Soft Greens themselves strongly favor mass transit over private cars. Yet buses and trains are big, relatively centralized, and more polluting, until you take into account the fact that they carry many more people, and then they are recognized to be very clean. If they had to pick their favorite transportation system in the west, most greens would probably nominate the French bullet train. It is indeed a marvelous, clean, efficient, well-run system. Electric, too. And France generates most of its electricity with breeder nuclear reactors.

PROFLIGATE EFFICIENCY

We know we should eat less, less fat, less food in general. We know it would be better for us and (thanks to the learned Dr. Samaras) we know

*There is only one notable exception. Lovins favors cogeneration, too, in which factories and others burn fuel on their premises to generate both electricity and heat. The numbers there are very attractive: Such arrangements can indeed beat central power plants hands down, because "waste" heat is put to good use. The private sector knows this, too, and cogeneration has been rising steadily.

it would be better for the environment, too. We know, but we gorge anyway. Richard Klein explains why, in his 1996 exegesis *Eat Fat.*[3] Fat tastes good. Fat is not beautiful—Klein doesn't quite persuade on that score, though he tries valiantly—but fat is indeed very comfortable, especially in the making. We really must cut down, we murmur sadly, as we step off the bathroom scale and contemplate a wardrobe of unwearable clothes. For consolation, we head out to dine with our good friend Klein.

But thanks to Lovins we can now take real comfort in knowing that our refrigerator is far more efficient than it used to be. As everything else he has touted has drifted into oblivion, Lovins can still cling to that one, big triumph. Our ceilings, walls, and floors, our furnaces, refrigerators, washers, and cars are all very much more efficient today than they were two decades ago. Nobody can dispute the real gains that have occurred *there.*

No, nobody can. No more than they can dispute the gains made with sweeteners that contain no calories and buttery tasting olestra that contains no digestible fat. We've been consuming more and more of such low-cal and no-cal substitutes for the last twenty years. And the gains are there for all to see. You can read them on your own bathroom scale. Diet sodas in hand, Americans have grown fatter and fatter.*

With diet refrigerators for our diet sodas, we have gained power plants and coal mines, too. The United States consumed 71 quadrillion BTUs of energy† in 1975 and 91 "quads" two decades later, a gain of a quad a year, the arrival of all that wonderfully Soft efficiency notwithstanding. Fossil fuel consumption rose about half a quad a year.†† Coal has displaced some oil, but year by year, the average American consumes more total BTUs of energy, not fewer. More electricity, too. The average American will increase his annual consumption of electricity by about two megawatt hours in the course of the 1990s, a bit more than his increase in the 1980s.

The most striking thing about the overall trends is that if you chart them over time you simply cannot discern the energy conservation movement at all. With only minor dips and blips here and there, the

*Michael Fumento lays out all the dispiriting details in his 1997 book, *The Fat of the Land: The Obesity Epidemic and How Overweight Americans Can Help Themselves* (New York: Penguin Group, 1997).

†A quadrillion is 1,000,000,000,000,000. A quad of BTUs comes in 183,000,000 barrels of petroleum, 38,500,000 tons of coal, or 980,000,000,000 cubic feet of natural gas.

††Some of this story is told in a patchy but useful 1997 book by Herbert Inhaber, *Why Energy Conservation Fails* (Westport, Conn.: Quorum Books, 1997).

curves are all quite smooth and steady. They just keep rising, decade by decade. Judging from the curves, Lovins never exhorted us to conserve energy, and we never responded: Nothing ever changed at all. The only thing you do see is that the mix changes, sometimes for the worse. Some oil has been displaced by an older, dirtier, more greenhouse-gas-producing fuel: coal.

Now, you can blame some of the steady rise on population, which increased from 215 million to 263 million in the same twenty-year period. But even the per capita figures are discouraging. Petroleum usage dropped a bit, from 152 to 132 MMBtu, but coal rose sharply, from 59 to 76. Annual per capita usage of all fossil fuels combined dropped modestly, from 303 to 292 MMBtu. But per capita energy consumption rose from 327 MMBtu in 1975 to 346 MMBtu in 1995. The Softs point out that we are doing better than in the baby-boom 1960s. We are, but for reasons that have less to do with the design of your fridge than with the design of your family. They point out that "rates of growth" are slowing. They are. If you gain five pounds a year, every year, your "rate of growth" (as a percent of your current weight) will steadily shrink, too. But your waistband won't.

The overall trends are obvious to anyone but those wholly lost in their Negawatt daydreams. Electric power—the hard kind—is inseparably linked to economic growth. Gross domestic product grew at 3.9 percent a year between 1950 and 1973, and electricity consumption grew fast. With the stagnant 1970s factored in, the economy grew at a more modest 2.6 percent a year between 1973 and 1997, and electricity consumption grew, a bit more slowly, with it. Hard power and economic output march hand in hand. They are joined at the hip. Efficiency doesn't affect them at all.

Why should we be at all surprised that higher efficiency does not translate into lower consumption? Soft Greens should be the least surprised of all. It was *their* Malthus, after all, who predicted that population would expand to consume the resources available. Efficiency expands resources. No Soft Green Malthusian can take the slightest comfort from the per capita numbers. Population has grown. Total consumption has grown. It has grown while—and indeed because—we have grown smarter at using what we have. At the turn of the last century, electrical generators operated at about 1 percent of theoretical limits; today's generators generate fifty times as much electricity from the same amount of fossil fuel. But overall they also burn fifty times *more* fossil fuel today, not fifty times less.

For a before-and-after comparison, consider again the *Titanic*. Two replicas of the ship are now under construction, almost a century after the original sank.* They will look much the same to passengers, but not to engineers. No modern ship operates on a coal-fired reciprocating steam engine: The new *Titanic* will burn diesel. All four funnels will now be dummies. Five diesel generators will occupy about the same space as five of the *Titanic*'s twenty-nine boilers. Below the waterline, the hull will have a different shape, a bulbous protrusion at the prow. The original's design was good for its day, but naval engineers have since discovered that these dolphin-like additions prevent the formation of an energy-robbing bow wave, improving fuel economy by about 4 percent.

No regulator required any of these considerable improvements in efficiency;† profit-maximizing capitalists discovered and implemented them all. But be that as it may, the replicas are, without doubt, considerably more efficient than the original. So what? Scrapping the other 24 boilers, and all 159 furnaces, will free up lots of space, to carry more passengers, more cheaply. The diesel generators will provide electricity for both propulsion and everything else on the ship: lights, air conditioning, hair dryers, and at least twice as many passenger elevators as the three on the original. Even the Astors and Guggenheims didn't enjoy any remotely comparable range of power-hungry electrical amenities. The replicas will be lighter, more efficient, and safer, more everything that Soft Greens endorse. But not more frugal. These improvements are not emblems of modern frugality at all. They are emblems of modern, middle-class bulge.

THE TRICKLE-UP FALLACY AND THE WEALTH EFFECT

However unlikely it may seem, the individual consumer can easily end up consuming more, not less, as all his motors and engines get more effi-

*In 1998, the keel for a full-scale replica of the original *Titanic* was laid in Durban, South Africa; the maiden voyage is planned for December 1999.

†What *has* environmental regulation contributed in this context? In the original *Titanic*'s day, garbage and waste, sanitary and bilge water were simply thrown overboard; replicas will need modern sewage treatment plants and garbage compactors. Ship construction and safety regulations have been tightened, too, of course. *Titanic*'s sister ship *Britannic*, under construction at the time of the disaster, couldn't be built to the original plans; its older sister, the *Olympic*, was put into dry dock for a major overhaul that included massive structural changes.

cient. He almost always does. The Soft Green's fallacy here is obvious. It is the trickle-up fallacy. It is the same fallacy that tells you that when you drink a Diet Coke you are dieting. The problem with trickle-up theories is that the trickling often doesn't head where people assume it must. Most of the time, the Diet Coke trickles down onto a large order of fries.

More efficient means much the same as less expensive. Most of the cost of owning a refrigerator lies in running it, and refrigerators do indeed run much more efficiently than they used to. So people can now buy bigger ones, and that is exactly what they do. And better ones: frost-free units with ice makers, which gobble up almost all the energy saved by the super-efficient compressor at the back. What buyers want is the most refrigeration for the money. A diet-soda compressor at the back justifies the extra-large brownie out front. It's the same with planes, cars, and just about everything else. More efficient engines mean cheaper travel, so you travel more. Today's soda cans contain one-fifth the aluminum they did three decades ago, but the number of cans purchased has grown by an even larger multiple. Fat people often insist their metabolic rates play similar tricks to thwart their diets. But whether or not metabolisms are that nasty (they probably aren't), the energy economy certainly is.

The second factor—an even more important one—is the wealth effect. At some point people just don't want any more ice maker or air travel. But people always want more money, and they find ways to spend it. With all that money saved by your gas furnace in the basement, you fly to Aspen for a weekend in the snow. If appetites didn't compensate for "savings," such trade-offs wouldn't happen. But if appetites didn't compensate, diet sodas and olestra would help us shed pounds, too. They don't.

Indeed, Softs themselves, or their close political allies, have been telling us that for years. In their many campaigns to limit or ban such products, they have invariably insisted that "diet" foods do no good at all. The average American has added the sugar equivalent of a pound of no-cal sweetener to his diet every year, and a pound of real sugar every year, too. People subconsciously adjust. The Diet Coke tastes even better with a double-fudge brownie, and that's how most dieters drink it.

With calories and BTUs alike, the story is just the same. Amory Lovins simply peddles the energy equivalent of *Thin Thighs in 30 Days* to an upscale policy market in Washington. The conservation "savings" have gone the same place as all the "savings" from diet sodas and fat-free potato chips: into belly and buttock. Lovins promised "technical fixes" that would entail "no significant change in how we live." So do all peddlers of quick diets. So do the people who sell aspartame and olestra, though they are generally more honest in that they promise less. But the thighs are not getting thinner, not in thirty days, not in thirty years. The fact—the dismal fact—is that we have done what the book told us to do, but the cellulite is still there.

The only surprise is that so many are surprised to hear this. Most Americans want to cut down on calories, but don't, even though the results of failure are personal and unpleasant, even though success is so visibly healthier, sexier, and rewarding in every way. How then can we expect success with the low-cal car or fridge? Most other forms of "fat" are not ugly to the average eye, they are rather attractive, which means that shunning is harder still. Unlike a banana split, a bigger refrigerator won't make you feel miserable the day after; it will just make you think how convenient it really is. You need it for all your diet soda. Big cars do ride better, especially on big highways. As Madison Avenue well knows, a great number of American drivers would rather like to drive 125 miles an hour on an autobahn: The nasty truth is that more than a few people find the idea thrilling, some even apparently consider it sexy. And if the woman in the passenger seat of the Mercedes is blonde, the man in the driver's seat is tall. The five-foot-four Samaras says it himself: Tall men get better jobs, better money, better girls. The psychological deck is perniciously stacked against the small.*

So "efficient" has nothing to do with "frugal" at all. Our atavistic appetites, our genes themselves, remember famine and cold too well to be fooled by Nutrasweet. However much our plenty, we will hunt and gather more. It isn't good for us, and it isn't good for the environment, and nothing stops it, nothing at all, not efficiency, not politics, not even war. Nobody who has actually looked at the scale and examined the long-term trends can possibly believe otherwise.

Or that, in any event, is where I shall leave it for now. As I argue in Chapter 9, efficiency does turn out to have one great, green grace, after all. The right kind of efficiency, the kind discovered by markets rather

*Even the fates seem to conspire against efficiency. Samaras doesn't quite finish the story. Big people require larger coffins when they die—more resources, there—but they die earlier. "(A)bout one year per inch" earlier, Samaras notes. What he does not note is that during their extra years of life, the short still eat, drink, drive, dress, and wash. Which—if you crank the numbers—suggests that on a life-time basis consumption by short and tall may pretty much even out, in the end.

than by Soft Green regulatory bureaucrats, makes us richer. And among its many virtues, wealth is green.

COMFORT FOOD, CALORIES, AND QUADS

Lovins prescribed comfort food to a nation snarled in endless lines at the gas pump. His story was perfectly tuned to its political times. Significantly, it was published first in *Foreign Affairs*. Why there? The Arab Oil Embargo had just hit, more threatening to the American way of life, it seemed, than nuclear weapons. America wondered if she might go out not with a bang, but with a whimper, not in fire, but in ice. Arabia, our best-loved McDonald's, had announced it would stop serving up the quadrillions. Lovins proposed some home cooking, from ingredients we already had on the premises, that no Arab could take away. We had plenty of nothing, but nothing would be plenty for us. It would be a safe plenty, too, not a scary one. Within three years Three Mile Island would make nukes scarier still. Nukes offered the energy equivalent of plastics and pesticides. Lovins promised unscary plenty, home grown, natural, free of all poisonous preservatives.

It sounded so plausible, so reassuring, so good. What a pity that it was pure bunkum, beginning to end. Technology has grown steadily more efficient in every decade of this century, including the last two. Efficiency remains a perfectly sensible thing to pursue, in power plants, refrigerators, in agriculture, too. It is as useful to save energy as it is to save time or Christmas wrapping paper. Which is to say, sometimes it's worth the trouble, sometimes it isn't. For the happy few who include them in a real diet rather than a fake one, low-fat potato chips offer a chance to brighten an otherwise spare meal. That's about all the people who sell such chips ever promise. Which makes them the most honest people in all the energy conservation chronicles. Lovins and his acolytes sold something more along the lines of *Thin Thighs*. There was to be no real pain. We could eat what we liked, so long as it was all tofu or pure chocolate washed down with wine, or macrobiotic pounds of avocados.

Catering to people's unscientific tastes and fears is perfectly legitimate. Soft sells. Madison Avenue knows that, too. It invents entire campaigns around fictitious uncles who brew beer on their back porches and fictitious aunts who whip up pancakes on their very own griddles, just before bottling, boxing and delivery to a supermarket near you. Mom's cooking tastes like love, even if it tastes like lard, too. It is perfectly fair to insist

that it tastes better than a tofu burger, better than any gene-altered tomato drenched in artificially colored ketchup. It is equally fair, of course, to prefer Mom's station wagon to the school bus. We just aren't free to assert that lard is healthier than sushi, or that cars get better per-passenger mileage than buses. The station wagon certainly feels safer than an econo-box, driving 70 mph is more convenient than driving 55 mph, and safety and environmental effects are what they are, not what we might wish them to be. Calories and quads are not hard or soft, they simply are. Fat and thin are not states of mind, they are states of avoirdupois. And anyone who cares to know the truth about *that* can examine the scale. The needle keeps rising.

Thus, obesity and cancer become, correctly, our new, post-Malthusian metaphors, the metaphoric opposites of starvation. Malthus said we would starve when we ran out of land; the Softs now tell us we will run out of land because we gorge. We swell and swell until we have absorbed everything: the whales, the redwoods, the elephants, the sandworts, and all the rest. The fatter the humans, the thinner the land.

Yet that, curiously, is the one thing that is *not* happening. There is something important we *have* begun to save in recent decades, something that we are using much more efficiently, and using less of, too. What we are using less of is land, the Earth itself. I return to this kind of efficiency, the only one that matters for environmental purposes, in Chapter 7.

powerful at spreading material human wealth so very widely that we now need government programs to institutionalize poverty, at least here and there. Conservation areas are poor, in Malthusian terms: They produce no food for human consumption, they generate no ordinary economic wealth of any kind. We guard them jealously for just that reason, because beauty is scarce, too, and because the wonder of the wilderness is something that no market can create.

7

Save the Earth

England was once heavily forested. The forests were all cut down, first to clear land for farming, then, at a much faster rate, to build warships and provide fuel. They never grew back.

The people of the day saw it coming. As the wealthier elements of society began to grasp what was being lost, forest conservation rose to prominent concern in seventeenth-century England and France. Then England found a substitute—coal. Coal was soon being used widely to make glass, bake bricks, brew beer, and heat homes. Newcastle eventually emerged as London's principal supplier. Coal made possible cement, bricks, and steel, which eventually replaced hardwoods in construction of buildings and ships. Had coal emerged a century or two earlier, the great forests of England would still be standing today.

In this century, too, we have witnessed an even more remarkable environmental shift: the rapid *reforestation* of the American continent. For the first time in history, a Western civilization has halted, and then reversed, the decline of its woodlands. What happened? Quite simply, America reduced, dramatically and rapidly, the amount of land it uses to produce its food and energy. The recent trends in the oceans and waterways under U.S. control are equally positive. One cannot say the same of most other countries. But we can say it of our own.

There is nothing ambiguous about the trends. So far as the simple, most direct, and most important measure of environmental quality is concerned—the total area of the Earth's surface directly exploited for human consumption—the trends are incontestably positive. People are

still getting fatter, but no longer off the fat of the land. Not any more. The land itself is getting fatter again, too.

The credit does not belong to T. R. and the conservation movement. Still less to the Soft Greens. We are saving the Earth with the technologies that the Softs most passionately oppose.

LIFE ON THE SURFACE

Before getting into the technology, however, we should pause to savor what an environmental miracle this truly is.

All modern estimates of species extinction assume a one-to-one correlation between acres put into human use—for agriculture, shopping malls, or anything else short of nature conservancy—and the reduction of wildlife in the biosphere. Most of the displacement is occurring in the Third World, for agriculture. Acres of cassava are not acres of rain forest. Cow pasture isn't prairie. Without doubt, the best environmental strategy of all is to literally save "earth": not just land, of course, but also stream, river, lake, and the life-bearing layers of ocean and air.

That is, indeed, the *only* effective strategy. This is just a matter of basic ecology. Life on Earth has evolved on the surfaces and at the edges, at the interface between land and air, land and water, water and air. With few exceptions, all life on Earth dwells within a few hundred feet of the interfaces. The less we disturb the interfaces, the better it is for the biosphere. It is as simple as that.

The Soft Greens say as much too, although rarely so directly and never drawing the right conclusion if they do. Where they say as much is in every one of their sandpile scenarios. With oil, the primary environmental concern is not the derrick or even the offshore platform, still less the drill bit a mile below the surface. The concern is not oil securely contained in the *Exxon Valdez*, it is oil spread for miles across Prince William Sound. It is spill, the ruptured pipeline, or the burning of the fuel, all of which spread the liquid fossils and their by-products across the surface, where the life is. With nuclear fuel, the environmental concerns likewise center on the accidental spreading or on the deliberate spreading by way of terrorists or nuclear war. So long as the fuel remains contained, from extraction to final disposal, nobody can much doubt that nuclear power is environmentally superior to the alternatives.

With all these technologies, in short, the Soft concerns center on the collapse of the sandpile, the accidents that might spread fuel or its by-products far and wide over the surface. So long as the materials in question stay deep underground or secure in the tanker or concrete reactor vessel, the surface, where the life is, stays green. Soft and Hard part company only insofar as they sharply disagree about the stability of the pile. The Softs believe that uranium is safe for the environment only so long as it remains buried wherever geophysical history buried it. Hards believe it is at least as safe when extracted, enriched, and contained in a reactor of human construction. Both believe that these are not materials we want spread across the Adirondacks, the Everglades, or Prince William Sound.

If the Softs are right about the sandpiles, then of course we should not be building them, not if we care about protecting life on the surface. If the oil and uranium we extract from deep in the Earth are bound to end up being spread far and wide across the surface, then we should obviously stop extracting them. If the Softs are right, high technology just provides new chainsaws for leveling the forest, albeit at more unpredictable intervals.

But suppose they are wrong about the sandpile. What then should true greens think of high technology? What then should true greens think of the Softs themselves?

LIFE IN THE THIRD DIMENSION

For most of history, humanity has grown on the Earth's surface alongside all other species, and humanity has gradually subdued them as it grew. For most of human history, we have contrived ways to disturb the Earth's surface more, rather than less. Every advance in human technology was used to extend our dominion over that surface. It could hardly have been otherwise. We evolved on the surface, too, so that was of course where we hunted, gathered, and cultivated. The surface—land, river, and shallow coastal waters—supplied all our food and, until very recently, all our fuel. To this day, our main use of land is to capture solar energy. Not with solar panels or windmills, but by growing crops.

And, until recently, the more our appetites and populations grew, the more land we consumed. Consumed it to produce our food, to supply building materials for furniture, homes, and ships, and especially to produce our energy. Capturing useful quantities of solar energy is extremely land-intensive, for the simple reason that solar energy is very diffuse. The most efficient way we have found so far is hydro-electric. The Hoover Dam captures solar power by harnessing the Earth's own water cycle, a

low pressure, high-volume, solar-heated steam engine. Until the 1930s, most of our electricity was hydroelectric, because until then hydro remained cheaper than thermal power from fossil fuel. But dams disrupt a lot of land and water, both upstream and down. Soft Greens hate them.

It was by learning to take more of what lies far beneath the land that we learned—only very recently—to use so much less of the land itself. This is the most important ecological truth in all our environmental debates about energy, and it is the one Amory Lovins got horrendously wrong. The best way to save the biological environment is to do things *away* from the surface, away from places where the living things dwell. The best way is to do the dirty work in the third dimension, rather than doing it in the first two.

In the last century or so, that is just what we have begun to do. Digging deep has done much to save what remains of our hardwood forests. Plastics, cement, and steel have replaced hardwoods as our main construction materials. Environmentally speaking, the high-rise apartment building in the city is doubly frugal: it houses many people on a small area of surface, and it is built largely from materials extracted from the dead depths of the earth, rather than materials harvested from the living surface.

Mining the depths has delivered even greater environmental benefits in connection with food and energy. We use less land to grow food because we convert oil into solar-power-enhancing additives: fertilizers, pesticides, and plastic packages. And still less land because we bioengineer high-yield crops, develop growth hormones for our cows, use better preservatives, and irradiate our food. Preservatives, packaging, and irradiation all save food, and thus save land. So do frost-free strawberries and genetically engineered tomatoes.

End to end, we keep increasing the efficiency of our agriculture, which means we extract more solar energy out of less acreage. Technology historian Jesse Ausubel calculates that worldwide, a land area the size of the Amazon basin has been spared since 1960 simply through the improvement of agricultural yields. Aquaculture, a booming new industry, is the energy-intensive, feed-rich cultivation of fish in ponds, artificial lakes, and ocean cages. Americans are eating more fish than ever before, but we are getting it out of far less water, with far less harm overall to oceans. By 1800, whale populations were in precipitous decline. Greenpeace didn't save the whales, Colonel Edwin Drake did. Leaving the Arctic Ocean to others, he mounted his harpoon on a derrick in Titusville, Pennsylvania. He began pumping oil commercially in 1859.*

*That same year, an ocean away, Charles Darwin published *The Origin of Species*.

So far as the rest of our energy supply is concerned, we are feeding off the fat of the coal, the oil, and the uranium. What we mine from the depths of the Earth now substitutes directly for what we would otherwise have to reap, harvest, gather, scrape, and flood from a vast area on the surface. Coal and oil deposits contain a lot of energy because they represent thousands of years of captured solar energy. Coal is dead trees, fossilized biomass, solar energy refined first by nature, then by geological process. Eight hundred million years ago the Earth's air was mostly carbon dioxide. Green plants evolved and flourished in such profusion that they sucked up most of it. Some sank into swamps and sank deeper. Coal is simply yesterday's landfill, all the stuff that didn't get recycled or composted. Uranium—radioactivity—is "solar" energy of another kind, even more elemental. It was formed through the same condensation of matter as the sun itself. Tiny volumes, extracted from a truly minuscule amount of real estate, could power all human activity on the planet for ages to come. Lovins is right about one thing: When we use those fuels, we are indeed living off "capital": *solar* capital, dead capital, immeasurably vast amounts of capital condensed or buried deep in the Earth at the creation itself or over billions of years thereafter.

Even mining and extraction affect the local environment, of course, which simply means that we should favor places and means that affect it the least. The more energy rich the fuel extracted the less disruption there will be. Generally speaking, the greenest fuels are the ones that contain the most energy per pound of material that must be mined, trucked, pumped, piped, and burnt. Coal is the least good hard fuel by that standard, oil is significantly better, and nuclear is millions of times better still. Strip mining is more environmentally disruptive than shaft mining, even if shafts are more dangerous for the miners. It is better to drill for oil in a desert, or over permafrost, than in a Louisiana bayou. There is a lot less life in those places to disturb.

We use considerable amounts of all these hard fuels. Extracting comparable amounts of energy from the surface would entail truly monstrous environmental disruption. Light and heat, and their immediate by-products, biomass, wind, and rain, are thin, diffuse, and difficult to harness, by comparison with hard fuels. To capture even a modest amount of such forms of energy requires a great deal of . . . *land*. You have to occupy a lot of land, a lot of surface, and you have to scrape it clear, again and again. Yes, you can live off this current energy "income" all right. It is the income that a wheat farmer captures in Idaho and that a cassava farmer captures in Brazil. But endless miles of wheat are not

biodiverse prairie. They are "green" only in the most superficial and misleading possible way.

So what do the Softs advise? Not another Hoover Dam, exactly, but its environmental equivalent. Amory Lovins exhorts us to live off the land once again. We are to grow vast plantations of guayule. We are to become Soft, post-industrial Bushmen, hunting and gathering our energy where we can find it, just as we used to. We are to burn wood, garbage, bacterial mats, sunflower oil, buffalo gourd, peanut shells, chicken droppings, and tallow from lambs. Or if we get ambitious enough, we may build the Hoover Dam again, but we have to build it (at enormous expense) fifty miles off the Scottish coast. The world's first commercial wave-power station was indeed built there. It sank in a storm in 1995 less than a month after it was launched.

To Hard Green eyes, the prescriptions of the Softs are grotesquely perverse. However good the intentions, the results are wantonly destructive of the environment. Stop using premium fuel in big power plants, Amory Lovins instructs. Prefer instead the fuel that led to the deforestation of all England, the fuel of the Third World today: biomass. Cow dung, in India. Wood in much of South America and Africa. And for the west, guayule or chicken excrement. The Hard Green recoils. This is a prescription for destroying land, not for saving it.

Everything Lovins would have us use for energy is land intensive. It has to be, because the only current energy "income" the Earth has is solar energy, and solar energy is very diffuse. Softs say that rooftops provide free acreage, but they rarely do, for a wide variety of reasons. Not the least of which is that in the city, where the most people dwell on the least amount of land, there is far too little rooftop to do the job. And because they are land intensive, Soft energy sources are the very antithesis of green. Farming wind is even less green than farming wheat. Wind farms litter the landscape, they kill birds, they are horribly noisy, and they generate only trivial amounts of power. Nobody talks about growing guayule any more: It requires vast amounts of land, yields little oil, and causes debilitating skin rashes. Wave machines generated ear-piercing screeches, but no useful power.

It is just as bad with food. "Organic" food requires far more land to produce—and is therefore far less green—than land-frugal, factory-farmed alternatives. The modern pursuit of absolute "purity" in our food is pleasant, for humans. But it takes more out of the rest of the biosphere, not less. The whole back-to-nature, farmer's market theory of Soft

Green, the entire psychological infrastructure of the movement, is anti-environmental. Taking five billion humans "back to nature" is the worst possible thing we could do, not only for the humans but for nature, too. It is when Monsanto develops a new pest-resistant corn that doubles the farmer's yield per acre that something really is saved: land itself. Same with a growth hormone that delivers more cow and milk on less pasture.

Imagine, now, what would happen if the acolytes of Soft somehow did develop a fantastically hardy and productive guayule plant, one that could grow oil for us in our very own forests or prairies more cheaply than we could drill it out of the desert in Saudi Arabia. That would certainly be the end of our forests and prairies; they would all be plowed and planted in short order. Imagine a super-efficient aquatic weed that might do the same at the edge of the ocean, a super-Sargasso sea, producing oil even more cheaply than a derrick. There would soon be millions upon millions of acres of the weed under cultivation, instead of coral reefs and all else that dwells there now. Imagine what would happen if solar cells ever became "too cheap to meter." We would plaster our rooftops with zero-cost solar collectors, but they wouldn't come close to powering the lights and computers in a high-rise. So we'd cover Kansas and Iowa, too, pretty much as we do now, when we grow wheat and corn, the cheapest collectors of solar energy currently at hand. The more energy we needed, the more surface we would cover. The effects would be about as benign for the environment as strip mining the continent and paving it with asphalt.

Soft Greens would have us live once again off the surface. Hard Greens are bottom feeders. Softs advise us to consume live fuel. Hard Greens dig for dead. Soft energy sources consume the surface of the land. Hard ones consume what lies far beneath it. They are Bushmen, we are troglodytes. With food and energy, the Softs prescribe the environmental equivalent of suburban sprawl; Hards prescribe the equivalent of living in the city. Lovins, an American expatriate in Britain during his intellectually formative years, never grasped the historical lesson of that small island. "Soft" energy sources are horribly land intensive. England was Soft until the 1600s. If it had gone Hard a century or two earlier, it would still have its great forests. But it didn't. The English did instead precisely what Amory Lovins advises us to do. They lived off the surface of their land, not its depths. They scraped and chopped their fuel from the surface, wherever they could find it.

Happily, we Americans changed course before we had completely deforested our own continent. And happily a second time, we gave Lovins

a polite hearing and then forgot all about him. We stuck with the Hard path. We stopped gorging on the fat of the land, as Lovins urged us to do. We continued to do our gorging, instead, far below the surface.

Doing things in the third dimension is difficult, but it is also green. Doing them in the first two, though said to be Soft, is more difficult still, and less green. The best we can do to conserve life at the surface is to find our energy, and do our traveling, somewhere else—in mines, tunnels, or jets—anywhere but on the surface where the life is. It is far more environmentally friendly to live in the three-dimensional city than in the sprawling two-dimensional suburb, in the high-rise rather than on the ranch. Planes use a lot of energy, but they are kind to the land, far more so than trains, which devour real estate. The greenest possible strategy is to mine and to bury, to fly and to tunnel, to search high and low, where the life mostly isn't, and so to leave the edge, the space in the middle, living and green.

SCARCITY

But we will run out of third-dimension stuff, the Softs reply, because it is not self-renewing. Oil, for example. Of course we will run out, some day. Malthusian doom can be predicted in three dimensions as easily as in two. But all experience teaches that before the doom arrives, human ingenuity comes up with something different. Uranium alone would serve as a complete substitute for such a long time to come that when that distant day arrives we might easily be gathering energy from the vicinity of Alpha Centauri. As I discussed in Chapter 1, *The Limits* modelers simply fail to confront the sheer vastness of the Earth itself. Weighed in three dimensions as it must be, the planet is truly huge. Its resources remain unmeasurable but vast.

On another front, Soft Greens now foresee a looming scarcity of genes. Species are being extinguished by man's relentless expansion across the face of the planet. While one may argue about the details, the trend surely is in that direction in most countries, although not in the United States. But even here, the Soft Greens muddle the diagnosis and obstruct the cure. We will need the genetic stock of the rain forest in future years, the Soft insists, to harvest cures for cancer or disease-resistant food crops. But genes are just complex chemicals. Darwin's Invisible Hand concocted the particular mix of DNA found on the surface of the planet at this moment in evolutionary history, not Adam Smith's. Except,

that is, in kennels, stables, and experimental farms, in fermentation tanks and gene labs, where capitalists readily cook up genetic diversity for themselves: Chihuahuas and St. Bernards, frost-free strawberries and disease-resistant corn, and transgenic pigs. And it is surely greener, all in all, to cook up genes in a Genentech laboratory than to harvest them from the upper reaches of the Amazon. *That* path to genetic diversity, much reviled by the Softs, is the only one that lets us leave the rain forest alone.

It is the rise of the sandpile, the rise of technological complexity, that averts scarcity of everything: food, energy, genes, life itself. The only limits to how much food we can grow, energy we can extract, houses we can build, miles we can travel, pigs we can breed, diseases we can cure, are the limits of human ingenuity. And they keep receding. The Malthusian limits will never arrive.

The Faustian limits might. Globally, the one real, growing scarcity is scarcity of green. Theodore Roosevelt saw that a century ago, and we certainly see it today, notwithstanding the real progress we have made. We are all the more conscious of green scarcities today because our love of the wilderness has grown along with our material wealth. As our ordinary needs are satiated, we crave all the more the things that T. R. cherished a century ago, the hidden spirit of the wilderness, the silent places, unworn of man.

The Softs see scarcity everywhere, scarcity of wood pulp, corn, aluminum, and oil. So they hector us from every side to husband and squirrel, to conserve and recycle. The Hards discern only one scarcity, scarcity of wilderness, of untouched forest, lake, river, shore, and ocean. The Hard Green is not distracted by a thousand phantom scarcities of dead things that are easily extracted from deep in the Earth. He focuses on the one great scarcity that matters, the looming scarcity of wilderness and wildlife at the interface.

EXTERNALITY

Many conservation objectives today involve things more fluid than forests, clean rivers and clear air being paramount among them. Such objectives are as much a part of the Hard Green agenda as of the Soft; we part company only when the pursuit shifts from visible green aesthetics to trans-scientific phantoms.

Saving the Earth—the Hard way—is the cheapest, most effective, and most pleasant way to control pollution. Conservation—the T. R. kind—

is by far the best way to purify air, water, and earth. As I noted in the last chapter, the most beautiful way to purify water is probably the most effective too: maintain unspoiled watersheds. The most effective way to suck carbon out of the air is to grow trees.

The most cogent Soft objection to a fossil-fuel economy is that if we dig up and burn all the fossilized plants of the Carboniferous period, we can expect to recreate the atmosphere of that period too: a carbon-rich hothouse. So what, the hardest of the Hards reply? Carbon dioxide is a nutrient for plants, so the planet will just get greener still. The rain forest will come to Idaho. And as for Miami being under twelve feet of water, well, it is curious to hear Softs opposing what's good for the rain forest because of what's good for the metropolis. But few Hards are *that* hard. Writing off Miami is a serious business, and transforming the global climate more serious still.

As it happens, however, it won't happen, at least not if we follow the Hard road where it naturally leads. As humans leave the land they once cultivated, trees return. And if we resist the "soft" urge to cut them down for fuel or to grow corn for methanol in their place, the trees will simply . . . grow. And remove carbon from the air as they do. The mature rain forest is of little use for that purpose: The greenery sucks in carbon all right, but rot, mold, and bugs on the forest floor work every bit as hard as the trees, composting dead leaves, biodegrading everything in sight, and sending carbon dioxide straight back into the air. But *new* growth *does* sequester carbon, and lots of it. New trees are where the carbon in the coal began. New trees are the first place to which a lot of it can return.

The numbers already bear this out. America releases 1.6 Pg of carbon per year into North American air by burning fossil fuels. (A Pg, or "petagram," is a million billion grams.) Prevailing winds blow west to east. This means carbon dioxide concentrations should be 0.3 parts per million (ppm) higher in the North Atlantic than in the North Pacific. But in fact, they're about 0.3 ppm lower. That last number isn't theory, it's direct measurement. All in all, North America doesn't dump carbon dioxide into the air. It sucks the gas out. Bottom line: America's "terrestrial uptake" of carbon runs about 1.7 Pg per year, just ahead of our fossil fuel emissions. The rest of the world doesn't keep its carbon books in balance. But America does.

How do we do it? An October 1998 article in *Science* summarized the Hard answers.* First, there's "regrowth on abandoned farmland and previously logged forests." Growing new trees sucks up a lot of carbon. Hard agriculture produces so much food on so little land that we are returning lots of old farmland to forest. Second, there's uptake "enhanced by anthropogenic nitrogen deposition." That's nitrogen "pollutants" and fertilizers, for the rest of us. Third, we owe some of our carbon uptake to the coal miners themselves, the culprits in chief. What *Science* obliquely refers to as "CO_2 fertilization" promotes green growth, just as phosphates do. Up to a point, greenhouse gas is its own antidote; nature sees to that. America, in short, has reached a unique stage in its development, high technology, and land management. Alone in the world, we're reforesting and fertilizing enough to suck more carbon than we blow. We recycle our carbon. If greenhouse gas is a problem at all, the rest of the world is the problem. America is the solution.

Carbon illustrates how easy it is to overlook the green upside of Hard technology. Few Softs spend much time defending the chemical factories that manufacture ammonia or the mining companies that extract phosphates. Yet mining phosphates for fertilizer, it turns out, is a direct antidote to mining coal for fuel. There are better ones, of course. Coal itself is a centuries-old fuel. Newer, harder technologies are cleaner still.

Much of the time, as I discussed in Chapter 2, it is our own past, the legacy of yesterday's market and of nature itself, that makes the problem of pollution so difficult. Externalities are everywhere, they surround us. We can't abolish them instantly, and we can't abolish them completely. The best we can do is migrate toward cleaner alternatives, and that means tolerating some measure of new externality pollution to displace a larger measure of old. As Harvard physicist Richard Wilson has demon-

*

Carbon Budget	Fossil emissions (Petagrams/year)	Terrestrial uptake (estimated range)
North America	1.6	1.6 to 1.7
Eurasia and North Africa	3.6	–0.4 to 0.5
Tropics & Southern Hemisphere	0.7	–1.1 to 0.9
Total	5.9	0.1 to 3.1

S. Fan et al., "A Large Terrestrial Carbon Sink in North America Implied by Atmospheric and Oceanic Carbon Dioxide Data and Models," *Science* 282 (October 16, 1998): 442–446.

strated, blocking almost any new power plant is anti-green, simply because nine-tenths of every "new" plant is not new, it is just a Taurus plant replacing a Model T, cleaner, more efficient, better all around. An older facility gets retired the day the new one opens.

The opportunities for such trade-offs are multiplying, and the gains are accelerating. The microchip and the communication revolution are changing everything. The advance from T to Taurus took seven decades; in many industries, cars among them, we now expect comparable advances in seven years. Such advance means more comfort, convenience, and efficiency, more wealth . . . and more green, too. A central plank of the Hard Green manifesto, then, must be to facilitate that dynamic. As Schumpeter observed, capitalist progress is itself a process of creative destruction, of tearing down what was to make room for what will be. Green progress must follow a similar trajectory. The greenest policy is to step out of the way of that process, not to obstruct it.

This doesn't mean pouring public money into one or two technological darlings like solar cells or electric cars; it means letting private money find its own path to progress. The way to liberate technology is to liberate capital. Capital is what fuels technological advance. High technology is capital piled upon more capital, it is the confluence of wealth and intellect. Capital is what lets us tear down old markets and replace them with new ones.

EFFICIENCY

Still, energy conservation is surely better than waste—the Soft Green can at least remain confident about *that*. However scarce or otherwise our energy resources, whichever ones we use, it is still surely better for the land if we use what we use efficiently. A penny's worth of energy saved by a more efficient refrigerator, lawn mower, or car, or of paper or wood or aluminum saved by recycling, is surely an inch of land saved back at the oil well or mine.

The Hard Green's mildest response is that the amount of surface disturbed by wells and mines is tiny compared with the amount of surface they allow us to save with fertilizers (less farmland) or planes (less highway and rail track). And because their principal dimension is down, into the Earth, the amount of surface these systems consume does not rise at all steeply with the amount of material or energy they extract.

But the Hard Green can respond a lot more strongly than that, and he must. Even efficiency—efficiency of the kind the Soft pursues and prescribes through myriad, meddlesome government programs—is bad for the environment, not good. Finding new ways to live in the third dimension is sometimes efficient, sometimes not, but it is always better for the land on the surface. The Soft Green preoccupation with gas guzzlers, refrigerator compressors, and "energy conservation" in general is distracting, at best. Much of the time it is positively harmful.

As I have argued already, efficiency is surely not green in and of itself. Strip mining is more efficient than shaft mining; more net fuel is extracted by stripping from the surface than by tunneling far beneath it. But for all its efficiency, strip mining destroys more land. In a strict, thermodynamic sense, nuclear power is highly inefficient: A reactor extracts only a tiny fraction of the energy locked up in the uranium atom nuclei. But nuclear nevertheless extracts enormous amounts of power from minuscule quantities of land. When it does reduce mining, lumbering, and such, as it occasionally (though not often) does, recycling has a positive environmental impact, even if the recycling trucks run on oil.

However easy it is to confuse the two—and Soft Greens confuse them all the time—efficiency is not the same as frugality. It is easy to suppose that every time we buy a little extra efficiency, in a refrigerator or a car engine, we are saving some coal back at the mine-head, just as it is easy to imagine that we reduce our caloric intake every time we pop the tab on a Diet Coke. This is the trickle-up theory of green, the vague logic that what you save in the more efficient refrigerator must translate into savings at the power plant, which must translate into savings at the mine-head.

But as I discussed in Chapter 4, the trickling-up is by no means inevitable; there are too many other directions in which the savings may trickle. The money you save from the more efficient compressor in your refrigerator can easily trickle into a bigger refrigerator, or into a winter vacation in Aspen. It generally does, just as the Diet Coke generally trickles into a brownie. The upshot is no savings at all. We insulate our houses better, build more efficient furnaces, refrigerators, washers, and cars, and still end up consuming more electricity, more carbon fuel, not less. Efficiency is green only when it definitely and directly lightens our tread on the land and its environs. It rarely does. The new *Titanic* is far more efficient than the old, but building and filling another cruise ship, however efficient, doesn't save any earth or ocean.

The only certain effect of efficiency is to increase wealth—and it does that only when the efficiency comes about through market forces and personal choice, not coercion. In the production of goods and services, effi-

ciency enriches the producer. This is why we hardly need government edicts to promote efficiency among producers: They are quite eager enough already to promote it on their own. The builders of the new *Titanic* didn't have to be ordered by the government to replace the old design's inefficient coal furnaces with efficient new diesel engines, nor to add a porpoise's nose to the hull, at the front, below the waterline. They thought of it all by themselves.

The same holds true among consumers, the only difference being that consumers maximize personal satisfaction rather than profit. And satisfaction is, of course, a lot more personal and quirky than business profit. Sometimes it is downright perverse, environmentally speaking. Some people are pleased to do green things like biking or walking; others take pleasure in driving too fast in a 1968 Mustang convertible. It is meaningless to speak of "efficiency" in this context; for those who take direct pleasure in profligacy, as for those who just prefer not to bother about saving every last possible dollar in their energy budgets, "inefficiency"—the thermodynamic kind—is often "efficient," in economic terms. The only overall effect of forcing such consumers to buy "efficiency" or "conservation" that they wouldn't buy otherwise is to make them a bit poorer.

Setting aside land for "conservation," as T. R. did: *that* saves the Earth. So does promoting technology that moves human life into the third dimension, the dead one, and away from the surface, where the rest of creation dwells. But "efficiency," "energy conservation," and such directly affect wealth, not the environment. Efficiency—voluntary, by choice, impelled by market forces and free consumer choice—has only one definite, predictable effect: It boosts wealth. Coerced efficiency—efficiency impelled by dictate, edict, fiat, regulation, and central control—has only one predictable effect, too: It lowers wealth. Coerced efficiency, like coerced recycling, is simply another instance of doing things well that should not be done at all.

DEATH IN THE THIRD DIMENSION

However efficiently we use it, extracting all that fuel from the bowels of the Earth creates wastes. Wastes, too, are an important part of living in three dimensions. Most of the time, the best thing to do with our copious wastes is to bury them. With rare exceptions, recycling is the worst possible option.

To illustrate, consider once again the carbon cycle, at its tail end. The carbon sinks we get by reforesting millions of acres of old farmland are

secure. But the sinks created by all the ammonia-fertilized, phosphate-fertilized corn and wheat don't remove carbon from the air for long if the crops end up in a grasshopper's gut. Guts and grasshoppers reverse carbon flows, pumping carbon dioxide back into the air. So pesticides are gas-busters. So are termite exterminators.

Our own voracious appetites can take care of the rest of the excess carbon, and already do, except where misguided Soft policy gets in the way. Our own growing bodies sequester a bit of carbon, of course, though most of that returns eventually to the air unless our coffins are sealed very tightly. But the one thing a fat society does persistently and well is generate copious amounts of carbon-rich waste. About two-thirds of what we put in landfills is carbon based. And buried in a modern landfill, the carbon goes . . . nowhere. It doesn't rot. The landfills are well compacted, their contents stay dry. They are not composters, they are mummifiers. University of Nebraska Professor Craig S. Marxsen calculates that "appropriately constructed landfills could capture roughly 2 billion tons of carbon annually, right now, and virtually stop global warming cold in its tracks."

By mummifying carbon, we simply complete the carbon cycle. For a society that is consuming 70 quadrillion BTUs of fossil-fuel energy every year, there is only one honest way of "recycling" carbon wastes, and that is to put them back where most of the carbon we use came from, deep underground. Composting food wastes and recyling newspapers are the last thing we should want to do: Both interrupt the return of carbon to the Earth. The notion that "there is no room" down there is absurd. If we take old carbon out of the ground, we can put new carbon back in. Only two-dimensional thinkers could possibly believe otherwise. In three dimensions, there is always plenty of room.

THE SANDPILE IS GREEN

Up to a point, we have simply been lucky to have all that coal and oil and uranium, all those dead-and-buried geophysical resources available as substitutes for living resources on the surface.

But the fact that humanity is now able to live in the third dimension is not just an accident of geophysics or of technological history. Man threatens all the rest of life on the planet because his frontal lobes have made him so adaptable, so very fit to survive, that he is now capable of surviving on the moon itself. Our ability to live off resources long dead and buried—resources that are wholly unusable by all other forms of life on Earth—is merely the logical, inevitable, extension of our ability to

subdue the biosphere. We are very clever indeed, clever enough to cut down all the forests of England for our stoves; clever enough to hunt whales into extinction for lamps; and now clever enough to stop destroying those ancient, living, surface-dwelling sources of fuel by aiming our steel harpoons and diamond drills at dead things rather than at living ones. The technology that empowers us to destroy all life on Earth is the same technology that empowers us not to.

Complexity—the sandpile—is green because it lets us do so much more with so much less and to do so much more of it away from the surface, in the third dimension. The ineffably complex technology of atom and photon is the greenest of all. Nuclear power, the original "solar," extracts limitless energy from the tiniest amounts of material because it extracts subatomically. Irradiation is an excellent preservative because its energy disrupts the chemical bonds we most want disrupted, the ones that the salmonella bacterium most needs to live. Improved genes in rice or a tobacco leaf substitute for a chemical factory producing phosphates or fertilizers or a pharmaceutical plant manufacturing drugs. Pesticides that disrupt the hormonal systems of insects, like the hormones that promote growth and milk production in cows, are extremely efficient and extremely safe, too, because they are so accurately aimed at such specific molecular targets. In medicine, the best drugs are likewise the ones most meticulously engineered to affect specific cells or specific proteins on the surface of the cells. Nobody dismisses complexity as "unreliable" or "brittle" in *that* context. We know it is just the opposite.

As I discussed at the outset of this chapter, most of the main objections to Hard fuels center on sandpile scenarios, or more simply on pollution. The coal's effluents will surely spread, the oil tanker may founder, the reactor melt down. Yes, they may. But if we are careful, they won't, and experience teaches that they generally don't. The Soft Green alternatives, by contrast—the guayule growers and chicken farmers and solar freaks—spread out and choke the land by definition and design. They have to, because they are gathering a very diffuse form of energy, and to gather any significant amount of energy that way you simply have to occupy a lot of surface. The Soft technologies cannot collapse like sandpiles because they are collapsed to begin with, and with dreadful environmental implications. The Hard, Faustian technologies are immeasurably better for the land because they are concentrated, because they confine a great amount of energy in a very small space. Their best green qualities, in short, inhere in what the Softs most passionately oppose.

From the perspective of the biosphere, nuclear power is the "simplest" of all in that it disturbs the least land, interferes least with the surface, and corrupts life the least, not the most. It is far more brittle, unstable, and dangerous, all in all, to cultivate endless miles of corn for gasohol, or guayule for oil, or to overlay the prairies with solar cells, because so much of the underlying, green complexity is disrupted by these Soft alternatives. Hard technologies are generally stable, safe, and green because they use more capital and concrete and less land, less biosphere, less nature itself, the highest complexity of all.

The greenest possible policy is to do the exact opposite of what the Softs advise. They advise us to burn live trees, not dead ones. To scrape the surface, not plumb the deep. They could not possibly have been more wrong. Amory Lovins's own little (adopted) island, beautiful England, the land of April and hedgerows and birds, lovely though it still is, should have taught him as much. It was once lovelier still. It once had forests. Our land still does. We should not make the English mistake. We should dig up our energy, bury our wastes, fly high, tunnel deep, and leave more of the surface alone.