The Next Industrial Revolution

IMAGINE FOR A MOMENT A WORLD WHERE CITIES HAVE BECOME PEACEFUL and serene because cars and buses are whisper quiet, vehicles exhaust only water vapor, and parks and greenways have replaced unneeded urban freeways. OPEC has ceased to function because the price of oil has fallen to five dollars a barrel, but there are few buyers for it because cheaper and better ways now exist to get the services people once turned to oil to provide. Living standards for all people have dramatically improved, particularly for the poor and those in developing countries. Involuntary unemployment no longer exists, and income taxes have largely been eliminated. Houses, even low-income housing units, can pay part of their mortgage costs by the energy they produce; there are few if any active landfills; worldwide forest cover is increasing; dams are being dismantled; atmospheric CO₂ levels are decreasing for the first time in two hundred years; and effluent water leaving factories is cleaner than the water coming into them. Industrialized countries have reduced resource use by 80 percent while improving the quality of life. Among these technological changes, there are important social changes. The frayed social nets of Western countries have been repaired. With the explosion of family-wage jobs, welfare demand has fallen. A progressive and active union movement has taken the lead to work with business, environmentalists, and government to create “just transitions” for workers as society phases out coal, nuclear energy, and oil. In communities and towns, churches, corporations, and labor groups promote a new living-wage social contract as the least expensive way to ensure the growth and preservation of valuable social capital. Is this the
vision of a utopia? In fact, the changes described here could come about in the decades to come as the result of economic and technological trends already in place.

This book is about these and many other possibilities.

It is about the possibilities that will arise from the birth of a new type of industrialism, one that differs in its philosophy, goals, and fundamental processes from the industrial system that is the standard today. In the next century, as human population doubles and the resources available per person drop by one-half to three-fourths, a remarkable transformation of industry and commerce can occur. Through this transformation, society will be able to create a vital economy that uses radically less material and energy. This economy can free up resources, reduce taxes on personal income, increase per-capita spending on social ills (while simultaneously reducing those ills), and begin to restore the damaged environment of the earth. These necessary changes done properly can promote economic efficiency, ecological conservation, and social equity.

The industrial revolution that gave rise to modern capitalism greatly expanded the possibilities for the material development of humankind. It continues to do so today, but at a severe price. Since the mid-eighteenth century, more of nature has been destroyed than in all prior history. While industrial systems have reached pinnacle of success, able to muster and accumulate human-made capital on vast levels, natural capital, on which civilization depends to create economic prosperity, is rapidly declining, and the rate of loss is increasing proportionate to gains in material well-being. Natural capital includes all the familiar resources used by humankind: water, minerals, oil, trees, fish, soil, air, etcetera. But it also encompasses living systems, which include grasslands, savannas, wetlands, estuaries, oceans, coral reefs, riparian corridors, tundras, and rainforests. These are deteriorating worldwide at an unprecedented rate. Within these ecological communities are the fungi, ponds, mammals, humus, amphibians, bacteria, trees, flagellates, insects, songbirds, ferns, starfish, and flowers that make life possible and worth living on this planet.

As more people and businesses place greater strain on living systems, limits to prosperity are coming to be determined by natural capital rather than industrial prowess. This is not to say that the world is running out of commodities in the near future. The prices for most raw materials are at a twenty-eight-year low and are still falling. Supplies are cheap and appear to be abundant, due to a number of reasons: the collapse of the Asian economies, globalization of trade, cheaper transport costs, imbalances in market power that enable commodity traders and middlemen to squeeze producers, and in large measure the success of powerful new extractive technologies, whose correspondingly extensive damage to ecosystems is seldom given a monetary value. After richer ores are exhausted, skilled mining companies can now level and grind up whole mountains of poorer-quality ores to extract the metals desired. But while technology keeps ahead of depletion, providing what appear to be ever-cheaper metals, they only appear cheap, because the stripped rainforest and the mountain of toxic tailings spilling into rivers, the impoverished villages and eroded indigenous cultures — all the consequences they leave in their wake — are not factored into the cost of production.

It is not the supplies of oil or copper that are beginning to limit our development but life itself. Today, our continuing progress is restricted not by the number of fishing boats but by the decreasing numbers of fish; not by the power of pumps but by the depletion of aquifers; not by the number of chainsaws but by the disappearance of primary forests. While living systems are the source of such desired materials as wood, fish, or food, of utmost importance are the services that they offer, services that are far more critical to human prosperity than are nonrenewable resources. A forest provides not only the resource of wood but also the services of water storage and flood management. A healthy environment automatically supplies not only clean air and water, rainfall, ocean productivity, fertile soil, and watershed resilience but also such less-appreciated functions as waste processing (both natural and industrial), buffering against the extremes of weather, and regeneration of the atmosphere.

Humankind has inherited a 3.8-billion-year store of natural capital. At present rates of use and degradation, there will be little left by the end of the next century. This is not only a matter of aesthetics and morality, it is of the utmost practical concern to society and all people. Despite reams of press about the state of the environment and rafts of laws attempting to prevent further loss, the stock of natural capital is plummeting and the vital life-giving services that flow from it are critical to our prosperity.

Natural capitalism recognizes the critical interdependency between the production and use of human-made capital and the maintenance
and supply of natural capital. The traditional definition of capital is accumulated wealth in the form of investments, factories, and equipment. Actually, an economy needs four types of capital to function properly:

- human capital, in the form of labor and intelligence, culture, and organization
- financial capital, consisting of cash, investments, and monetary instruments
- manufactured capital, including infrastructure, machines, tools, and factories
- natural capital, made up of resources, living systems, and ecosystem services

The industrial system uses the first three forms of capital to transform natural capital into the stuff of our daily lives: cars, highways, cities, bridges, houses, food, medicine, hospitals, and schools.

The climate debate is a public issue in which the assets at risk are not specific resources, like oil, fish, or timber, but a life-supporting system. One of nature's most critical cycles is the continual exchange of carbon dioxide and oxygen among plants and animals. This "recycling service" is provided by nature free of charge. But today carbon dioxide is building up in the atmosphere, due in part to combustion of fossil fuels. In effect, the capacity of the natural system to recycle carbon dioxide has been exceeded, just as overfishing can exceed the capacity of a fishery to replenish stocks. But what is especially important to realize is that there is no known alternative to nature's carbon cycle service.

Besides climate, the changes in the biosphere are widespread. In the past half century, the world has lost a fourth of its topsoil and a third of its forest cover. At present rates of destruction, we will lose 70 percent of the world's coral reefs in our lifetime, host to 25 percent of marine life. In the past three decades, one-third of the planet's resources, its "natural wealth," has been consumed. We are losing freshwater ecosystems at the rate of 6 percent a year, marine ecosystems by 4 percent a year. There is no longer any serious scientific dispute that the decline in every living system in the world is reaching such levels that an increasing number of them are starting to lose, often at a pace accelerated by the interactions of their decline, their assured ability to sustain the continuity of the life process. We have reached an extraordinary threshold.

Recognition of this shadow side of the success of industrial production has triggered the second of the two great intellectual shifts of the late twentieth century. The end of the Cold War and the fall of communism was the first such shift; the second, now quietly emerging, is the end of the war against life on earth, and the eventual ascendance of what we call natural capitalism.

Capitalism, as practiced, is a financially profitable, nonsustainable aberration in human development. What might be called "industrial capitalism" does not fully conform to its own accounting principles. It liquidates its capital and calls it income. It neglects to assign any value to the largest stocks of capital it employs—the natural resources and living systems, as well as the social and cultural systems that are the basis of human capital.

But this deficiency in business operations cannot be corrected simply by assigning monetary values to natural capital, for three reasons. First, many of the services we receive from living systems have no known substitutes at any price; for example, oxygen production by green plants. This was demonstrated memorably in 1991-93 when the scientists operating the $200 million Biosphere 2 experiment in Arizona discovered that it was unable to maintain life-supporting oxygen levels for the eight people living inside. Biosphere 1, a.k.a. Planet Earth, performs this task daily at no charge for 6 billion people.

Second, valuing natural capital is a difficult and imprecise exercise at best. Nonetheless, several recent assessments have estimated that biological services flowing directly into society from the stock of natural capital are worth at least $36 trillion annually. That figure is close to the annual gross world product of approximately $39 trillion—a striking measure of the value of natural capital to the economy. If natural capital stocks were given a monetary value, assuming the assets yielded "interest" of $36 trillion annually, the world's natural capital would be valued at somewhere between $400 and $500 trillion—tens of thousands of dollars for every person on the planet. That is undoubtedly a conservative figure given the fact that anything we can't live without and can't replace at any price could be said to have an infinite value.

Additionally, just as technology cannot replace the planet's life-support systems, so, too, are machines unable to provide a substitute for human intelligence, knowledge, wisdom, organizational abilities, and culture. The World Bank's 1995 Wealth Index found the sum value of human capital to be three times greater than all the financial and manufactured capital reflected on global balance sheets. This, too,
appears to be a conservative estimate, since it counts only the market value of human employment, not uncompensated effort or cultural resources.

It is not the aim of this book to assess how to determine value for such unaccounted-for forms of capital. It is clear, however, that behaving as though they are valueless has brought us to the verge of disaster. But if it is in practice difficult to tabulate the value of natural and human capital on balance sheets, how can governments and conscientious businesspersons make decisions about the responsible use of earth’s living systems?

CONVENTIONAL CAPITALISM
Following Einstein’s dictum that problems can’t be solved within the mind-set that created them, the first step toward any comprehensive economic and ecological change is to understand the mental model that forms the basis of present economic thinking. The mind-set of the present capitalist system might be summarized as follows:

- Economic progress can best occur in free-market systems of production and distribution where reinvested profits make labor and capital increasingly productive.
- Competitive advantage is gained when bigger, more efficient plants manufacture more products for sale to expanding markets.
- Growth in total output (GDP) maximizes human well-being.
- Any resource shortages that do occur will elicit the development of substitutes.
- Concerns for a healthy environment are important but must be balanced against the requirements of economic growth, if a high standard of living is to be maintained.
- Free enterprise and market forces will allocate people and resources to their highest and best uses.

The origins of this worldview go back centuries, but it took the industrial revolution to establish it as the primary economic ideology. This sudden, almost violent, change in the means of production and distribution of goods, in sector after economic sector, introduced a new element that redefined the basic formula for the creation of material products: Machines powered by water, wood, charcoal, coal, oil, and eventually electricity accelerated or accomplished some or all of the work formerly performed by laborers. Human productive capabilities began to grow exponentially. What took two hundred workers in 1770 could be done by a single spinner in the British textile industry by 1812. With such astonishingly improved productivity, the labor force was able to manufacture a vastly larger volume of basic necessities like cloth at greatly reduced cost. This in turn rapidly raised standards of living and real wages, increasing demand for other products in other industries. Further technological breakthroughs proliferated, and as industry after industry became mechanized, leading to even lower prices and higher incomes, all of these factors fueled a self-sustaining and increasing demand for transportation, housing, education, clothing, and other goods, creating the foundation of modern commerce.

The past two hundred years of massive growth in prosperity and manufactured capital have been accompanied by a prodigious body of economic theory analyzing it, all based on the fallacy that natural and human capital have little value as compared to final output. In the standard industrial model, the creation of value is portrayed as a linear sequence of extraction, production, and distribution; Raw materials are introduced. (Enter nature, stage left.) Labor uses technologies to transform these resources into products, which are sold to create profits. The wastes from production processes, and soon the products themselves, are somehow disposed of somewhere else. (Exit waste, stage right.) The “somewheres” in this scenario are not the concern of classical economics: Enough money can buy enough resources, so the theory goes, and enough “elsewheres” to dispose of them afterward.

This conventional view of value creation is not without its critics. Viewing the economic process as a disembodied, circular flow of value between production and consumption, argues economist Herman Daly, is like trying to understand an animal only in terms of its circulatory system, without taking into account the fact it also has a digestive tract that ties it firmly to its environment at both ends. But there is an even more fundamental critique to be applied here, and it is one based on simple logic. The evidence of our senses is sufficient to tell us that all economic activity — all that human beings are, all that they can ever accomplish — is embedded within the workings of a particular planet. That planet is not growing, so the somewheres and elsewheres are always with us. The increasing removal of resources, their transport and use, and their replacement with waste steadily erodes our stock of natural capital.
With nearly ten thousand new people arriving on earth every hour, a new and unfamiliar pattern of scarcity is now emerging. At the beginning of the industrial revolution, labor was overworked and relatively scarce (the population was about one-tenth of current totals), while global stocks of natural capital were abundant and unexploited. But today the situation has been reversed: After two centuries of rises in labor productivity, the liquidation of natural resources at their extraction cost rather than their replacement value, and the exploitation of living systems as if they were free, infinite, and in perpetual renewal, it is people who have become an abundant resource, while nature is becoming disturbingly scarce.

Applying the same economic logic that drove the industrial revolution to this newly emerging pattern of scarcity implies that, if there is to be prosperity in the future, society must make its use of resources vastly more productive — deriving four, ten, or even a hundred times as much benefit from each unit of energy, water, materials, or anything else borrowed from the planet and consumed. Achieving this degree of efficiency may not be as difficult as it might seem because from a materials and energy perspective, the economy is massively inefficient. In the United States, the materials used by the metabolism of industry amount to more than twenty times every citizen's weight per day — more than one million pounds per American per year. The global flow of matter, some 500 billion tons per year, most of it wasted, is largely invisible. Yet obtaining, moving, using, and disposing of it is steadily undermining the health of the planet, which is showing ever greater signs of stress, even of biological breakdown. Human beings already use over half the world's accessible surface freshwater, have transformed one-third to one-half of its land surface, fix more nitrogen than do all natural systems on land, and appropriate more than two-fifths of the planet's entire land-based primary biological productivity. The doubling of these burdens with rising population will displace many of the millions of other species, undermining the very web of life.

The resulting ecological strains are also causing or exacerbating many forms of social distress and conflict. For example, grinding poverty, hunger, malnutrition, and rampant disease affect one-third of the world and are growing in absolute numbers; not surprisingly, crime, corruption, lawlessness, and anarchy are also on the rise (the fastest-growing industry in the world is security and private police protection); fleeing refugee populations have increased throughout the nineties to about a hundred million; over a billion people in the world who need to work cannot find jobs, or toil at such menial work that they cannot support themselves or their families; meanwhile, the loss of forests, topsoil, fisheries, and freshwater is, in some cases, exacerbating regional and national conflicts.

What would our economy look like if it fully valued all forms of capital, including human and natural capital? What if our economy were organized not around the lifeless abstractions of neoclassical economics and accountancy but around the biological realities of nature? What if Generally Accepted Accounting Practice booked natural and human capital not as a free amenity in putative inexhaustible supply but as a finite and integrally valuable factor of production? What if, in the absence of a rigorous way to practice such accounting, companies started to act as if such principles were in force? This choice is possible and such an economy would offer a stunning new set of opportunities for all of society, amounting to no less than the next industrial revolution.

CAPITALISM AS IF LIVING SYSTEMS MATTERED

Natural capitalism and the possibility of a new industrial system are based on a very different mind-set and set of values than conventional capitalism. Its fundamental assumptions include the following:

- The environment is not a minor factor of production but rather is "an envelope containing, provisioning, and sustaining the entire economy."[10]
- The limiting factor to future economic development is the availability and functionality of natural capital, in particular, life-supporting services that have no substitutes and currently have no market value.
- Misconceived or badly designed business systems, population growth, and wasteful patterns of consumption are the primary causes of the loss of natural capital, and all three must be addressed to achieve a sustainable economy.
- Future economic progress can best take place in democratic, market-based systems of production and distribution in which all forms of capital are fully valued, including human, manufactured, financial, and natural capital.
- One of the keys to the most beneficial employment of people, money, and the environment is radical increases in resource productivity.
- Human welfare is best served by improving the quality and flow of desired services delivered, rather than by merely increasing the total dollar flow.
- Economic and environmental sustainability depends on redressing global inequities of income and material well-being.
The best long-term environment for commerce is provided by true democratic systems of governance that are based on the needs of people rather than business.

This book introduces four central strategies of natural capitalism that are a means to enable countries, companies, and communities to operate by behaving as if all forms of capital were valued. Ensuring a perpetual annuity of valuable social and natural processes to serve a growing population is not just a prudent investment but a critical need in the coming decades. Doing so can avert scarcity, perpetuate abundance, and provide a solid basis for social development; it is the basis of responsible stewardship and prosperity for the next century and beyond.

1. Radical Resource Productivity. Radically increased resource productivity is the cornerstone of natural capitalism because using resources more effectively has three significant benefits: It slows resource depletion at one end of the value chain, lowers pollution at the other end, and provides a basis to increase worldwide employment with meaningful jobs. The result can be lower costs for business and society, which no longer has to pay for the chief causes of ecosystem and social disruption. Nearly all environmental and social harm is an artifact of the uneconomically wasteful use of human and natural resources, but radical resource productivity strategies can nearly halt the degradation of the biosphere, make it more profitable to employ people, and thus safeguard against the loss of vital living systems and social cohesion.

2. Biomimicry. Reducing the wasteful throughput of materials — indeed, eliminating the very idea of waste — can be accomplished by redesigning industrial systems on biological lines that change the nature of industrial processes and materials, enabling the constant reuse of materials in continuous closed cycles, and often the elimination of toxicity.

3. Service and Flow Economy. This calls for a fundamental change in the relationship between producer and consumer, a shift from an economy of goods and purchases to one of service and flow. In essence, an economy that is based on a flow of economic services can better protect the ecosystem services upon which it depends. This will entail a new perception of value, a shift from the acquisition of goods as a measure of affluence to an economy where the continuous receipt of quality, utility, and performance promotes well-being. This concept offers incentives to put into practice the first two innovations of natural capitalism by restructuring the economy to focus on relationships that better meet customers' changing value needs and to reward automatically both resource productivity and closed-loop cycles of materials use.

4. Investing in Natural Capital. This works toward reversing worldwide planetary destruction through reinvestments in sustaining, restoring, and expanding stocks of natural capital, so that the biosphere can produce more abundant ecosystem services and natural resources.

All four changes are interrelated and interdependent; all four generate numerous benefits and opportunities in markets, finance, materials, distribution, and employment. Together, they can reduce environmental harm, create economic growth, and increase meaningful employment.

RESOURCE PRODUCTIVITY
Imagine giving a speech to Parliament in 1750 predicting that within seventy years human productivity would rise to the point that one person could do the work of two hundred. The speaker would have been branded as daft or worse. Imagine a similar scene today. Experts are testifying in Congress, predicting that we will increase the productivity of our resources in the next seventy years by a factor of four, ten, even one hundred. Just as it was impossible 250 years ago to conceive of an individual's doing two hundred times more work, it is equally difficult for us today to imagine a kilowatt-hour or board foot being ten or a hundred times more productive than it is now.

Although the movement toward radical resource productivity has been under way for decades, its clarion call came in the fall of 1994, when a group of sixteen scientists, economists, government officials, and businesspeople convened and, sponsored by Friedrich Schmidt-Bleek of the Wuppertal Institute for Climate, Environment, and Energy in Germany, published the "Carnoules Declaration." Participants had come from Europe, the United States, Japan, England, Canada, and India to the French village of Carnoules to discuss their belief that human activities were at risk from the ecological and social impact of materials and energy use. The Factor Ten Club, as the group came to call itself, called for a leap in resource productivity to reverse the growing damage. The declaration began with these prophetic words: "Within one generation, nations can achieve a ten-fold increase in the efficiency with which they use energy, natural resources and other materials."

In the years since, Factor Ten (a 90 percent reduction in energy and materials intensity) and Factor Four (a 75 percent reduction) have
harness economically efficient market mechanisms, and we share economists’ devotion to that goal. But to avoid confusion, when we suggest using market tools to achieve “resource productivity” and “resource efficiency,” we use those terms in the engineering sense.

Resource productivity doesn’t just save resources and money; it can also improve the quality of life. Listen to the din of daily existence — the city and freeway traffic, the airplanes, the garbage trucks outside urban windows — and consider this: The waste and the noise are signs of inefficiency, and they represent money being thrown away. They will disappear as surely as did manure from the nineteenth-century streets of London and New York. Inevitably, industry will redesign everything it makes and does, in order to participate in the coming productivity revolution. We will be able to see better with resource-efficient lighting systems, produce higher-quality goods in efficient factories, travel more safely and comfortably in efficient vehicles, feel more comfortable (and do substantially more and better work) in efficient buildings, and be better nourished by efficiently grown food. An air-conditioning system that uses 90 percent less energy or a building so efficient that it needs no air-conditioning at all may not fascinate the average citizen, but the fact that they are quiet and produce greater comfort while reducing energy costs should appeal even to technophobes. That such options save money should interest everyone.

As subsequent chapters will show, the unexpectedly large improvements to be gained by resource productivity offer an entirely new terrain for business invention, growth, and development. Its advantages can also dispel the long-held belief that core business values and environmental responsibility are incompatible or at odds. In fact, the massive inefficiencies that are causing environmental degradation almost always cost more than the measures that would reverse them.

But even as Factor Ten goals are driving reductions in materials and energy flows, some governments are continuing to create and administer laws, policies, taxes, and subsidies that have quite the opposite effect. Hundreds of billions of dollars of taxpayers’ money are annually diverted to promote inefficient and unproductive material and energy use. These include subsidies to mining, oil, coal, fishing, and forest industries as well as agricultural practices that degrade soil fertility and use wasteful amounts of water and chemicals. Many of these subsidies are vestigial, some dating as far back as the eighteenth century, when European powers provided entrepreneurs with incentives to find and
exploit colonial resources. Taxes extracted from labor subsidize patterns of resource use that in turn displace workers, an ironic situation that is becoming increasingly apparent and unacceptable, particularly in Europe, where there is chronically high unemployment. Already, tax reforms aimed at increasing employment by shifting taxes away from people to the use of resources have started to be instituted in the Netherlands, Germany, Britain, Sweden, and Denmark, and are being seriously proposed across Europe.

In less developed countries, people need realistic and achievable means to better their lives. The world’s growing population cannot attain a Western standard of living by following traditional industrial paths to development, for the resources required are too vast, too expensive, and too damaging to local and global systems. Instead, radical improvements in resource productivity expand their possibilities for growth, and can help to ameliorate the polarization of wealth between rich and poor segments of the globe. When the world’s nations met in Brazil at the Earth Summit in 1992 to discuss the environment and human development, some treaties and proposals proved to be highly divisive because it appeared that they put a lid on the ability of nonindustrialized countries to pursue development. Natural capitalism provides a practical agenda for development wherein the actions of both developed and developing nations are mutually supportive.

BIOMIMICRY

To appreciate the potential of radical resource productivity, it is helpful to recognize that the present industrial system is, practically speaking, a couch potato: It eats too much junk food and gets insufficient exercise. In its late maturity, industrial society runs on life-support systems that require enormous heat and pressure, are petrochemically dependent and materials-intensive, and require large flows of toxic and hazardous chemicals. These industrial “empty calories” end up as pollution, acid rain, and greenhouse gases, harming environmental, social, and financial systems. Even though all the reengineering and downsizing trends of the past decade were supposed to sweep away corporate inefficiency, the U.S. economy remains astoundingly inefficient: It has been estimated that only 6 percent of its vast flows of materials actually end up in products. Overall, the ratio of waste to the durable products that constitute material wealth may be closer to one hundred to one. The whole economy is less than 10 percent — probably only a few percent — as energy-efficient as the laws of physics permit.

This waste is currently rewarded by deliberate distortions in the marketplace, in the form of policies like subsidies to industries that extract raw materials from the earth and damage the biosphere. As long as that damage goes unaccounted for, as long as virgin resource prices are maintained at artificially low levels, it makes sense to continue to use virgin materials rather than reuse resources discarded from previous products. As long as it is assumed that there are “free goods” in the world — pure water, clean air, hydrocarbon combustion, virgin forests, veins of minerals — large-scale, energy- and materials-intensive manufacturing methods will dominate, and labor will be increasingly marginalized. In contrast, if the subsidies distorting resource prices were removed or reversed, it would be advantageous to employ more people and use fewer virgin materials.

Even without the removal of subsidies, the economics of resource productivity are already encouraging industry to reinvent itself to be more in accord with biological systems. Growing competitive pressures to save resources are opening up exciting frontiers for chemists, physicists, process engineers, biologists, and industrial designers. They are reexamining the energy, materials, and manufacturing systems required to provide the specific qualities (strength, warmth, structure, protection, function, speed, tension, motion, skin) required by products and end users and are turning away from mechanical systems requiring heavy metals, combustion, and petroleum to seek solutions that use minimal inputs, lower temperatures, and enzymatic reactions. Business is switching to imitating biological and ecosystem processes replicating natural methods of production and engineering to manufacture chemicals, materials, and compounds, and soon maybe even microprocessors. Some of the most exciting developments have resulted from emulating nature’s life-temperature, low-pressure, solar-powered assembly techniques, whose products rival anything human-made. Science writer Janine Benyus points out that spiders make silk, strong as Kevlar but much tougher, from digested crickets and flies, without needing boiling sulfuric acid and high-temperature extruders. The abalone generates an inner shell twice as tough as our best ceramics, and diatoms make glass, both processes employing seawater with no furnaces. Trees turn sunlight, water, and air into cellulose, a sugar stiffer and stronger than
nylon, and bind it into wood, a natural composite with a higher bending strength and stiffness than concrete or steel. We may never grow as skillful as spiders, abalone, diatoms, or trees, but smart designers are apprenticing themselves to nature to learn the benign chemistry of its processes.

Pharmaceutical companies are becoming microbial ranchers managing herds of enzymes. Biological farming manages soil ecosystems in order to increase the amount of biota and life per acre by keen knowledge of food chains, species interactions, and nutrient flows, minimizing crop losses and maximizing yields by fostering diversity. Meta-industrial engineers are creating "zero-emission" industrial parks whose tenants will constitute an industrial ecosystem in which one company will feed upon the nontoxic and useful wastes of another. Architects and builders are creating structures that process their own wastewater, capture light, create energy, and provide habitat for wildlife and wealth for the community, all the while improving worker productivity, morale, and health. High-temperature, centralized power plants are starting to be replaced by smaller-scale, renewable power generation. In chemistry, we can look forward to the end of the witches' brew of dangerous substances invented this century, from DDT, PCB, CFCs, and Thalidomide to Dieldrin and xeno-estrogens. The eighty thousand different chemicals now manufactured end up everywhere, as Donella Meadows remarks, from our "stratosphere to our sperm." They were created to accomplish functions that can now be carried out far more efficiently with biodegradable and naturally occurring compounds.

SERVICE AND FLOW
Beginning in the mid-1980s, Swiss industry analyst Walter Stahel and German chemist Michael Braungart independently proposed a new industrial model that is now gradually taking shape. Rather than an economy in which goods are made and sold, these visionaries imagined a service economy wherein consumers obtain services by leasing or renting goods rather than buying them outright. (Their plan should not be confused with the conventional definition of a service economy, in which burger-flippers outnumber steelworkers.) Manufacturers cease thinking of themselves as sellers of products and become, instead, deliverers of service, provided by long-lasting, upgradeable durables. Their goal is selling results rather than equipment, performance and satisfaction rather than motors, fans, plastics, or condensers.

The system can be demonstrated by a familiar example. Instead of purchasing a washing machine, consumers could pay a monthly fee to obtain the service of having their clothes cleaned. The washer would have a counter on it, just like an office photocopier, and would be maintained by the manufacturer on a regular basis, much the way mainframe computers are. If the machine ceased to provide its specific service, the manufacturer would be responsible for replacing or repairing it at no charge to the customer, because the washing machine would remain the property of the manufacturer. The concept could likewise be applied to computers, cars, VCRs, refrigerators, and almost every other durable that people now buy, use up, and ultimately throw away. Because products would be returned to the manufacturer for continuous repair, reuse, and remanufacturing, Stahel called the process "cradle-to-cradle."19

Many companies are adopting Stahel's principles. Agfa Gaertner pioneered the leasing of copier services, which spread to the entire industry.20 The Carrier Corporation, a division of United Technologies, is creating a program to sell coolth (the opposite of warmth) to companies while retaining ownership of the air-conditioning equipment. The Interface Corporation is beginning to lease the warmth, beauty, and comfort of its floor-covering services rather than selling carpets.

Braungart's model of a service economy focuses on the nature of material cycles. In this perspective, if a given product lasts a long time but its waste materials cannot be reincorporated into new manufacturing or biological cycles, then the producer must accept responsibility for the waste with all its attendant problems of toxicity, resource overuse, worker safety, and environmental damage. Braungart views the world as a series of metabolisms in which the creations of human beings, like the creations of nature, become "food" for interdependent systems, returning to either an industrial or a biological cycle after their useful life is completed. To some, especially frugal Scots and New Englanders, this might not sound a novel concept at all. Ralph Waldo Emerson once wrote, "Nothing in nature is exhausted in its first use. When a thing has served an end to the uttermost, it is wholly new for an ulterior service."21 In simpler times, such proverbial wisdom had highly practical applications. Today, the complexity of modern materials makes this almost impossible. Thus, Braungart proposed an Intelligent Product System whereby those products that do not degrade back into natural nutrient cycles be designed so that they can
be deconstructed and completely reincorporated into technical nutrient cycles of industry.\textsuperscript{22}

Another way to conceive of this method is to imagine an industrial system that has no provision for landfills, outfalls, or smokestacks. If a company knew that nothing that came into its factory could be thrown away, and that everything it produced would eventually return, how would it design its components and products? The question is more than a theoretical construct, because the earth works under precisely these strictures.

In a service economy, the product is a means, not an end. The manufacturer’s leasing and ultimate recovery of the product means that the product remains an asset. The minimization of materials use, the maximization of product durability, and enhanced ease of maintenance not only improve the customer’s experience and value but also protect the manufacturer’s investment and hence its bottom line. Both producer and customer have an incentive for continuously improving resource productivity, which in turn further protects ecosystems. Under this shared incentive, both parties form a relationship that continuously anticipates and meets the customer’s evolving value needs — and meanwhile rewards both parties for reducing the burdens on the planet.

The service paradigm has other benefits as well: It increases employment, because when products are designed to be reincorporated into manufacturing cycles, waste declines, and demand for labor increases. In manufacturing, about one-fourth of the labor force is engaged in the fabrication of basic raw materials such as steel, glass, cement, silicon, and resins, while three-quarters are in the production phase. The reverse is true for energy inputs: Three times as much energy is used to extract virgin or primary materials as is used to manufacture products from those materials. Substituting reused or more durable manufactured goods for primary materials therefore uses less energy but provides more jobs.\textsuperscript{23}

An economy based on a service-and-flow model could also help stabilize the business cycle, because customers would be purchasing flows of services, which they need continuously, rather than durable equipment that’s affordable only in good years. Service providers would have an incentive to keep their assets productive for as long as possible, rather than prematurely scrapping them in order to sell replacements. Over- and undercapacity would largely disappear, as business would no longer have to be concerned about delivery or backlogs if it is contract-

ING FROM A SERVICE PROVIDER. GONE WOULD BE END-OF-YEAR REBATES TO MOVE EXCESS AUTOMOBILE INVENTORY, BUILT FOR CUSTOMERS WHO NEVER ORDERED THEM BECAUSE MANAGERIAL PRODUCTION QUOTAS WERE INCREASED IN ORDER TO AMORTIZE EXPENSIVE CAPITAL EQUIPMENT THAT WAS NEVER NEEDED IN THE FIRST PLACE. AS IT STANDS NOW, DURABLES MANUFACTURERS HAVE A LOVE-HATE RELATIONSHIP WITH DURABILITY. BUT WHEN THEY BECOME SERVICE PROVIDERS, THEIR LONG- AND SHORT-TERM INCENTIVES BECOME PERFECTLY ATTUNED TO WHAT CUSTOMERS WANT, THE ENVIRONMENT DESERVES, LABOR NEEDS, AND THE ECONOMY CAN SUPPORT.\textsuperscript{24}

**INVESTING IN NATURAL CAPITAL**

When a manufacturer realizes that a supplier of key components is overextended and running behind on deliveries, it takes immediate action lest its own production lines come to a halt. Living systems are a supplier of key components for the life of the planet, and they are now falling behind on their orders. Until recently, business could ignore such shortages because they didn’t affect production and didn’t increase costs. That situation may be changing, however, as rising weather-related claims come to burden insurance companies and world agriculture. (In 1998, violent weather caused upward of $90 billion worth of damage worldwide, a figure that represented more weather-related losses than were accounted for through the entire decade of the 1980s. The losses were greatly compounded by deforestation and climate change, factors that increase the frequency and severity of disasters. In human terms, 300 million people were permanently or temporarily displaced from their homes; this figure includes the dislocations caused by Hurricane Mitch, the deadliest Atlantic storm in two centuries.)\textsuperscript{25} If the flow of services from industrial systems is to be sustained or increased in the future for a growing population, the vital flow of life-supporting services from living systems will have to be maintained and increased. For this to be possible will require investments in natural capital.

As both globalization and Balkanization proceed, and as the per-capita availability of water, arable land, and fish continues to decline (as they have done since 1980), the world faces the danger of being torn apart by regional conflicts instigated at least in part by resource shortages or imbalances and associated income polarization.\textsuperscript{26} Whether it involves oil\textsuperscript{27} or water,\textsuperscript{28} cobalt or fish, access to resources is playing an ever more prominent role in generating conflict. In addition, many social instabilities and refugee populations — twelve million
refugees now wander the world — are created or worsened by ecological destruction, from Haiti to Somalia to Jordan. On April 9, 1996, Secretary of State Warren Christopher gave perhaps the first speech by an American cabinet officer that linked global security with the environment. His words may become prophetic for future foreign policy decisions: "... [E]nvironmental forces transcend borders and oceans to threaten directly the health, prosperity and jobs of American citizens. ... [A]ddressing natural resource issues is frequently critical to achieving political and economic stability, and to pursuing our strategic goals around the world."

Societies need to adopt shared goals that enhance social welfare but that are not the prerogatives of specific values or belief systems. Natural capitalism is one such objective. It is neither conservative nor liberal in its ideology, but appeals to both constituencies. Since it is a means, and not an end, it doesn’t advocate a particular social outcome but rather makes possible many different ends. Therefore, whatever the various visions different parties or factions espouse, society can work toward resource productivity now, without waiting to resolve disputes about policy.

The chapters that follow describe an array of opportunities and possibilities that are real, practical, measured, and documented. Engineers have already designed hydrogen-fuel-cell-powered cars to be plug-in electric generators that may become the power plants of the future. Buildings already exist that make oxygen, solar power, and drinking water and can help pay the mortgage while their tenants work inside them. Deprintable and reprintable papers and inks, together with other innovative ways to use fiber, could enable the world’s supply of lumber and pulp to be grown in an area about the size of Iowa. Weeds can yield potent pharmaceuticals; cellulose-based plastics have been shown to be strong, reusable, and compostable; and luxurious carpets can be made from landfilled scrap. Roofs and windows, even roads, can do double duty as solar-electric collectors, and efficient car-free cities are being designed so that men and women no longer spend their days driving to obtain the goods and services of daily life. These are among the thousands of innovations that are resulting from natural capitalism.

This book is both an overview of the remarkable technologies that are already in practice and a call to action. Many of the techniques and methods described here can be used by individuals and small busi-
23 Things They Don't Tell You about Capitalism

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Thing 1
There is no such thing as a free market

What they tell you

Markets need to be free. When the government interferes to dictate what market participants can or cannot do, resources cannot flow to their most efficient use. If people cannot do the things that they find most profitable, they lose the incentive to invest and innovate. Thus, if the government puts a cap on house rents, landlords lose the incentive to maintain their properties or build new ones. Or, if the government restricts the kinds of financial products that can be sold, two contracting parties that may both have benefited from innovative transactions that fulfill their idiosyncratic needs cannot reap the potential gains of free contract. People must be left 'free to choose', as the title of free-market visionary Milton Friedman's famous book goes.

What they don't tell you

The free market doesn't exist. Every market has some rules and boundaries that restrict freedom of choice. A market looks free only because we so unconditionally accept its underlying restrictions that we fail to see them. How 'free' a market is cannot be objectively defined. It is a political definition. The usual claim by free-market economists that they are trying to defend the market from politically motivated interference by the government is false. Government is always involved and those free-marketeers are as politically motivated as anyone. Overcoming the myth that there
is such a thing as an objectively defined 'free market' is the first step towards understanding capitalism.

Labour ought to be free

In 1819 new legislation to regulate child labour, the Cotton Factories Regulation Act, was tabled in the British Parliament. The proposed regulation was incredibly 'light touch' by modern standards. It would ban the employment of young children—those under the age of nine. Older children (aged between ten and sixteen) would still be allowed to work, but with their working hours restricted to twelve per day (yes, they were really going soft on those kids). The new rules applied only to cotton factories, which were recognized to be exceptionally hazardous to workers' health.

The proposal caused huge controversy. Opponents saw it as undermining the sanctity of freedom of contract and thus destroying the very foundation of the free market. In debating this legislation, some members of the House of Lords objected to it on the grounds that 'labour ought to be free'. Their argument said: the children want (and need) to work, and the factory owners want to employ them; what is the problem?

Today, even the most ardent free-market proponents in Britain or other rich countries would not think of bringing child labour back as part of the market liberalization package that they so want. However, until the late nineteenth or the early twentieth century, when the first serious child labour regulations were introduced in Europe and North America, many respectable people judged child labour regulation to be against the principles of the free market.

Thus seen, the 'freedom' of a market is, like beauty, in the eyes of the beholder. If you believe that the right of children not to have to work is more important than the right of factory owners to be able to hire whoever they find most profitable, you will not see a ban on child labour as an infringement on the freedom of the labour market. If you believe the opposite, you will see an 'unfree' market, shackled by a misguided government regulation.

We don't have to go back two centuries to see regulations we take for granted (and accept as the 'ambient noise' within the free market) that were seriously challenged as undermining the free market, when first introduced. When environmental regulations (e.g., regulations on car and factory emissions) appeared a few decades ago, they were opposed by many as serious infringements on our freedom to choose. Their opponents asked: if people want to drive in more polluting cars or if factories find more polluting production methods more profitable, why should the government prevent them from making such choices? Today, most people accept these regulations as 'natural'. They believe that actions that harm others, however unintentionally (such as pollution), need to be restricted. They also understand that it is sensible to make careful use of our energy resources, when many of them are non-renewable. They may believe that reducing human impact on climate change makes sense too.

If the same market can be perceived to have varying degrees of freedom by different people, there is really no objective way to define how free that market is. In other words, the free market is an illusion. If some markets look free, it is only because we so totally accept the regulations that are propping them up that they become invisible.

Piano wires and kungfu masters

Like many people, as a child I was fascinated by all those gravity-defying kungfu masters in Hong Kong movies. Like many kids,
I suspect, I was bitterly disappointed when I learned that those masters were actually hanging on piano wires.

The free market is a bit like that. We accept the legitimacy of certain regulations so totally that we don’t see them. More carefully examined, markets are revealed to be propped up by rules — and many of them.

To begin with, there is a huge range of restrictions on what can be traded; and not just bans on ‘obvious’ things such as narcotic drugs or human organs. Electoral votes, government jobs and legal decisions are not for sale, at least openly, in modern economies, although they were in most countries in the past. University places may not usually be sold, although in some nations money can buy them — either through (illegally) paying the selectors or (legally) donating money to the university. Many countries ban trading in firearms or alcohol. Usually medicines have to be explicitly licensed by the government, upon the proof of their safety, before they can be marketed. All these regulations are potentially controversial — just as the ban on selling human beings (the slave trade) was one and a half centuries ago.

There are also restrictions on who can participate in markets. Child labour regulation now bans the entry of children into the labour market. Licences are required for professions that have significant impacts on human life, such as medical doctors or lawyers (which may sometimes be issued by professional associations rather than by the government). Many countries allow only companies with more than a certain amount of capital to set up banks. Even the stock market, whose under-regulation has been a cause of the 2008 global recession, has regulations on who can trade. You can’t just turn up in the New York Stock Exchange (NYSE) with a bag of shares and sell them. Companies must fulfil listing requirements, meeting stringent auditing standards over a certain number of years, before they can offer their shares for trading. Trading of shares is only conducted by licensed brokers and traders.

Conditions of trade are specified too. One of the things that surprised me when I first moved to Britain in the mid 1980s was that one could demand a full refund for a product one didn’t like, even if it wasn’t faulty. At the time, you just couldn’t do that in Korea, except in the most exclusive department stores. In Britain, the consumer’s right to change her mind was considered more important than the right of the seller to avoid the cost involved in returning unwanted (yet functional) products to the manufacturer. There are many other rules regulating various aspects of the exchange process: product liability, failure in delivery, loan default, and so on. In many countries, there are also necessary permissions for the location of sales outlets — such as restrictions on street-vending or zoning laws that ban commercial activities in residential areas.

Then there are price regulations. I am not talking here just about those highly visible phenomena such as rent controls or minimum wages that free-market economists love to hate.

Wages in rich countries are determined more by immigration control than anything else, including any minimum wage legislation. How is the immigration maximum determined? Not by the ‘free’ labour market, which, if left alone, will end up replacing 80–90 per cent of native workers with cheaper, and often more productive, immigrants. Immigration is largely settled by politics. So, if you have any residual doubt about the massive role that the government plays in the economy’s free market, then pause to reflect that all our wages are, at root, politically determined (see Thing 3).

Following the 2008 financial crisis, the prices of loans (if you can get one or if you already have a variable rate loan) have become a lot lower in many countries thanks to the continuous slashing of interest rates. Was that because suddenly people didn’t want loans and the banks needed to lower their prices to shift them? No, it was the result of political decisions to boost demand
by cutting interest rates. Even in normal times, interest rates are set in most countries by the central bank, which means that political considerations creep in. In other words, interest rates are also determined by politics.

If wages and interest rates are (to a significant extent) politically determined, then all the other prices are politically determined, as they affect all other prices.

Is free trade fair?

We see a regulation when we don’t endorse the moral values behind it. The nineteenth-century high-tariff restriction on free trade by the US federal government outraged slave-owners, who at the same time saw nothing wrong with trading people in a free market. To those who believed that people can be owned, banning trade in slaves was objectionable in the same way as restricting trade in manufactured goods. Korean shopkeepers of the 1980s would probably have thought the requirement for ‘unconditional return’ to be an unfairly burdensome government regulation restricting market freedom.

This clash of values also lies behind the contemporary debate on free trade vs. fair trade. Many Americans believe that China is engaged in international trade that may be fair but is not fair. In their view, by paying workers unacceptably low wages and making them work in inhumane conditions, China competes unfairly. The Chinese, in turn, can riposte that it is unacceptable that rich countries, while advocating free trade, try to impose artificial barriers to China’s exports by attempting to restrict the import of ‘sweatshop’ products. They find it unjust to be prevented from exploiting the only resource they have in greatest abundance – cheap labour.

Of course, the difficulty here is that there is no objective way to define ‘unacceptably low wages’ or ‘inhumane working conditions’. With the huge international gaps that exist in the level of economic development and living standards, it is natural that what is a starvation wage in the US is a handsome wage in China (the average being 10 per cent that of the US) and a fortune in India (the average being 2 per cent that of the US). Indeed, most fair-trade-minded Americans would not have bought things made by their own grandfathers, who worked extremely long hours under inhumane conditions. Until the beginning of the twentieth century, the average work week in the US was around sixty hours. At the time (in 1905, to be more precise), it was a country in which the Supreme Court declared unconstitutional a New York state law limiting the working days of bakers to ten hours, on the grounds that it ‘deprived the baker of the liberty of working as long as he wished’.

Thus seen, the debate about fair trade is essentially about moral values and political decisions, not economics in the usual sense. Even though it is about an economic issue, it is not something economists with their technical tool kits are particularly well equipped to rule on.

All this does not mean that we need to take a relativist position and fail to criticize anyone because anything goes. We can (and I do) have a view on the acceptability of prevailing labour standards in China (or any other country, for that matter) and try to do something about it, without believing that those who have a different view are wrong in some absolute sense. Even though China cannot afford American wages or Swedish working conditions, it certainly can improve the wages and the working conditions of its workers. Indeed, many Chinese don’t accept the prevailing conditions and demand tougher regulations. But economic theory (at least free-market economics) cannot tell us what the ‘right’ wages and working conditions should be in China.
I don't think we are in France any more

In July 2008, with the country's financial system in meltdown, the US government poured $200 billion into Fannie Mae and Freddie Mac, the mortgage lenders, and nationalized them. On witnessing this, the Republican Senator Jim Bunning of Kentucky famously denounced the action as something that could only happen in a 'socialist' country like France.

France was bad enough, but on 19 September 2008, Senator Bunning's beloved country was turned into the Evil Empire itself by his own party leader. According to the plan announced that day by President George W. Bush and subsequently named TARP (Troubled Asset Relief Program), the US government was to use at least $700 billion of taxpayers' money to buy up the 'toxic assets' choking up the financial system.

President Bush, however, did not see things quite that way. He argued that, rather than being 'socialist', the plan was simply a continuation of the American system of free enterprise, which 'rests on the conviction that the federal government should interfere in the marketplace only when necessary'. Only that, in his view, nationalizing a huge chunk of the financial sector was just one of those necessary things.

Mr Bush's statement is, of course, an ultimate example of political double-speak - one of the biggest state interventions in human history is dressed up as another workaday market process. However, through these words Mr Bush exposed the flimsy foundation upon which the myth of the free market stands. As the statement so clearly reveals, what is a necessary state intervention consistent with free-market capitalism is really a matter of opinion. There is no scientifically defined boundary for free market.

If there is nothing sacred about any particular market boundaries that happen to exist, an attempt to change them is as legitimate as the attempt to defend them. Indeed, the history of capitalism has been a constant struggle over the boundaries of the market.

A lot of the things that are outside the market today have been removed by political decision, rather than the market process itself - human beings, government jobs, electoral votes, legal decisions, university places or uncertified medicines. There are still attempts to buy at least some of these things illegally (bribing government officials, judges or voters) or legally (using expensive lawyers to win a lawsuit, donations to political parties, etc.), but, even though there have been movements in both directions, the trend has been towards less marketization.

For goods that are still traded, more regulations have been introduced over time. Compared even to a few decades ago, now we have much more stringent regulations on who can produce what (e.g., certificates for organic or fair-trade producers), how they can be produced (e.g., restrictions on pollution or carbon emissions), and how they can be sold (e.g., rules on product labelling and on refunds).

Furthermore, reflecting its political nature, the process of re-drawing the boundaries of the market has sometimes been marked by violent conflicts. The Americans fought a civil war over free trade in slaves (although free trade in goods - or the tariffs issue - was also an important issue). The British government fought the Opium War against China to realize a free trade in opium. Regulations on free market in child labour were implemented only because of the struggles by social reformers, as I discussed earlier. Making free markets in government jobs or votes illegal has been met with stiff resistance by political parties who bought votes and dished out government jobs to reward loyalists. These practices came to an end only through a combination of political activism, electoral reforms and changes in the rules regarding government hiring.
Recognizing that the boundaries of the market are ambiguous and cannot be determined in an objective way lets us realize that economics is not a science like physics or chemistry, but a political exercise. Free-market economists may want you to believe that the correct boundaries of the market can be scientifically determined, but this is incorrect. If the boundaries of what you are studying cannot be scientifically determined, what you are doing is not a science.

Thus seen, opposing a new regulation is saying that the status quo, however unjust from some people’s point of view, should not be changed. Saying that an existing regulation should be abolished is saying that the domain of the market should be expanded, which means that those who have money should be given more power in that area, as the market is run on one-dollar-one-vote principle.

So, when free-market economists say that a certain regulation should not be introduced because it would restrict the ‘freedom’ of a certain market, they are merely expressing a political opinion that they reject the rights that are to be defended by the proposed law. Their ideological cloak is to pretend that their politics is not really political, but rather an objective economic truth, while other people’s politics is political. However, they are as politically motivated as their opponents.

Breaking away from the illusion of market objectivity is the first step towards understanding capitalism.

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**Thing 2**

Companies should **not** be run in the interest of their owners

*What they tell you*

Shareholders own companies. Therefore, companies should be run in their interests. It is not simply a moral argument. The shareholders are not guaranteed any fixed payments, unlike the employees (who have fixed wages), the suppliers (who are paid specific prices), the lending banks (who get paid fixed interest rates), and others involved in the business. Shareholders’ incomes vary according to the company’s performance, giving them the greatest incentive to ensure the company performs well. If the company goes bankrupt, the shareholders lose everything, whereas other ‘stakeholders’ get at least something. Thus, shareholders bear the risk that others involved in the company do not, incentivizing them to maximize company performance. When you run a company for the shareholders, its profit (what is left after making all fixed payments) is maximized, which also maximizes its social contribution.

*What they don’t tell you*

Shareholders may be the owners of corporations but, as the most mobile of the ‘stakeholders’, they often care the least about the long-term future of the company (unless they are so big that they cannot really sell their shares without seriously disrupting the
5. Can Capitalism Go Green?

The most obvious way out [of the climate crisis] is a new round of growth—a giant burst of economic activity designed to replace our fossil-fuel system with something else that will let us go on living just as we do now (or better!), but without the carbon. Even, or especially, as our economy has tanked, we've seized on the idea of green growth as the path out of all our troubles.

—BILL McKIBBEN

Some people who recognize the ecological and social problems that capitalism brings still think that capitalism can and should be reformed. According to Benjamin Barber: "The struggle for the soul of capitalism is ... a struggle between the nation's economic body and its civic soul: a struggle to put capitalism in its proper place, where it serves our nature and needs rather than manipulating and fabricating whims and wants. Saving capitalism means bringing it into harmony with spirit—with prudence, pluralism and those 'things of the public' ... that define our civic souls. A revolution of the spirit." William Greider has written a book entitled The Soul of Capitalism: Opening Paths to a Moral Economy. There are books that tout the potential of "green cap-
italism" and the *Natural Capitalism* of Paul Hawken, Amory Lovins, and L. Hunter Lovins. *Green to Gold*, a book by Daniel Esty and Andrew Winston—"printed on acid-free paper made from 100% postconsumer recycled pulp with soy ink"—is subtitled *How Smart Companies Use Environmental Strategy to Innovate, Create Value, and Build Competitive Advantage.* So we can get rich, continue growing the economy, increase consumption without end, and save the planet—all at the same time! How good can it get?

There is, however, a big problem with such thinking. A system that has only one goal, the maximization of profits in an endless quest for the accumulation of capital on an ever-expanding scale, and which thus seeks to transform every single thing on earth into a commodity with a price, is a system that is soulless; it can never have a soul, never be green. It can never stand still, but is driven to manipulate and fabricate whims and wants in order to grow and sell more . . . forever. Nothing is allowed to stand in its path.

There are a number of important "out of the box" ecological and environmental thinkers and doers who are highly critical of the status quo and identify with the environmental resistance to the system, but who have nevertheless found ingenious ways to reconcile themselves with capitalism. For example, Hawken and the Lovinses argue that capitalism is not really capitalism unless it fully embraces so-called "natural capital," which means that all will be well if capitalism internalizes everything in nature, bringing the external world under its laws, reducing everything in existence to the status of a commodity—with a price. Consequently, these seemingly nonconformist environmental thinkers do not differ much from a more establishment figure like Al Gore, with his aspirations for a "sustainable capitalism."²⁴

Hawken and the Lovinses and many others in the broad tradition they represent—people seeking progressive solutions but finding it impossible to get out of the capitalist framework—are no doubt genuinely good and well-meaning people who are sincerely concerned with the health of the planet. Most are also concerned with issues of social justice. Some truly admirable figures like Wes Jackson and Wendell Berry are working toward concrete low-tech solutions, emphasizing local sustainability and community, while understanding that there is no real silver bullet cure for what ails the planet. We ourselves have been inspired at times by the ideas of such out-of-the-box thinkers.

But there is one box from which it is impossible to escape without confronting it directly: the capitalist economic system. Many, if not most, influential environmental thinkers in the world's rich countries still shy away from such a direct confrontation. Even the increasing numbers of green thinkers who criticize capitalism and its market failures, frequently settle in the end for what they regard as practical solutions directed at creating a tightly controlled humane, green, and non-corporate capitalism, instead of actually getting outside the box of capitalism. Some call for reinventing "the purpose and design of business," or using tax policy to better direct investment and consumption to green ends, or for trade policies that might promote the goods of more sustainable economies.⁵ Others suggest eliminating the myriad government subsidies to businesses and taking into account social and ecological consequences of production ("externalities") so as to give rise to "honest prices" that reflect the real costs, including those to the environment.⁶ The contradictions and complexities of actually implementing a new way to price commodities, in a system in which the profit is the only god, and power rests in the hands of people who have no interest in doing this, makes all of this an insurmountable task. As David Harvey has said: "If capitalism is forced to internalize" all of the social and environmental costs it generates "it will go out of business. This is the simple truth."⁷
The Mystique of the Market

The remedies proposed by environmental reformers often include maintaining a strong role for private ownership of businesses as well as the role of markets. In many people's minds markets (especially so-called free markets) are an important positive aspect of capitalism because they provide cues telling businesspeople what to invest in, and whether more or less of some product or service should be produced. Markets are also, in this view, the only efficient way of distributing goods. Thus markets are supposed to make sure that what's needed gets produced and what people don't need or want doesn't get produced.

Such claims with regard to market efficiency are frequently based on mystical notions of what markets are—and what the market system is. Indeed, much of this has its basis in a form of circular reasoning: market prices are described as efficient, while efficiency itself is whatever arises from a system of market prices. Widespread market inefficiencies and market failures are downplayed as peripheral issues no matter how pervasive. Negative effects, resulting from the externalization of costs on people and the environment, are often ignored even if they threaten the existence of most human beings and the planet itself. The fact that markets in a capitalist society serve the narrow interest of the accumulation of capital and reinforce the power of the wealthy is frequently hidden, since the power relations that lie behind most real markets are not transparent. Often we are told that markets should be self-regulating, and hence “free,” which means governments should not intervene. Yet, markets in the real world are dominated by giant corporations, which intervene in numerous ways in their functioning, employing enormous monopoly power. Indeed, economists commonly speak of the market power of such giant corporations, in order to refer to their monopoly power over the market.

Most discussions of markets ignore not only corporate power but also class power and other forms of social and economic inequality. Market economies are mystifying in that they disguise these vastly unequal relations, generating results that appear accidental—the violence of things rather than the violence of property. The “highest and best use” of a resource or a commodity in a market system is not what benefits the population as a whole, but what benefits those with the greatest purchasing power.

The neoliberal idea of the smoothly operating and efficient self-regulating market society—nothing more than a self-serving myth—dominates much of current policy, and is used to beat down any barriers to economic interests. Rather than a self-regulating market, what we increasingly have today is a society in which private interests increasingly regulate the state. For example, in the financial crisis of 2007–2009 the first priority of all of the mature capitalist states was to bail out big capital and big finance, to the tune of trillions of dollars. The population was simply told that the market demanded it, since certain firms were “too big to fail.” At the same time that the riches of the wealthiest members of society were being preserved millions of people lost their homes and jobs and slipped into poverty.

The whole notion of the market has become so abstract, and so removed from reality in every way, as economist James K. Galbraith has stated, that “when you come down to it, the word market is a negation. It is a word to be applied to the context of any transaction so long as that transaction is not directly dictated by the state.”

The Neoliberal Concept of Democracy

The commonplace notion of the opposition between state and market, between public and private, is important. The state represents the realm of political action, in which democracy—the rule of the people, by the people, and for the people—is theoretically possible. In contrast, the market under capitalism represents the rule of capital, by capital, and for capital.
Today, rather than a true democracy we have a plutocracy (rule by moneyed interests) in which some of the formal elements of democracy nonetheless remain. Needless to say a real democracy, as this was classically understood in egalitarian terms, is impossible where income, wealth, and power are concentrated and where inequality is growing, that is, in the normal way of things under capitalism. Hence, ever since the publication in 1942 of Joseph Schumpeter’s *Capitalism, Socialism, and Democracy*, in which the neoliberal concept of democracy as a market relationship was first introduced, attempts have been made by defenders of the system to redefine “democracy” in economic terms, transforming it into something nearly opposite its original meaning. In ancient Greece democracy was associated with the rule of the *demos*, i.e., the common people. In contrast, democracy has now been redefined in the United States and some other countries as a system in which individuals simply vote periodically for political entrepreneurs, who seek out their votes much like commercial interests seek out dollars in the marketplace. The essential content of democracy has therefore been eviscerated. So politically corrupted is the U.S. political system that instead of one person, one vote being the rule, an individual’s political influence is weighted according to his/her wealth, which determines how responsive politicians are to that individual’s interests. Big money, as is well known, provides access to politicians and opens doors. At the same time, corporations themselves “vote” with their dollars, feeding the financial campaign chests of politicians and hiring a phalanx of lobbyists to forward their interests. Politicians frequently end up paying their financial donors back “with interest” for what they receive. As in any business transaction, corporations provide political campaign financing and naturally expect “value added” in return.

The capitalist system, since it worships what Rachel Carson called “the gods of profit and production” rather than real needs, is unable to supply all people with the essential requirements of a decent life, or, in some cases, life itself. This derives from the fact that capitalism is inherently an alienated system, in which those on the receiving end of the system measure themselves by their distance not only from the rest of the world’s population but also from nature itself, glorying in the “conquest of nature.” It is a world turned upside down: one that places abstract value above human beings, making it, and not the living, creative forces of nature and humanity, the measure of what is material and productive.

It follows that the various ways of “reforming” capitalism that are promoted by often well-meaning, practical people, who are trying to change things within the parameters of what is allowed by the system, are little more than intellectual contortions: people trying to get around or smooth over basic features of the system because in their eyes a real alternative is unthinkable. In what Derrick Jensen and Aric McBay call the “inversion of what is real,” capitalism is seen as more real than the environment; and hence it is capitalism that needs to be saved in the context of the environmental crisis, as opposed to the earth’s environment itself.

Not surprisingly, then, the dominant strategies with respect to global warming to be found in environmental circles are concerned not with preserving the planet but with preserving capitalism, the very system that is destroying the earth as we know it. In a speech calling for “urgent action to fight global warming,” UN Secretary General Ban Ki-moon said: “We must be actively engaged in confronting the global challenge of climate change, which is a serious threat to development everywhere.” In this view, it is not capitalist development, that, by promoting global warming, constitutes a threat to the earth’s environment and its
inhabitants, but rather global warming that constitutes a threat to capitalist development. What nearly all mainstream solutions to the global environmental problem have in common, as Jensen and McBay write, is that

they all take industrial capitalism as a given, as that which must be saved, as that which must be maintained at all costs (including the murder of the planet, the murder of all that is real), as the independent variable, as primary; and they take the real, physical world—filled with real physical beings who live, die, make the world more diverse—as secondary, as a dependent variable, as something (never someone, of course) that (never who) must conform to industrial capitalism or die. . . . Within this culture, the world is consistently less important than industrial capitalism, the end of the world is less to be feared than the end of industrial capitalism.17

The “out of the box” environmental thinkers, who often parade as the most radical and critical green thinkers, but who all too often fail prey to the mystique of capital, are thus unable even to envision, let alone promote, an economic system that has fundamentally different goals and decision-making processes than those that are currently dominant. As cultural theorist Fredric Jameson has said, for many people in this society, “it is easier to imagine the end of the world than to imagine the end of capitalism.”18

The Morality of “Green Capitalism”

Today green is good. “Being green” has become very fashionable as well as profitable, and corporations are outdoing each other to portray themselves as green and socially responsible. After all, who doesn’t want to be considered sustainable? You can buy and wear your Gucci clothes with a clean conscience because the company is helping to protect rain forests by using less paper.19 Newsweek claimed that corporate giants such as Hewlett-Packard, Dell, Johnson & Johnson, Intel, and IBM were the top five green companies of 2009. This was because of their use of renewable sources of energy, their reporting of greenhouse gas emissions (or their lowering of them), and their implementation of formal environmental policies.20 Some environmentalists and business leaders say that you should “vote with your wallet,” by purchasing green products. Environmental problems can be and in some cases are being ameliorated by better production practices (for example, growing organic food or using renewable inputs instead of nonrenewable ones). The business offensive along these lines just prior to the Copenhagen Climate Change meeting was described by the Guardian (UK): “Climate change catastrophe can be averted by ‘greening’ consumer behaviour rather than by curbing economic growth and mass consumerism, leaders of some of the world’s biggest businesses including Tesco, Coca-Cola and Reckitt Benckiser argued today.”21

The mainstream emphasis on corporate responsibility as the solution to the environmental problem can be examined by looking at the case of BP. On April 22, 1999, Sir John Browne, CEO of BP, received an award for Individual Environmental Leadership from the UN Environmental Programme for his leadership in promoting environmental causes. Under Browne’s leadership BP had adopted the slogan “Beyond Petroleum,” and had acknowledged that greenhouse gases might cause global warming. In 2000 Browne was also awarded FIRST Magazine’s FIRST Award for Responsible Capitalism for his advances in social responsibility. Browne and BP became symbols of a new green corporate world. “Can business be about more than profits? We think it can”—went a Browne-inspired BP ad. Browne promised growth with environmental cleanliness. Browne was a leading advocate of the “precautionary principle,” in which business
would refrain from economic activities that might be environmentally destructive.\textsuperscript{22}

However, despite BP’s “Beyond Petroleum” slogan the company continued its aggressive expansion of oil drilling, even in environmentally sensitive and hazardous areas, such as the Arctic Circle and the deep ocean. Browne argued that there was no conflict between green values and cars that emphasized performance over fuel efficiency. Nor, he insisted, was BP’s opposition to government regulation with regard to the environment a contradiction, since socially responsible corporations would police themselves.\textsuperscript{23} Under Browne’s leadership BP entered an era of extreme cost cutting with regard to safety, which generated greater profits but also greater environmental hazards.

In March 2005 fifteen workers were killed and another 180 injured in chemical fires and explosions at BP’s plant in Texas City—later shown to be the fault of drastic cuts in safety personnel.\textsuperscript{24} Although Browne resigned as CEO of BP in 2007, BP’s practice of putting profits before safety and the environment continued, leading to the Deepwater Horizon oil spill in 2010, after an explosion that killed eleven workers. Oil flowed for three months into the Gulf of Mexico, in the biggest accidental marine oil spill in the history of the oil industry. The spill itself was the result of numerous, egregious reductions in safety standards by BP, associated with a business culture of cost cutting to improve its bottom line.\textsuperscript{25}

The fact that BP’s celebrated status as a leading “green” company was shown to be mere corporate “greenwashing” should of course hardly surprise us. When noted conservative economist Milton Friedman was asked in 2004 whether John Browne as CEO could go so far with his supposed green convictions as to sacrifice BP’s economic interests, Friedman flatly answered: “No. . . . He can do it with his own money. [But] if he pursues those environmental interests in such a way as to run the corporation less effectively for its stockholders, then I think he’s being immoral. He’s an employee of the stockholders, however elevated his position may appear to be. As such, he has a very strong moral responsibility to them.”\textsuperscript{26} In other words, it is the fiduciary responsibility of any CEO to pursue the highest profits or the maximum increase in stockholders’ equity. If a CEO were so deluded as to think that other values could in some way intrude upon this objective, such that profits would be diminished—say by an oil company cutting back on its drilling or by putting safety and the environment first—then that CEO would soon be out of a job. Quite clearly, John Browne knew the corporate bottom line in this respect, and never let his talk about environmental values and corporate social responsibility interfere with BP’s real, exploitative relation to the environment.

The corporate green movement has also reached into consumption, leading to endless hype on “green consumers” and “green markets.” All the emphasis in media stories and advertising on sustainable consumption has created would-be green consumers, who feel that by purchasing “sustainable” commodities they can pursue their same consumerist lifestyles and feel virtuous at the same time. However, many so-called green products have been shown to be no better for the environment than their non-green counterparts.\textsuperscript{27} As environmentalist Heather Rogers informs us:

What I learned [while doing research for \textit{Green Gone Wrong}] is that the outcome of industrial organic [food], commodity biofuels, and CO\textsubscript{2} offsetting isn’t authentic protection and stewardship of the environment. What’s transpiring is a tailoring of environmental crises so they can be dealt with in ways today’s economic and political structures deem least threatening to the status quo.\textsuperscript{28}

The Corporate Social Responsibility (CSR) programs, although supported by some genuinely concerned individuals,
have mainly become marketing opportunities, and somewhat successful as such:

Companies use CSR programs to build brand loyalty and make personal connections with customers. There can be a payoff: 70 percent of consumers say they would pay a premium for goods from socially responsible companies, according to a recent poll of 1,001 adults. Of that group, 28 percent said they would pay at least $10 more for a product because of the social responsibility link.39

An expert consultant on issues such as “social responsibility” has some doubts about it: “There’s often more spin than substance when it comes to social responsibility… Companies want to take credit for things that they ought to be doing anyway.” One of the companies leading the movement, as we have seen, has been BP, one of the least socially responsible companies on Earth. But BP’s obfuscating propaganda was effective as indicated by its stock being held in the portfolios of a number of “socially responsible” mutual funds.31

Today, mainstream environmentalists, oddly enough, look to Wal-Mart as the leader in corporate responsibility and green business. Thus Wal-Mart, the world’s largest corporation in 2009, is celebrated in the Worldwatch Institute’s State of the World, 2010 report as the firm that best exemplifies the move from an exclusive focus on profits to a sustainable business model as its “primary fiduciary responsibility.” Former Wal-Mart CEO (now board chairman) Lee Scott is quoted as committing the company in 2005 to “100 percent renewable energy, to create zero waste” (while at the same time admitting he had no idea how Wal-Mart can achieve such goals). We are told that Wal-Mart is now on a “sustainable journey” (at little cost to itself), promoting green values among all of its 1.4 million U.S. employees, who are encouraged to be more sustainable consumers, recycling and eating more healthy meals. Among its other measures, Wal-Mart has pledged to market only wild-caught fish certified by the Marine Stewardship Council (an organization viewed dubiously by Food and Water Watch and by many environmentalists). Its chief concrete environmental commitment, made in 2005, was to become 20 percent more energy efficient by 2013 through cutting the carbon emissions associated with its current stores by 2.5 million metric tons. But by 2006 Wal-Mart’s carbon emissions had already risen, by its own admission, another 9 percent. The new stores that were being added in 2007 alone were expected to consume enough electricity to add one million metric tons to its overall greenhouse emissions, exceeding any efficiency gains. As Wes Jackson put it, “When the Wal-Marts of the world say they’re going to put in different lightbulbs and get their trucks to get by on half the fuel, what are they going to do with the savings? They’re going to open up another box store somewhere. It’s just nuts.” In the end, Wal-Mart is an economic juggernaut—anything but representative of a new, sustainable economic order.32

It is known especially for its harsh policies toward labor and its readiness to go to virtually any length (including closing down stores) to prevent the unionization of its workers.

The reality is that none of the proposals for reforming capitalism deal with the essential issue, the bottom line of net gain or profit. For the sake of the environment and our future as a species, the economy cannot keep growing forever with more and more goods and services (green or not) consumed per person. But if the economy doesn’t grow, how are jobs going to be created and maintained? Experience has shown that slow or no growth in a capitalist economy is a disaster for working people.

Is Reversing Global Climate Change Compatible with Capitalism?

Let’s put aside corporate greenwashing efforts, the systemic imperative to growth and environmental exploitation, and the
question of the role of technology under capitalism and take a look at some of the proposed technical ways to deal with global climate change—currently the most critical problem facing the earth and its inhabitants—without disturbing capitalism.

**Technologies That Are More Energy Efficient, Less Harmful, and/or Use Fewer Material Inputs**

Some proposals to enhance energy efficiency—such as helping people tighten up and insulate their old homes so that less fuel is required for winter heating, and the use of simple rooftop solar water heaters—are just plain common sense. Machinery, including household appliances and automobiles, is continually becoming more energy efficient—a normal part of the system, sometimes coaxed by government regulations. Nevertheless, it is important to note that increased energy efficiency usually leads to lower costs of use, but also increased use, and often increased size as well, as in automobiles and refrigerators—so that the amount of energy used is frequently increased, or the energy savings are less than they would be if product size remained the same. People may drive their fuel-efficient Toyota Prius more miles and leave on the efficient LED lighting more hours than with more energy-consuming technologies. They may think that they are doing the earth a favor by buying hybrid SUVs that are more fuel-efficient than non-hybrids, but still use a lot more fuel than a smaller vehicle.

There are proposals to provide less polluting technologies, particularly solar, wind, and water power. It is certainly true that this is the way to go in generating energy, as opposed to fossil fuels, agrofuels, or nuclear energy. There is also the possibility of combining hydropower with either wind or solar power by pumping water uphill during the day when energy from wind and solar are available and then allowing the water to return through turbines, generating electricity at night if needed. But these sources of energy do not provide a free lunch with respect to the environment, and hence do not allow for unlimited economic expansion without cost. They frequently come with their own problems. There is renewed interest in hydropower, especially in smaller-scale projects—although large-scale projects continue to be developed in Asia and South America. The damage to the environment and to humans caused by large dams—forests inundated, species destroyed, seawater intrusion and the killing off of mangroves in deltas, and relocation of indigenous peoples—has generated a movement to try to stop such projects.

The earth's geothermal energy can be safely developed in some areas (Iceland has done quite a bit with this source of energy) and holds promise, although appropriate locations are difficult to find and drilling for such projects in northern California and Switzerland triggered earthquakes. Resource extraction needed for some of the "clean" technologies, such as the rare earths required for wind electric generators and hybrid car batteries, come with their own environmental issues.

While some of the proposals make sense, the misguided push to "green" agrofuels (biofuels made from agricultural crops such as corn, soybeans, rapeseed, and palm oil) has been enormously detrimental to the environment and people. The idea is to replace oil-derived gasoline and diesel by producing the liquid fuels ethanol and biodiesel from farmed crops. Not only has the growth of the agrofuel industry put food and auto fuel in direct competition, pushing food prices higher, but the production of agrofuels also sometimes actually uses more energy to grow and transport and process the crop than the energy obtained. In addition, significant air and water pollution is frequently associated with the growing and processing of crops for liquid fuels.

Tropical forests are being cut down to plant oil palms, to supply oil to produce biodiesel (in addition to its customary use as a cooking oil and in cosmetics), resulting in displacement of indigenous peoples and massive emissions of CO₂ as trees are burned.
and soils disturbed. Conversion of forests to produce oil palm to make "green" biodiesel ends up increasing CO₂ emissions, even in the fairly long term. It is estimated that it will take four hundred years of diesel production of palm oil from these plantations to "pay back" the environment for the CO₂ emissions occurring during preparation and planting of oil palm trees.

Another idea for producing "green" liquid fuels is to convert plant cellulose to alcohol, although it is not yet economically feasible to do so. One of the potential materials, the crop "waste," considered to be one of the important feedstocks for this endeavor, is not waste at all. The return to the soil of crop residues is essential for maintaining organic matter, which has such positive effects on crop yields. Another avenue being explored is the use of algae that make oil. However, this has its own potential problems such as the amount of land needed and the possibility that genetically modified algae will be used, with unknown consequences if they escape into the environment.

Instead of rethinking the entire system as environmental problems develop, people look for silver bullets—technologies such as agrofuels that will "solve" the problem. However, it is not uncommon to discover later that the silver bullet itself causes other problems. For example, in order to find a replacement for ozone-depleting chemicals used in refrigerators and air conditioners as well as insulating foam, HFCs (hydrofluorocarbons) were introduced as a substitute in the 1990s. Though this did help the protective ozone layer recover, HFCs turn out to have over 4,000 times the heat-trapping ability of CO₂, thus worsening global warming. The increase in atmospheric HFCs from leakage from junked refrigerators and air conditioners is projected to be large enough by 2050 to account for six years' worth of CO₂ emissions.

There are technologies that allow for some kind of conservation, lessening the throughput of resources and energy, generating less waste, reducing toxins, etc. But increased efficiency in the use of energy and resources tends, as we have seen, to result in the expansion of the capitalist economic system as a whole, negating any reductions in energy and resource use per unit of output. This is known as the Jevons Paradox, after nineteenth-century economist William Stanley Jevons, who first raised the issue in his book *The Coal Question*. Jevons pointed out that every new steam engine was more efficient in its use of coal than the one before, and yet the introduction of each more efficient engine led to the consumption of greater amounts of coal due to the expansion of production. The Jevons Paradox is now widely recognized by environmentalists as a key reason why technology alone—outside the transformation of social relations—cannot solve the ecological contradictions of capitalism. As philosopher Hannah Arendt put it in *The Human Condition*: "Under modern conditions, not destruction but conservation spells ruin because the very durability of conserved objects is the greatest impediment to the turnover process [of capital], whose constant gain in speed is the only constancy left wherever it has taken hold."

**HIGH-TECH/HIGH-RISK SOLUTIONS**

The fact that accumulation is the single drumbeat of capitalist society means that ecological systems, and the biological-health systems of species, are stretched to the limits, leading to ever-increasing risk. This has led sociologists to speak of the emergence of a "risk society," as a product of capitalism and modernity. Toxic chemicals, radiation, and other hazards pervade our environment and our bodies, with no attempt to discern the full effects—or even to test most of the chemicals, despite their frequent carcinogenic, teratogenic, and mutagenic effects. It is enough for the system that such technologies are useful in expanding the economy at low cost to business. The consequences are dealt with in terms of so-called risk management,
attempting to discern (while underestimating and playing down) the number of deaths per million that constitute "acceptable risk." In a society organized in this way it is natural enough to respond to the threat to the planet represented by global warming by turning to riskier and riskier technologies, continually upping the general level of risk. Where "progress" is confused with higher profit margins, which often means the willingness to take on greater risk, such a solution may even seem rational.

The risk-society issue is immediately evident when the question of nuclear power as a solution to global warming arises. Some scientists concerned with climate change, including James Lovelock and James Hansen, see nuclear power as an energy alternative and as a partial technological answer to the use of fossil fuels—one that is much preferable to the growing use of coal. However, nuclear energy at present releases 9 to 25 times the carbon emissions of wind energy, due to uranium refining, transport, and reactor construction. Although the technology of nuclear energy has improved somewhat with third-generation nuclear plants, and although there is now the possibility (still not a reality) of fourth-generation nuclear energy, the dangers of nuclear power are still enormous—given radioactive waste lasting hundreds and thousands of years, the social management of complex systems, and the sheer level of risk involved. The 2011 post earthquake/sunrise disaster at Japan’s Fukushima Dai-Ichi facility once again illustrates the ongoing dangers and immense risks associated with dependence on nuclear power.

The breeder nuclear reactor—a third-generation nuclear technology currently available and often presented as an alternative—has similar problems to those of conventional fission reactors, though producing less low-level radioactive waste and able to reuse the spent fuel, thereby alleviating the problem of limited uranium reserves. However, they also generate nuclear materials closer to weapons grade that can be more readily reprocessed for nuclear weapons. This close connection between nuclear power and nuclear weapons development is of course a major concern for all humanity.

Nuclear plants take about ten years to build and are extremely costly and uneconomic. It has been estimated that to satisfy the world’s electrical power demands through nuclear energy it would require building a nuclear power plant every day for the next forty-three years. If a mere 5 percent of these were built it would double the world’s current nuclear power installations worldwide. The result would be an increased likelihood of what sociologist Charles Perrow has called “normal accidents,” as these extremely high-risk facilities proliferate. There are all sorts of reasons, therefore, to be extremely wary of nuclear power as any kind of environmental solution. To go in that direction would clearly be a Faustian bargain.

A number of vast geoengineering schemes have been proposed either to take CO2 out of the atmosphere or to increase the reflectance of sunlight back into space, away from Earth. These include:

- Finding ways of absorbing carbon more effectively, such as fertilizing the oceans with iron to stimulate algal growth to absorb carbon, and reforested the planet with genetically altered fast-growing trees.
- Various proposals to decrease solar energy absorbed by the Earth by means of enhanced sunlight reflection schemes, such as deploying huge white islands in the oceans to restore the albedo effect, creating large satellites to reflect incoming sunlight; contaminating the stratosphere with sulfur dioxide particles that reflect light and promote global dimming.
- Geoengineering carbon sequestration on a massive scale. Here the assumption is that physics and economics will allow the capture of carbon, and the use of large machines distrub-
uted around the world will make it possible to scrub CO₂ from the atmosphere itself instead of from individual industrial plant emissions. After trapping CO₂ on an adsorbing material, it would then be liquefied for disposal.⁴²

No one knows what detrimental side effects might occur from such huge schemes—attempts to play God with the planet. The sheer complexity of the problems raised suggests the enormous, planetary-risk nature of such ventures. For example, stimulating algal growth by applying iron to oceans might just lead to more “dead zones” when the algae die and fall to the lower depths, harming other aquatic life. Dumping sulfur dioxide into the stratosphere to block sunlight could reduce photosynthesis throughout the planet.

“CLEAN COAL”

One common technological solution proposed is the shift to what is referred to as “clean coal” as a way of expanding the production of fossil fuels—but without carbon emissions. The U.S. government has poured billions of dollars into supporting such clean coal research. Although clean coal is not a reality (and never can be), the mere idea is used to defend continued coal production and the building of more dirty coal plants. The clean-coal technology claim is based on what is called carbon capture and storage (CCS) technology. This technology is designed to remove carbon from the air prior to its being released into the atmosphere and turn it into a non-harmful substance that can be injected into geological formations or into the ocean. Even the most optimistic scenarios, however, do not see CCS technology as available until 2030—way too late to deal with the immediate climate change problem. The technology, while nascent, has never been used on an industrial scale. Moreover, it carries with it enormous eco-

nomic costs—with price increases from the implementation of CCS technology estimated to be in the range of 21 to 91 percent. The fuel needs of plants employing CCS technology are expected to go up by 25 percent. A May 2011 report by the American Physical Society on the physics of DAC (direct air capture) of carbon dioxide concluded:

With optimistic assumptions about some important technical parameters, the cost of this system is estimated to be of the order of $600 or more per metric ton of CO₂. Significant uncertainties in the process parameters result in a wide, asymmetric range associated with this estimate, with higher values being more likely than lower ones. Thus, DAC is not currently an economically viable approach to mitigating climate change... Since a 1000-megawatt coal power plant emits about six million metric tons of CO₂ per year, a DAC system consisting of structures 10 meters high that removes CO₂ from the atmosphere as fast as this coal plant emits CO₂ would require structures whose total length would be about 30 kilometers. Large quantities of construction materials and chemicals would be required. It is likely that the full cost of the benchmark DAC system scaled to capture six million metric tons of CO₂ per year would be much higher than alternative strategies providing equivalent decarbonized electricity.⁴³

The injection of captured carbon into the ocean could increase the acidity of the ocean with consequences potentially as large as climate change itself. The ramifications of attempting to store the captured carbon dioxide in geological formations is still uncertain, though it is clear that the escape of large amounts of the gas could be dangerous (residents near an African lake were suffocated in 1986 when a natural pocket of carbon dioxide escaped). For all of these reasons, clean coal is largely a hoax. The real priority, as James Hansen indicates, is to stop building new
coal plants and to retire those that exist. If the coal reserves are burned climate change will become unstoppable and catastrophic. CCS technology also does not address the many other environmental damages caused by coal production and coal plants: mountaintop removal, long-wall mining, plus all the mercury, arsenic, sulfates, and other air and water pollutants that come with the coal system.

Low-Tech Solutions

Also proposed are a number of low-tech ways to sequester carbon such as increasing reforestation and using ecological soil management to increase soil organic matter (which is composed mainly of carbon). Most of the management techniques for increasing soil organic matter—use of cover crops, return of crop residue to the soil, integrating livestock and crop farming once again, and using better crop rotations—should be done for their own sake because organic material helps to improve soils in many ways. As agricultural soil organic matter content increases and forests grow (and the soil underneath the forest also increases in organic matter), this keeps at least some CO₂ out of the atmosphere. Thus reforestation, by pulling carbon from the atmosphere, is sometimes thought of as constituting negative emissions.

Another scheme for increasing stored carbon in the soil is to incorporate “biochar,” the product of relatively low temperature burning with limited oxygen. This char is very stable and is believed to be one of the factors responsible for the maintenance of soil fertility in long abandoned fields in the Amazon basin (these dark soils are referred to as terra preta de índio). However, forests must be cut down to produce large quantities of biochar, and croplands will have to be used to grow residue to burn—and about half of the carbon contained in these materials will end up in the atmosphere during the combustion process.

Can Capitalism Go Green?

Some low-tech solutions may help, but obviously cannot solve the problem given an expanding economic system, especially since trees planted now take a long time to sequester meaningful amounts of carbon, can be cut down later, and carbon stored as soil organic matter may later be converted to CO₂ if practices are changed. However, if practiced, widely increasing soil organic matter might provide a temporary slowing down of the rate of increase of atmospheric CO₂.

Cap-and-Trade and Other Market Schemes

Government regulation of polluting industries has worked to some extent and can in the future if the regulations address the actual problems and the regulators are not in bed with those being regulated, which, however, is the normal case in the present system. A struggle for increased government regulation with respect to the environment, particularly if structured to respond to the needs of the actual population as a result of constant public pressure, is a necessary immediate response to the environmental problem.

But many environmentalists, unable to imagine a non-capitalist economy, and responding to what they consider practical—that is, what the reigning economic interests are willing to accept—have endorsed market-based “solutions” to environmental problems. These run the gamut from paying businesses to be more ecologically sound (such as “green payments” for farmers to use practices that reduce soil erosion), to the heavy taxation of fossil fuel use, to giving or selling tradable rights to pollute after imposing a cap on emissions of the pollutant.

Until the last couple of years, the darling of market-oriented solutions to carbon emissions was “cap-and-trade.” This involves placing a cap on the allowable level of greenhouse gas emissions and then distributing, either by fee or by auction, permits that
allow industries to emit carbon dioxide and other greenhouse gases. Those corporations that have more permits than they need may sell them to other firms that want additional permits to pollute. Such schemes invariably include “offsets” that act like medieval indulgences, allowing corporations to continue to pollute as long as they buy good grace through helping to curtail pollution somewhere else, perhaps in the third world.

How did cap-and-trade, as opposed to taxing pollution or simply legally mandating reductions in emissions, go from a theory to a near consensus? According to a 2009 article in the *New York Times*:

The answer is not to be found in the study of economics or environmental science, but in the realm where most policy debates are ultimately settled: politics. Many members of Congress remember the painful political lesson of 1993, when President Bill Clinton proposed a tax on all forms of energy, a plan that went down to defeat and helped take the Democratic majority in Congress down with it a year later. Cap and trade, by contrast, is almost perfectly designed for the buying and selling of political support through the granting of valuable emissions permits to favor specific industries and even specific Congressional districts.45

Cap-and-trade—originally proposed by conservatives for reducing sulfur dioxide (a significant contributor to acid rain) emissions from power plants—has gone out of favor in the United States as a response to carbon emissions because conservatives now claim it is a new tax, and some of the political liberals in Congress are aware of its failure in Europe. It is clear that this proposed solution is much less efficient than a straight tax or mandate for lowering pollution, partly because it tends to put a floor under existing emissions, partly because it promotes offsets that “reduce” emissions only on paper, not in reality.

In theory, carbon cap-and-trade would stimulate technological innovation to increase energy and commodity output per amount of carbon dioxide emitted. In practice, however, it has not led to carbon dioxide emission reductions in areas where it has been introduced, such as Europe. The main result of carbon trading has been enormous profits for some corporations and individuals and the creation of a subprime carbon market.46

Carbon offsets are invariably part of cap-and-trade schemes but also can be stand-alone projects. You can now travel wherever you want, guilt-free, by purchasing carbon “offsets,” such as having a few trees planted somewhere, and thus supposedly cancel out the environmental effects of your trip. The lack of verification and long-term commitment of these supposed offsets can result in fraudulent or poorly designed and carried out projects that will not be enough to compensate truly for the CO₂ emitted and supposedly offset.47 In addition, there are no prohibitions against changing conditions sometime in the future that will result in carbon dioxide release to the atmosphere.

Europe dominates the $144 billion a year (in 2009) greenhouse gas market. A primary offset purchased by many European companies has been for Chinese firms to destroy HFC-23, a by-product of producing the gas HFC-22, used as a refrigerant. One molecule of HFC-23 in the atmosphere has about ten thousand times the heat retention of one molecule of CO₂. It turns out that companies can make a lot of money destroying HFC-23. There is evidence that some plants in China have been producing more refrigerant than they can sell in order to have more HFC-23 that they can be paid to destroy.48 About half of all offsets approved by the United Nations through the summer of 2010 are for credits for HFC-23 destruction. As Clare Perry of the Environmental Investigation Agency has stated, “It would be far cheaper and more effective to directly finance the factories to deal with the HFC-23 problem rather than use this kind of byzantine financing.”49
For James Hansen cap-and-trade is the "temple of doom" and "worse than nothing" because it prevents effective action directly limiting carbon through regulations and a properly designed tax, while giving people the impression that something is being done. Indeed, the various technofixes discussed above associated with today's green technology and markets—more efficient and/or cleaner energy production and use, better regulations, cap-and-trade of greenhouse gases, carbon offsets, etc.—are all roads to climate catastrophe rather than climate protection. "Green capitalism," even if products are produced using the utmost environmental care and designed for easy reuse, offers no way out of a system that must expand exponentially and thus, continue to ratchet up its use of natural resources, its chemical pollution, its contaminated sewage sludge, its garbage, and its many other toxic substances. Some of these "fixes" will probably slow down the rate of environmental destruction, but the magnitude of the needed changes dwarfs these approaches.

Indeed, the problem with all of these approaches is that they allow the economy to continue on the same disastrous course it is currently following. The economy can keep on growing and we can go on consuming all we want (or as much as our income and wealth allow)—driving greater distances in our more fuel-efficient cars, living in very large but well-insulated homes, consuming all sorts of new products made by green corporations, and so on. All we need to do is support the new green technologies and be "good" about separating out waste that can be composted or reused in some form, and we can go on living pretty much as before, in an economy of perpetual growth and profits.

**The Need for Sustainable Human Development**

The seriousness of the climate change problem arising from human-generated carbon dioxide and other greenhouse gas emis-

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sions has led to notions that it is merely necessary to reduce carbon footprints (a difficult problem in itself). The reality is that there are numerous, interrelated, and growing ecological problems arising from a system geared to the infinitely expanding accumulation of capital. What needs to be reduced is not just carbon footprints but ecological footprints, which means that economic expansion on the world level and especially in the rich countries needs to be reduced, even cease. At the same time, many poor countries need to expand their economies, requiring an even bigger cut in the ecological footprints of rich economies to make room for development in the periphery.

The new principles we should promote under these circumstances are those of sustainable human development. This means enough for everyone and no more. Human development would certainly not be hindered, and could even be considerably enhanced, for the benefit of all by an emphasis on sustainable human, rather than unsustainable economic, development.

A drastic transformation in global energy use—staying within the solar energy budget—will be required to overcome the problem of climate change. To give some idea of the incredible effort needed to keep global warming to only 2 degrees C (3.6 degrees F) simply by technical means, about 80 percent of all of the energy used in the world (13 out of 16 trillion watts) would need to be replaced by CO₂-neutral technologies. According to a *New Yorker* article profiling inventor Saul Griffith, accomplishing this "would require building the equivalent of all the following: a hundred square metres of new solar cells, fifty square metres of new solar-thermal reflectors, and one Olympic swimming pool's volume of genetically engineered algae (for biofuels) every second for the next twenty-five years; one three-hundred-foot-diameter wind turbine every five minutes; one hundred-megawatt geothermal-powered steam turbine every eight hours; and one three-gigawatt nuclear power plant every week." All of this new construction would of course mean a huge, if temporary, increase in energy
demands. Griffith has explained: "Everyone sees climate change as a problem in the domain of scientists and engineers... But it's not enough to say that we need some nerds to invent a new energy source and some other nerds to figure out a carbon-sequestration technology—and you should be skeptical about either of those things actually happening. There are a lot of ideas out there, but nothing nearly as radical as the green-tech hype. We've been working on energy, as a society, for a few thousand years, and especially for the last two hundred years, so we've already turned over most of the stones." Regardless of whether major advances in cleaner energy production are coming soon, the magnitude of the climate change problem calls for drastic reductions in energy use through conservation and alterations in lifestyle. This requires radical transformations in human priorities—not just placing one's hopes in technological fixes.

The reality is that the major environmental problems we face today—of which climate change is only one—cannot be solved by means of technological or market-based solutions while keeping existing social relations intact. Rather, what is needed most is a transformation in social relations: in community, culture, and economy, in how we relate to each other as human beings, and how we relate to the planet. What is needed, in other words, is an ecological revolution.

6. An Ecological Revolution Is Not Just Possible—It's Essential

I am convinced there is only one way to eliminate these grave evils, namely through the establishment of a socialist economy... A planned economy which adjusts production to the needs of the community, would distribute the work to be done among all those able to work and would guarantee a livelihood to every man, woman, and child. The education of the individual, in addition to promoting his own innate abilities, would attempt to develop in him a sense of responsibility for his fellow men in place of the glorification of power and success in our present society.

—ALBERT EINSTEIN

The analysis in earlier chapters, if correct, points to the fact that the ecological crisis cannot be solved within the logic of the present economic/political/social system. The various suggestions for doing so have no hope of success. The system of world capitalism is clearly unsustainable in: (1) its quest for never-ending accumulation of capital leading to production that must constantly expand to provide profits; (2) its agriculture and food system that pollutes the environment and still does not allow universal access
Stumbling Into Bad Behavior
By MAX H. BAZERMAN and ANN E. TENBRUNSEL

IT'S easy to look at big names like Warren E. Buffett, and big companies like Ernst and Young, and be judgmental. Of course they overlooked ethical lapses. Why wouldn't they? That's business.

Regulators, prosecutors and journalists tend to focus on corruption caused by willful actions or ignorance. But in our research, and in the work of other scholars who study the psychology of behavioral ethics, we have found that much unethical conduct that goes on, whether in social life or work life, happens because people are unconsciously fooling themselves. They overlook transgressions — bending a rule to help a colleague, overlooking information that might damage the reputation of a client — because it is in their interest to do so.

When we are busy focused on common organizational goals, like quarterly earnings or sales quotas, the ethical implications of important decisions can fade from our minds. Through this ethical fading, we end up engaging in or condoning behavior that we would condemn if we were consciously aware of it.

The underlying psychology helps explain why ethical lapses in the corporate world seem so pervasive and intractable. It also explains why sanctions, like fines and penalties, can have the perverse effect of increasing the undesirable behaviors they are designed to discourage.

In one study, published in 1999, participants were asked to play the role of a manufacturer in an industry known for emitting toxic gas. The participants were told that their industry was under pressure from environmentalists. To ward off potential legislation, the manufacturers had reached a voluntary but costly agreement to run equipment that would limit the toxic emissions. Some participants were told they would face modest financial sanctions if they broke the agreement; others were told they would face no sanctions if they did.

An economic analysis would predict that the threat of sanctions would increase compliance with the agreement. Instead, participants who faced a potential fine cheated more, not less, than those who faced no sanctions. With no penalty, the situation was construed as an ethical dilemma; the penalty caused individuals to view the decision as a financial one.
When we fail to notice that a decision has an ethical component, we are able to behave unethically while maintaining a positive self-image. No wonder, then, that our research shows that people consistently believe themselves to be more ethical than they are.

In addition to preventing us from noticing our own unethical conduct, ethical fading causes us to overlook the unethical behavior of others. In the run-up to the financial crisis, corporate boards, auditing firms, credit-rating agencies and other parties had easy access to damning data that they should have noticed and reported. Yet they didn’t do so, at least in part because of “motivated blindness” — the tendency to overlook information that works against one’s best interest. Ample research shows that people who have a vested self-interest, even the most honest among us, have difficulty being objective. Worse yet, they fail to recognize their lack of objectivity.

In one experiment for a study published last year, student participants were asked to estimate a fictitious company’s value. They were assigned one of four roles: buyer, seller, buyer’s auditor or seller’s auditor. All participants read the same information, including an array of data to help them estimate the firm’s worth. Not surprisingly, sellers provided higher estimates of the company’s worth than buyers did. More interestingly, the auditors, who were advising either a buyer or a seller, were also strongly biased toward the interests of their clients.

Rather than making a conscious decision to favor their clients, the auditors incorporated information about the company in a biased way — with the sellers’ auditors providing estimates that were 30 percent higher, on average, than the estimates of auditors who served buyers. The study was replicated, with actual auditors from one of the “Big Four” accounting firms, and with similar results.

A solution often advocated for this lack of objectivity is to increase transparency through disclosure of conflicts of interest. But a 2005 study by Daylian M. Cain, George Loewenstein and Don A. Moore found that disclosure can exacerbate such conflicts by causing people to feel absolved of their duty to be objective. Moreover, such disclosure causes its “victims” to be even more trusting, to their detriment.

Our legal system often focuses on whether unethical behavior represents “willful misconduct” or “gross negligence.” Typically people are only held accountable if their unethical decisions appear to have been intentional — and of course, if they consciously make such decisions, they should be. But unintentional influences on unethical behavior can have equally damaging outcomes.
Our confidence in our own integrity is frequently overrated. Good people unknowingly contribute to unethical actions, so reforms need to address the often hidden influences on our behavior. Auditors should only audit; they should not be allowed to sell other services or profit from pleasing their customers. Similarly, if we want credit-rating agencies to be objective, they need to keep an appropriate distance from the issuers of the securities they assess. True reform needs to go beyond fines and disclosures; if we are to truly eliminate conflicts of interest we must understand the psychology behind them.

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Off the Pedestal: Creating a New Vision of Economic Growth

The idea of economic growth as an unquestioned force for good is ingrained in the American psyche. But a longtime environmental leader argues it’s time for the U.S. to reinvent its economy into one that focuses on sustaining communities, family life, and the natural world.

BY JAMES GUSTAVE SPETH

Is anything in America more faithfully followed than economic growth? Its movements are constantly watched, measured to the decimal place, deplored or praised, diagnosed as weak or judged healthy and vigorous. Newspapers, magazines, and cable channels report endlessly on it. Promoting growth may be the most widely shared and robust cause in the United States today.

If the growth imperative dominates U.S. political and economic life, what happens when growth hits some serious stumbling blocks?

When I was in school in England, the dean of my college told us when we first arrived that we could walk on the grass in the courtyard — but not across it. That helped me love the English and their language. Here is another creative use of prepositions: there are limits to growth, and there are limits of growth.

Let’s first take up the limits of growth. Despite the constant claims that we need more growth, there are limits on what growth can do for us. The ecological economist Herman Daly has reminded us that if neo-classical economists were true to their trade, they would recognize that there are diminishing returns to growth. Most obviously, the value of income growth declines as one gets richer and richer. Similarly, growth at some point has increasing marginal costs. For example, workers have to put in too many hours, or the climate goes haywire. It follows that for the economy as a whole, we can reach a point where the extra costs of more growth exceed the extra benefits. One should stop growing at that point. Otherwise the country enters the realm of “uneconomic growth,” to use Daly’s delightful phrase, where the costs of growth exceed the benefits it produces.

There are some, myself included, who believe that the U.S. is now experiencing uneconomic growth. If one could measure and add up all the environmental, security, social and psychological costs that U.S. economic growth generates at this point in our history, they would exceed the benefits of further ramping up what is already the highest GDP per capita of any major economy.

Though not widely accepted, the case is strong that growth in the affluent U.S. is now doing more harm than good. Today, the reigning policy orientation holds that the path to greater well-being is to grow and expand the economy. GDP, productivity, profits, the stock market, and
consumption must all go up. This growth imperative trumps all else. It can undermine families, jobs, communities, the climate and environment, and a sense of place and continuity because it is confidently asserted and widely believed that growth is worth the price that must be paid for it.

But an expanding body of evidence is now telling us to think again. The never-ending drive to grow the overall U.S. economy is ruining the environment; it fuels a ruthless international search for energy and other resources; it fails at generating the needed jobs; it hollows out communities; and it rests on a manufactured consumerism that is not meeting the deepest human needs. Americans are substituting growth and consumption for dealing with the real issues — for doing things that would truly make us and the country better off.

It is time for America to move to post-growth society where the natural environment, working life, our communities and families, and the public sector are no longer sacrificed for the sake of mere GDP growth; where the illusory promises of ever-more growth no longer provide an excuse for neglecting to deal generously with our country's compelling social needs; and where true citizen democracy is no longer held hostage to the growth imperative.

Another way of pointing out the limits of growth is to consider the long list of public policies that would slow GDP growth, thus sparing the environment, while simultaneously improving social and individual well-being. Such policies include: shorter workweeks and longer vacations, with more time for children and families; greater labor protections, job security and benefits, including generous parental leaves; guarantees to part-time workers and combining unemployment insurance with part-time work during recessions; restrictions on advertising; a new design for the twenty-first-century corporation, one that embraces re-chartering, new ownership patterns, and stakeholder primacy rather than shareholder primacy; incentives for local and locally-owned production and consumption; strong social and environmental provisions in trade agreements; rigorous environmental, health and consumer protection, including full incorporation of environmental and social costs in prices; greater economic and social equality, with genuinely progressive taxation of the rich (including a progressive consumption tax) and greater income support for the poor; heavy spending on neglected public services; and initiatives to address population growth at home and abroad. Taken together, these policies would undoubtedly slow GDP growth, but well-being and quality of life would improve, and that's what matters.

Of course, it is clear that even in a post-growth America, many things do indeed need to grow: growth in good jobs and in the incomes of the poor and working Americans; growth in availability of health care and the efficiency of its delivery; growth in education, research and training; growth in security against the risks of illness, job loss, old age and disability; growth in investment in public infrastructure and in environmental protection and amenity; growth in the deployment of climate-friendly and other green technologies; growth in the restoration of both ecosystems and local communities; growth in non-military government spending at the expense of military; and growth in international assistance for sustainable, people-centered development for the half of humanity that live in poverty. These are all areas where public policy needs to ensure that growth occurs.
That’s one case against growth — the argument that we should no longer prioritize growth, much less fetishize it as we do now. I believe this case will be pressed with increasing urgency in the years ahead, and I doubt we’ll miss our growth fetish after we say good-bye to it. We’ve had tons of growth — growth while wages stagnated, jobs fled our borders, life satisfaction flatlined, social capital eroded, poverty mounted, and the environment declined.

The case that there are limits to growth — not that we shouldn’t grow but that we can’t grow — is based on the reality that we are entering a new age of scarcity and rising prices that will constrain growth. The world economy, having doubled in size three times since 1950, is now phenomenally large — large even in comparison with the planetary base that is the setting for economic activity. Today’s huge world economy is consuming the planet’s available resources on a scale that rivals their supply, and it is releasing almost all of those resources, often transformed and toxic, back to the environment on a scale that is beyond the environment’s assimilation capacities, thus greatly affecting the major biogeophysical cycles of the planet. Natural resources are becoming increasingly scarce, and the planet’s sinks for absorbing waste products are already exhausted in many contexts. According to the Ecological Footprint analysis, Earth would have to be 50 percent larger than it is for today’s economy to be environmentally sustainable.

In effect, humans have entered a new geological epoch — the Anthropocene. As Paul Crutzen and Christian Schwägerl explained in an article on Yale Environment 360: “It’s a pity we’re still officially living in an age called the Holocene. The Anthropocene — human dominance of biological, chemical and geological processes on Earth — is already an undeniable reality.”

If we now live in a world where the natural resources and environmental sinks needed for economic activity are becoming more scarce across a wide front, we should see prices rising. And indeed we do. Prices of many things are rising rather rapidly: oil, coal, food, and numerous non-fuel minerals. Lithium and rare earths are probably not far behind.

If these patterns hold, as seems likely, and one factors in the economic losses due to climate disruption and the higher energy prices due to climate protection policies, it’s hard to imagine that economic growth won’t be slowed. Moreover, as noted earlier, the increasing scarcity of the atmospheric sink for greenhouse gas emissions is going to challenge growth among the affluent countries. Reducing carbon emissions at required rates may not be possible in national economies that are stressing growth maximization.

Author Richard Heinberg and many others have been calling attention to the looming challenge of peak oil. After much controversy, the reality of peak oil is now widely accepted. Oil production did actually reach its all-time high in 2005 and has plateaued since. Peak oil, the point of maximum production after which production begins to decline, may thus have already happened, but, if not, a widely held view today is that oil will have peaked and begun to decline before 2030, perhaps a decade or so hence.

In 2005, the U.S. Department of Energy released the now-famous “Hirsch Report,” Peaking of
World Oil Production, which warned that "the problems associated with world oil production peaking will not be temporary, and past 'energy crisis' experience will provide relatively little guidance." But the report recommended accelerating development of oil sands and coal liquefaction and other steps that would send the world rushing down a path that would exacerbate the already grave challenges of global warming. Clearly, it makes no sense to separate the two challenges: energy supply and climate change must be dealt with together — and soon. Clearly, today we are not prepared or preparing for either.

Many who have looked at the combined challenge of energy and climate change have concluded that our civilization, having completed its exuberant, flamboyant phase, is headed toward a dramatic simplification and re-localization of life and the end of economic growth as we have known it. Some even see the collapse of modern civilization as just a matter of time.

In The Transition Handbook, the bible of the fast-growing Transition Town movement, Rob Hopkins identifies three scenarios: adaptation, which assumes "we can somehow invent our way out of trouble"; evolution, which requires a collective change of mindset, but assumes that "society, albeit in a low-energy, more localized form, will retain its coherence"; or collapse, which assumes that "the inevitable outcome of peak oil and climate change will be the fracturing and disintegration, either sudden or gradual, of society as we know it."

The eventual outcome will likely involve elements of all three of these scenarios, occurring at different times and different places. Hopefully, the "evolution" scenario will predominate.

"Within this century, environmental and resource constraints will likely bring global economic growth to a halt...," Canadian political scientist Thomas Homer-Dixon wrote in Foreign Policy earlier this year. "We can't live with growth, and we can't live without it. This contradiction is humankind's biggest challenge this century, but as long as conventional wisdom holds that growth can continue forever, it's a challenge we can't possibly address."

So there we have it: the traditional solution that America has invoked for nearly every problem — more growth — is in big trouble. If we are going to move beyond growth, we will need to build a different kind of economy. We Americans need to reinvent our economy, not merely restore it. We will have to shift to a new economy, a sustaining economy based on new economic thinking and driven forward by a new politics. Sustaining people, communities and nature must henceforth be seen as the core goals of economic activity, not hoped for by-products of market success, growth for its own sake, and modest regulation. That is the paradigm shift we must now begin to pursue and promote.

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