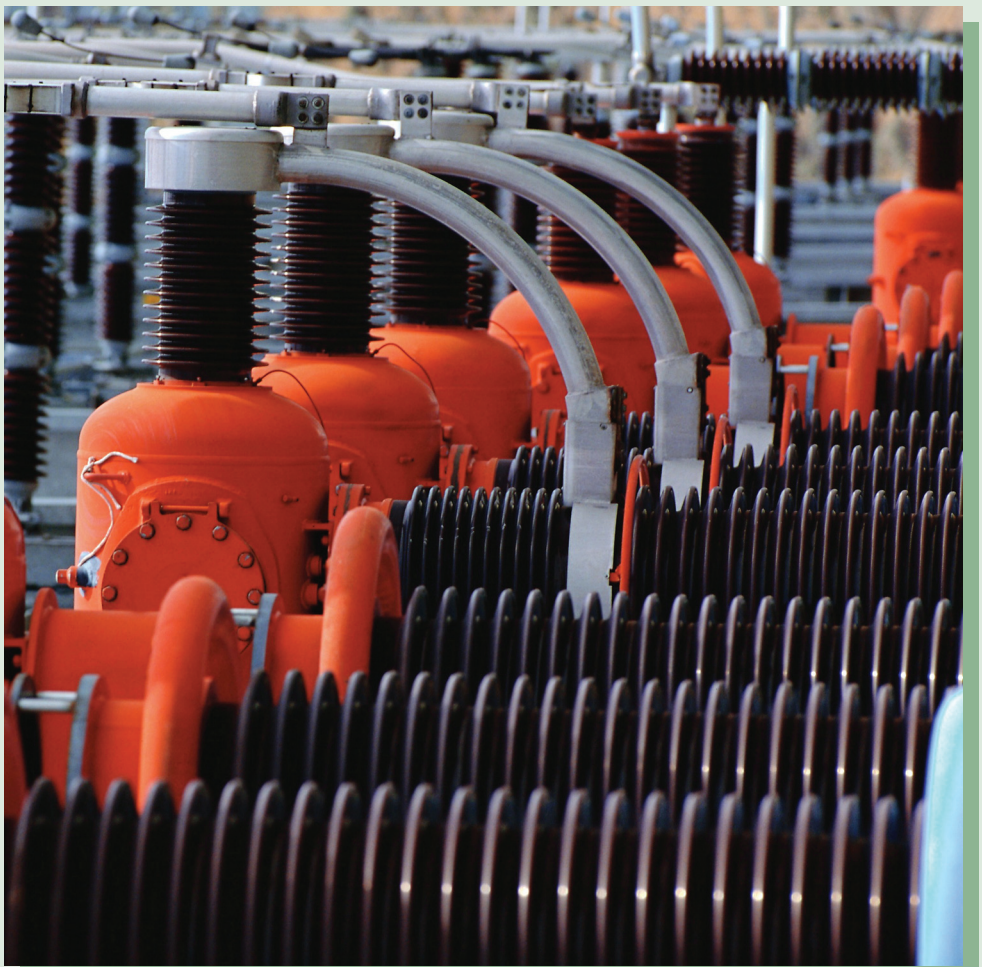
ENERGY FOR THE FUTURE



CHAPTER

7

LOOKING FOR TROUBLE

The year before his death, Julian Simon made what he called his "long run forecast . . . in brief:"

> The material conditions of life will continue to get better for most people, in most countries, most of the time, indefinitely. Within a century or two, all nations and most of humanity will be at or above today's Western living standards.
>
> I also speculate, however, that many people will continue to *think* and *say* that the conditions of life are getting *worse*.[275]

Enormous material progress has been made in the past two hundred years. Much of this progress was the result of advances in energy technology made by people living in freedom. Moreover, these advances are accelerating even as the environment, at least in the West, improves.

One would think that energy alarmism, along with its unbroken string of failed predictions and policies, would have been buried under this mountain of good news long ago. Yet today, alarmism is alive, well, and newsworthy. Scary computer-generated climate-change scenarios, rising natural gas and gasoline prices, and turmoil in the Middle East have made energy pessimism nearly as popular as it was during the American energy crises of the 1970s and the British coal panic of the 1860s.

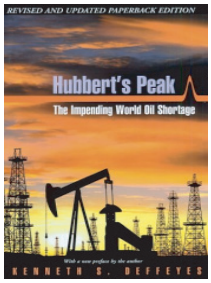
Examples abound. The *New York Times* reports that Saudi Arabia's oil fields are "tired."[276] One popular book predicts that global oil production will reach

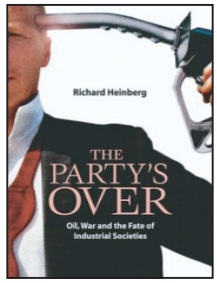
[275]Julian Simon, quoted in Ed Regis, "The environment is going to hell . . ." *Wired*, February 1997, p. 198. Bjørn Lomborg, who discovered Julian Simon by reading this article, used Simon's prediction as the epigraph for *The Skeptical Environmentalist*.

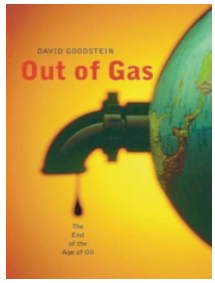
[276]Jeff Gerth, "Forecast of Rising Oil Demand Challenges Tired Saudi Fields," *New York Times*, February 24, 2004, p. A1.

SIX RECENT BOOK AND MAGAZINE COVERS

A spate of popular books and articles is sounding the energy alarm. Some argue we will not have enough oil to fuel future growth, while others contend we have too much oil and will destabilize the climate by burning it. Covers reprinted courtesy of their original publishers.







its "Hubbert's Peak" by 2009. Others declare that the "fabulous party" of cheap energy is over, "civilization as we know it will come to an end sometime in this century unless we can find a way to live without fossil fuels," and crude oil will reach $100 a barrel by decade-end.[277]

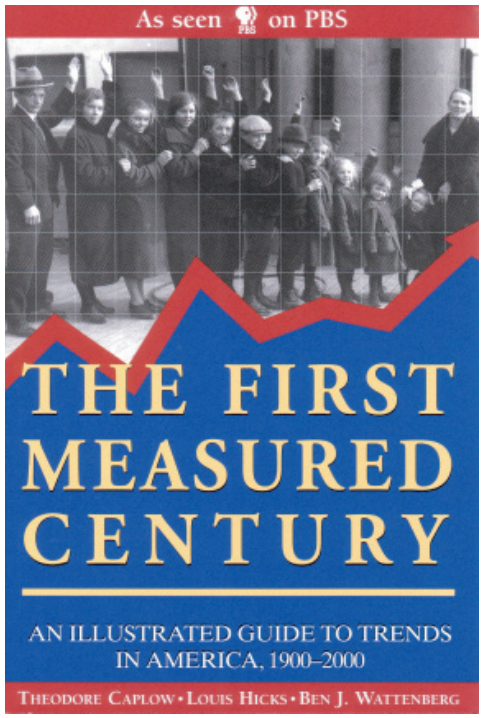
Sometimes, these alarms are contradictory. On the one hand, we are told the world will soon run out of carbon-based fuels, while on the other hand predictions of global warming Armageddon rely on the assumption that the world will continue to burn more and more of these fuels for decades to come.

The statistical record of improvement over the last two centuries challenges these gloomy scenarios and the pessimism behind them. By any index—availability, affordability, reliability, cleanliness, efficiency, utility—the long-term energy trends have been positive. Problems have been faced and solved by creative people, and, in special cases (such as air pollution), incremental regulation. Our own predictions, based in part on official forecasts, reflect those trends.

[277]Kenneth Deffeyes, *Hubbert's Peak: The Impending World Oil Shortage* (Princeton: Princeton University Press, 2001), p. 158; Richard Heinberg, *The Party's Over: Oil, War and the Fate of Industrial Societies* (Canada: New Society Publishers, 2003), p. 242; David Goodstein, *Out of Gas: The End of the Age of Oil* (New York: W. W. Norton, 2004), p. 15; Stephen Leeb and Donna Leeb, *The Oil Factor: Protect Yourself—AND PROFIT—from the Coming Energy Crisis* (New York: Time Warner, 2004), p. 50.

TWO POSITIVE TREND BOOKS

The statistical record of the last century shows long-term trends of improving human welfare. Short-term trends can be negative (e.g., rising energy prices since 2000), but they spur adjustments that shape longer-term positive trends. Covers reprinted courtesy of their original publishers.



There is, however, one urgent energy alarm that must be sounded. Not a hypothetical warning of something that may happen in the distant future, but a major energy sustainability problem that is happening right now. It concerns one-fourth of the world's inhabitants. It is *wretched energy poverty*, the lack of electricity and fuel for heating and transportation and of all that modern energy provides: clean air and water, adequate lighting, medical facilities, education aids, communication infrastructure, labor-saving devices, and more.

This energy sustainability problem is not the result of fossil-fuel depletion or combustion. It is a child of *statism* and all the philosophies behind it—philosophies that justify coercive government control of economies, of people's lives, and of the energy resources that make life possible.

Major reforms are needed to eradicate—house by house, village by village—the poverty that comes from a lack of basic market institutions such as property rights, property titles, and the freedom to exchange, contract, and associate with others.

LOOKING AHEAD

The perils of prediction are well known. An earlier chapter of this book quotes a number of people whose pessimistic forecasts have proved to be spectacularly wrong. There are many pitfalls waiting for those who venture to peer into a crystal ball.[278]

First, people often assume, as Thomas Malthus did more than two hundred years ago, that technology will not change significantly and new substitutes will not emerge. If they do foresee changes, they often see improvement in some favored areas (e.g., solar and wind power), while ignoring the fact that the other technologies will also be improving at the same time. Alternative fuels will not compete with conventional fuels as they are but as they will *become*.

Some forecasters tend to over-estimate the changes in the near term (20 years out), and underestimate the changes in the long term (50 to 100 years). Near-term overestimation occurs because forecasters often do not take into account the tremendous inertia in any system.

Some proponents of energy transformation predict that hydrogen will replace gasoline as the primary transportation fuel in the next few decades. But even if all the technical problems with using hydrogen were to be resolved, it would take years for a hydrogen infrastructure to be established and for the vehicles now on the road to be replaced. Large hydrogen generation units would have to be constructed, along with the electric plants to provide for their power needs. In addition, hydrogen transportation and delivery facilities would have to be created. All this would take enormous effort and capital, and none of it would happen overnight. In the meantime, millions of new vehicles with a life expectancy of at least 10 years—virtually all fueled by gasoline or diesel—are added to the fleet every year.

Long-term underestimation of future technology stems from our inability to imagine the directions that even existing technology can take during large time spans. As late as the 1970s, many experts were confidently predicting that con-

[278]See Ch. 4, pp. 81–82.

sumption of electricity would level off in the United States because most homes already had nearly all of the household appliances of the day. Few could predict the explosion in the use of personal computers, the creation of the Internet, and the resulting rise in demand for electricity.[279] Even today, many new uses for electricity are appearing that consumers welcome.

Moreover, we are unable to predict the breakthroughs in basic science that will be made. Who in 1900 could have foreseen the mapping of the human genome, nanotechnology, or superconductivity? Who today can imagine the impact these advances will have on society in fifty or a hundred years? What we do know is that these discoveries will open new horizons for new discoveries and breakthroughs.

> *"The future is inevitably and irreducibly unpredictable, for the simple reason that we cannot now know what still remains to be known."*[280]
>
> **Brink Lindsey**

> *"The outstanding fact of history is that it is a succession of events that nobody anticipated before they occurred."*[281]
>
> **Ludwig von Mises**

Another problem in forecasting is the inability to differentiate between what is *possible* and what is *practical*. As technologist Mark Mills points out, "It is possible to build personal, Buck Rogers-style jet backpacks. They were first built in the late 1950s. They're commercially available today. They're just not useful."[282] The creation of large solar farms is possible, but such farms have not proved practical.

Keeping in mind these pitfalls, it is with great caution that we venture to present a summary of forecasts from well-known energy agencies and to make a few predictions (qualitative, not quantitative) of our own.

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[279]We (the authors of this book) were reminded of the difficulty in identifying new technologies that will have a lasting impact on society as we were selecting items for the timeline in *Appendix* A. It is a safe bet that the Wright Brothers were really onto something with their flying machine, but how does one identify inventions made in the last decade or two that will have the same sort of lasting impact?

[280]Brink Lindsey, *Against the Dead Hand*, p. 51.

[281]Ludwig von Mises, *Theory and History* (Arlington, VA: Arlington House, 1969), p. 378.

[282]Mark Mills, *Getting It Wrong: Energy Forecasting and the End-of-Technology Mindset*, p. 30.

SHORT-TERM FORECAST

The short-term outlook for energy, as for other goods in a market economy, is that it will remain much as it is today. Problems will arise and will be resolved, leaving us better off than before. This is an easy prediction to make because free markets inspire solutions to problems.

Assume, for example, that the price jumps for a particular fuel. Abnormally high prices will spur buyers and sellers into remedial action. High prices will lead consumers to conserve and to look for substitutes. At the same time, high prices will encourage suppliers to find and produce more of the fuel in order to increase their profits.

For instance, after a decade in which the delivered price of natural gas to American power plants was under $3 per million BTU (MMBTU), prices since late 2000 have averaged close to $5 per MMBTU. This 60 percent sustained increase cannot be blamed on a sudden scarcity in the natural resource itself given that proved gas reserves are the highest level ever recorded in both the United States and Canada. Rather, demand for this cleanest of carbon-based fuels simply grew faster than did the infrastructure that supplies it.

In response, producers are drilling new gas wells at a brisk pace. Suppliers are applying to the Federal Energy Regulatory Commission (FERC) for permission to import more liquefied natural gas from abroad and to build new terminals to receive the LNG. Several proposals to pipe natural gas from Canada's Northwest Territories and Alaska to the Lower-48 states are under consideration by investors and regulators. New gas storage facilities are being built to take advantage of price volatility (buy low, store, sell high). Meanwhile, electric utilities are turning, where possible, to substitute-energies to generate the power they need. Finally, higher gas prices are promoting conservation.

U.S. Coast Guard

Movement is also taking place on the political front. Gas pipeline projects in the United States that have been delayed by regulatory roadblocks are being revisited. Promising geologic structures that are on public lands and that have been politically off-limits are getting another look. The Rocky Mountain area and areas off the East, West, and Florida coasts are of particular interest.

Given all this activity, it might be a good bet that the price of natural gas will be lower in the next few years than it has been in 2001–2004. In fact, that is exactly how commodity traders *are* betting as indicated by futures prices on the New York Mercantile Exchange.

Suppose, on the other hand, that the price of a fuel falls below its historical average. Then a bet on a longer-term price rise might be a good one. This is how markets work in the continually unfolding short term.

Much of the cyclical nature of prices is due to imperfect knowledge. Producers do not know what future demand for their products will be, though they try to forecast demand as best they can because the rewards for getting it right can be high, and the penalties for getting it wrong can be severe.

Take the case of a natural gas company that correctly predicts higher future demand and expands its facilities in time to take advantage of that demand. Due to its foresight, the company stands to increase its profits and gain market share. If, on the other hand, the predicted increase in demand does not materialize, the expanded facilities could lie idle and the company might lose its investment. If the firm goes ahead and produces more fuel anyway, the additional supply will depress prices (though such lower prices will, eventually, result in higher demand).

Finally, if the company fails to foresee an increase in demand, it may well lose business to competitors whose vision was clearer. While the company may try to quickly increase its production capacity, it may be years before it can get the necessary government permits and complete the construction work.

Fuel consumers have similar incentives to correctly anticipate future prices. Suppose a power company plans to build a new electricity generation plant. It wants to use the cheapest fuel available. If the price of natural gas is currently high, should it build a coal-fired plant? But by the time the plant is built, natural gas producers may well have caught up with demand, and the price of their product could again be competitive. Typically, developers hedge their bets by entering into long-term contracts to purchase fuel and to sell power.

This corrective process never ends. The market is not perfect and problems occur, but problems are also a key driver of progress. We learn by trial and error, and progress happens in fits and starts, but it does happen.

MID-TERM U.S. FORECAST

The forecasting arm of the U.S. Department of Energy, the Energy Information Administration (EIA), has estimated American energy supply and demand through the year 2025. Based on a projected economic growth of 3 percent a year, EIA sees energy demand increasing by 1.5 percent a year, indicating an increase in energy efficiency, or (stated another way) a decrease in *energy intensity*, of 1.5 percent per annum (see next page).

Use of all three carbon-based fuels is forecast to increase significantly during the forecast period. The EIA estimates that non-hydropower renewables (ethanol, geothermal, biomass, solar, and wind) will provide less than seven percent of America's total energy by the year 2025.[283] However, because alternative energies largely depend upon government subsidies, this figure will shift if government support changes one way or another.

MID-TERM GLOBAL FORECAST

The EIA has also made a forecast of world energy supply and demand through 2025 (see page 184). It sees total demand rising by almost 60 percent—a growth rate of nearly 2 percent per year.[284] These projections assume an annual decline in energy intensity of 1.1 percent.

World demand is expected to increase faster than in the United States as the developing world strives to catch up with the West. As it has in the past, electricity demand is expected to grow at a faster pace than overall energy demand.

Oil use will rise along with the transportation market as gasoline and diesel will remain the dominant fuels. Natural gas is expected to be the fuel of choice for electricity generation because of its superior economics and relatively low environmental impact. Coal consumption is also expected to increase, but at less than the overall average. In fact, during the forecast period, natural gas use is predicted to overtake coal for the first time in history. Nuclear power is expected to remain flat, and renewables, still dominated by hydroelectricity, will grow near the average.

The combined market share of carbon fuels will increase to 88 percent from 85 percent in the forecast period. More than 90 percent of the increase in total energy demand is expected to be met by oil, gas, or coal.

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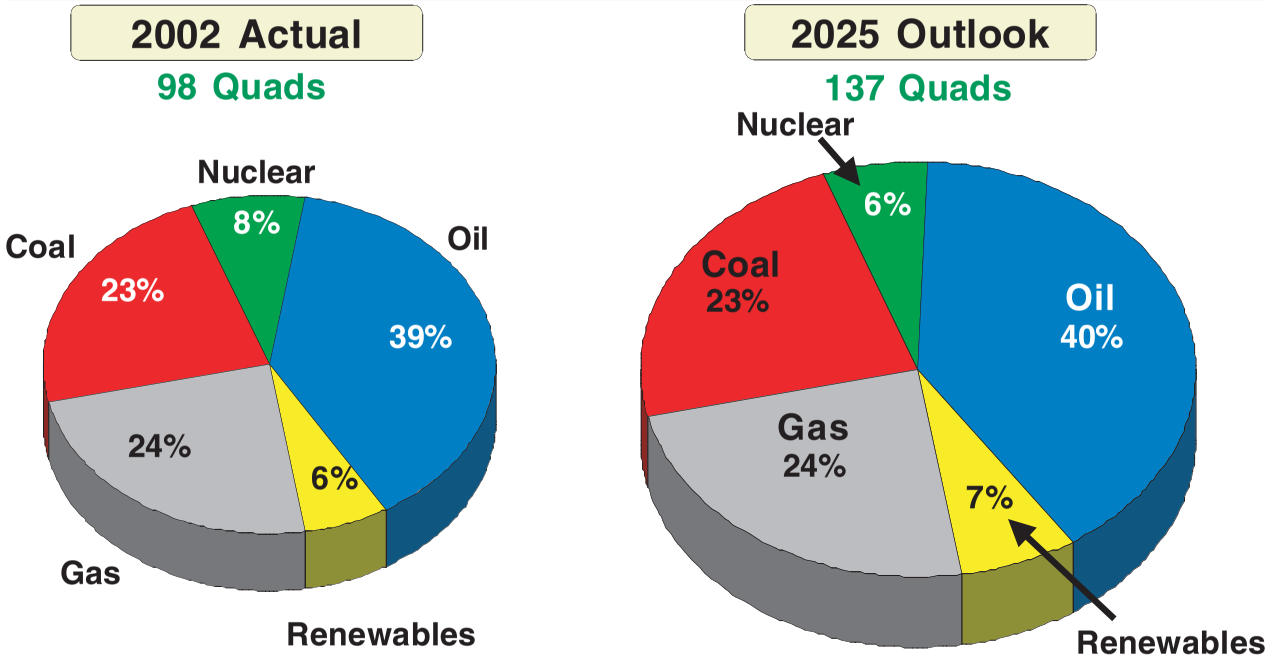
[283]U.S. Energy Information Administration, *Annual Energy Outlook* 2003 (Washington: Department of Energy, 2003), tables A1 and A18.

[284]U.S. Energy Information Administration, *International Energy Outlook* 2003 (Washington: Department of Energy, 2003), pp. 183, 188, 190.

FORECAST OF U.S. ENERGY DEMAND

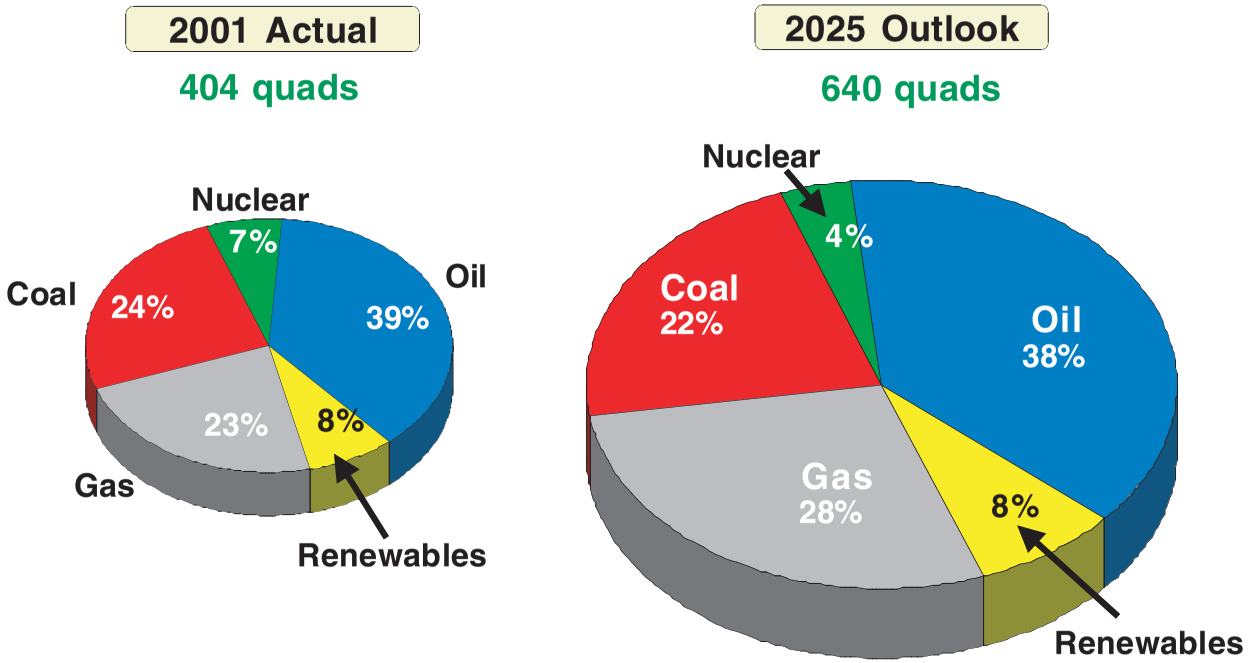
Robust energy demand growth will be met by all the carbon-based energies—oil, gas, and coal. Renewable energy growth is higher than the overall average but still small in absolute terms. *Source:* U.S. Energy Information Administration, *Annual Energy Outlook 2004,* p. 133.



Quadrillion Btu	2002	2025	Change	Growth	Growth/yr.
Coal	22	32	10	43%	1.6%
Gas	23	32	9	38%	1.4%
Nuclear	8	9	1	5%	0.2%
Renewables	6	9	3	54%	1.9%
Oil	38	55	17	44%	1.6%
Total	98	137	40	40%	1.5%

FORECAST OF WORLD ENERGY DEMAND

Demand for natural gas is forecast to grow the most in the coming decades, but coal and oil usage will remain strong. Renewables have the highest growth rate but start from a low base, so their overall contribution will remain modest. *Source:* U.S. Energy Information Administration *International Energy Outlook 2003* p. 183.



Quadrillion Btu	2001	2025	Change	Growth	Growth/yr.
Coal	96	139	43	45%	1.6%
Gas	93	182	89	96%	2.8%
Nuclear	26	29	3	12%	0.3%
Renewables	32	50	18	56%	1.9%
Oil	157	241	84	54%	1.8%
Total	404	640	237	59%	1.9%

LONG-TERM FORECAST

Oil, natural gas, and coal will remain abundant throughout the twenty-first century at prices competitive with other energy alternatives.

While some argue that world oil production will peak in the next one to two decades, the mainstream view is more optimistic. The World Energy Council stated, "The conclusion can be reliably drawn that fossil fuel resources are adequate to meet a wide range of possible scenarios through to 2050 . . . and well beyond."[285] The Intergovernmental Panel on Climate Change found that "there are abundant fossil fuel resources that will not limit carbon emissions during the 21st century."[286] In fact, the IPCC estimates that only about 1.5 percent of the total potential hydrocarbons in the Earth's crust has been consumed.[287]

This does not mean that energy sustainability issues have been put to rest. As explained in Chapter 6, the question is not "will we will run out of fossil fuels?" but "what happens to the environment if we burn what we have?" Harvard environmentalist John Holdren questions whether carbon-based fuels will remain affordable if the cost of correcting the environmental damage they do is included in their price.[288]

Corbis

[285]World Energy Congress, *Living in One World: Sustainability from an Energy Perspective* (London: WEC, 2001), p. 161.

[286]IPCC, *Climate Change* 2001: *Mitigation*, p. 4.

[287]Ibid., p. 236.

[288]In Holdren's words, the energy sustainability problem stems from "environmental impacts and sociopolitical risks—and, potentially, of rising monetary costs for energy when its environmental and sociopolitical hazards are adequately internalized and insured against." John Holdren, "Energy: Asking the Wrong Question," *Scientific American*, January 2002, p. 65.

However, so far no alternatives can compete with the convenience, portability, efficiency, or cost of oil, gas, and coal. In addition, carbon-based fuels will continue to be made cleaner and more efficient.

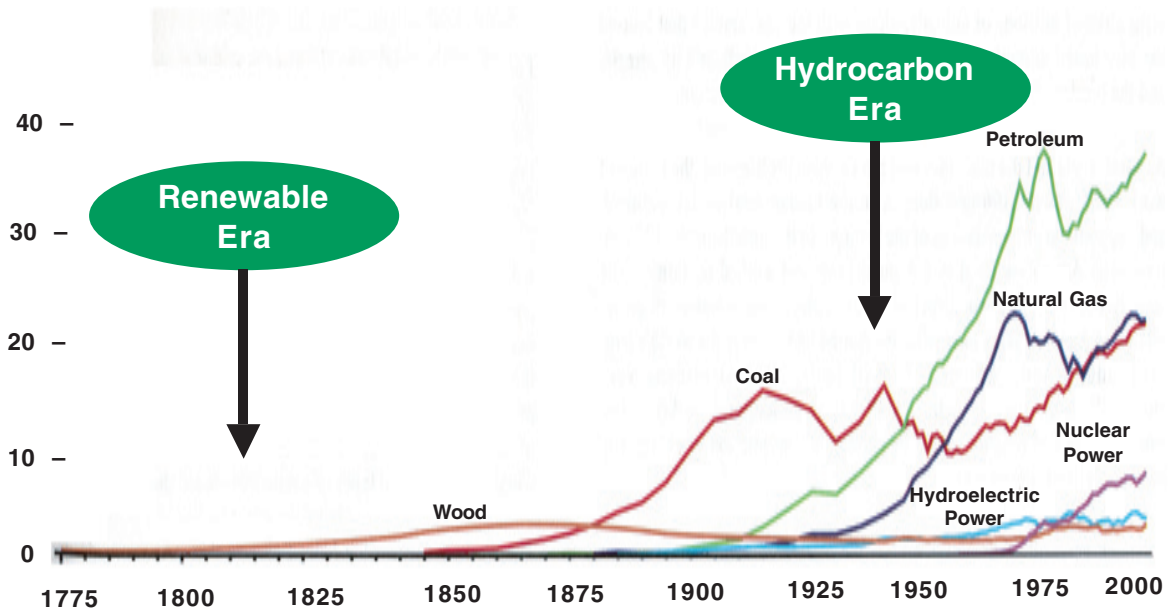
As the following chart shows, the renewable energy era has already come and gone. Even though alternative energy sources like biomass, alcohol, and solar and wind power are being touted as energy sources for the future, they are actually throwbacks to the past.

Eventually, however, fossil fuels will be replaced with other primary energy sources. A new form of energy will ease out hydrocarbons when consumers judge it a better product at a better price. If the transition is left to the free market, it will happen in one of two ways:

1. If hydrocarbons become increasingly scarce, their cost will increase until substitutes are found, just as kerosene once replaced whale oil.
2. A technological breakthrough, or cluster of breakthroughs, will make some substitute more efficient and less costly.

U.S. ENERGY CONSUMPTION: 1775-2000

During the past 225 years, the United States has experienced two distinct energy eras: the renewable era and the (current) carbon-fuel era. *Source:* U.S. Energy Information Administration, *Annual Energy Review 2001,* pp. 355–357.



> *"[E]nergy can be produced indefinitely so long as human ingenuity is allowed to keep up with demand. Any such perceived shortage is simply a practical problem to which man's creativity will, if permitted, find a solution. . . . This is the lesson of history, and the reason we need not fear any permanent energy shortage. Human ingenuity carried us from firewood to coal, from whale oil to petroleum. And human ingenuity will carry us to the next stage of energy evolution."*[289]
>
> ***Rabbi Daniel Lapin***

> *"It's reasonable to expect the supply of energy to continue becoming more available and less scarce, forever."*[290]
>
> ***Julian Simon***

While the prices of individual fuels may rise, there is little reason to believe that energy *per se* will grow less abundant and more costly. The lesson of history is that in free societies individuals produce more energy than they consume.

As Julian Simon wrote:

> There is no physical or economic reason why human resourcefulness and enterprise cannot forever continue to respond to impending shortages and existing problems with new expedients that, after an adjustment period, leave us better off than before the problem arose. Adding more people will cause us more such problems, but at the same time there will be more people to solve these problems and leave us with the bonus of lower costs and less scarcity in the long run. The bonus applies to such desirable resources as better health, more wilderness, cheaper energy, and a cleaner environment.[291]

ENERGY AND POVERTY

According to the International Energy Agency, "some 2.4 billion people rely on traditional biomass—wood, agricultural residues and dung—for cooking and heating."[292] And typically this biomass is burned very inefficiently with much of the heat lost. People in developing nations often have no incentive to use such fuel efficiently because it costs them nothing more than the effort to gather it.

Yet, there are unseen costs to using these so-called free fuels. Deforestation is a serious problem in many parts of the world. Because no one owns the forests and jungles, no one has an incentive to conserve them—the tragedy

[289]Rabbi Daniel Lapin, "Existential (Energy) Crisis," *National Review Online*, June 11, 2001.

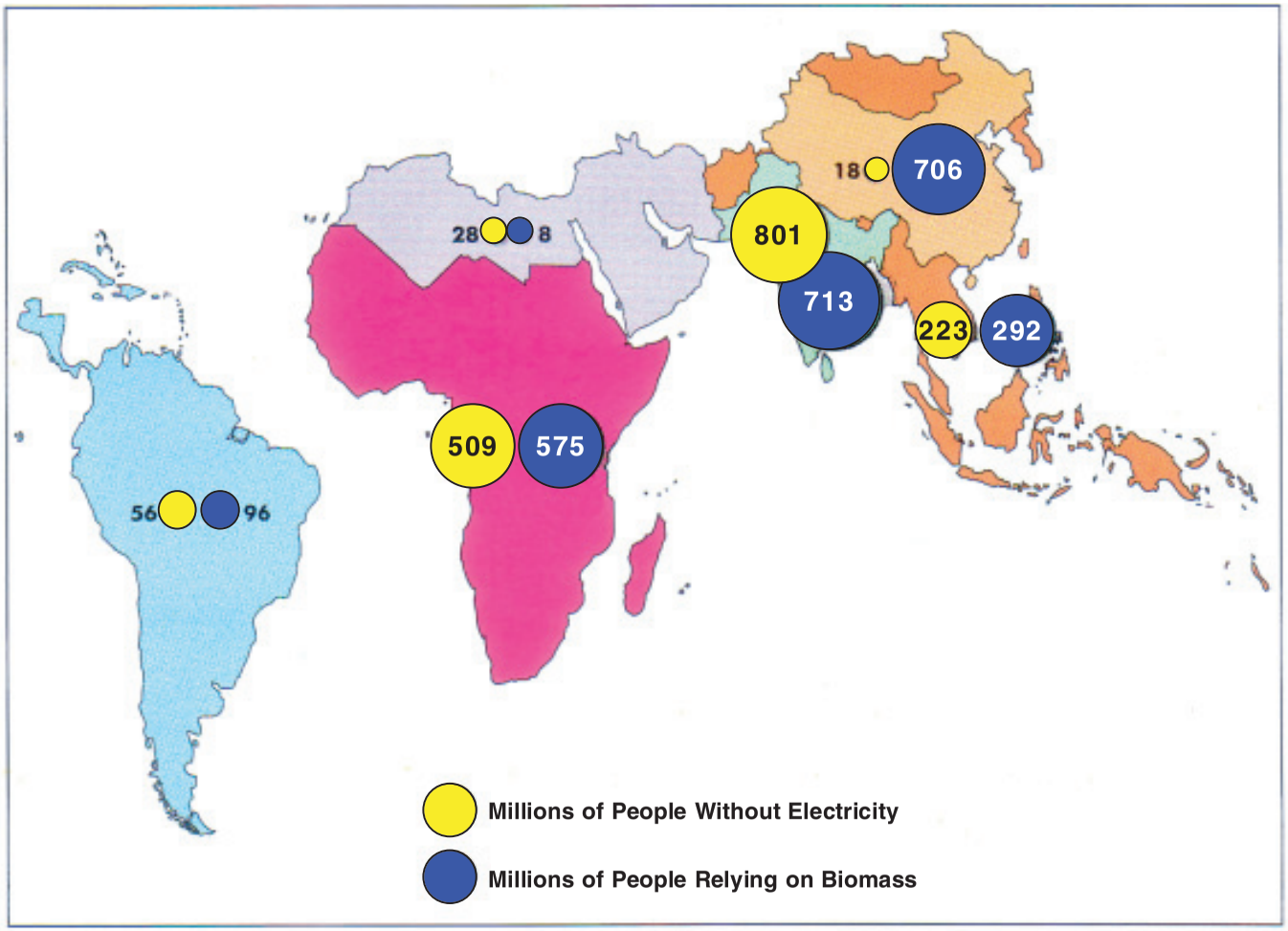
[290]Julian Simon, *The Ultimate Resource 2* (Princeton: Princeton University Press, 1996), p. 181.

[291]Ibid., p. 580.

[292]International Energy Agency, *World Energy Outlook*: 2002, p. 365.

GLOBAL ENERGY POVERTY

The energy poor: people with no access to electricity and those with some electricity but who must still rely on primitive biomass for heating and cooking. *Source:* International Energy Agency, *World Energy Outlook 2002,* p. 372. Copyright OECD/IEA.



of the commons. In addition, burning primitive biomass produces smoke and fumes that can cause serious health problems.

There are opportunity costs as well. Using dung for fertilizer instead of fuel would increase agricultural yields and help free more people from the hardships of subsistence living.

Eventually, people in developing countries will have the incentive to use biomass more efficiently. In developing countries that continue to outlaw the private ownership of land, people will be forced to conserve fuel when deforestation reaches crisis levels. Countries that allow private ownership will avoid such crises and the environmental damage that goes with them.

An individual who owns a piece of forest or jungle has an incentive to preserve its value, both for himself and for his children. While an individual might choose to sell some of the biomass on his property, he would have no incentive to allow it to be stripped of all vegetation given that doing so would destroy the land's value. At the same time, because the fuel would no longer be free for the taking, buyers would have an incentive to conserve it.

Either way, whether people are forced to conserve by a crisis or led to conserve by market processes, the more efficient use of primitive biomass fuels will increase their wealth and improve their lives in many ways.

In the United States, landowners dream that oil or other mineral wealth will be discovered on their property. In Argentina, such a discovery would be a landowner's nightmare. Why? Well, while land in Argentina can be privately owned, all subsurface rights belong to the government.

According to Argentinean Guillermo Yeatts, "Public ownership of the subsurface generates a disincentive for the surface owner."[293] Owners do not benefit from any mineral wealth found beneath their property. They do, however, suffer the damage to their land and disruption to their lives that mineral exploration and production causes—often without adequate compensation. As a result, surface owners are encouraged to hide any mineral wealth their property may hold and fight any attempt to explore their land.

Yeatts points out that if the landowner also owned the mineral rights beneath his land, he would "analyze the relative profitability of exploiting (agriculturally or industrially) the surface versus the mining exploitation of the subsurface. . . . His 'profit motive' will lead him to select the most profitable activity, generating more wealth for society by assigning resources in the most efficient manner."[294]

Yeatts has proposed deeding mineral rights in Argentina and other Latin American countries to the landowners. He argues that this reform would help not only the landowners, many of whom are poor, but also the nations as a whole by providing incentives for people to use each country's resources to their best effect.

[293]Guillermo Yeatts, *Subsurface Wealth: The Struggle for Privatization in Argentina* (Irvington-on-Hudson, NY: Foundation for Economic Education, 1996), p. 71.

[294]Ibid

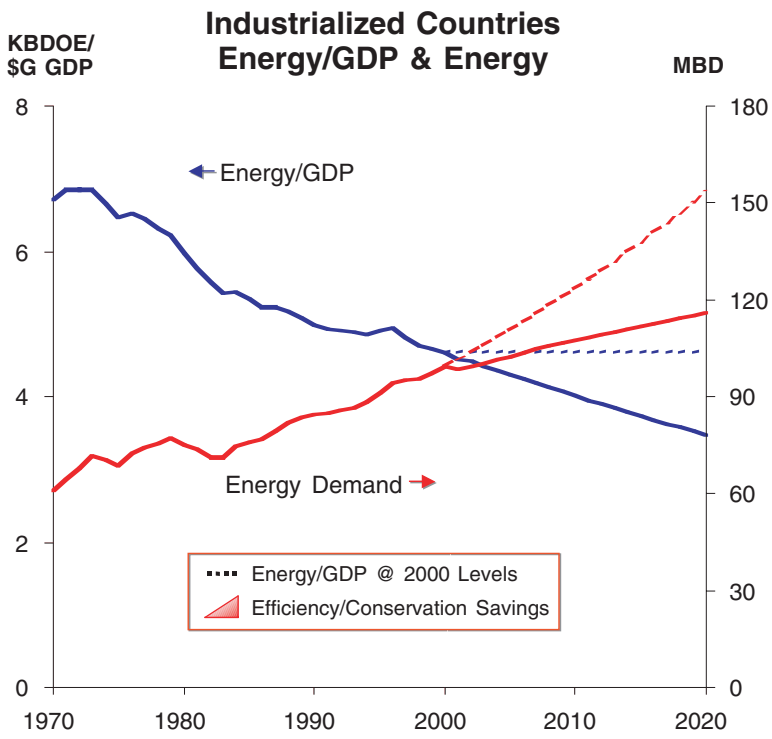
ENERGY AND WEALTH

Historically, market pressures have driven producers towards increased efficiency. As the following chart indicates, the amount of energy used per dollar of economic output has dropped steadily in the United States. This trend is expected to continue.

For more than a hundred years, natural resources of every kind, including fuel, have become more affordable. Often the real (i.e., inflation-adjusted) prices have dropped, but always the amount of labor required to purchase a resource has declined.[295] While these decreases have been marked by short-term fluctuations, the overall trend has been steady, downward, and driven by technology. We see this trend continuing indefinitely in market-driven economies around the world.

As efficiency increases and prices drop, consumption will rise both in the developed and the developing worlds. Currently, one-quarter of the world's population, some 1.6 billion people, are without access to electricity.[296] As

FALLING ENERGY INTENSITY
Energy intensity has been dropping in the industrialized world even as energy demand has been rising. *Source:* ExxonMobil Corporation.



[295]Robert Bradley, Jr., *Julian Simon and the Triumph of Energy Sustainability*, pp. 50–52.

[296]International Energy Agency, *World Energy Outlook*: 2002, p. 365.

these people become more affluent, their consumption of energy and of other resources will increase significantly.

Greater wealth will result from lower energy costs as people spend less of their wages for the necessities of life.

Because of rising levels of carbon dioxide in our atmosphere, agricultural crop yields will rise significantly in the coming decades. The four most important food crops—rice, wheat, corn, and potatoes (which together make up more than a third of the world's food supply)—are very responsive to CO_2 enrichment.[297]

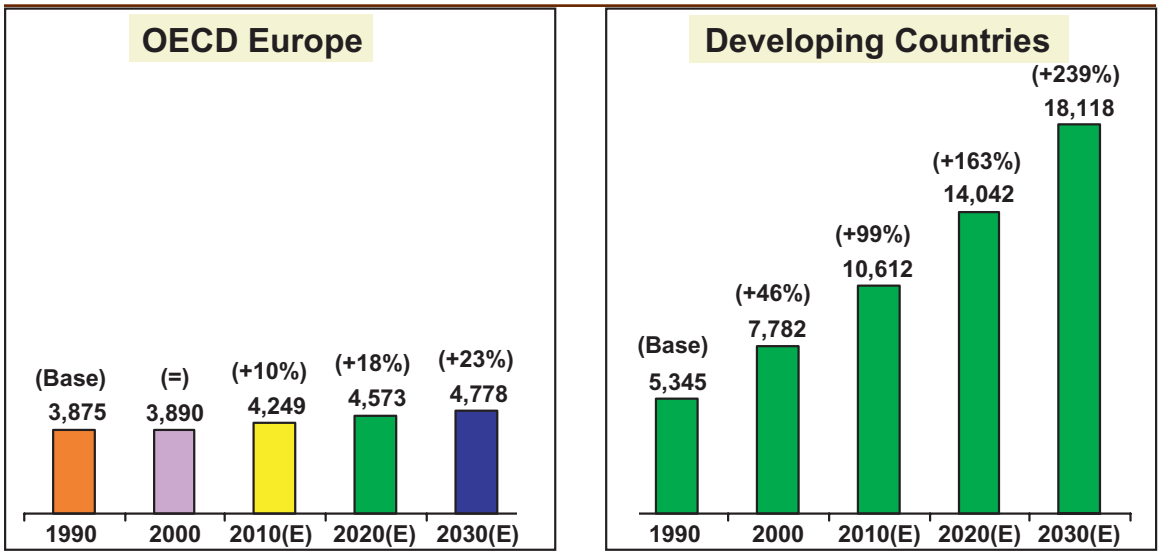
ENVIRONMENT

The environment will become cleaner as efficiency improves and wealth grows. This trend will be most apparent in the third world given their current, significant environmental problems.

Because it believes that carbon-based fuels will continue to be the industrialized world's main energy source for the foreseeable future, the EIA predicts that greenhouse gas emissions, mainly carbon dioxide, will increase by 1.5 percent per year. By 2025, American CO_2 emissions are projected to be 76 percent above 1990 levels. Kyoto would mandate that United States' emissions be

CO2 EMISIONS: PAST & PROJECTED (MILLION TONS)

Source: International Energy Agency, *World Energy Outlook 2002,* pp. 433, 461.



[297]Sylvan Wittwer, *Food, Climate, and Carbon Dioxide*, pp. 110–124.

7 percent below 1990 emission levels, making the protocol unrealistic. The developing countries rejected any obligation as locking them into energy poverty, a situation quite unlike European countries that are favorably situated under the agreement (see previous figure).

Still, as seen in previous chapters, great progress is being made on most energy-environment fronts, and alarms about climate change from fossil-fuel combustion may be wrong or at least premature. At this time, no one knows whether the problems associated with anthropogenic global warming will outweigh the benefits. However, any problems associated with climate change, natural or manmade, can be effectively addressed within the context of a growing and prosperous economy.

> *"The prospects for having a modest climate impact instead of a disastrous one are quite good, I think."*[298]
>
> **James Hansen—NASA meteorologist**

RESOURCES

The Earth's pool of proven resources will continue to expand. People will keep exploring for those materials that have already been found to be useful. But the resource pool will also grow as uses are discovered for things that were never before thought of as resources. Sand was only something to walk on until someone found that it could be turned into glass. Oil was just a foul smelling goo that tainted water wells until someone learned that it could be used as a fuel. Resources lie not in what can be seen but in what can be envisioned. They are limited only by the boundaries of our minds and by the physical universe.

RESEARCH AND DEVELOPMENT

Research and development will continue to be driven largely by industry's need to produce marketable products at low cost.

As in the past, the U.S. Department of Energy (DOE) will spend many billions of dollars on research and development, but will have little to show for it. One of the main problems will be the inability of the DOE to back away from

[298]Quoted in Andrew Revkin, "Study Proposes New Strategy to Stem Global Warming," *New York Times*, August 19, 2000, p. A12. A physicist by training, James Hansen is the director of NASA's Goddard Institute for Space Studies (GISS). Hansen's testimony before a House and Senate subcommittee in June 1988 is credited with starting the global warming debate.

technologies that show little or no promise but have strong political support. With the possible exception of nuclear energy technology and fuel cells (used to power space vehicles), most progress will be made in the private sector.

ENERGY INTERDEPENDENCE

The trend toward globalization is as evident with energy as it has been with other goods and services. Today, the United States imports more than one-half of the crude oil that is refined to meet domestic demand. The country also imports more than 15 percent of the natural gas it consumes. These percentages are expected to increase in the next decades according to the U.S. Energy Information Administration and virtually all other energy forecasting groups.

Many worry about these trends toward what is often termed "energy dependence." A better term is *energy interdependence*, describing a situation in which buyers are dependent on sellers for fuel and sellers on buyers for revenue. The same is true for any other commodity that is traded between individuals. Exchange occurs only when it is in the interests of both parties.

International trade problems generally arise only as a result of government interference in the free flow of goods. With globalization, political boundaries become secondary to economic self-interest. If free trade is allowed to continue its expansion, conflicts between nations will diminish.

TECHNOLOGY

Jacob Harry Fulmer, the grandfather of one of the authors of this book, was born in 1876 and died in 1975. In his 99 years, he literally went from the horse-and-buggy era to the landing on the moon. Who in 1876 could have predicted that he would live to see such marvels? And who, having wisdom, would try? We cannot hope to imagine what technology will be like 99 years from now, but we will hazard two predictions. The first: if a person could somehow be transported into the next century, he would think the world populated by wizards. The second: the middle class of that century will live longer, healthier lives than even the richest people living today.

At the end of the nineteenth century, 94 percent of the industrial work in the United States was done by human labor. Now, one hundred years later, only 8 percent is done manually.[299] Consider how many human servants would be needed to do the work of all the machines in our everyday lives. Viewed in

[299] Bjørn Lomborg, *The Skeptical Environmentalist*, p. 119.

this light, each American has the equivalent of about 300 people working for him or her, the average European about 150, and even in India each person has the equivalent of 15 servants.[300]

As these trends continue, the number of virtual servants working for each person will grow, and people around the world will be commensurately better off.

It is hard to overstate the significance of this trend. It means not just more creature comforts but a fundamental change in the human condition. If we take the current population of the United States as being about 280 million people, then the country as a whole has an equivalent of 84 billion electromechanical servants! While this is astounding, consider the amount of resources that it would take to feed, clothe, and house 84 billion human workers! Clearly, our machines use far fewer resources than would be required by people doing the same work.

TWO PATHS

While such a future is within our power to build, it is by no means assured. History has shown that while freedom and creativity produce security and abundance, the lack of freedom produces waste, poverty, and misery.

We face a number of threats to the freedom needed to ensure an abundant future:

1. *The* NIMBY (*Not In My Back Yard*) *Syndrome*. One of the lessons of the California power crunch is that while people want cheap electricity, they do not want the oil and gas wells, refineries, coal mines, power plants, transmission lines, and pollution that come with it.
2. *Government controls*. Regulations can stifle creativity, discourage investment, reduce efficiency, and increase pollution. Countries whose economies are controlled by their governments are dirty and poor. Countries whose economies are in the hands of a free citizenry are more prosperous and far cleaner.
3. *Economic isolation*. People from across the political spectrum oppose free trade, which is one of the main engines of our nation's prosperity. In 1994, for example, activists—including conservative Patrick J. Buchanan, liberal Jeremy Rifkin, consumerist Ralph Nader, New Right organizer Paul Weyrich, feminist Gloria Steinem, and anti-feminist Phyllis Schlafly—all signed a letter opposing the General Agreement on Tariffs and Trade, an international treaty whose purpose was to foster trade among nations.[301]

[300] Ibid

[301] Virginia Postrel, *The Future and Its Enemies: The Growing Conflict Over Creativity, Enterprise, and Progress* (New York: The Free Press, 1998), p. 3.

4. *Demand for a controlled, zero-risk society.* Change is upsetting and uncomfortable to many. Free societies are dynamic and unpredictable—filled with opportunity and risk. And they are impossible to control. How can a government command the economy of a country in which two brothers can disappear into the back of a bicycle shop and invent the airplane, or two college dropouts can create the personal computer in a garage?
5. *The Bleak House Effect.* Charles Dickens' novel, *Bleak House*, told of a family that tore itself apart in a fight over the inheritance of a large estate. In the end, the lives of several generations of the family were destroyed in the fight, and the estate was picked clean by lawyers' fees and taxes.

   The American Dream used to be to create wealth by "building a better mousetrap." Now it seems to have degenerated into the hope of striking it rich by suing the guy who built the mousetrap. Will America become Bleak House writ large? Will the country's best and brightest go into law and politics in order to do nothing more than dissect and distribute the remains of the nation's wealth, or will they work to create new wealth, new technologies, and new sources of prosperity and hope for the world?[302]
6. *Envy.* Envy is a destructive emotion that often tries to disguise itself as a desire for equality. Too many people want to take the shirts off others' backs even though it will not make their own any warmer.

   The former Soviet Union was driven by an envy so corrosive that it helped destroy the nation. Mikhail Gorbachev, the last Soviet president, tried to open up the economy, but when anyone became prosperous under Gorbachev's policy of *perestroika*, the neighbors complained. The government obligingly responded by taxing away the offending inequity. Without either the stick of coercion or the carrot of profits, the Soviet economy quickly collapsed.

   Envy was so pervasive that even the Soviets themselves joked about it. One such joke was that an Englishman, a Frenchman, an Italian, and a Russian were each asked what would make him the happiest man in the world. The Englishman replied that he wanted to be the world's greatest equestrian, the Frenchman said he wanted to be the world's greatest lover, and the Italian dreamed of becoming the world's greatest opera singer. The Soviet said, "I want that my neighbor's cow should die." Any nation will remain destitute as long as its people would rather that their children go without milk than that their neighbor have one more cow than they.

[302]Class action suits can create incentives for people to engage in self-destructive activities. If someone hurts themselves enough by smoking or eating high-fat foods, they may reap huge rewards in court.

7. *Pessimism and Despair.* Despite the fact that poverty and pollution have been steadily dropping in the West for more than one hundred years, many intellectuals and educators are teaching our children the exact opposite. What kind of future will our children build if we continue to teach them that they have none?

In the end, however, people's powerful and natural desire to leave their children with a better and more prosperous world will work to defeat any such threats to freedom. The remarkable history of the ultimate resource, human ingenuity, is a strong argument for optimism. Our future will be as great as our freedom, knowledge, resolve, and energy allow it to be.

> *"The natural effort of every individual to better his own condition, when suffered to exert itself with freedom and security, is so powerful a principle, that it is alone, and without any assistance, not only capable of carrying on the society to wealth and prosperity, but of surmounting a hundred impertinent obstructions with which the folly of human laws too often encumbers its operations; though the effect of these obstructions is always more or less either to encroach upon its freedom, or to diminish its security."*[303]
>
> ***Adam Smith—Scottish professor of moral philosophy***

[303]Adam Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations* (New York: Modern Library, 1776, 1937), p. 508.