History's Greatest Investment Opportunity

by Lester R. Brown

As growth in the world economy slows in 2001, attention focuses on such things as excessive inventories, declining consumer confidence, and key countries such as Japan and China with dangerously high levels of bad loans. To this litany has recently been added the economic effects of the terrorist attack on the World Trade Center in New York and the fallout from the worldwide effort to root out terrorism.

But there is a far more basic threat to the global economy, namely the destruction of the natural systems on which it depends. The relationship between the global economy and the earth's ecosystem is an increasingly stressed one. Signs of stress can be seen in the daily news reports of collapsing fisheries, shrinking forests, eroding soils, deteriorating rangelands, expanding deserts, falling water tables, rising temperatures, more destructive storms, melting glaciers, rising sea level, dying coral reefs, and disappearing species.

These trends are taking a growing economic toll. At some point, they could collectively overwhelm the worldwide forces of progress, leading to economic decline. The challenge is to reverse these trends before environmental deterioration leads to long-term economic decline, as it did for so many earlier civilizations.

Demands of the expanding economy, *as now structured*, are surpassing the sustainable yield of ecosystems. Easily a third of the world's cropland is losing topsoil at a rate that is undermining its long-term productivity. Fully half of the world's rangeland is overgrazed and deteriorating into desert. The world's forests have shrunk by about half since the dawn of agriculture and are still shrinking. Two thirds of oceanic fisheries are now being fished at or beyond their capacity; overfishing is now the rule, not the exception. And overpumping of ground water is common in key food-producing regions.

Nigeria is losing over 500 square kilometers of productive land to desert each year. In Kazakhstan, site of the 1950s Soviet Virgin Lands project, half the cropland has been abandoned since 1980 as soil erosion lowered its productivity. This has dropped Kazakhstan's wheat harvest from roughly 13 million tons in 1980 to 8 million tons in 2000 – an economic loss of $900 million per year.

The rangelands that supply much of the world's animal protein are also under excessive pressure. As human populations grow, so do livestock numbers. With 180 million pastoralists worldwide now trying to make a living raising 3.3 billion cattle, sheep, and goats, grasslands are simply collapsing under the demand. In Africa, the annual loss of livestock production from the cumulative degradation of rangeland is estimated at $7 billion, a sum almost equal to the gross domestic product of Ethiopia.

Water tables are falling in the three leading food-producers – China, India, and the United States. Under the North China Plain, which produces twenty-five percent of China's grain, the water table is falling by 1.6 meters (roughly 5 feet) per year. The same thing is happening in the Punjab, India's breadbasket. In the United States, water tables are falling under the southern Great Plains, shrinking the irrigated area.

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Economic demands on forests are also excessive. Trees are being cut or burned faster than they can regenerate or be planted. Overharvesting is common in Southeast Asia, West Africa, and the Brazilian Amazon. Worldwide, forests are shrinking by over 9 million hectares per year, an area equal to Portugal.

Evidence of excessive human demands can be seen in oceanic fisheries. Many are collapsing, even in industrial countries that should be able to manage them responsibly. In 1992, the rich Newfoundland cod fishery that had been supplying fish for several centuries collapsed abruptly, costing 40,000 Canadians their jobs. Despite a subsequent ban on fishing, nearly a decade later the fishery has yet to recover. Farther to the south, the U.S. Chesapeake Bay has experienced a similar decline. A century ago, this extraordinarily productive estuary produced over 100 million pounds of oysters a year. In 1999, it produced barely 3 million pounds.

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Expanding economic activity is also upsetting some of nature's basic balances. With the huge growth in burning of fossil fuels since 1950, carbon emissions have overwhelmed the capacity of the earth's ecosystem to fix carbon dioxide, a greenhouse gas. As CO_2 levels have risen, so has the earth's temperature. The 14 warmest years since record keeping began in 1866 have all occurred since 1980.

One consequence of higher temperatures is more energy driving storm systems. Three powerful winter storms in France in December 1999 destroyed millions of trees, some of which had been standing for centuries. Thousands of buildings were demolished. These storms, the most violent on record in France, wreaked more than $10 billion worth of damage – $170 for each French citizen. Nature was apparently levying a tax of its own on fossil fuel burning.

In October 1998, Hurricane Mitch – one of the most powerful storms ever to come out of the Atlantic – moved through the Caribbean and stalled for several days on the coast of Central America. While there, it acted as a huge pump pulling water from the ocean and dropping it over the land. Parts of Honduras received 2 meters of rainfall within a few days. So powerful was this storm that it altered the topography, converting mountains and hills into vast mud flows that simply inundated whole villages, claiming an estimated 10,000 lives. Four fifths of the crops were destroyed. The huge flow of rushing water removed all the topsoil in many areas, ensuring that this land will not be farmed again during our lifetimes.

The overall economic effect of the storm was devastating. The wholesale destruction of roads, bridges, buildings, and other infrastructure set back the development of Honduras and Nicaragua by decades. The estimated $8.5 billion worth of damage in the region approached the gross domestic product of both countries combined.

What we call natural disasters are often of human origin. Munich Re, one of the world's largest re-insurance companies, reported that three times as many great natural catastrophes occurred during the 1990s as during the 1960s. Economic losses increased eightfold. Insured losses multiplied 15-fold.

Perhaps the most disturbing consequence of rising temperature is ice melting. Over the last thirty-five years, the ice covering the Arctic Sea has thinned by 42 percent. A study by two Norwegian scientists projects that within 50 years there will be no summer ice left in the Arctic Sea.

This particular melting does not affect sea level because the ice is already in the ocean. But the Greenland ice sheet is also starting to melt. Greenland is three times the size of Texas and the ice sheet is up to 2 kilometers (1.2 miles) thick in some areas. An article in *Science* notes that if the entire ice sheet were to melt, it would raise sea level by some 7 meters (23 feet), inundating the world's coastal cities and Asia's rice-growing river floodplains. The World Bank reports that even a one-meter rise

would inundate half of Bangladesh's riceland.

Restructure or Decline

Economic decision-making, whether by political leaders, corporate planners, investment bankers, or individual consumers, is guided by market signals. The market regularly under-prices goods and services by failing to incorporate the environmental costs of providing them.

Consider, for example, the cost of electricity from a coal-fired power plant. It includes building the power plant, mining the coal, transporting it to the power plant, and distributing the electricity to consumers. What it does not include is the cost of climate disruption caused by carbon emissions from coal burning – whether it be more destructive storms, rising sea level, or record heat waves. Nor does it include the damage to freshwater lakes and forests from acid rain, or the health care costs of treating respiratory illnesses caused by air pollution. Thus the market price of coal-fired electricity greatly understates its cost to society.

How do we get the market to tell the ecological truth? One way of getting the market to give the real price of coal-fired electricity would be to have environmental scientists and economists work together to calculate the cost of climate disruption, acid rain, and air pollution. This figure could then be incorporated as a tax on coal-fired electricity that, when added to the current price, would give the full cost of coal use. This procedure, followed across the board, would mean that all economic decision-makers would have the information needed to make more intelligent, ecologically responsible decisions.

China has learned the hard way the cost of distorted prices. After several weeks of near-record flooding in the Yangtze river valley, which displaced 120 million people and inflicted $30 billion worth of damage, the Chinese realized that the principal reason was that the Yangtze river basin, home to 400 million people, had lost 85 percent of its original tree cover. The government announced a ban on all tree cutting in the Yangtze river basin. Trees standing, a government official noted, were worth three times as much as trees cut.

Øystein Dahle, retired Vice President of Esso for Norway and the North Sea, observes, "Socialism collapsed because it did not allow prices to tell the economic truth. Capitalism may collapse because it does not allow prices to tell the ecological truth."

Building an Eco-Economy

Converting our economy into an eco-economy, one that can sustain economic progress, is a monumental undertaking. It is also a monumental investment opportunity, the greatest in history.

Trends in World Energy Use, by Source, 1990-2000

Energy Source	Annual Rate of Growth (%)
Wind Power	25
Solar Cells	20
Geothermal Power	4
Hydroelectric Power	2
Natural Gas	2
Oil	1
Nuclear Power	1
Coal	-1

Source: WorldWatch Institute
Vital Signs 2001
New York: W. W. Norton & Co.

We can now see what an eco-economy looks like. Instead of being run on fossil fuels, it will be powered by sources of energy that derive from the sun, such as wind and sunlight, and by geothermal energy from within the earth. It will be hydrogen-based instead of carbon-based. Cars and buses will run on fuel-cell engines powered by hydrogen instead of internal combustion engines.

Building a new economy involves phasing out old industries, restructuring existing ones, and creating new ones. Within the energy sector, world coal use has dropped seven percent since peaking in 1996. Oil is expanding but only by one percent a year. These contrast sharply with wind and solar cells, which have grown at twenty-five and twenty percent per year over the last decade. (See Table.) And they are only getting started.

Turning to the Wind

Wind electricity generation, now in its embryonic stage, promises to become the foundation of the new energy economy. Millions of turbines soon will be converting wind into electricity, becoming an integral part of the global

landscape. In many countries, wind will supply both electricity and, through the electrolysis of water, hydrogen. Together, electricity and hydrogen can meet all the energy needs of a modern society.

The robustness of the wind turbine industry was evident in 2000 and 2001 when high tech stocks were in a free fall worldwide. While high tech firms as a group were performing poorly, sales of wind turbines from leading manufacturers, such as Vestas and NEG Micon, were soaring, pushing earnings off the top of the charts. Continuing growth of this sector is expected for the next few decades.

Advances in wind turbine technology, drawing heavily on the aerospace industry, have lowered the cost of wind power from 38¢ per kilowatt-hour in the early 1980s to less than 4¢ at prime wind sites in 2001. In some locations, wind is cheaper than oil or gas-fired power. With major corporations such as ABB, Royal Dutch Shell, and Enron plowing resources into this field, further cost cuts are in prospect.

Wind is a vast, worldwide source of energy. In the United States, North Dakota, Kansas, and Texas have enough harnessable wind to meet national electricity needs. China can double its existing generating capacity from wind alone. Densely populated Western Europe can meet all its electricity needs from offshore wind power out to an ocean depth of 30 meters.

As wind generating costs fall and as concern about climate change escalates, more and more countries are climbing onto the wind energy bandwagon. Beginning in December 2000, the scale of world wind energy development climbed to a new level. Early in the month, France announced it will develop 5,000 megawatts of wind power by 2010. Later in the month, Argentina announced a plan to develop 3,000 megawatts of wind power in Patagonia by 2010. Then in April 2001, the United Kingdom accepted offshore bids for 1,500 megawatts of wind power. In May, a report from Beijing indicated that China plans to develop some 2,500 megawatts of wind power by 2005.

The actual growth in wind power is consistently outrunning earlier estimates. The European Wind Energy Association, which in 1996 had set a target of 40,000 megwatts for Europe by 2010, recently upped its goal to 60,000 megawatts.

In the United States, new wind farms have recently come online in Colorado, Iowa, Minnesota, Oregon, Pennsylvania, Texas, and Wyoming. (One megawatt of wind generating capacity typically supplies 350 homes.) A 300-megawatt wind farm under construction on the Oregon/Washington border, currently the world's largest, can supply 105,000 homes with electricity. This year, U.S. wind-generating capacity is expected to jump by more than 60 percent.

A 3,000-megawatt wind farm in the early planning stages in east central South Dakota, near the Iowa border, is 10 times the size of the Oregon/Washington wind farm. Named Rolling Thunder, this proposed project, under the leadership of Jim Dehlsen, a wind energy pioneer in California – is designed to feed power into the Midwest around Chicago. It is not only large by wind power standards, it is one of the largest energy projects of any kind in the world today.

Income from wind-generated electricity tends to remain in the community, bolstering local economies by providing local income, jobs, and tax revenue. One large advanced-design wind turbine, occupying a quarter-acre of land, can easily yield a farmer or rancher $2,000 in royalties per year while providing the community with $100,000 of electricity.

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Once we get cheap electricity from wind, we can use it to electrolyze water, producing hydrogen. Hydrogen is the fuel of choice for the new, highly efficient fuel cell engine on which every major auto manufacturer is now working. DaimlerChrysler and Honda plan to market fuel cell–powered cars by 2003. Ford and Toyota will probably not be far behind.

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Surplus wind power can be stored as hydrogen and used in fuel cells or gas turbines to generate electricity, leveling supply when winds are variable. With the technologies for harnessing wind and powering motor vehicles with hydrogen advancing, we can now see a future in which U.S. farmers and ranchers supply not only most of the country's electricity, but much of the hydrogen for its fleet of automobiles as well.

Electricity From the Sun

After wind power, the second fastest growing source of energy – solar cells – is a relatively new one, developed in 1952 by three scientists at Bell Labs in Princeton, New Jersey. Initially very costly, solar cells could be used only for high-value purposes such as providing the electricity to operate satellites. Now they are becoming competitive for household electricity generation in villages in developing countries not yet linked to an electrical grid. In the more remote villages, it is already more economical to install solar cells than to both build a power plant and connect the villages by grid. By the end of 2000, about a million homes worldwide were getting their electricity from solar cell installations, 700,000 of them in Third World villages.

Perhaps the most exciting recent advance in solar cells has been the development in Japan of a photovoltaic roofing material, a material that makes the roof of a building its power plant. A joint effort involving the construction industry, the solar cell manufacturing industry, and the Japanese government plans to have 4,600 megawatts of electrical generating capacity in place by 2010, enough to satisfy all of the electricity needs of a country like Estonia. In some countries, including Germany and Japan, buildings now have a two-way meter – selling electricity to the local utility when they have an excess and buying it when they do not have enough.

Growth in the sales of photovoltaic cells averaged just under 20 percent a year from 1990 to 1999. Then in 2000, sales jumped by 43 percent.

The potential is enormous. Aerial photographs show that even in notoriously cloudy Britain, putting solar cells on the country's existing roofs could generate 68,000 megawatts of power on a bright day, about half of peak power demand.

Natural Gas: Bridge to the Hydrogen Economy

Over the last half-century, the use of natural gas has increased 12-fold. Indeed, in 1999 natural gas eclipsed coal as a world source of energy, making it second only to oil. This growth in natural gas use is fortuitous, because as this energy source grows, the storage and distribution system is also expanding, creating the infrastructure for the eventual switch to a hydrogen economy.

Some major corporations are not only visualizing an eco-economy, but are starting to build it. Royal Dutch Shell and DaimlerChrysler are leading a consortium of corporations that is working with the Icelandic government to make that country the world's first hydrogen-powered economy.

In June 2000, ABB, the Swiss-based giant in the global power industry, with an annual turnover of $24 billion, announced a major restructuring. It indicated that henceforth it would be emphasizing alternative energy sources, investing heavily in the development of renewable energy, such as wind. It said that its engineers had designed a new wind turbine called the Wind Former, a machine that reduces generating costs by 20

percent below that of turbines now in use.

Looking to the future, ABB sees 755 million households in the world without electricity. The overwhelming majority of these households do not even have access to an electricity grid. For them, ABB believes it will be cheaper to install small-scale power than to invest in large thermal power plants and build a grid, both of which are costly. In its vision of the new energy economy, ABB suggests, for example, that "a small town might be supplied by a mix of combined heat and power generating facilities, wind power, fuel cells, and photovoltaic energy with output from individual sources being adjusted via a micro-grid to compensate for seasonal variations in wind speeds and sunshine."

Many companies have set their own goals for reducing carbon emissions – and they substantially exceed the goals of the Kyoto Protocol. For example, Dupont, measuring its goals in terms of CO_2 equivalent emissions, plans to reduce greenhouse gas emissions 65 percent from 1990 levels.

Firms in some other industries are going even further in setting environmental goals. Among these are Interface, a manufacturer of industrial carpet based in Atlanta, Georgia, and STMicroelectronics, an Italian-based semiconductor manufacturer. Ray Anderson, the CEO of Interface, has become an enthusiastic advocate of building an eco-economy. The Interface plan is to generate no waste and no carbon emissions. Instead of selling carpet to companies, Anderson wants to sell carpeting services, an arrangement whereby Interface agrees to maintain the carpeting in a company's offices for a fixed period, say 10 years. Worn carpet is returned to the factory, melted down, and respun into new fiber. This new carpet then goes on the floor. "Our goal," Anderson says, "is not to lose a single molecule of carpeting material." This system, which requires no raw materials and sends nothing to the landfill, closes the loop.

STMicroelectronics, one of the world's largest manufacturer of semiconductors, is also committed to an environmentally sustainable operation. Pasquale Pistorio, president and CEO, matches the fervor of Ray Anderson. After being ranked first in eco-efficiency among 14 semiconductor companies worldwide, Pistorio said that "none of ST's environmental initiatives have taken more than three years to pay back, while our reputation as the semiconductor industry's 'green leader' helps us to attract the young, talented engineers that are essential to sustain our growth and keep us at the leading edge of the industry that is transforming the world."

Like Anderson, Pistorio also wants to build an environmentally benign corporation, and to do it by 2010. The company plans to reduce carbon emissions by shifting to an energy mix for 2010 that relies on cogeneration for 65 percent of its energy, conventional sources for 30 percent, and renewables for 5 percent. This will still leave it with a net contribution of CO_2 into the atmosphere, which it plans to offset by planting enough trees to sequester roughly 1 million tons of carbon emissions per year. The company's net revenues in 1999 exceeded $5 billion, with net earnings of $547 million; in 2000, net revenues were estimated at $6.7 billion, with earnings of $1.3 billion.

These two firms are models of eco-economy corporations. Both CEOs support a restructuring of the tax system, one that reduces income taxes and raises taxes on environmentally destructive activities, including climate-disrupting carbon emissions. These two firms, in different industries and from different cultures, have identical goals. Each wants to build a corporation that meets human needs, provides generous profits to stockholders, and does it in a way that does not destroy or disrupt the economy's natural support systems.

No sector of the global economy will be untouched by the economic restructuring. In this new economy, some companies will be winners and some will be losers. Those who anticipate the emerging eco-economy and plan for it will be the winners. Those who cling to the past risk becoming part of it. •