VITAL SIGNS 2002

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VITAL SIGNS 2002

The Trends That Are Shaping Our Future

WORLDWATCH INSTITUTE

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ACKNOWLEDGMENTS

As we strive to make each edition of *Vital Signs* more useful than the last, we thank you, our readers. From educators and reporters to government officials and concerned citizens, many of you have taken the time to tell us how you are using this book to make a difference in the world. A lecturer at Florida State University is mining *Vital Signs* for an "Environmental Minute" TV show. On the other side of the world, the Director of the Global Environment Program at Vietnam National University has sent copies of the Vietnamese edition to senior government officials. An editor of a weekly publication in Latin America says she uses *Vital Signs* as a primary resource, "alongside my Webster's dictionary, AP style book, and *New York Times Almanac*." And to keep colleagues informed of crucial global trends, a Scottish parliamentarian asked the Parliament's library to order *Vital Signs*.

We also acknowledge a similarly rich array of outside experts who lent their time to read early drafts or provide essential data for this year's book: Tracey Axelsson, Dirk Bake, Judy Ballard, Nalini Basarajav, Nancy Birdsall, Sebastian Bizarri, Nils Borg, Mario Borsese, Barry Bredenkamp, Robert Bryant, Anil Cabraal, Judy Canny, Mark Chase, Jennifer Clapp, Colin Couchman, Charlie Craig, Adele Crispoldi, Stacy Davis, John Dearing, Lisa DiRosa, Peter du Pont, Michael Eckhart, Robert Engelman, Edward Finlay, Sharon Flesher, Satoshi Fujino, Lew Fulton, Michael Graber, Pierre Graftieaux, Maria Graschew, Roland Griffiths, Trudi Griggs, Steve Haley, Suzanne S. Hurd, Mike Jacobson, Doris Johnsen, Tim Kelly, Alison H. Kranias, Jonathan Krueger, Joe La Dou, Kimmo Laine, Benoit Lebot, David Leonhardt, Arne Lindelien, David Ludwig, Angus Maddison, Peter Markusson, Paul Maycock, Kevin McLaughlin, James McMahon, Lai Meng, Gladys C. Moreno Garcia, Bill Mott, Gerald Mutisya, Patricia Noel, Linda Novick, Peter Novy, Kate O'Neill, Brendan O'Neill, Jim Paul, Steve Plotkin, Jim Puckett, Morten Rettig, Benoît Robert, John Rodwan, Sara Scherr, Lee Schipper, J-Baptiste Schmider, Kira Schmidt, Wolfgang Schreiber, Susan Shaheen, Vladimir Slivyak, Margareta Sollenberg, Kathryn Steinberg, Diane Striar, Russell Sturm, Elizabeth Sullivan, Cornelia Thoma, Lou Thompson, Jennifer Thorne, Paul Waide, Reg Watson, Arthur Westing, Paul Steely White, Neville Williams, Stanley Wood, Wilson Wood, Karen Worminghaus, Cathy Wright, Marc Xuereb, and Dorothy Zbicz.

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This is the second edition we have produced in cooperation with the U.N. Environment Programme (UNEP). We appreciate in particu-

lar the help provided by Marion Cheatle and Tim Foresman at UNEP, who have made the relationship such a comfortable as well as a beneficial one. In addition, we benefited greatly from the careful review provided for UNEP by Mirjam Schomaker, who helped us with accuracy and clarity.

Numerous foundations support our general research program, which underlies all our publications and lets Worldwatch speak with an independent voice: Geraldine R. Dodge Foundation, The Ford Foundation, Richard & Rhoda Goldman Fund, The William and Flora Hewlett Foundation, The Frances Lear Foundation, Steve Leuthold Family Foundation, The John D. and Catherine T. MacArthur Foundation, Charles Stewart Mott Foundation, The Curtis and Edith Munson Foundation, The David and Lucile Packard Foundation, The Shenandoah Foundation, The Summit Foundation, Surdna Foundation, Inc., Turner Foundation, Inc., the Wallace Global Fund, the Weeden Foundation, and The Winslow Foundation.

We are privileged to have a particularly close relationship with our U.S. publisher, W.W. Norton & Company. Amy Cherry, Lucinda Bartley, and Andrew Marasia at Norton speed the book through the publishing process. We also value our partners who publish *Vital Signs* outside the United States in 22 languages.

The in-house people and talents that Worldwatch draws on to produce *Vital Signs* are as varied as the indicators in this book. This year, the Project Team consisted of Michael Renner (Project Director), Brian Halweil, and Molly O'Meara Sheehan. As we prepared this edition, crucial support was provided by Institute stalwarts Barbara Fallin and Suzanne Clift; our business and development team of Adrianne Greenlees, Elizabeth Nolan, Kevin Parker, Mary Redfern, and Cyndi Cramer; and our communications team of Dick Bell, Leanne Mitchell, Patrick Settle, Sharon Lapier, Niki Clark, and Susanne Martikke. For the hardest-to-find reports and data sets, authors rely on our research librarian Lori Brown, assisted by Jonathan Guzman, and on Joseph Gravely in our mailroom.

This year, our regular research staff was bolstered by a network of Worldwatch alumni: Ann Hwang, Janet Larsen, Nick Lenssen, and Mike Scholand. While not full-time staffers, Worldwatch Board Member Lester Brown and Senior Fellow Sandra Postel, assisted by Katie Blake, also made key contributions. An especially talented crew of interns, including Jessica Dodson, Kathleen Huvane, and Uta Saoshiro, found time to draft pieces of their own while assisting senior researchers, as did Erik Assadourian, who has since come on board as a full-time researcher. Arriving late in December, our newest intern, Meghan Crimmins, pitched in during crunch time.

Finally, we thank two individuals at the core of this book. Independent editor Linda Starke held authors' feet to the fire, turning dozens of drafts submitted by 23 nearby and far-flung authors into polished prose at breakneck speed. Working under the most intense deadline pressure, Art Director Eizabeth Doherty maintained her creative spark to make *Vital Signs* both better-looking and easier to understand. Several of the photos Liz selected for this edition are from Photoshare, the online photo database of the Media/Materials Clearinghouse at the Johns Hopkins University Population Information Program at <www.jhuccp.org/mmc>. We are sad to note that this is Liz's final *Vital Signs*. Since September 1996 Liz has brought considerable talents and an untiring spirit to six editions of this book. We wish her well in her new endeavors.

Information on our CD-ROM, which contains the data used to prepare all of the Figures in this book, can be found on page 6. Let us know if you have ideas of other trends we can cover. Please contact us by e-mail (worldwatch@worldwatch.org), fax (202-296-7365), or regular mail.

Vital Signs Project Team
March 2002

Worldwatch Institute
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PREFACE

By most standards, including many of the "vital signs" catalogued in this book, the past year would be classified as an *annus horribilis*. A year that began with economic recession and heavily publicized food safety scares was later marked by violent outbreaks of ethnic conflict and the most deadly single episode of terrorism the world has ever seen.

Hopes that the world had entered a period of peace and prosperity at the dawn of the twenty-first century had to be put aside as the year proceeded, amid growing awareness of the instabilities inherent in a period of accelerating change—and the web of interconnections that make people everywhere vulnerable to crises that break out anywhere.

Vital Signs 2002 focuses not on the spectacular events that dominated news coverage of the past year but on the deeper, more chronic trends that define the health of people and the planet—and that provide the context for the crises that command public attention. These trends now point to a dangerous instability, one that can only be righted by concerted efforts to create a more secure and sustainable world.

The fact that 1.2 billion people live on less than $1 a day—a figure roughly unchanged even after a decade of phenomenal economic growth in much of the developing world—is clearly undermining stability in some societies. And rapid economic growth has created a rising gap between rich and poor in many countries, another force of instability.

So long as 3 million people die yearly from AIDS, 100–150 million suffer from asthma, and 2.4 billion lack basic sanitation—all documented in the pages that follow—it is hard to imagine that we can achieve a stable or secure world.

Growing instability is seen in the natural world as well. The year 2001 was the second warmest on record, joining a list of the 10 warmest years in the last century—all of which have occurred since 1990. Carbon dioxide, the leading greenhouse gas, continues to build up in the atmosphere as carbon emissions reached a new high.

On the ground, an estimated 150–300 million hectares of cropland—10–20 percent of the world total—is now degraded. More than 2 billion people live in water-stressed countries in which water supplies are insufficient to meet food, industrial, and household needs.

When world leaders gather at the World Summit on Sustainable Development in Johannesburg, South Africa, they will face no shortage of challenges. Indeed, the need for a global action plan on the interlinked problems of environmental decline and human poverty has never been as evident as it is this year.

While the problems facing the world in Johannesburg are daunting, *Vital Signs 2002* also offers encouraging evidence that national policy and even human behavior can change in response to new threats—and that sometimes solutions emerge that no one would have expected.

Who would have guessed a decade ago, for

example, that the world leader in producing the efficient compact fluorescent light bulbs pioneered in Europe and the United States would be China? Or that wind power would become the world's fastest-growing energy source—with annual additions to generating capacity on the verge of overtaking hydropower? And who would have imagined that the fastest-growing transportation trend in industrial countries would be car *sharing*, an alternative to private ownership that reduces the temptation to overuse the automobile?

As these few examples suggest, change can sometimes happen quickly, and it is most effective when it involves both the innovative capacities of private citizens and companies and the societal goals and incentives that are the province of governments and international agencies. The Johannesburg Summit offers an opportunity to move forward with implementation of agreements now in place, pursuing strategies that will provide economic opportunities at the same time that they solve environmental problems.

The Worldwatch Institute and the United Nations Environment Programme are both convinced that change is possible—and that an informed public is the first ingredient of productive change. We hope that *Vital Signs 2002* will provide some of the information that people and their leaders need to make wise decisions.

Christopher Flavin
President
Worldwatch Institute

Klaus Töpfer
Executive Director
United Nations Environment Programme

VITAL SIGNS 2002

TECHNICAL NOTE

Units of measure throughout this book are metric unless common usage dictates otherwise. Historical population data used in per capita calculations are from the Center for International Research at the U.S. Bureau of the Census. Historical data series in *Vital Signs* are updated each year, incorporating any revisions by originating organizations.

Data expressed in U.S. dollars have for the most part been deflated to 2000 terms. In some cases, the original data source provided the numbers in deflated terms or supplied an appropriate deflator, as with gross world product data. Where this did not happen, the U.S. implicit gross national product (GNP) deflator from the U.S. Department of Commerce was used to represent price trends in real terms.

OVERVIEW

Making the Connections

Michael Renner

In the aftermath of 11 September 2001, many people have said that the terror attacks changed the world in fundamental ways. It may be more appropriate to say that the shocking events of that day were a dramatic wake-up call—a catalyst for undertaking a critical reassessment of the state of affairs on our globe, and of the underlying conditions that feed desperation, fuel resentment, and breed violence. A candid appraisal reveals widening disparities between rich and poor, mounting health challenges, battered ecosystems, and persistent social and political conflicts. Yet there are also many opportunities for positive change through the promotion of social justice and environmental health, international cooperation, technological innovation, and greater prudence in the pursuit of human ingenuity. Many of those topics will be addressed in Johannesburg in August–September at the World Summit on Sustainable Development—an ideal time to capitalize on the opportunities for change.

Vital Signs 2002 offers information on a broad range of issues critical to putting the world on a more just, ecologically resilient, and ultimately peaceful trajectory. It brings together a careful selection of topics, seen through the lens of global equity and sustainability. As in previous editions, *Vital Signs* covers a range of basic and long-established indicators such as gross economic product and trade flows, population growth, grain production, fossil fuel consumption, automobile manufacturing, and roundwood production. And it continues to document alternative indicators of ever-growing significance, like wind and solar power development, bicycle production, carbon emissions, chlorofluorocarbon (CFC) use, and the growth of biotechnology.

But in recognition of the many issues critical to sustainability, new topics are also covered in *Vital Signs 2002*. Roughly one third of the book addresses issues not covered earlier, including sugar crops, soft drink consumption, oil spills, hazardous waste trade, ecolabeling, appliance efficiency standards, car-sharing, urban sprawl, asthma, mental health, the cruise industry, transboundary parks, teacher shortages, and gender-based violence.

Among the most promising developments documented in *Vital Signs 2002* are the surging sales of efficient compact fluorescent lamps (CFLs, with an estimated 1.8 billion in use worldwide), the continued rapid expansion of wind and solar-generated electricity, the steady decline in the amount of oil spilled accidentally, and the ongoing reduction in production of ozone-destroying chemicals. Other encouraging developments are the decreasing metals intensity of the world economy, the growing reliance on transboundary parks as tools for biodiversity conservation and peace- and confidence-building, the expansion of commercial forest areas that have been certified as well-managed, reductions in the number of active armed conflicts, and progress in curtailing reliance on landmines.

On the downside, there is ongoing forest loss in the tropics, the threat of extinction for

many freshwater species, the relentless generation of huge amounts of hazardous waste, the continued expansion of the car-centered transportation system, the massive spread of HIV infections, runaway consumption of sugar and soft drinks, widespread teacher shortages, an epidemic of violence against women, and declining foreign aid.

The impacts of some of the trends documented in *Vital Signs* are self-evident. Others may be less clear-cut. For instance, there is nothing intrinsically wrong with increased cocoa production, but reports of children being forced to work in slavery-like conditions in some areas add a negative tint to this trend. Most economists regard growing car production as a positive development because of job creation and enhanced mobility. But the rising costs of a car-centered transportation system—from air pollution and carbon emissions to urban sprawl and the fatalities and injuries from traffic accidents—suggest a more negative assessment.

Qualitative assessments of Earth's vital signs are of necessity subjective in nature, the result of different sets of values, philosophies, expectations, and goals. The proverbial glass can be seen as half full or half empty. Readers may draw their own conclusions.

CONNECTIONS

Although each individual item in this book was written as a stand-alone piece, the intention is to encourage readers to engage in cross-cutting comparisons among related issues. The contents of this year's *Vital Signs* can be grouped in a variety of topic clusters. This overview looks at three such clusters—energy, climate, and transportation; land, water, and food; and the impact of technology. These are only some of many cross-cutting issues to emerge. Readers might want to do their own comparisons of material in this book and draw linkages and conclusions that are germane to their work and interests.

Due to expanding trade, travel, and communications networks, the world has become ever more interlinked, so that events in far-flung places affect millions elsewhere on the planet. This is as true for economic and political issues as for social and environmental ones.

Other connections are equally crucial and yet too often remain unacknowledged. When millions of motorists turn on their cars in the morning on their way to work, they may not be aware that the simple act of driving is contributing to the unraveling of the climate system, thus helping to cause or worsen floods in Bangladesh, mudslides in Central America, or droughts in parts of Africa. At the furniture store, consumers may buy products made from wood harvested in destructive logging operations that threaten the livelihoods of indigenous populations. As these two simple examples illustrate, no society lives in isolation in this interlinked world. Oceans and other natural barriers are no longer insurmountable; borders are far from impermeable. The challenge in a world of nation-states of different size and power is to devise ways to maximize the benefits and minimize the damage from the globalization now being experienced.

ENERGY, CLIMATE, AND TRANSPORTATION

An understanding of the manifold and complex connections that characterize the modern world is increasingly critical. Energy plays a particularly important role. The global economy has long depended on the availability of abundant supplies of cheap energy, particularly from the politically volatile Persian Gulf region. Maintaining access to oil at all cost has been a central tenet of economic and military policies of western industrial countries. But this policy has contributed to repeated upheavals in the Middle East. The energy status quo not only implies continued instability for the world economy and for world peace, it also has grim consequences for the stability of the global atmosphere. (See Figure 1.)

Fossil fuel consumption and carbon emissions each rose more than 1 percent in 2001, reaching new peaks. (See pages 38–39 and 52–53.) Global temperatures have been on the

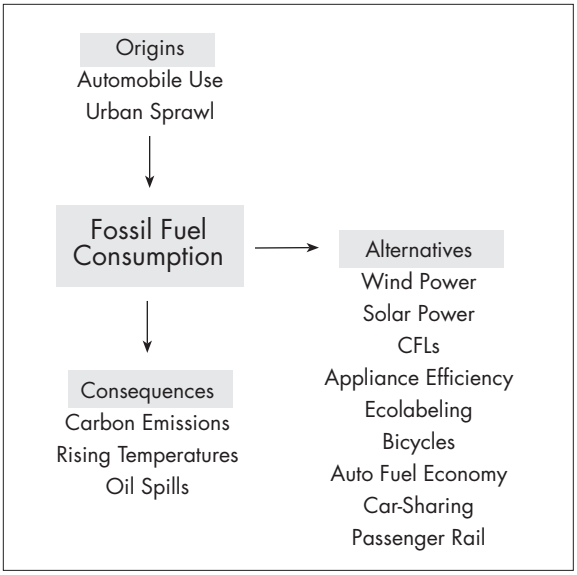

Figure 1: Energy, Climate, and Transportation Connections

upswing during the past half-century, and land and ocean measurements show that 2001 was the second-warmest year on record since the late nineteenth century. Not surprisingly, 2001 brought several episodes of abnormal weather, including an above-average number of hurricanes and tropical storms in the north Atlantic basin; severe flooding in Viet Nam, Siberia, and different parts of Africa; and devastating droughts in Iran, Afghanistan, Pakistan, the Horn of Africa, Brazil, northern China, North Korea, and Japan. (See pages 50–51.)

To quench the industrial world's thirst for fossil fuels, tankers transport some 107 million tons of oil each day. Oil tankers are a leading source of oil spills, though pipelines, production wells, storage facilities, and refineries are important sources as well. The good news is that a variety of safety measures have helped reduce oil spills from civilian operations. The amount of oil lost in 2000, almost 50,000 tons, was the lowest since continuous recordkeeping began in 1968. Still, even small amounts of oil can do major damage if an accident occurs in or near a fragile ecosystem. (See pages 68–69.)

Car-centered transportation is playing a major role in the world's voracious appetite for fossil fuels. This is particularly the case in sprawling urban areas where long travel distances render biking and public transport almost impossible while making reliance on cars a daily inevitability. During the 1990s, road transportation was the fastest-growing source of carbon emissions from fuel burning. There are now 555 million passenger vehicles on the world's roads, and factories churn out about 40 million new cars each year. (See pages 74–75.) Although car fuel economy is again improving after having stagnated for many years, it remains far short of technical possibilities. And in the United States, which has slightly more than a quarter of the world's cars, there is little prospect of significant improvement over the next decade. (See pages 152–53.)

Passenger-kilometers traveled by rail have stagnated since the late 1980s, and rail continues to lose out to travel by car and airplane. (See pages 78–79.) Meanwhile, global production of bicycles has recovered from a slump, topping 100 million units in 2000 for the first time since 1995. But the bicycle industry continues to struggle. (See pages 76–77.) Particularly in Europe, an alternative approach is rapidly gaining adherents. Car-sharing is attracting rising numbers of people who do not see a need to own a car themselves. Such ventures offer social and environmental benefits to cities. (See pages 150–51.)

Headway is being made in some other ways to reduce energy use. Compact fluorescent lamps are longer-lasting and far more energy-thrifty than conventional incandescent light bulbs. Sales of CFLs worldwide grew 15 percent in 2001 alone, and have increased more than 13-fold since 1988. (See pages 46–47.) Efficiency standards for domestic appliances have been initiated in 43 countries worldwide, and have helped eliminate more energy-thirsty models from the market. (See pages 132–33.) Consumers can make more responsible pur-

chasing decisions by relying on ecolabeling that guides them toward more-efficient and environmentally benign goods and services. (See pages 124–25.)

Making more efficient use of fossil fuels is only part of the equation. An equally important task is to promote alternative sources of energy. Wind and solar power have been growing rapidly in recent years, and use of each expanded by more than 30 percent in 2001 alone. (See pages 42–45.)

LAND, WATER, AND FOOD

A number of critical connections also exist in the realm of food and agriculture. Arable land and water for agriculture are among the most critical resources for human well-being and survival, no matter the technological prowess of a society. Yet freshwater resources are often tapped beyond sustainable rates and many cropland areas are pushed to the limits. Although the global grain harvest is near peak levels, farmers and consumers confront a number of serious quantitative and qualitative challenges. (See Figure 2 and pages 26–27.)

An estimated 10–20 percent of the world's 1.5 billion hectares of cropland are degraded to some degree, the result of excessive tillage and fertilizer use, inappropriate land use, removal of vegetation, and overgrazing. In the developing world, the pace of decline has accelerated during the past 50 years to the point where a quarter of the farmland suffers from degradation. Worldwide, farmland degradation has reduced cumulative food production by an estimated 13 percent over the last half-century. (See pages 102–03.)

Urban expansion eats into prime agricultural land, particularly in the case of cities that are characterized by a pattern of sprawl. For instance, although only 3 percent of the U.S. land surface is urbanized, the most productive soils are often developed first as cities expand. In fact, more than 1 million hectares of arable land in the United States are paved over each year. In China, the figure is 200,000 hectares. (See pages 152–53.)

Another common factor in farmland degradation is salinization—a buildup of salt that occurs when excess irrigation water evaporates. Salinization can hurt yields and even force the abandonment of irrigated land. Today, about 20 percent of the world's 274 million hectares of irrigated land are damaged in this way. (See pages 34–35 and 102–03.)

Improved irrigation efficiency could avoid these problems and raise farm yields, but at the moment, inefficient methods are used on 90 percent of artificially watered fields. Greater efficiency is also important because growing water shortages in Africa, Asia, and the Middle East are forcing an increasing number of countries to rely on grain imports. By 2015, with rising water shortages and populations, a projected 40 percent of humanity will live in water-stressed countries, putting increasing pressure on global grain supplies. Making low-cost, efficient irrigation available to poor farmers will be key to alleviating hunger and malnutrition. (See pages 34–35 and 148–49.)

More efficient water use is also essential to save many freshwater species from extinction and to preserve the valuable ecological services

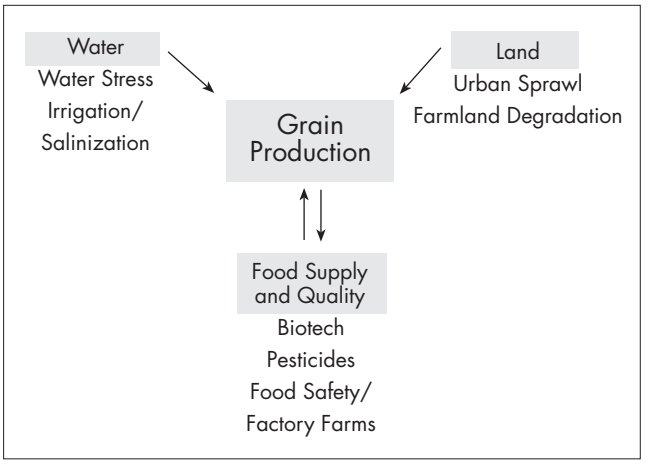

Figure 2: Land, Water, and Food Connections

they provide, such as filtering and cleansing water supplies and mitigating floods and droughts. The habitat of these species is increasingly under assault by dams, river diversions, pollution, and the introduction of non-native species. Almost 80 percent of the largest river systems in North America, Europe, and the former Soviet Union are moderately or strongly altered by dams, reservoirs, diversions, and irrigation systems, and similar challenges are now arising in the developing world. (See pages 106–07.)

Farming and other components of food production have become industrialized, resource-intensive systems. On the input side, pesticide use (two thirds of it in agriculture) has grown 15-fold since 1950 but imposes a terrible toll, poisoning 3 million people severely and killing 220,000 each year. Meanwhile, farmers confront increasing pesticide resistance. (See pages 126–27.)

For consumers, food quality ranks among the most widespread health concerns. Food-borne diseases strike 30 percent of the population in industrial countries each year, but people living in developing countries bear a more frightful burden due to a wide range of hazards and inadequate prevention and treatment. Though lack of household hygiene is a factor, many problems begin far earlier. Livestock in many modern factory farms, for instance, are often raised in crowded, unsanitary conditions, which promotes food-borne illnesses. (See pages 138–39.)

THE HAZARDS OF HIGH-TECH AND OLD TECH

Humanity is confronting some of the broad boomerang effects of modern technology. The unintended consequences of what once seemed technological marvels can entail severe threats to human health and well-being. Nuclear power, at first considered too cheap to meter, is bequeathing the unwanted long-term "gift" of radioactive waste. (See pages 40–41.) Chlorofluorocarbons, for decades judged ideal for refrigerating, air-conditioning, and a host of other purposes, turned out to be efficient killers of the atmospheric ozone layer that protects life on Earth from deadly ultraviolet radiation. Though CFC production is now down sharply, it may take a half-century for the ozone layer to heal completely. (See pages 54–55.)

Modern industrial life is characterized by the generation of substantial amounts of hazardous waste—both in traditional industries such as metals mining and processing, petrochemicals, pesticides, and plastics manufacturing and in newer, more high-tech sectors. Some 300–500 million tons of heavy metals, solvents, toxic sludge, and other wastes accumulate each year. (See Figure 3 and pages 66–67 and 112–13.)

The semiconductor industry has undergone explosive growth in the past two decades. In 2001, some 60 million transistors—the tiny components used to build semiconductor chips—were manufactured for each person in the world. But because of the rapid pace at which electronic products become obsolete and are being replaced, production is expected to skyrocket in coming years, to perhaps as many as 1 billion transistors per person in 2010. Yet the industry requires copious amounts of chemicals and leaves behind huge quantities of dangerous wastes. Production of a single six-inch silicon wafer results in 14 kilograms of solid waste and 11,000 liters of waste water. Workers in the industry are on the frontline of exposure and at risk of developing cancer or seeing birth defects in their children. (See pages 110–11.)

Cell phones are among the products that incorporate semiconductors. While they allow an ever more connected world and give millions of people access to phone service for the first time, discarded cell phones contribute to the growing mountain of electronics waste. And there is an ongoing, unresolved discussion surrounding possible harm to human health from the radio waves they emit. (See pages 84–85.)

More than 80 percent of the world's hazardous waste is produced in the United States

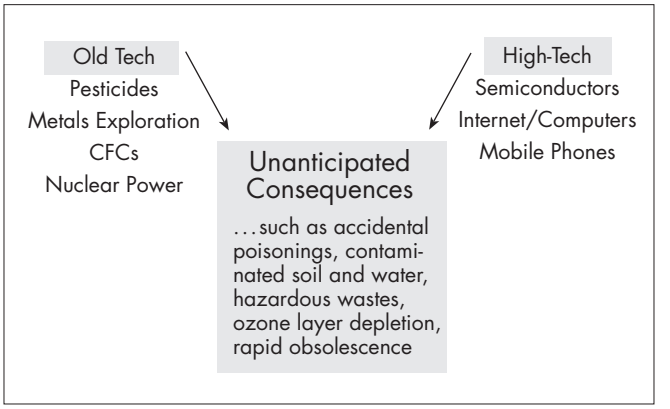

Figure 3: Impacts of Technology

and other industrial countries. The international community has struggled to devise and enforce rules to reduce cross-border movements in the hope of preventing poor countries from being turned into dumping grounds for the wastes of the rich. Today, about 10 percent of all hazardous waste is shipped across an international border. (See pages 112–13.)

Though much hazardous waste trade takes place among industrial countries, there are some important exceptions. The Basel Action Network, with support from other citizens' groups, found that huge quantities of computer monitors, cell phones, circuit boards, and other items from the United States end up in China, India, and Pakistan. There, they are either being dumped or the materials they contain—lead, mercury, cadmium, copper, gold, and many others—are salvaged in such crude ways as to pose a severe occupational and environmental threat. (See pages 82–83.) Separated by thousands of kilometers, beneficiaries and victims of the high-tech revolution never meet face-to-face, but the connections between them are real.

Time and again, technological innovation has kicked loose a range of unintended consequences. Depending on the situation and the time, an overly narrow focus of scientific inquiry, excessive technological optimism, unbridled reign of the profit motive, or plain lack of foresight may lead societies to pursue technological promise with abandon, only to discover surprising side effects, unknown long-term consequences, and unanticipated feedback loops. The world is still learning to cope with the repercussions of the chemical revolution, even as it hurtles with great speed through the electronics age and plunges headlong into the biotech era.

Increasingly, the challenge for scientists, corporations, governments, and individuals is to use human inventions more judiciously—with an eye to the likely implications for equity and sustainability. That requires greater wisdom in deciding what technologies to pursue, how to mold them, and when to look for alternatives. Simply striving for the technically feasible is no longer a responsible option. Indeed, the precautionary principle—in the face of scientific uncertainty, exercise caution—becomes ever more important as our lives are increasingly permeated by the creations of human ingenuity and hubris. This is possible only with a more holistic view of the world, and a better understanding of the kinds of connections that this book explores.

PART ONE
Key Indicators

Food and Agricultural Trends

GENE THIEMANN, LUTHERAN WORLD RELIEF, M/MC PHOTOSHARE, WWW.JHUCCP.ORG/MMC

Aquaculture Production Intensifies

Grain Harvest Lagging Behind Demand

Meat Production Hits Another High

Cocoa Production Jumps

Sugar and Sweetener Use Grows

Irrigated Area Rises

Aquaculture Production Intensifies

Anne Platt McGinn

Global aquaculture production has grown nearly 400 percent in the past 15 years, from 7 million tons in 1984 (the first year with global data) to 33.3 million tons in 1999.[1] (See Figure 1.) Preliminary data indicate production climbed to 36.1 million tons in 2000.[2]

Aquaculture is the fastest-growing segment of food production in the world.[3] As global marine catches stagnate and even decline in some areas, aquaculture is quickly filling the gap. It now provides 31 percent of the world's food fish, up from 19 percent in 1990.[4] Globally, the value of farmed fish doubled from $24.5 billion in 1990 to $47.9 billion in 1999.[5] (By comparison, fish catches were valued at $83 billion in 1998.)[6]

Almost 9 out of 10 farmed fish in the world—some 86 percent—are now raised in Asia.[7] Farmers in China boosted output by 252 percent during the 1990s, and now contribute 68 percent of the world's farmed fish by volume and nearly half of its value.[8] (Unofficial reports indicate, however, that China has inflated its production data.)[9] India is a distant second in terms of output, followed by Japan, Indonesia, and Bangladesh.[10] By value, Japan, India, Indonesia, and Thailand round out the top five producers in the world.[11]

Links: pp. 106, 138

Chile posted the largest percentage gain in the last decade, with production jumping more than 700 percent—from 32,447 tons of fish in 1990 to 274,216 tons in 1999.[12] Farmed salmon and trout account for nearly 85 percent of Chile's output.[13]

Some 220 fish species are now cultivated in captivity, although 20 species account for 90 percent of world production.[14] From 1990 to 1999, world production of farmed carp, tilapia, and other freshwater fish nearly tripled, and now accounts for 56 percent of total output.[15] (See Figure 2.) These low-value species are generally raised and consumed locally.

In contrast, high-end species such as shrimp and salmon are grown primarily for export to Japan, North America, and Europe. Production of farmed shrimp and salmon roughly doubled during the 1990s, to just 8 percent of the total, but these two species now account for 24 percent of the value of world aquaculture.[16]

The net trade earnings from captured and cultured fish in developing countries grew from $5.2 billion in 1985 to $15 billion in 1998.[17] Developing countries now earn more foreign exchange from exported fish products than from coffee, tea, rice, and rubber exports combined.[18]

Rapid growth in aquaculture has raised a number of concerns, however. Disease outbreaks have taken a stiff toll, especially where high numbers of a single species are raised in small areas. In 1999, Ecuador lost nearly $500 million in export earnings due to a catastrophic outbreak of white spot virus in farmed shrimp.[19]

Another concern is aquaculture's growing appetite for wild fish. Carnivorous fish such as salmon and shrimp are typically fed high-protein pellets made from a combination of fishmeal and plant-based proteins. (Small pelagic species, such as anchovy, herring, and menhaden, are used to produce fishmeal.) Today, increasing numbers of farmers are replacing an entirely plant-based diet for omnivorous and herbivorous fish with feed pellets, to induce faster growth and weight gain.[20] As a result, the share of world fishmeal dedicated to aquaculture has increased from 10 percent in 1988 to 35 percent in 1998.[21] During that time, global fishmeal output remained steady while the share for poultry and cattle declined.[22]

In contrast, marine-raised mollusks need few artificial inputs because they feed on nutrients from the surrounding water. In 1999, cultured oysters and clams commanded 14 percent of the value of global aquaculture.[23] Some experts are encouraging displaced fishers to adopt environmentally sound aquaculture to help generate income. For example, farmers can cultivate species that fetch high prices on international markets, such as oysters for pearls and giant clams for the aquarium industry.[24] But export-driven aquaculture does not eliminate the importance of raising fish for local consumption, a growing need in many food-deficit countries.

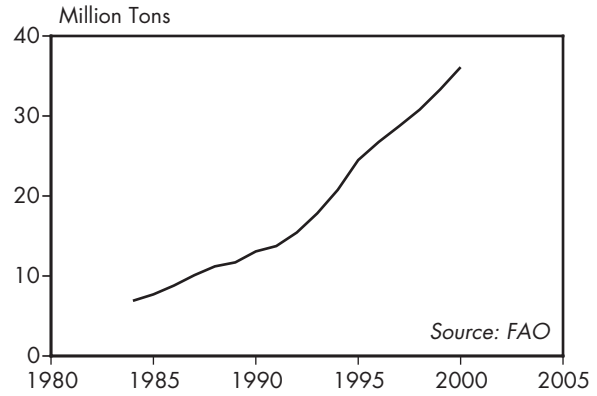

Figure 1: World Aquaculture Production, 1984–2000

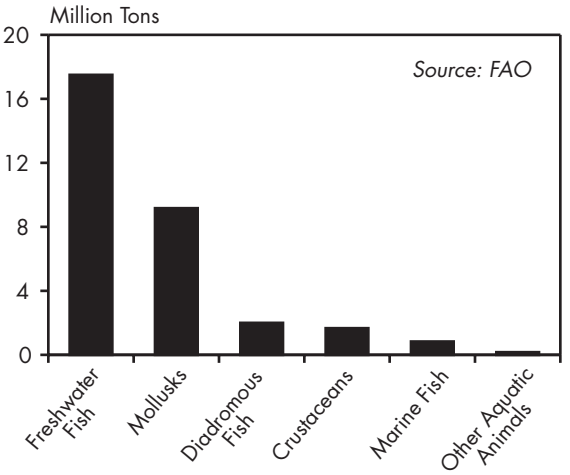

Figure 2: World Aquaculture Production by Major Species Groups, 1998

World Aquaculture Production, 1984–2000

Year	Production (million tons)
1984	6.9
1985	7.7
1986	8.8
1987	10.1
1988	11.2
1989	11.7
1990	13.1
1991	13.7
1992	15.4
1993	17.8
1994	20.8
1995	24.5
1996	26.8
1997	28.7
1998	30.8
1999	33.3
2000 (prel)	36.1

Source: FAO, *Aquaculture Production Statistics 1984–93* and *Fishery Statistics: Aquaculture Production*.

Grain Harvest Lagging Behind Demand

Lester R. Brown

This year's world grain harvest, estimated at 1,843 million tons, is up slightly from last year's poor harvest of 1,836 million tons.[1] (See Figure 1.) It is, nonetheless, a depressed harvest—40 million tons below 1997's record 1,880 million tons.[2]

Grain production per person worldwide this year totals 299 kilograms, down from the peak of 342 kilograms in 1984.[3] (See Figure 2.) This 14-percent decline since 1984 contrasts with a 38-percent gain from 1950 to 1984, a period of widespread progress in reducing hunger and malnutrition worldwide.[4]

The poor harvests of the last two years are a result of weak world prices for grain, of drought stretching from the Middle East through central Asia and across northern China, and of spreading shortages of irrigation water. Prices will recover and the drought will end, but irrigation water shortages will worsen as population growth outruns the water supply in more and more countries.

Links: pp. 34, 102, 126, 134

The longer-term worldwide drop in grain production per person has been concentrated in Africa, Eastern Europe, and the former Soviet Union.[5] In Africa, soil degradation and aridity have constrained gains in food production. Limited gains or declines in grain output, coupled with the fastest population growth of any continent, have increased hunger and malnutrition.[6] Economic decline in the former Soviet Union and Eastern Europe following economic reforms and the breakup of that large nation a decade ago greatly reduced both grain production and consumption.[7]

China, the world's largest grain producer, is primarily responsible for the decline in grain-harvested area in the last two years that has lowered the world grain harvest so dramatically.[8] While world output was dropping 30 million tons in the last two years, China's grain harvest shrunk by 53 million tons, more than offsetting modest gains elsewhere.[9]

Among the forces shrinking China's grain harvest are severe drought in the north during the last two years, spreading irrigation water shortages as aquifers are depleted and as water is diverted to cities, and a lowering of support prices.[10] In a country dependent on irrigated land for 70 percent or more of its grain, water shortages are fast becoming a security issue.[11]

In 1994, in an ambitious and initially successful effort to be self-sufficient, China raised grain support prices by 40 percent.[12] Unfortunately, the drain on the treasury was too great, so the support prices were lowered in 2000 and 2001, dropping close to world market levels.[13] As grain prices have fallen over the last three years, the area planted to grain has shrunk by 10 percent.[14]

China has absorbed the harvest shortfall by drawing down stocks, but there are signs that supplies are now tightening.[15] If this huge nation, with a population equal to that of India and the United States combined, has another large harvest shortfall, it will likely have to import substantial quantities of grain to maintain food price stability.

Among the three major grains, the harvest of the two food grains—wheat and rice—each dropped in 2001 from the previous year.[16] (See Figure 3). Corn, used mostly as a feed grain for livestock, poultry, and fish, edged out wheat again as the world's leading grain.[17]

Although world grain production was down during the last two years, consumption continued to rise.[18] Grain use exceeded production by 35 million tons in 2000 and by 51 million tons in 2001.[19] The excess of production over consumption dropped grain stocks as a share of consumption to 23 percent—one of the lowest levels in two decades.[20]

If world grain demand continues to grow during 2002 at the same pace as the last decade—16 million tons a year—then this year's harvest will have to jump by 70 million tons to avoid a further drawdown in stocks.[21]

With grain stocks at such a low level, grain market analysts will be watching the 2002 harvest closely. If it falls well short of consumption, grain prices will likely climb. Spreading shortages of irrigation water as aquifers are depleted and as water is diverted to cities are making it much harder for the world's farmers to keep up with the growth in demand.

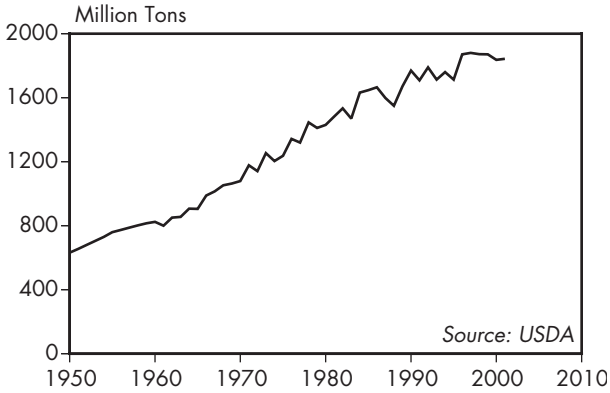

Figure 1: World Grain Production, 1950–2001

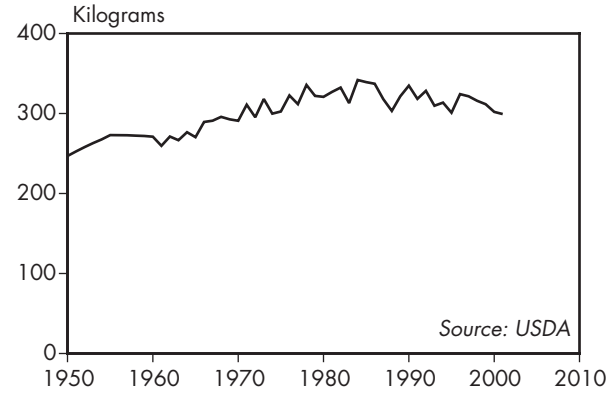

Figure 2: World Grain Production Per Person, 1950–2001

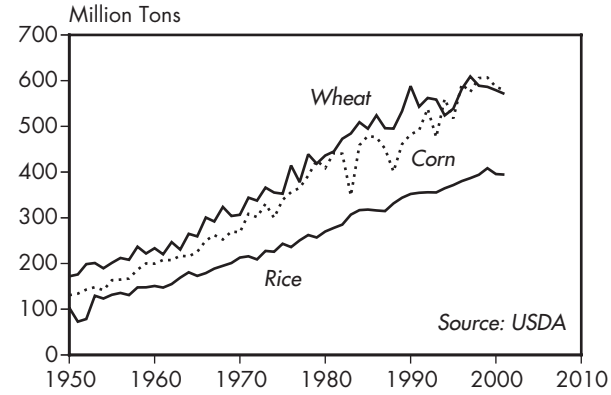

Figure 3: Wheat, Corn, and Rice Production, 1950–2001

World Grain Production, 1950–2001

Year	Total (mill. tons)	Per Person (kilograms)
1950	631	247
1955	759	273
1960	824	271
1965	905	270
1970	1,079	291
1971	1,177	311
1972	1,141	295
1973	1,253	318
1974	1,204	300
1975	1,237	303
1976	1,342	323
1977	1,319	312
1978	1,445	336
1979	1,411	322
1980	1,430	321
1981	1,482	327
1982	1,533	332
1983	1,469	313
1984	1,632	342
1985	1,647	339
1986	1,665	337
1987	1,598	318
1988	1,549	303
1989	1,671	322
1990	1,769	335
1991	1,708	318
1992	1,790	328
1993	1,713	310
1994	1,760	314
1995	1,713	301
1996	1,871	324
1997	1,880	322
1998	1,872	316
1999	1,871	312
2000	1,836	302
2001 (prel)	1,843	299

Source: USDA, *Production, Supply, and Distribution*, electronic database, December 2001.

Meat Production Hits Another High

Lester R. Brown

World meat production climbed to a new high in 2001, marking the forty-first consecutive annual gain.[1] (See Figure 1.) At 237 million tons, this is up more than 2 percent over the 232 million tons of 2000.[2]

Meat production has increased more than fivefold since 1950.[3] Over this half-century, consumption per person has more than doubled, climbing from 17 kilograms to 39 kilograms.[4] (See Figure 2.)

Beef, pork, and poultry account for over 90 percent of world meat production.[5] (See Figure 3.) Most of the growth in meat output in 2001 was in pork and poultry; beef production rose less than 1 percent.[6] In fact, beef production per person has fallen by 17 percent since the historical peak in 1976.[7]

Links: pp. 26, 138

The key beef-consuming countries are the United States (12 million tons), Brazil (just over 6 million tons), and China (just under 6 million tons).[8] These three account for half of world beef consumption.[9] The European Union (EU) also weighs in with just over 6 million tons.[10]

World pork production, which overtook beef production in 1979, continued to widen the lead in 2001 as production climbed to 93 million tons, a gain of more than 3 percent.[11] Pork consumption is totally dominated by China, at 42 million tons, compared with 8 million tons in the United States, the second-ranking consumer.[12] No country dominates the consumption of a meat the way China does pork, accounting for half of world consumption.[13] The EU countries collectively eat 16 million tons of pork a year.[14]

World poultry production climbed from 67 million tons to almost 69 million tons, also gaining nearly 3 percent.[15] The steadily growing world production of poultry eclipsed that of beef in 1995, moving it into second place behind pork.[16] As of 2001, poultry consumption worldwide reached 10 kilograms per person.[17]

The United States still leads in consumption of poultry, with nearly 14 million tons, but China is closing fast at just under 13 million tons and could eclipse the United States within a few years.[18] Brazil, at just over 5 million tons of poultry, is in third place.[19] Poultry consumption in the EU is nearly 8 million tons.[20]

Despite the uninterrupted growth in world meat consumption for more than half a century, there have been some local disruptions in recent years. For example, meat consumption in Russia declined precipitously over the last decade following economic reforms, but is now beginning to recover.[21] Meat production in the EU was disrupted a few years ago with evidence of mad cow disease and more recently by an outbreak of foot-and-mouth disease.[22] Europe is also now showing signs of recovery.[23] The identification of two cows with mad cow disease in Japan in the fall of 2001 has lowered beef consumption there.[24]

The share of world meat output that is being traded is rising, totaling nearly 16 million tons in 2001.[25] Growth in international meat trade reflects both the rising appetite for meat in middle-income countries and advances in storage and transport. Although meat is much more difficult to ship internationally than grain, the share of world meat consumption that is traded is now 8 percent, compared with 12 percent for grain.[26]

Although meat consumption is at the near-saturation point in most industrial countries, it is still growing rapidly in low- and middle-income countries, where most of the world lives. The growth in consumption in middle-income countries is evident in the most recent data. China, for example, has now emerged as the world's leading meat producer and consumer, eating some 61 million tons of meat in 2001.[27] The United States is second, at 34 million tons, and Brazil is third, at 13 million tons.[28]

While future growth in meat consumption in both the United States and Europe is expected to be limited, there is a broad potential for greater consumption not only in China and Brazil, but in other developing countries as well, such as Mexico, Thailand, and Indonesia.[29] Barring a depression in the global economy or a major disruption from livestock disease, world meat consumption is likely to continue its uninterrupted growth for the foreseeable future.

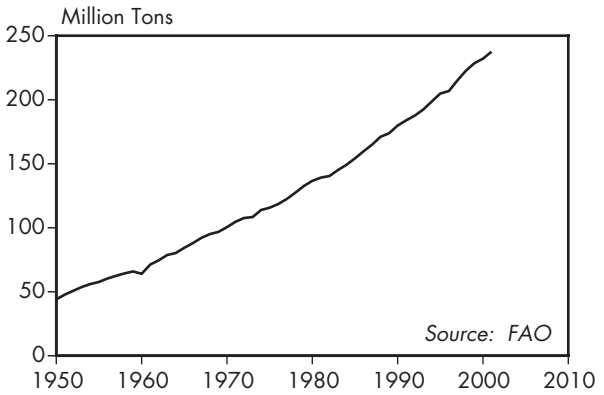

Figure 1: World Meat Production, 1950–2001

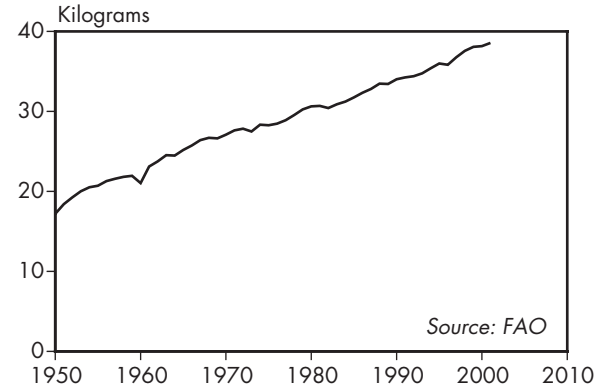

Figure 2: World Meat Production Per Person, 1950–2001

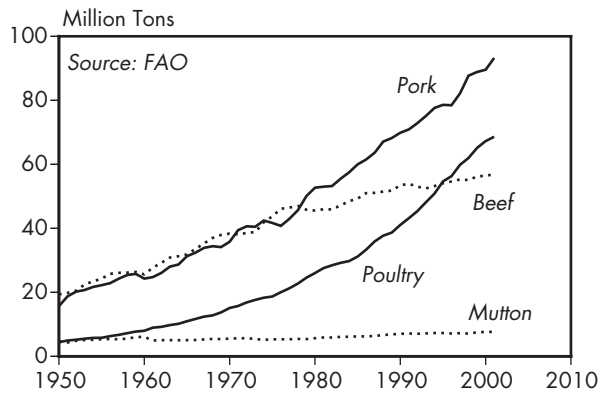

Figure 3: World Meat Production by Source, 1950–2001

World Meat Production, 1950–2001

Year	Total (mill. tons)	Per Person (kilograms)
1950	44	17.2
1955	58	20.7
1960	64	21.0
1965	84	25.2
1970	100	27.1
1971	105	27.6
1972	108	27.8
1973	108	27.5
1974	114	28.3
1975	116	28.3
1976	118	28.5
1977	122	28.9
1978	127	29.6
1979	133	30.2
1980	137	30.6
1981	139	30.7
1982	140	30.4
1983	145	30.9
1984	149	31.2
1985	154	31.8
1986	160	32.3
1987	165	32.8
1988	171	33.5
1989	174	33.4
1990	180	34.0
1991	184	34.3
1992	187	34.4
1993	192	34.8
1994	199	35.4
1995	205	36.0
1996	207	35.8
1997	215	36.8
1998	223	37.6
1999	229	38.1
2000	232	38.2
2001 (prel)	237	38.6

Source: FAO, *FAOSTAT Statistics Database*, at <apps.fao.org>, updated 7 November 2001.

Cocoa Production Jumps

Kathleen Huvane

Global cocoa production in 2000 exceeded 3.2 million tons, a 10.5-percent increase from 1999 levels.[1] (See Figure 1.) Production expanded nearly threefold between 1961 and 2000.[2] And over the past century, as chocolate has become a staple rather than a luxury item in wealthy countries, production increased 24-fold.[3]

Although more than 50 nations grow cocoa, the top five producers account for over 70 percent of the total crop.[4] (See Figure 2.) Land area under cocoa cultivation increased 67 percent between 1961 and 2000, but major producing nations have scarce land resources left.[5] The economies of many producing countries hinge upon the cocoa trade. Côte d'Ivoire and Ghana, which grow three fifths of the world's cocoa, each rely on the crop for more than 20 percent of their export revenues.[6]

Falling prices in the 1990s caused Malaysian farmers to shift from cocoa to other crops like palm oil.[7] And Nigeria's cocoa industry is still rebounding from the 1970s petroleum boom that reduced the relative profitability of this crop.[8] Cocoa prices in 2000 reached record lows: three times lower than in 1960, and four times below the price in 1980.[9]

Development of the organic chocolate industry, which represents 1 percent of the chocolate market, provides an alternative for farmers seeking a greater share of the profits. Though the organic market is small, it has grown by 400 percent since 1998, and is expected to expand another 60 percent by 2002.[10]

Cacao trees grow best in humid tropical forests situated within 10 degrees of the equator.[11] As the trees age, productivity decreases, while vulnerability to pests and disease increases. Cocoa cultivated under full sun, as is two thirds of Côte d'Ivoire's crop, yields bumper crops initially, but returns diminish as soil moisture and fertility decline.[12]

Seeds of the cacao tree are ground into cocoa liquor, and separated into cocoa butter and powder. Three varieties dominate production: Criollo, Forastero, and Trinitario, a natural genetic cross.[13] The latter two account for 90 percent of production. With 40 percent fewer seeds per pod, Criollo plants have lower yields, but their superior quality fetches the highest market price.[14] Composed of 40 percent fat, 40 percent carbohydrates, and 20 percent protein, cocoa has more caffeine per liquid ounce than Pepsi-Cola.[15]

Three fourths of the 1998–99 crop was imported by Europe and the United States.[16] Most cocoa is exported whole, but producer countries are expanding their grinding operations, which accounted for 32 percent of global grindings in 2000–01.[17] Between 1996 and 1998, Côte d'Ivoire doubled its grinding capacity, capturing more profits but at the same time wedding its economy to continued cocoa production.[18]

Since chocolate may contain sugar, milk, oil, and other ingredients, chocolate consumption is not a direct measure of cocoa consumption. The average northern European eats 8.5 kilograms of chocolate annually, more than the average African eats in a lifetime.[19] Because markets in Europe and the United States are relatively saturated, producers are beginning to focus on markets in Africa, Asia, and Latin America, where four fifths of the world's population consume just one fifth of the world's cocoa.[20] (See Figure 3.)

Small landholders, who produce 90 percent of the world's cocoa, have a comparative advantage in lower labor and input costs. The estimated 15,000 children who provide forced labor to cocoa, coffee, and cotton farms in northern Côte d'Ivoire reveal the brutal tactics used by some producers to ensure profitability.[21] In December 2001, chocolate manufacturers, consumer groups, and labor advocates signed an accord addressing these labor abuses.[22]

Production of cocoa and other economically valuable non-timber forest products in the shade of the rainforest can boost local incentives for forest conservation and reduce encroachment in protected areas. Diversification leaves farmers less vulnerable to market fluctuations, diseases, and pests; reduces chemical input requirements; and provides secondary habitat and corridors for native forest species and seasonal migrants.[23]

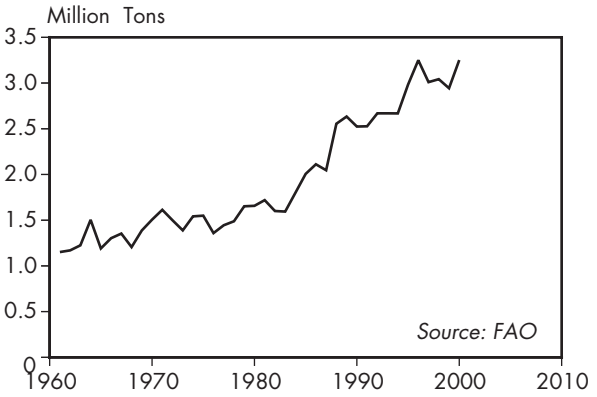

Figure 1: World Cocoa Production 1961–2000

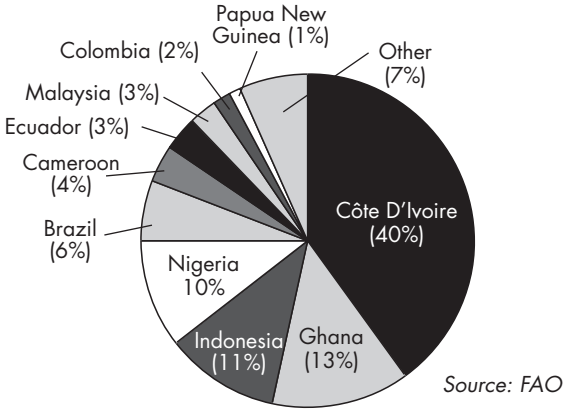

Figure 2: World Cocoa Production by Country, 2000

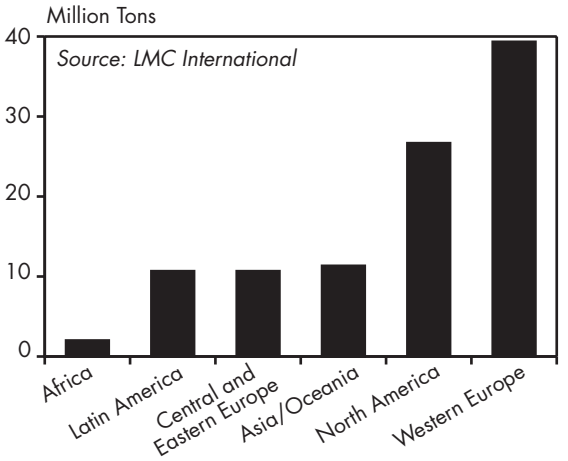

Figure 3: Cocoa Consumption by Region, 1997–98

World Cocoa Production, 1961–2000

Year	Production (million tons)
1961	1.2
1965	1.2
1970	1.5
1971	1.6
1972	1.5
1973	1.4
1974	1.5
1975	1.5
1976	1.4
1977	1.4
1978	1.5
1979	1.6
1980	1.7
1981	1.7
1982	1.6
1983	1.6
1984	1.8
1985	2.0
1986	2.1
1987	2.0
1988	2.6
1989	2.6
1990	2.5
1991	2.5
1992	2.7
1993	2.7
1994	2.7
1995	3.0
1996	3.2
1997	3.0
1998	3.0
1999	3.0
2000	3.2

Sources: FAO, *FAOSTAT Statistics Database,* at <apps.fao.org>, updated 7 November 2001.

Sugar and Sweetener Use Grows

Erik Assadourian

The consumption of sugar and other sweeteners, which are added to foods to enhance flavor, reached an estimated 157 million tons in 2001, more than 2.5 times the figure in 1961.[1] (See Figure 1.) Global per capita consumption rose from 194 calories per day in 1961 to 245 calories in 2001.[2] (See Figure 2.)

The overwhelming majority of sweetener is sugar (sucrose), derived from sugarcane and sugar beets, which contributes almost 90 percent of the sweetener supply.[3] India and Brazil, the two largest global sugar producers, produced more than a quarter of the world's sugar supply (36 million tons) in 2001.[4]

At 11.7 million tons, the next largest source of sweetener is high-fructose syrups (HFS), which are primarily produced from corn and used mostly to sweeten soft drinks.[5] HFS accounts for 7 percent of the global sweetener supply, about three quarters of which is consumed in the United States.[6] Other sweeteners include honey, maple syrup, sugar alcohols, and fruit-derived sugars, as well as high-intensity (artificial) sweeteners like saccharin and aspartame.

Link: p. 140

Worldwide, consumption of sugar increased at a modest 1 percent in 2001. Some of the fastest growth occurred in China, where it grew by 4 percent.[7] Globally, consumption of high-fructose syrup grew more rapidly, increasing 2.9 percent in 2001.[8] Over the last 10 years, HFS consumption has increased 50 percent while sugar consumption grew by 22 percent.[9]

Even faster growth has been seen in the high-intensity sweetener category. In 1999, consumption of these totaled 59,100 tons, more than a 10-fold increase since 1966.[10] As high-intensity sweeteners are anywhere from 30 to 600 times sweeter than sucrose, consumption at this level was the equivalent of using an additional 10.8 million tons of sugar.[11]

High-intensity sweeteners are essentially non-caloric, making them popular in diet beverages and foods.[12] Unlike all other sweeteners, most of these are produced not from plants but from petrochemicals. The debate continues about whether these products are harmful. The United States retracted its carcinogen warning for saccharin in 2000, while Canada has banned saccharin usage in food products since 1978.[13]

The largest consumers of sugar and sweeteners are India and the United States, having used 30 percent of the total—46 million tons—in 1999. China also used a significant amount, at 9 million tons. Considering consumption per capita, however, the United States is by far the leader—using almost three times as many sweeteners as India and 10 times as many as China.[14] (See Figure 3.) Americans on average consumed 686 calories of sweeteners a day in 1999—more than a quarter of the recommended 2,250-calorie diet.[15]

Because sweeteners are just empty calories, containing no vitamins or minerals, the World Health Organization considers them an unnecessary part of the diet.[16] Yet sweetener consumption is growing, especially in the developing world, where it has jumped 61 percent since 1961.[17] In China, per capita consumption during this period has more than tripled.[18] This growth is being pushed along by the falling costs of processed foods, growing income, heavy marketing of high-sugar foods, and urbanization, all of which are associated with eating more sweets.

Diets high in added sugars can contribute to high rates of tooth decay, especially in the absence of preventative dental care.[19] Further, as refined foods are introduced into new areas of the world, the cavity-causing effects of sugars are exacerbated by the reduction in consumption of more fibrous foods that help to inhibit decay.[20]

Sugar and sweeteners often squeeze more nutritious foods out of the diet. While Americans on average eat almost three times as much sweeteners as the recommended maximum, they eat only a third to two thirds as much fruit as they should.[21] Yet when other foods are not displaced, increased sweetener consumption can contribute to increases in obesity, which has been linked to diabetes, certain cancers, and heart disease.[22]

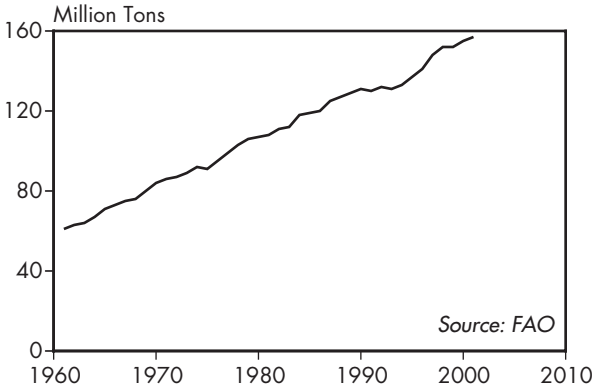

Figure 1: World Sugar and Sweetener Consumption, 1961–2001

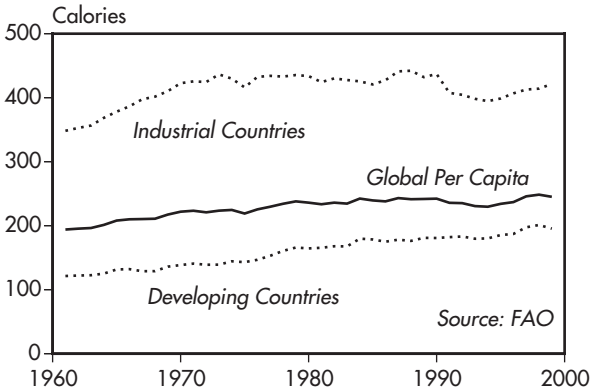

Figure 2: World Sugar and Sweetener Consumption Per Person, 1961–2000

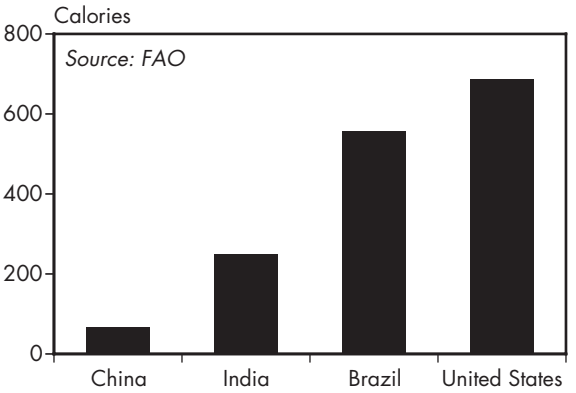

Figure 3: Daily Consumption of Sweeteners Per Person, Selected Countries, 1999

World Sugar and Sweetener Consumption, 1961–2001

Year	Consumption (million tons)
1961	61
1965	71
1970	84
1971	86
1972	87
1973	89
1974	92
1975	91
1976	95
1977	99
1978	103
1979	106
1980	107
1981	108
1982	111
1983	112
1984	118
1985	119
1986	120
1987	125
1988	127
1989	129
1990	131
1991	130
1992	132
1993	131
1994	133
1995	137
1996	141
1997	148
1998	152
1999	152
2000 (prel)	155
2001 (prel)	157

Sources: FAO, *FAOSTAT Statistics Database*, at <apps.fao.org>, updated 7 November 2001; USDA, *Production Supply, and Distribution*, electronic database, December 2001.

Irrigated Area Rises

Janet Larsen

In 1999, the latest year for which global figures are available, world irrigated area rose by 3 million hectares to 274 million hectares—a gain of 1.1 percent.[1] (See Figure 1.) Since peaking in 1978, irrigated land per person has declined to around 0.046 hectares.[2] (See Figure 2.)

Asia, with an increase of 1.7 percent, is responsible for the worldwide irrigation expansion in 1999.[3] This continent holds 70 percent of total irrigated area.[4] (See Figure 3). China and India claim 54 million and 59 million irrigated hectares respectively—41 percent of the total.[5]

Links: pp. 26, 102, 134

Since 1995, irrigated area in other parts of the world has remained steady, or, as in Europe and Oceania, has declined.[6] Irrigation expansion has largely bypassed Africa: just 6 percent of the continent's farmland is irrigated, up from 5 percent in 1961.[7]

The crop yield on irrigated lands is often twice that of rain-fed lands because individual plants grow better with a controlled water supply and because two or three harvests may be reaped from the same plot each year. The 274 million hectares under irrigation represent only 18 percent of farmland worldwide, but they produce some 40 percent of global agricultural goods and 60 percent of world grain supply.[8]

Some 2,500 cubic kilometers of water were applied to farmland in 1999, approaching 70 percent of all fresh water withdrawn by humans.[9] When water supplies dwindle, however, economics tends to favor industry over agriculture and in many parts of the world, water is diverted away from the field. In the last half-century, agricultural water consumption doubled but industrial consumption jumped sixfold.[10]

China, India, and the United States contain half of the world's irrigated area and produce almost half the grain supply, yet water supplies in each country show signs of depletion.[11] The water table under the North China Plain, which produces 25 percent of China's grain harvest, drops 1.5 meters annually.[12] Beneath the Punjab, India's breadbasket, the water table is falling a half-meter each year.[13] Since 1978, farmers in the southern Great Plains of the United States have cut back over 1 million hectares once watered from the Ogallala aquifer.[14] The country faces further losses if the Ogallala, which supports one fifth of U.S. irrigated land, continues to be depleted at the brisk rate of some 12 billion cubic meters a year.[15]

Worldwide tallies of irrigation area do not necessarily account for the conversion of irrigated land to other uses or the abandonment of land because of water scarcity or environmental damage. Salinization, which occurs when water evaporates from upper soil layers, leaving behind excess salts, inhibits production on one out of every five hectares of irrigated land worldwide, reducing the income of the world's farmers by more than $11 billion.[16]

Global irrigation efficiency, the ratio of water actually used by plants to the amount of water extracted, now averages only 43 percent, largely because 90 percent of the land that is artificially watered is under highly inefficient flood and furrow irrigation.[17] Improved irrigation efficiency can raise both land and water productivity.

Low-pressure and low-energy precision application sprinkler systems in the U.S. Texas High Plains, for example, at efficiencies of 80–95 percent, have produced water savings of 25–37 percent over conventional furrow systems.[18] Drip irrigation, used on an estimated 2.8 million hectares worldwide, could more than halve water use while raising yields anywhere from 20 to 90 percent.[19] Because they deliver water directly to plant roots, drip irrigation systems can have application efficiencies as high as 95 percent.[20]

Though traditionally viewed as costly and suitable only for large commercial farms, new affordable small-scale drip irrigation schemes have the potential to boost annual income for the world's rural poor by some $3 billion annually while improving food production and reducing hunger in drought-prone areas.[21] In both India and China, drip irrigation could be expanded over some 10 million hectares.[22] With water for irrigation expected to be increasingly scarce in the future, the importance of water-efficient technologies and farming practices will grow.

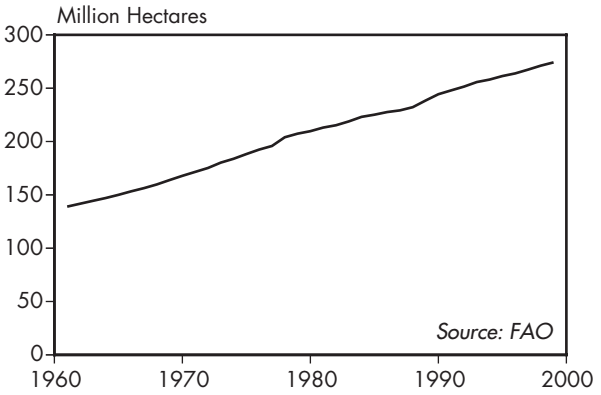

Figure 1: World Irrigated Area, 1961–99

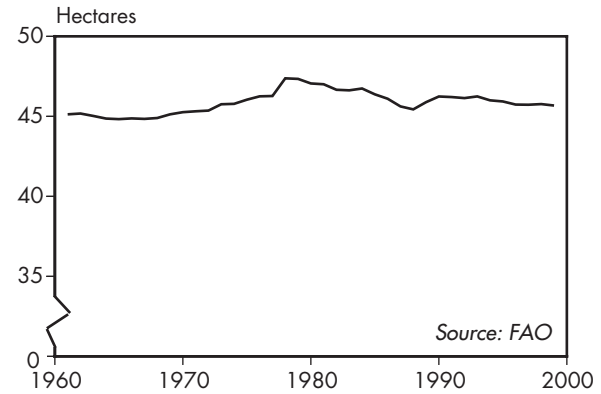

Figure 2: World Irrigated Area, Per Thousand People, 1961–99

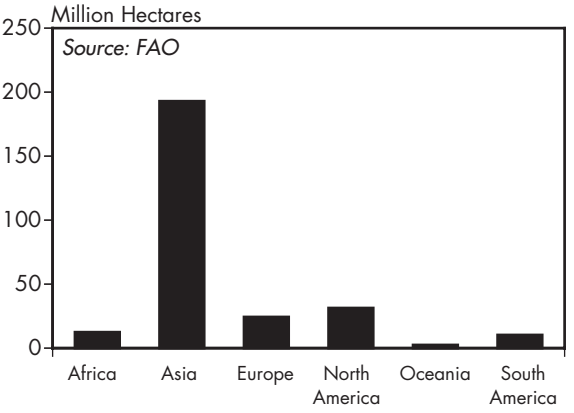

Figure 3: Irrigated Area by Continent, 1999

World Irrigated Area and Irrigated Area Per Thousand People, 1961–99

Year	Total (mill. hectares)	Area Per Thousand People (hectares)
1961	139	45.1
1965	150	44.8
1970	168	45.3
1971	172	45.3
1972	175	45.4
1973	180	45.8
1974	184	45.8
1975	188	46.0
1976	192	46.3
1977	196	46.3
1978	204	47.4
1979	207	47.3
1980	210	47.1
1981	213	47.0
1982	215	46.7
1983	219	46.6
1984	223	46.7
1985	225	46.4
1986	228	46.1
1987	229	45.6
1988	232	45.4
1989	238	45.9
1990	244	46.2
1991	248	46.2
1992	251	46.1
1993	256	46.2
1994	258	46.0
1995	261	45.9
1996	264	45.7
1997	267	45.7
1998	271	45.8
1999	274	45.7

Source: FAO, "Irrigation" and "Land Use," *FAOSTAT Statistics Database*, at <apps.fao.org>, updated 10 July 2001.

Energy Trends

ELIZABETH CECELSKI, ENERGIA, M/MC PHOTOSHARE, WWW.JHUCCP.ORG/MMC

Fossil Fuel Use Inches Up

Nuclear Power Up Slightly

Wind Energy Surges

Solar Cell Use Rises Quickly

Compact Fluorescents Set Record

Fossil Fuel Use Inches Up

Seth Dunn

World consumption of coal, oil, and natural gas rose by 1.3 percent in 2001, to 7,956 million tons of oil equivalent, according to a preliminary estimate based on industry and government sources.[1] (See Figure 1.) Since 1950, fossil fuel use has increased by more than fourfold.[2]

Global oil consumption grew by 0.2 percent, to 3,511 million tons of oil equivalent, based on preliminary statistics from the International Energy Agency (IEA).[3] (See Figure 2.) In the United States, which accounts for 26 percent of world oil use, consumption stayed level.[4] It fell by 0.2 percent in Europe, but rose by 1.9 percent in China and declined by 0.2 percent in Asia as a whole.[5] Oil use rose the most in the former Soviet bloc and the Middle East, by 2.1 and 3.4 percent, respectively.[6] Africa registered a 1.3-percent increase in oil consumption, while Latin America logged a 1.2-percent decline.[7]

Links: pp. 52, 68, 132

Natural gas consumption rose by 3.2 percent to 2,233 million tons of oil equivalent.[8] The United States, with 27 percent of global natural gas use, saw a 1.9-percent drop.[9] Among industrial nations as a whole, however, gas consumption dipped by just 0.2 percent.[10]

Global coal use rose by 1.2 percent, to 2,212 million tons of oil equivalent.[11] In the United States, which uses 26 percent of world coal, consumption increased by 0.7 percent.[12] China, with a 22-percent share of coal use, saw a 1.1-percent rise, according to preliminary estimates.[13] This departure from several years of reported declines in Chinese coal use may, however, reflect a correction of official statistics that had understated consumption by excluding illegal coal mines from calculations.[14]

A major uncertainty in assessing future fossil fuel use trends is cost.[15] While improvements in technology and productivity are bringing down production and transportation costs, the cheapest reserves are being depleted, and new supplies must be brought over increasingly long distances—driving energy costs upward. As natural gas reserves near the market are depleted, for example, costs rise as supplies must be shipped from further afield. At the same time, renewable energy resources, which can be harnessed at a local or regional level, are in general becoming less costly to produce—and more competitive with fossil sources.

Another uncertainty in projecting fossil fuel trajectories is price. In particular, oil prices are highly uncertain because they depend on the policies of major oil-producing countries. In late December 2001, ministers from the Organization of Petroleum-Exporting Countries (OPEC) committed to cutting crude oil supply during the first six months of 2002, shortly after five non-OPEC producers agreed to reduce their production or exports.[16]

As the IEA's *World Energy Outlook 2001* report points out, there are more than enough reserves of oil, gas, and coal to meet projected growth in energy demand through 2020.[17] But exploiting these reserves will require massive investments in energy production and transportation infrastructure, which in turn will have to be measured against the policy objectives of energy security and environmental protection. It is unclear, for example, how willing Middle East oil producers will be to exploit their low-cost reserves. Use of natural gas will depend, meanwhile, on the further development of technology and future prices.[18]

Renewable energy also poses a long-term threat to fossil fuels and has received added attention in the wake of the events of September 2001 and growing concern over climate change and energy security. If strong government backing achieves further reductions in the cost of renewables, the IEA study notes, there is "a huge potential for expanding the supply," which would over time cut significantly into coal use for power generation.[19] Beyond 2020, the IEA concludes, new technologies such as hydrogen-based fuel cells "hold out the prospect of abundant and clean energy supplies in a world largely free of climate-destabilising carbon emissions."[20]

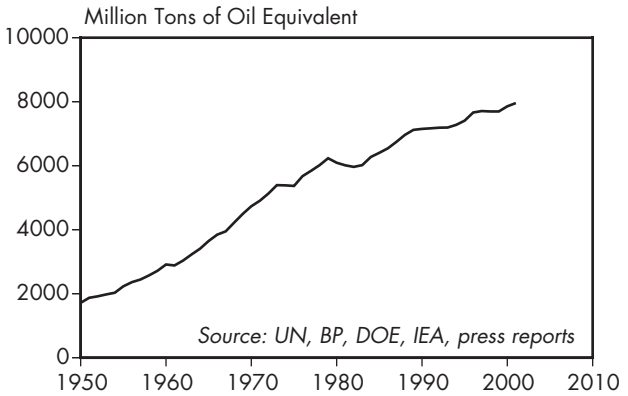

Figure 1: World Fossil Fuel Consumption, 1950–2001

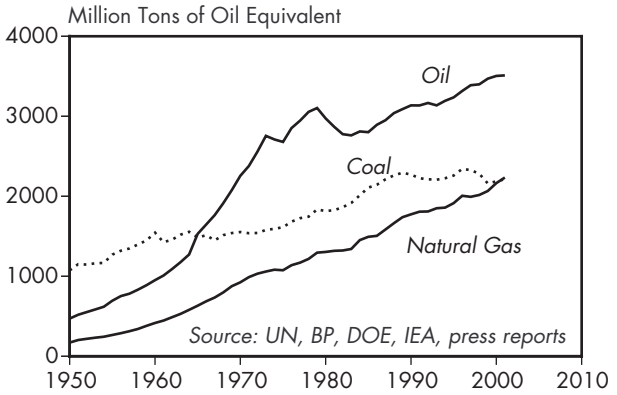

Figure 2: World Fossil Fuel Consumption, by Source, 1950–2001

World Fossil Fuel Consumption, 1950–2001

Year	Coal	Oil	Natural Gas
	(mill. tons of oil equivalent)		
1950	1,074	470	171
1955	1,270	694	266
1960	1,544	951	416
1965	1,486	1,530	632
1970	1,553	2,254	924
1971	1,538	2,377	988
1972	1,540	2,556	1,032
1973	1,579	2,754	1,059
1974	1,592	2,710	1,082
1975	1,613	2,678	1,075
1976	1,681	2,852	1,138
1977	1,726	2,944	1,169
1978	1,744	3,055	1,216
1979	1,834	3,103	1,295
1980	1,814	2,972	1,304
1981	1,826	2,868	1,318
1982	1,863	2,776	1,322
1983	1,914	2,761	1,340
1984	2,011	2,809	1,451
1985	2,107	2,801	1,493
1986	2,143	2,893	1,504
1987	2,211	2,949	1,583
1988	2,261	3,039	1,663
1989	2,293	3,088	1,738
1990	2,270	3,136	1,774
1991	2,225	3,134	1,806
1992	2,211	3,165	1,810
1993	2,206	3,135	1,849
1994	2,224	3,192	1,858
1995	2,258	3,235	1,913
1996	2,342	3,316	2,005
1997	2,327	3,388	1,993
1998	2,281	3,398	2,016
1999	2,160	3,469	2,065
2000	2,186	3,504	2,164
2001 (prel)	2,212	3,511	2,233

Source: Worldwatch estimates based on UN, BP, DOE, IEA, and press reports.

Nuclear Power Up Slightly

Nicholas Lenssen

Between 2000 and 2001, total installed nuclear power generating capacity increased by 1,505 megawatts (0.4 percent), passing 350,000 megawatts for the first time.[1] (See Figure 1.) But since 1990, global nuclear capacity has risen just 7 percent—compared with 240-percent growth in the 1980s—an indication of nuclear power's stagnation in the past decade.[2]

Only one new reactor was grid-connected in 2001, in Russia, bringing the world's total to 436.[3] The remaining capacity increase in 2001 is due to upgrades at existing reactors, where more power was squeezed from operating units. Last year, for the first time ever, there was neither new construction started on a reactor (see Figure 2) nor any operating reactors permanently shut down.[4]

Some 26 reactors remain under active construction (with a combined capacity of 23,537 megawatts), with as many as eight of these due for completion in 2002.[5] And a total of 99 reactors (representing more than 30,000 megawatts) have been retired after an average service life of less than 18 years.[6] (See Figure 3.)

In the United States, 2001 started with industry and government talking about a "nuclear renaissance." The new administration touted nuclear power in its energy plan, and power shortages in California encouraged promoters in believing that the country would seriously consider initiating a new nuclear project for the first time since the early 1970s.[7]

The terrorist attacks of September 11th, however, quickly put a damper on these aspirations: armed troops were deployed around existing reactors, and even the International Atomic Energy Agency confessed that little could be done to protect nuclear power plants from such airborne attacks.[8]

Official or de facto moratoria remain on new nuclear power in most of Western Europe. Belgium reiterated its plan to shut down existing plants before they are 40 years old, and the German government and industry formalized an agreement to phase out existing reactors.[9]

The United Kingdom considered an energy policy that would include building new reactors, but instead chose to rely on renewable energy sources such as wind.[10] In Sweden, the coalition government moved to postpone the planned closure of a unit until 2003 due to the concern that replacement power would not yet be available.[11]

A breath of life returned to Russia's nuclear program in 2001, as economic recovery resulted in more funding. In addition to the one reactor completed in 2001, work restarted on two others, with plans calling for as many as 10 new reactors in the next decade.[12] Russia may also help Ukraine complete two reactors stalled since the 1986 Chernobyl meltdown.[13]

Japan's nuclear program continues to face local opposition as public referenda in Kariwa Village and Miyama resulted in votes against nuclear projects.[14] Another planned plant was "temporarily suspended" due to local opposition in Amori Prefecture.[15] Only four units were under construction in Japan, with two more units in pre-construction safety review.

China has the world's largest nuclear expansion effort, with 10 reactors being built to go along with its three operating units.[16] Four of the new units are likely to be grid-connected in 2002, and the country initiated work on a site for as many as four more new ones.[17] South Korea has four reactors under construction.[18] And Taiwan restarted building two units in 2001 after the government's move to scrap the plant in 2000 was declared unconstitutional.[19] But the election victory by the Progress Democrat Party in late 2001 is likely to halt the project once again.[20]

Numerous other countries—including Argentina, Brazil, India, and Romania—continue to discuss restarting stalled projects or ordering new units, but none of these discussions have yet turned into secure financing, much less cement being poured.

Indeed, in a post–September 11th world, many countries and policymakers have reason to reevaluate nuclear energy. The threat extends beyond the simple disruption of nuclear power plant operation to the trafficking of nuclear materials. On two occasions in late 2001, for example, police arrested black marketers attempting to sell weapons-grade enriched uranium in Russia and Turkey.[21]

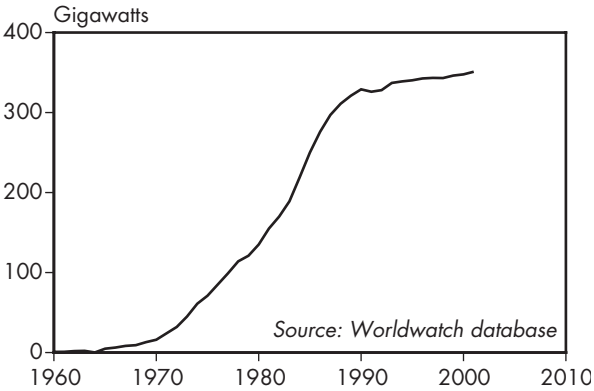

Figure 1: World Electrical Generating Capacity of Nuclear Power Plants, 1960–2001

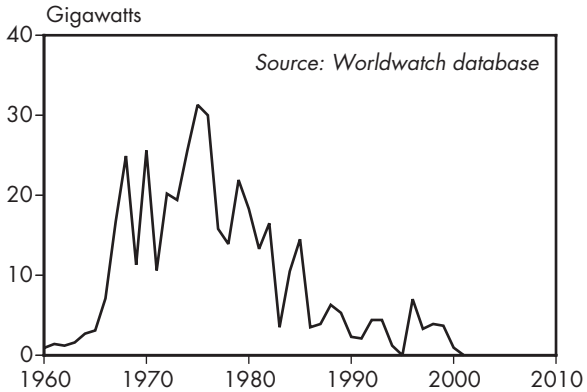

Figure 2: World Nuclear Reactor Construction Starts, 1960–2001

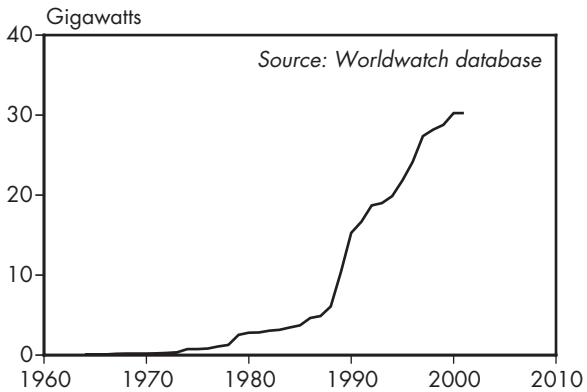

Figure 3: Nuclear Capacity of Decommissioned Plants, 1964–2001

World Net Installed Electrical Generating Capacity of Nuclear Power Plants, 1960–2001

Year	Capacity (gigawatts)
1960	1
1965	5
1970	16
1971	24
1972	32
1973	45
1974	61
1975	71
1976	85
1977	99
1978	114
1979	121
1980	135
1981	155
1982	170
1983	189
1984	219
1985	250
1986	276
1987	297
1988	310
1989	320
1990	328
1991	325
1992	327
1993	336
1994	338
1995	340
1996	343
1997	343
1998	343
1999	346
2000	348
2001 (prel)	351

Source: Worldwatch Institute database, compiled from the IAEA and press reports.

Wind Energy Surges

Christopher Flavin

Wind energy generating capacity jumped 37 percent, to approximately 24,800 megawatts at the end of 2001.[1] (See Figure 1.) The capacity addition of roughly 6,700 megawatts during the year was up sharply from the year before—and reinforces wind's position as the world's fastest growing energy source.[2] (See Figure 2.) Annual wind capacity additions are now approaching annual additions to global hydropower capacity, and are more than four times the nuclear capacity added in 2001.[3]

Europe now has over 70 percent of the world's wind capacity, thanks mainly to the strong laws encouraging its growth in Germany, Spain, and Denmark.[4] Germany strengthened its role as the world leader in 2001, with 2,600 megawatts added, taking its capacity to over 8,700 megawatts—more than one third of the world total.[5] Wind power now provides 3.5 percent of Germany's electricity, and the government has announced plans to raise that figure to at least 25 percent by 2025, while phasing out the nuclear industry, which now provides 30 percent of the country's power.[6]

Spain established a clear position as Europe's second leading wind generator in 2002, with an additional 1,100 megawatts—taking its total to 3,340 megawatts and providing an estimated 3 percent of the country's electricity.[7] Spain's wind industry is becoming an increasingly important international player, with ventures now under way in other parts of Europe, Latin America, and China. The country's leading wind company, Gamesa Eolica, linked to one of the country's leading aeronautical and industrial enterprises, was 40-percent owned by Denmark's Vestas until the end of 2001, when the Gamesa Group acquired those shares in order to be able to compete with Vestas in markets around the world.[8]

Denmark, which gets a world-leading 18 percent of its electricity from the wind, saw a sharp slowdown in its pace of growth in 2001, with just over 100 megawatts added, taking its total to 2,400 megawatts.[9] The slowdown stems from a government decision in 2000 to end the minimum purchase price requirement and introduce a new system of renewable certificate trading that has not been successfully implemented so far.[10] The situation turned even bleaker in early 2002, when a new right-wing government announced plans to dismantle the country's remaining support for wind energy.[11]

Countering the negative trend in Denmark was Italy's addition of 270 megawatts, moving it into the fourth position in Europe, with nearly 700 megawatts installed.[12] And outside Europe, India reinvigorated its wind power industry in 2001, with an added 300 megawatts, taking the national total to 1,500 megawatts installed.

The United States rejoined the wind energy big leagues in 2001, with nearly 1,700 megawatts added, a rush spurred by a federal tax credit that expired at the end of the year.[13] The country's total installed capacity remains second to Germany's, as it has since the late-1990s. The record-breaking U.S. installations were spread broadly across the country's western plains and mountains, with major projects in Texas, Kansas, and Oregon.[14] Even larger projects are planned, following congressional reinstatement of the federal wind energy tax credit in March 2002.[15]

The newest player on the wind energy scene is Brazil, which was hit hard by drought-induced power shortages in 2001, and is now turning to wind as a quick and affordable way of boosting its generating capacity. Some 4,000 megawatts of wind power projects were authorized by Brazil's federal electricity regulator, Aneel, in late 2001 and early 2002—which could make Brazil the world's fourth largest market in the next two years.[16] Much of the development is occurring in the economically deprived but wind-rich northeastern states of Rio Grande do Norte, Ceara, Pernambuco, and Bahia.[17]

The global wind power industry generated an estimated $7 billion in business in 2001, and is now attracting the interest of the world's largest energy companies, ranging from ABB to Royal Dutch Shell.[18] Another major player joined the scene in early 2002 when General Electric reached agreement with the bankrupt Enron Corp to purchase the company's wind energy business, which is the largest in North America.[19]

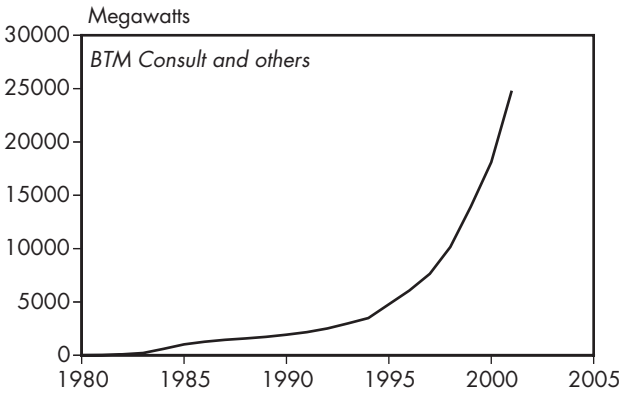

Figure 1: World Wind Energy Generating Capacity, 1980–2001

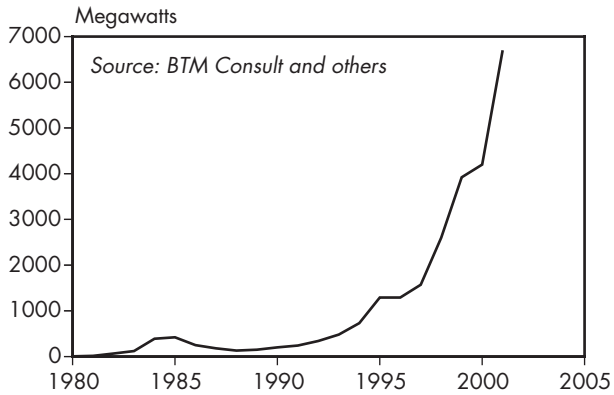

Figure 2: Annual Addition to World Wind Energy Generating Capacity, 1980–2001

World Wind Energy Generating Capacity, Total and Annual Addition, 1980–2001

Year	Total	Annual Addition
	(megawatts)	
1980	10	5
1981	25	15
1982	90	65
1983	210	120
1984	600	390
1985	1,020	420
1986	1,270	250
1987	1,450	180
1988	1,580	130
1989	1,730	150
1990	1,930	200
1991	2,170	240
1992	2,510	340
1993	2,990	480
1994	3,490	730
1995	4,780	1,290
1996	6,070	1,290
1997	7,640	1,570
1998	10,150	2,600
1999	13,930	3,920
2000	18,100	4,200
2001 (prel)	24,800	6,700

Sources: BTM Consult, EWEA, AWEA, *Windpower Monthly*, and *New Energy*.

Solar Cell Use Rises Quickly

Molly O. Sheehan

Production of photovoltaic (PV) cells, which turn sunlight into electricity, exceeded 390 megawatts in 2001, according to a survey of manufacturers.[1] The 36-percent surge made 2001 the fourth straight year of growth at or above 30 percent.[2] (See Figure 1.) The 1,140 megawatts of installed PVs in the world today have just a bit more capacity than the largest coal-fired power plant and account for less than 1 percent of global electricity.[3] But if current growth is sustained, PVs could become a globally significant power source within the next three decades.[4]

Government support in a few industrial nations has powered the PV market recently, prompting a dramatic leap in the share of PVs that supplement existing power grids. Grid-connected PVs accounted for only 14 percent of solar power installed in 1995, but by 2000, they accounted for more than 50 percent, according to a survey by Strategies Unlimited.[5]

Japan has subsidized tens of thousands of PV rooftops since 1996.[6] The government paid for 50 percent of a new solar system when it first launched the program, although by 2001 it had lowered the subsidy to 15 percent.[7] Japanese manufacturers produced just under 44 percent of the global output in 2001, keeping Japan in the lead as the world's largest PV producer.[8] (See Figure 2.) As much as 120 of the 171 megawatts of PV cells produced in Japan in 2001 were used in that country.[9]

Support for PVs is also strong in Europe, where 86.3 megawatts were produced in 2001.[10] Government initiatives helped spur the purchase of some 65 megawatts in Germany alone, and more than 20 megawatts in other European nations.[11]

Although the United States is the second largest producer of solar cells, with an output of 100.3 megawatts in 2001, most of this product is exported.[12] State and city initiatives, led by California, are starting to lower barriers for solar, however, and enlarge the market.[13] In 2000, just 12 megawatts were purchased in the United States, but that grew by 50 percent in 2001, with 10 megawatts sold in California alone.[14]

Over the last two decades, mass production and technological advances have slashed the cost of PVs, but strong demand since the mid-1990s has slowed the decline in prices.[15] Some 90 percent of PVs produced in 2001 were made from crystalline silicon, which is sliced into wafers and encased in glass panels.[16] The remaining 10 percent is cheaper but less efficient "thin-film" silicon, which can be made into flexible sheets and integrated into building materials.[17] Industry analyst Paul Maycock now quotes two factory prices for PVs: $3.50 per watt for the crystalline PVs and $2 for the less efficient thin-film variety.[18]

The solar arrays being installed in industrial nations fill an urban niche, helping cities avoid blackouts during peak air conditioning demand.[19] As PVs can be mounted directly on homes and businesses, power can be used right where it is generated, eliminating transmission losses. Without subsidies, the price of installed solar power can be several times the average retail electricity price, but it can be competitive at times of peak use.[20]

There is even greater need for off-grid PVs in the developing world, where some 1.7 billion people live without access to electricity that can help boost education, health, and income by powering water pumps, refrigeration for vaccines, computers, and communications.[21] Since 1991, up to $520 million in loans have been pledged by the World Bank Group to support this market; so far, such support has resulted in the installation of an estimated 500,000 off-grid, residential solar systems.[22]

The total number of solar systems in the developing world is likely much higher, as nonprofit groups and private entrepreneurs have been helping to devise financing and credit schemes so that businesses and consumers can overcome the high up-front cost of PVs.[23] By offering loans, partnering with local microfinance partners, or selling a "fee-for-service" package, the Solar Electric Light Company has sold more than 16,000 solar home systems in India, Sri Lanka, and Viet Nam since it was launched in 1997.[24]

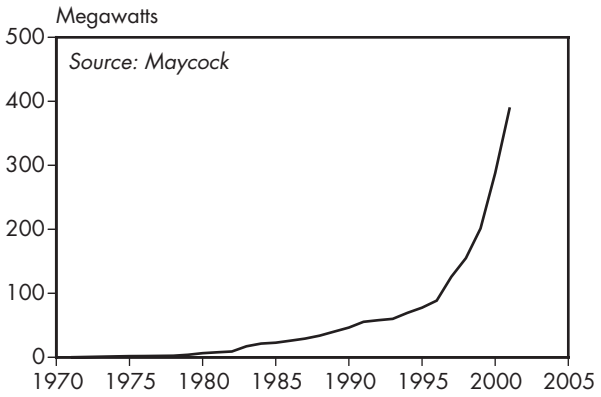

Figure 1: World Photovoltaic Production, 1971–2001

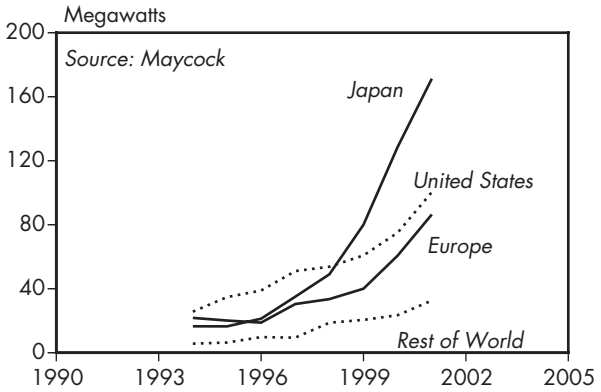

Figure 2: Photovoltaic Production by Country or Region, 1994–2001

World Photovoltaic Production, 1971–2001

Year	Production (megawatts)
1971	0.1
1975	1.8
1976	2.0
1977	2.2
1978	2.5
1979	4
1980	7
1981	8
1982	9
1983	17
1984	22
1985	23
1986	26
1987	29
1988	34
1989	40
1990	46
1991	55
1992	58
1993	60
1994	69
1995	79
1996	89
1997	126
1998	153
1999	201
2000	288
2001 (prel)	391

Source: Paul Maycock, *PV News*, various issues.

Compact Fluorescents Set Record

Michael Scholand

Global sales of energy-efficient compact fluorescent lamps (CFLs) grew by 15 percent in 2001, achieving record levels of over 600 million units.[1] (See Figures 1 and 2.) CFLs, a technology with nearly two decades of commercialization, are a tiny version of the common 4-foot fluorescent tubes. Compared with incandescent light bulbs they are designed to replace, quality CFLs last about 10 times longer and use just one quarter of the electricity while providing the same amount of light.[2]

Between 1988 and 2001, CFL sales increased more than 13-fold.[3] There are an estimated 1.8 billion CFLs in operation today, consuming 27,000 megawatts of electricity—much less than the 109,000 megawatts that would be required to operate the same number of incandescent lamps.[4] The electricity these CFLs are saving is equivalent to that produced by nearly 40 medium-sized coal-fired power plants.[5]

Link: p. 132

Avoided electricity generation translates into pollution reduction. In North America, the 316 million CFLs in use at the start of 2002 will save 4.8 million tons of carbon and 94,000 tons of sulfur dioxide emissions during the year.[6] CFLs also reduce energy bills: in Thailand, consumers pay about 300 baht ($6.70) for a high-quality CFL that, if lit four hours a day, offers a payback on the additional first cost in just 1.5 years.[7] Looking at bulb replacement and electricity savings over the 10,000-hour life of the lamp, a CFL has a net present value of over 1,000 baht—more than three times what it cost.[8]

Recognizing a great opportunity, China launched a three-year Green Lights program in January 1997 to expand their efficient-lighting market and improve production quality.[9] The program covers education, certification, labeling, demonstrations, and technical assistance.[10] China's CFL industry expanded, fueled by this government support and a robust domestic market that grew by over 350 percent in the last six years.[11] Today, China manufactures more than 80 percent of the world's CFL supply.[12] Growing sales volumes stimulated competition and innovation, reducing prices and improving quality—trends that continue today.[13]

Recognizing the economic benefits of CFLs, the International Finance Corporation (IFC) launched the Efficient Lighting Initiative (ELI) in 1999 with support from the Global Environment Facility. Now in its third year, ELI is expanding the market for efficient lighting in seven countries: Argentina, the Czech Republic, Hungary, Latvia, Peru, the Philippines, and South Africa.[14] Russell Sturm, program manager at the IFC, indicates that accelerating market adoption of efficient lighting will not only reduce household expenditures, it will also help countries meet their energy needs more cost-effectively and reduce greenhouse gas emissions for less than $5 per ton.[15]

In South Africa, ELI has succeeded in raising awareness and gaining market acceptance for this previously unknown technology. Barry Bredenkamp of Bonesa, the organization coordinating ELI in South Africa, reported that "after only two years, our program achieved an estimated 59 percent growth in CFL sales in the last year, increasing annual sales to over 4 million lamps. We have targeted customers across income groups, including lower-income households that often install a CFL as their first electric light source."[16]

In Peru, South Africa, Argentina, and the Philippines, which have seen an influx of low-cost, low-quality CFLs, ELI provides a labeling scheme to certify the lamps, protecting consumers against counterfeit or inferior products. This kind of quality assurance is particularly crucial for the first-time buyer, who could reject the technology outright after a negative experience.[17]

While CFL bulbs have many environmental and economic advantages, like all fluorescent lamps they do contain a small amount of mercury. Recently, manufacturers have succeeded in reducing the mercury content to less than 5 milligrams per CFL, or about 1 percent as much as a household thermometer.[18] Moreover, in the United States energy savings from CFLs cut environmental mercury emissions by reducing electricity produced from coal-burning power stations.[19] Consumers can also recycle their CFLs, thereby eliminating any environ-

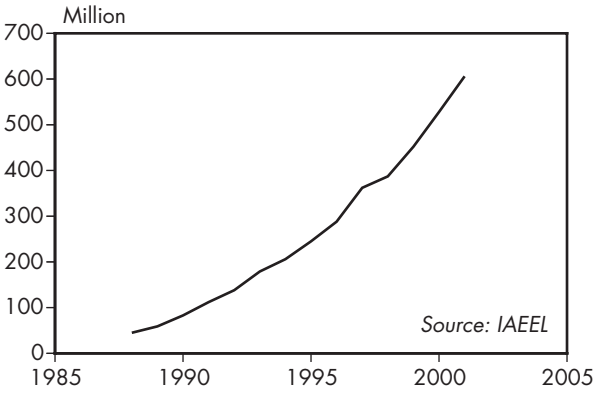

Figure 1: World Sales of Compact Fluorescent Lamps, 1988–2001

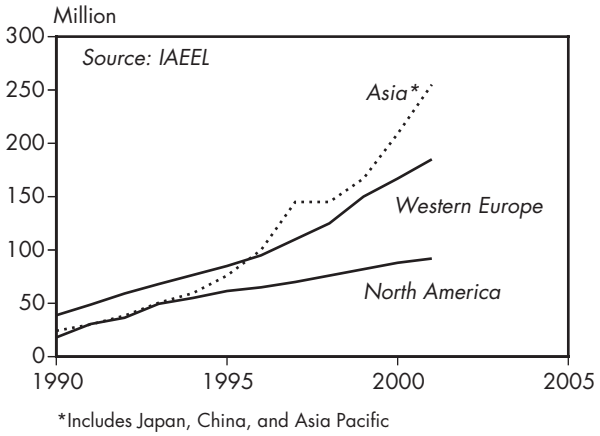

Figure 2: World Sales of Compact Fluorescent Lamps, Selected Regions, 1990–2001

World Sales of Compact Fluorescent Lamps, 1988–2001

Year	Units (million)
1988	45
1989	59
1990	83
1991	112
1992	138
1993	179
1994	206
1995	245
1996	288
1997	362
1998	387
1999	452
2000	528
2001 (prel)	606

Source: Nils Borg, IAEEL, e-mails to Worldwatch; 1988–89 from Evan Mills, Lawrence Berkeley Laboratory.

Atmospheric Trends

Global Temperature Close to a Record

Carbon Emissions Reach New High

CFC Use Declining

Global Temperature Close to a Record

Seth Dunn

Global surface air temperatures rose to 14.43 degrees Celsius in 2001, based on land and ocean measurements dating back to 1880 from NASA's Goddard Institute for Space Studies (GISS). (See Figure 1.)[1] Another GISS dataset, based only on land measurements but extending back to 1867, showed similar results. (See Figure 2.)[2] Both indicate that 2001 was the second warmest year on record—a finding supported by datasets from the U.S. National Oceanic and Atmospheric Administration and the U.K. Hadley Centre for Climate Prediction.[3] The warmest year thus far was 1998.[4]

Regional surface patterns reflected above-average temperature conditions, though large parts of the tropical and north Pacific were cooler than average.[5] Canada has now had 18 straight seasons of above-average temperatures.[6] October 2001 was the warmest October in the 343-year Central England temperature series.[7] Some regions experienced unusually cool weather, however.[8] Russia registered more than 100 deaths from hypothermia from low temperatures during the 2000–01 winter.[9] And northern India saw more than 130 deaths from extreme cold in January 2002.[10]

Link: p. 52

Several areas experienced above- or below-average rainfall.[11] The period from March 1999 to March 2001 was the wettest 24-month period in the 236-year time series for England and Wales.[12] India experienced its second lowest total of winter precipitation in early 2001, and a drier-than-normal summer monsoon season that exacerbated water shortages in some areas.[13] Several countries, such as Australia and Zambia, experienced a mix of both wetter and drier weather in various locations.[14]

The year saw an above-average number of hurricanes and tropical storms in the north Atlantic basin, with 15 named storms—5 more than the long-term average.[15] Tropical Storm Allison caused the most extensive flooding in the United States ever associated with a tropical storm.[16] Hurricane Michelle severely affected the coffee crop in Jamaica and was the strongest hurricane to make landfall in Cuba since 1952.[17] In the western Pacific, Typhoon Chebi reached sustained winds of close to 160 kilometers an hour, killing at least 79 people.[18]

Unusual flood events were reported.[19] Mozambique and Zambia experienced as many as 200 deaths from heavy rainfall that ruined crops and left hundreds homeless.[20] Hungary's rain-swollen Tisza River reached its highest level since 1888.[21] In Siberia, rainfall and accelerated snowmelt caused ice-jammed rivers to overflow, destroying or damaging the homes of more than 300,000 people.[22] Viet Nam's Mekong Delta region saw several hundred deaths from October flooding.[23] Heavy rains in West Africa affected nearly 70,000 people and submerged 17,000 hectares of agricultural land.[24] And hundreds were killed in Algiers from Algeria's worst flooding in almost 40 years.[25]

Drought affected many areas. The region encompassing Iran, Afghanistan, and Pakistan continued to suffer from a devastating drought that began in 1998, with a wet season more than 45 percent below average precipitation.[26] This lack of rainfall has stressed both water supplies and agriculture, directly affecting more than 60 million people.[27] The region was also subject to periods of extreme heat, one of which caused many deaths in Pakistan in early May.[28] Drought persisted in the Greater Horn region of Africa; in Brazil, exacerbating the nation's hydropower supply shortage; and in northern China, the Korean peninsula, and Japan in the first half of 2001.[29] Winter precipitation deficits affected the western United States, and Canada reported drought in many regions from coast to coast.[30]

These climatic phenomena are likely to become more frequent and intense as surface temperatures rise, according to the latest assessment of the Intergovernmental Panel on Climate Change.[31] Concluding that "there is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities," the panel projects that average global surface temperature will increase by 1.4–5.8 degrees Celsius between 1990 and 2100.[32] The actual temperature rise will be largely determined by future trends in greenhouse gas emissions.

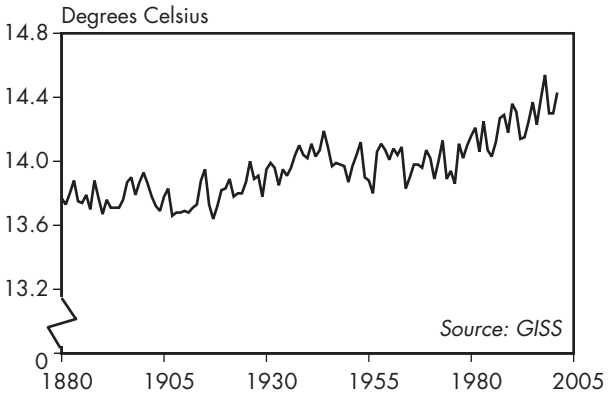

Figure 1: Global Average Temperature at Earth's Surface, 1880–2001

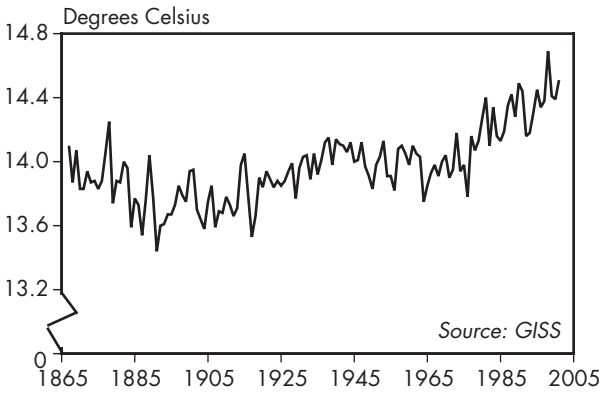

Figure 2: Global Average Temperature at Earth's Surface (Land-Based Series), 1867–2001

Global Average Temperature, 1950–2001

Year	Temperature (degrees Celsius)
1950	13.87
1955	13.88
1960	14.01
1965	13.90
1970	14.02
1971	13.89
1972	14.00
1973	14.13
1974	13.89
1975	13.94
1976	13.86
1977	14.11
1978	14.02
1979	14.10
1980	14.16
1981	14.21
1982	14.06
1983	14.25
1984	14.07
1985	14.03
1986	14.12
1987	14.27
1988	14.29
1989	14.18
1990	14.36
1991	14.31
1992	14.14
1993	14.15
1994	14.25
1995	14.37
1996	14.23
1997	14.39
1998	14.54
1999	14.30
2000	14.30
2001 (prel)	14.43

Source: Surface Air Temperature Analysis, Goddard Institute for Space Studies, 25 January 2002.

Carbon Emissions Reach New High

Seth Dunn

Global emissions of carbon from fossil fuel combustion increased by 1.1 percent in 2001, reaching a new high of 6.55 billion tons.[1] (See Figure 1.) This was the second consecutive record-setting year, and the eighth annual record since 1990. Annual carbon emissions have now more than quadrupled since 1950.[2]

Behind the global trend, national and regional emissions patterns vary widely. (National data are available only through 2000.) The United States, which accounts for 24 percent of the global total, registered an 18.1-percent increase between 1990 and 2000.[3] In contrast, emissions in the European Union (EU) over this period fell by 1.8 percent, owing mainly to declines in Germany and the United Kingdom of 19 and 5 percent, respectively.[4] The steepest drops in carbon emissions occurred in former Eastern bloc nations. Russia, for example, had a 30.7-percent decline.[5]

Links: pp. 38, 50, 114

Collectively, industrial and former Eastern bloc nations saw a 1.7-percent drop in carbon emissions between 1990 and 2000.[6] This compares with the commitment of these nations, under the 1997 Kyoto Protocol, to reduce emissions of carbon dioxide and other greenhouse gases by 5.2 percent between 1990 and 2010.[7]

Carbon emissions trends among the larger developing nations were generally upward, although starting from a smaller base. China's carbon emissions grew by 7.7 percent over the decade, while those of India increased 67 percent.[8] However, per capita emissions in China and India—at 0.68 and 0.3 tons—are well below the global average of 1.1 tons, and roughly one seventh and one fourteenth that of the U.S. average.[9]

The carbon intensity of the world economy continued its gradual decline, falling to 150 tons per million dollars of economic output.[10] (See Figure 2.) This represents a 40-percent decline in carbon intensity since 1950, with half of the decline occurring since 1982.[11] This "decarbonization" trend needs to be accelerated, however, to achieve a 60–80 percent reduction in carbon emissions during this century—which is what scientists believe is necessary to stabilize atmospheric concentrations of carbon dioxide (CO_2) below a doubling of pre-industrial levels.[12]

Atmospheric CO_2 levels rose to 370.9 parts per million volume (ppmv) in 2001, according to measurements from the Mauna Loa Observatory in Hawaii, part of a record dating back to 1957.[13] (See Figure 3.) The annual increase of 1.49 ppmv, up from 1.11 ppmv the previous year, suggests the possible onset of another El Niño—a climatic phenomenon related to surface warming of the Pacific Ocean.[14] The previous El Niño, in 1997–99, saw annual rises in CO_2 levels of 2.87 and 1.66 ppmv.[15]

Prospects for reducing carbon emissions improved in late 2001 when more than 170 nations finalized the rules for the Kyoto Protocol at talks in Marrakesh, Morocco.[16] For the protocol to enter into force, it must be ratified by 55 countries representing 55 percent of the 1990 emissions of industrial and former Eastern bloc nations—called Annex I nations under the original Framework Convention on Climate Change.[17] As of March 2002, 49 parties had ratified or acceded to the protocol, but they represented only 2.4 percent of Annex I emissions—as the Czech Republic and Romania are the only Annex I ratifiers thus far.[18]

The United States, with 36 percent of the Annex I share, withdrew from the Kyoto negotiations in 2001, and in March 2002 announced a set of voluntary measures and incentives for energy efficiency and renewable energy.[19] These steps represent more a continuation of previous policy than a new initiative, however, and are unlikely to restrain U.S. emissions growth.

The U.S. absence implies that, for the Kyoto Protocol to become law, the EU, Russia, Japan, Australia, and Canada must all ratify the pact.[20] In March 2002, EU environment ministers agreed to ratify the protocol by June and directed member state parliaments to ratify the treaty under national law; they also called on Japan and Russia to follow their lead.[21] The governments of Denmark, France, Luxembourg, and

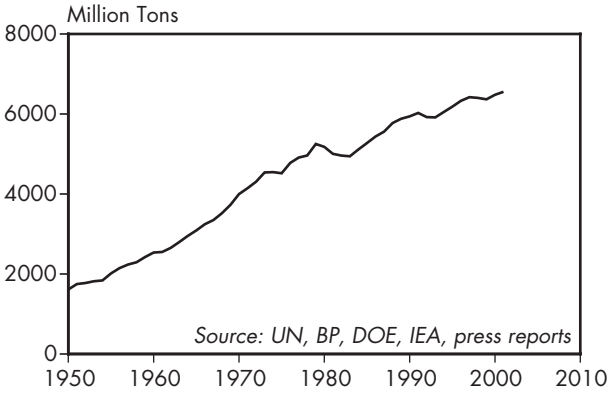

Figure 1: World Carbon Emissions from Fossil Fuel Burning, 1950–2001

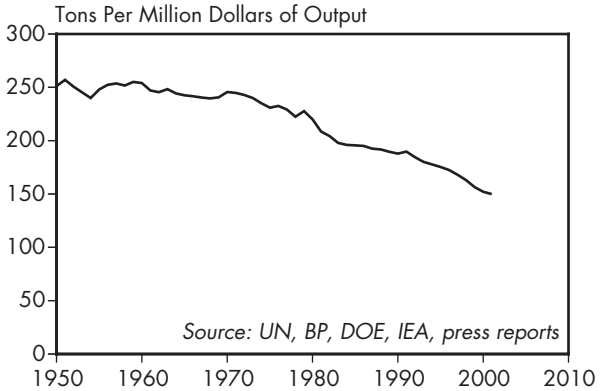

Figure 2: Carbon Intensity of the World Economy, 1950–2001

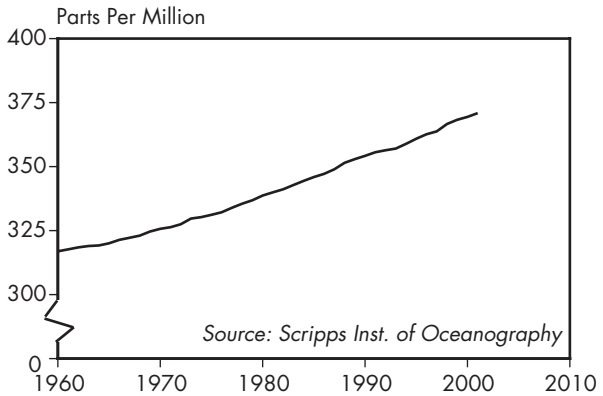

Figure 3: Atmospheric Concentrations of Carbon Dioxide, 1960–2001

World Carbon Emissions from Fossil Fuel Burning, 1950–2001, and Atmospheric Concentrations of Carbon Dioxide, 1960–2001

Year	Emissions (mill. tons of carbon)	Carbon Dioxide (parts per mill.)
1950	1,612	n.a.
1955	2,013	n.a.
1960	2,535	316.7
1965	3,087	319.9
1970	3,997	325.5
1971	4,143	326.2
1972	4,305	327.3
1973	4,538	329.5
1974	4,545	330.1
1975	4,518	331.0
1976	4,776	332.0
1977	4,910	333.7
1978	4,962	335.3
1979	5,249	336.7
1980	5,177	338.5
1981	5,004	339.8
1982	4,959	341.0
1983	4,942	342.6
1984	5,113	344.2
1985	5,274	345.7
1986	5,436	347.0
1987	5,558	348.7
1988	5,774	351.3
1989	5,879	352.7
1990	5,939	354.0
1991	6,025	355.5
1992	5,922	356.4
1993	5,914	357.0
1994	6,050	358.9
1995	6,182	360.9
1996	6,327	362.6
1997	6,419	363.8
1998	6,401	366.6
1999	6,366	368.3
2000	6,480	369.4
2001 (prel)	6,553	370.9

Source: Worldwatch estimates based on UN, BP, DOE, IEA, and press reports.

CFC Use Declining

Molly O. Sheehan

Global production of chlorofluorocarbons (CFCs), which harm Earth's protective ozone layer, fell by less than 1 percent between 1998 and 1999, the most recent year for which relatively complete data are available.[1] (See Figure 1.) CFCs were once widely used as coolants, aerosol propellants, and industrial solvents, and in foam insulation. A 1987 treaty to protect the ozone layer initiated dramatic declines in CFC output, which is now many times below peak production years, the late 1980s.[2]

China, India, and Russia produced the most CFCs in 1999.[3] (See Figure 2.) Developing nations are the largest producers because the 1987 Montreal Protocol and its amendments banned CFC production in industrial nations as of 1996, except for a small volume for export to developing countries or for essential uses, such as asthma inhalers.[4] One of the largest manufacturing plants in the industrial world, in the Netherlands, will close at the end of 2005.[5] All CFC production ceased in Russia in December 2000.[6] The Montreal Protocol requires developing countries to phase CFCs out by 2010. Many nations, including China and India, are receiving assistance from the treaty's Multilateral Fund to make this transition.[7]

Link: p. 114

Many CFCs were initially replaced by hydrochlorofluorocarbons (HCFCs), which are now being supplanted by hydrofluorocarbons because HCFCs harm the ozone layer too, albeit to a lesser extent.[8] All fluorocarbons, however, are potent greenhouse gases, so some CFC alternatives bypass this family of chemicals altogether. "Greenfreeze" refrigerators, for example, use hydrocarbons instead of fluorocarbons for coolant and insulating foam. Some 55 million Greenfreeze refrigerators dominate markets in Western Europe.[9] Prodded by Greenpeace, three major Japanese companies announced in late 2001 they would produce this type of refrigerator too.[10]

The government of Canada estimates that only 5 percent of vehicle air conditioners there still used CFCs as of mid-2001.[11] In contrast, a U.S. survey in 2001 found that building owners were only nearing the halfway point in replacing chillers that use CFCs—and that it would take at least until 2010 to complete the conversion, much longer than expected.[12] (The CFCs still used in this equipment are either recycled or obtained illegally.)

Indeed, fed by production in developing countries, a black market is thriving in industrial nations where CFC-using appliances are still in use.[13] Illegal exports from India and China have been growing.[14] Since 1995, when the United States launched a national enforcement initiative, more than 100 people have been convicted of smuggling CFCs into the country.[15]

Another threat to the ozone layer is that some chemicals originally touted as replacements to CFCs are not as benign as scientists hoped. A scientific panel advised the treaty secretariat in October 2001 to ban n-propyl bromide, hexachlorobutadiene, Halon-1202, and 6-bromo-2-methoxy-napthalene.[16] "We cannot be complacent. If enough of these new chemicals are manufactured, we will delay the recovery of the ozone layer quite significantly," warned Mario Molina, who shared the 1995 chemistry Nobel Prize for his work on ozone loss.[17]

Although CFC production has declined steeply, the ozone layer has yet to recover, as these compounds take years to reach the upper atmosphere and last for decades or centuries once there. In October 2001, researchers at the U.S. National Oceanic and Atmospheric Administration said the seasonal "hole" in the ozone layer above Antarctica appeared to have stabilized for the previous three years.[18] In September 2001, satellite data showed that the geographic area covered by the ozone hole area was about the same as the year before.[19]

Scientists in late 2000 predicted that the hole in the ozone layer should begin to close within a decade, healing completely by 2050.[20] Unfortunately, some damage has already been done: skin cancer reportedly rose 66 percent between 1994 and 2001 in Punta Arena, Chile, the world's southernmost city.[21]

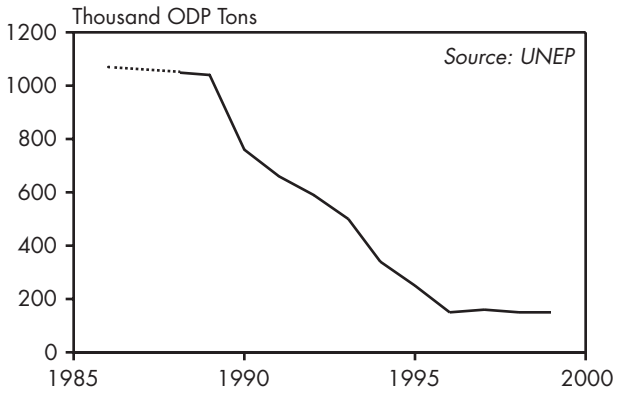

Figure 1: World CFC Production, 1986–99

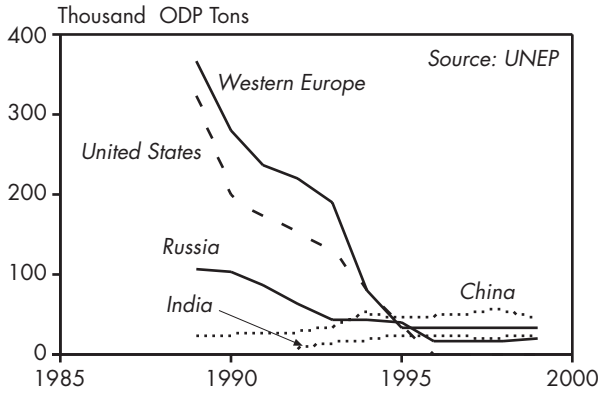

Figure 2: CFC Production by Country or Region, 1989–99

World CFC Production, 1986–99

Year	Production (thousand ODP tons)*
1986	1072.3
1989	1046.0
1990	764.3
1991	664.3
1992	590.8
1993	506.0
1994	338.5
1995	253.8
1996	151.6
1997	158.8
1998	146.9
1999	146.8

*These numbers reflect the volume of the major CFCs (CFC-11, CFC-12, CFC-113, CFC-114, and CFC-115) multiplied by their respective ozone-depleting potentials (ODPs). The ODP value is the ratio of a given compound's ability to deplete ozone compared with the ability of a similar amount of CFC-11.

Source: Gerald Mutisya, UNEP Ozone Secretariat.

Economic Trends

Economic Growth Falters

David Malin Roodman

As it has every year for half a century, gross world product (GWP)—the tally of government estimates of the output of goods and services in nations around the world—reached a new high in 2001, at $45.9 trillion (in 2000 dollars).[1] (See Figure 1.) But the rate of growth, 2.1 percent, was among the lowest since 1950.[2] (See Figure 2.)

The current growth slowdown is the most widespread since the early 1980s, according to the International Monetary Fund.[3] It was most marked in the Americas, with growth dropping from 4.1 percent in 2000 to 1.0 percent in 2001 in the United States and nearly the same in Latin America.[4] For Western Europe, growth fell from 3.4 percent to 1.7 percent.[5] For Asia (excluding republics of the former Soviet Union), the rate fell from 5.3 percent to 2.8 percent, as a true recession—"growth" of –0.4 percent—occurred in Japan.[6]

Growth generally slowed less in poorer countries. In China, the second-largest economy, it slipped from 6.1 percent to 5.6 percent.[7] In India, the fourth-largest, it went from 6.0 percent to 4.4 percent.[8] The deceleration was also less pronounced in Eastern Europe, where the rate declined from 3.9 percent to 2.7 percent, and in the former Soviet Union, where it went from 7.5 percent (the highest rate since 1973) to 6.0 percent.[9] Growth accelerated slightly in Africa, from 3.2 percent to 3.6 percent.[10]

Overall, though, the simultaneity of the slowdown illustrates the interconnectedness of the global economy. One cause of the slowdown appears to be the rally in the world's oil markets during 2000, which sent crude prices above $30 per barrel late that year.[11]

Another is the bursting of the great technology stock bubble.[12] In the United States, the stock market peaked in total value on March 24, 2000, at about $14.5 trillion, but then lost nearly 30 percent in 12 months.[13] This, too, was part of a global phenomenon: London's FTSE 100 index fell 20 percent and Tokyo's Nikkei 225 plunged 34 percent.[14] In retrospect, perhaps trillions of dollars invested in high-technology equipment and companies went to waste. Had it been invested differently, the global economy might have grown faster in 2001.

A final common cause is the terrorist attacks of September 11, 2001, and the war in Afghanistan—but preliminary analysis suggests that these effects were and will remain relatively minor at the global level.[15] The U.S. economy had already slipped into recession six months before the attacks.[16] The 1995 earthquake in Kobe, Japan, killed more people than the 2001 terrorist attacks and did more property damage, but it had little long-term economic impact on Japan, let alone the world.[17] The attacks could deal a lasting blow to global airline and hotel industries, however, and permanently raise the cost of international commerce.

The growth rate of 2.1 percent seen in 2001 is rapid enough to double economic output every 30 years. Yet many economists consider the world economy to be in recession when it grows less than 2.5 percent a year.[18]

The global recession is bad news if it significantly slows economic development in poor countries. While income per person has climbed steadily in the industrial west since World War II, reaching an average $29,000 in 2001, it has stayed far lower in many other countries.[19] (See Figure 3.) Yet cash income is one important source of economic well-being. In poor countries, economic growth that is steady and shared by the broad mass of people is essential to development. In Africa, average gross domestic product (GDP) per person has fluctuated around $1,700 since 1973 (in 2000 dollars).[20] A demonstration of the link between GDP and poverty came in 1998, when Indonesia's economy shrank 13.7 percent and its poverty rate reportedly climbed from 11 to 18 percent.[21]

In rich countries, too, because of the way their economies work, the burden of recessions can fall on a small minority of people, often those least able to absorb the shock. Companies are much more likely to cut costs by laying off, say, 5 percent of their workers than by cutting everyone's salary 5 percent. In the United States, 1.8 million jobs disappeared in 2001 even while those looking for work expanded by 800,000—adding 2.6 million people to the ranks of the unemployed.[22]

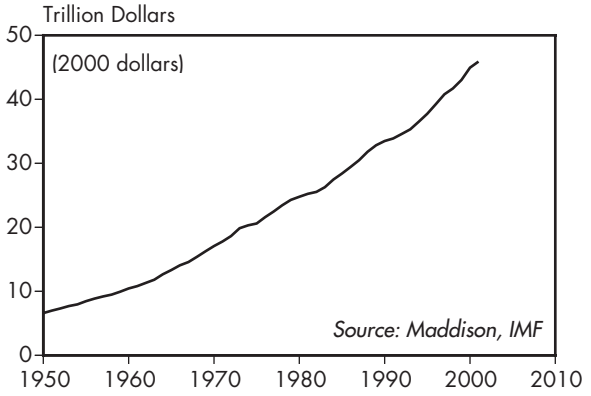

Figure 1: Gross World Product, 1950–2001

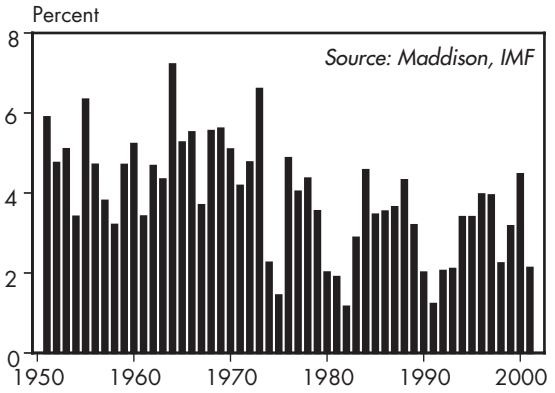

Figure 2: Growth of Gross World Product, 1951–2001

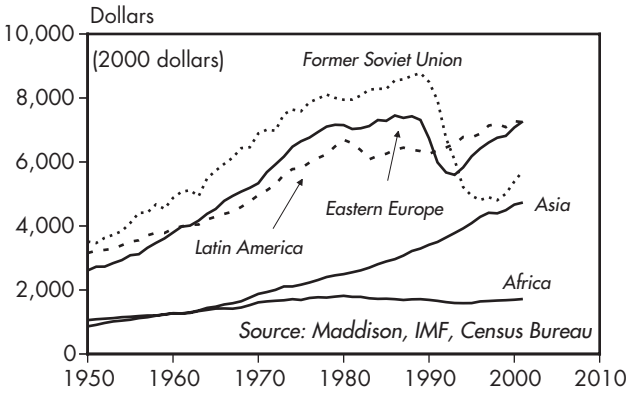

Figure 3: Gross Regional Product Per Capita, Selected Regions, 1950–2001

Gross World Product, 1950–2001

Year	Total (trill. 2000 dollars)	Per Person (2000 dollars)
1950	6.6	2,582
1955	8.5	3,042
1960	10.4	3,438
1965	13.3	3,980
1970	17.1	4,603
1971	17.8	4,697
1972	18.6	4,823
1973	19.9	5,041
1974	20.3	5,058
1975	20.6	5,038
1976	21.6	5,191
1977	22.5	5,308
1978	23.4	5,446
1979	24.3	5,542
1980	24.8	5,557
1981	25.2	5,567
1982	25.5	5,534
1983	26.3	5,595
1984	27.5	5,753
1985	28.4	5,853
1986	29.4	5,958
1987	30.5	6,069
1988	31.8	6,224
1989	32.8	6,316
1990	33.5	6,336
1991	33.9	6,314
1992	34.6	6,346
1993	35.3	6,384
1994	36.5	6,506
1995	37.7	6,633
1996	39.2	6,803
1997	40.8	6,976
1998	41.7	7,038
1999	43.0	7,167
2000	44.9	7,392
2001 (prel)	45.9	7,454

Sources: Worldwatch update of Angus Maddison, *The World Economy: A Millennial Perspective* (Paris: OECD, 2001); updates from IMF, *World Economic Outlook*

Trade Slows

David Malin Roodman

According to a preliminary estimate, the total value of world exports declined 4.1 percent in 2001—from $7.75 trillion the year before to $7.43 trillion (in 2000 dollars).[1] (See Figure 1.) This percentage drop is the largest since 1983.[2]

This drop in fact may be an underestimate, because it is based on incomplete data for late 2001, when ripple effects from the global economic slowdown and terrorist attacks began to spread. The fall in demand for jet fuel late in the year, for example, pushed down both the volume of oil exports, measured in barrels, and the price paid for each barrel, which doubly depressed the total value of oil exports.[3]

From an economic point of view, international trade occurs whenever a resident of one country sells something to a resident of another. The "something" can be a tangible good such as a barrel of oil or a car. It can also be an intangible service. When a Japanese hotel sells the use of a room for a night to a German tourist, that service counts as an export from Japan to Germany (even though the tourist traveled from Germany to Japan).

Links: pp. 30, 58, 126

International trade in goods has accelerated radically since 1950. Goods exported in 1950 were worth $380 billion (in 2000 dollars).[4] Fifty-one years later, that figure was reached every three weeks, and it totaled some $5.96 trillion for 2001 as a whole.[5]

Since 1970, exports growth for services has paralleled that for goods. From $310 billion in 1970, service exports climbed to $1.47 trillion in 2001 (in 2000 dollars).[6] Major categories of exported services in 1999 included freight (earning $134 billion), passenger transport ($83 billion), and other travel-related services ($437 billion).[7]

The ratio between the value of world trade and the value of total economic production (gross world product, or GWP) is one indicator of "globalization." Since World War II, this ratio has climbed overall. But since 1995 it actually has fallen, from a peak of 18.4 percent to 15.9 percent.[8] (See Figure 2.) Between 1996 and 1998, prices for traded goods fell 12 percent on average—rather than rising with general inflation in the U.S. dollar—mainly because of the currency crises in East Asia.[9] Prices then recovered, but the global economic slowdown took hold and reduced the physical volume of goods exports.[10]

In November 2001, diplomats met in Doha, Qatar, to launch a new round of negotiations to reduce restrictions on world trade. The previous round had lasted six years and concluded in 1994 with the creation of the World Trade Organization (WTO). If the new round indeed gets off the ground, it will be the ninth since World War II, and the most controversial yet.[11]

Especially in rich countries, many people are concerned about the way the WTO system tends to put the cause of trade liberalization ahead of important concerns such as ecological stability, protection of workplace safety standards, and human rights. In 1991, for example, the WTO ruled against a U.S. import ban on tuna caught with dolphin-ensnaring nets.[12] The law may have been good for the environment, but it was deemed harmful to trade.

At least as potent at Doha was skepticism from developing countries.[13] Historically, the United States, Western Europe, and Japan have muscled through rules that benefit their own companies more than those of poorer countries.[14] Notably, at Doha, developing countries united more than they had before, enough to extract major rhetorical concessions from richer countries.

Industrial countries promised to phase out their subsidies for agricultural exports, which glut global food markets, lower prices, and harm farmers in poor countries.[15] Delegates also endorsed a declaration stating that public health emergencies can take precedence over protecting the intellectual property of pharmaceutical companies.[16] That may make it easier for developing-country governments to break drug patents in order to obtain cheaper, copycat drugs to fight malaria, tuberculosis, and AIDS. But it will be years before negotiators hammer out what all these concessions mean in practice.

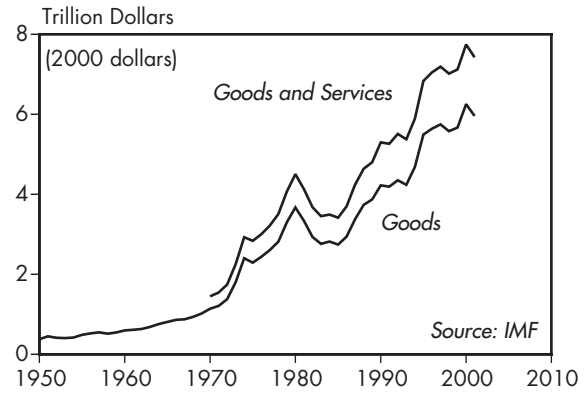

Figure 1: World Exports of Goods 1950–2001, and Goods and Services, 1970–2001

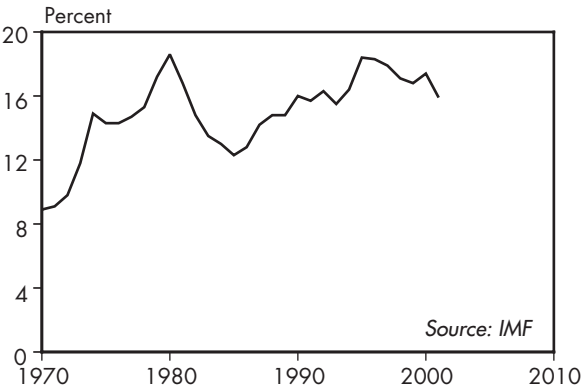

Figure 2: World Exports of Goods and Services as a Share of Gross World Product, 1970–2001

World Exports of Goods, 1950–2001, and Goods and Services, 1970–2001

Year	Goods	Goods and Services
	(trill. 2000 dollars)	
1950	0.38	
1955	0.49	
1960	0.60	
1965	0.81	
1970	1.14	1.45
1971	1.21	1.54
1972	1.38	1.74
1973	1.81	2.26
1974	2.40	2.93
1975	2.29	2.84
1976	2.44	3.00
1977	2.61	3.22
1978	2.82	3.51
1979	3.30	4.07
1980	3.67	4.50
1981	3.34	4.13
1982	2.93	3.68
1983	2.76	3.45
1984	2.82	3.49
1985	2.74	3.42
1986	2.94	3.70
1987	3.38	4.25
1988	3.74	4.64
1989	3.87	4.80
1990	4.22	5.23
1991	4.19	5.26
1992	4.35	5.51
1993	4.24	5.38
1994	4.69	5.90
1995	5.49	6.83
1996	5.64	7.05
1997	5.75	7.13
1998	5.58	7.02
1999	5.67	7.12
2000	6.25	7.75
2001 (prel)	5.96	7.43

Source: IMF, *International Financial Statistics*, electronic database, November 2001; IMF, *World Economic Outlook Database*, December 2001.

Foreign Debt Falls in Dollar Terms

David Malin Roodman

In 2000, the cumulative foreign debt of developing and former Eastern bloc nations posted its largest one-year drop in dollar terms since detailed recordkeeping began in 1970.[1] The fall from $2.62 trillion to $2.53 trillion (in 2000 dollars) followed a smaller decline in 1999.[2] (See Figure 1.)

The drops over these two years may be statistical aberrations, however. At least 36 percent of the debt is owed in currencies other than dollars.[3] As many of those currencies fell against the dollar in 1999 and 2000, loans denominated in them shrank in the dollar-based statistics.[4] As a result, even as total debt fell in dollar terms, it rose when expressed in euros, the second-most-used currency for loans to these countries—from 2.27 trillion to 2.69 trillion (in 2000 euros).[5] Overall, the debt total is best seen not as having fallen, but as having reached a standstill after a long climb.

Link: p.118

Since loans are investments, whether high debt is good or bad for a country hinges on how well the money is used. Ideally, it supports projects—from public railroad construction to education—that ultimately boost economic output, and exports earn enough to repay the loans. In South Korea, for example, foreign lending has helped finance rapid economic development and poverty reduction.[6]

Worldwide, however, foreign funds have often been used poorly—supporting arms purchases, corruption, capital flight, and prestige projects (such as unneeded airports), in addition to more well-intended but poorly implemented projects.[7] This is one reason that countries have frequently fallen into debt trouble in recent decades, becoming unable to meet their repayment obligations. Herd mentality of investors is another.

Developing and former Eastern bloc countries divide roughly into two groups, based on the kind of debt trouble they are prone to. Middle-income countries are industrialized enough to attract serious interest from commercial creditors—bond investors and banks—and consequently borrow most heavily from them.[8] These countries accounted for 78 percent of the outstanding debt of developing and former Eastern bloc nations at the end of 1999.[9]

Middle-income countries have been struck by major debt crises at remarkably regular intervals of about 50 years since the 1820s.[10] (See Figure 2.) The most recent one hit in 1982, and sent many nations, including most of South America, into recession for nearly a decade. In Mexico, wages fell by half between 1982 and 1988.[11] In the Philippines, a million or more desperate peasants moved into the hills, where they cleared erodible slopes of protective trees and started farming to survive.[12] The last decade has seen crises in Argentina, Brazil, Ecuador, East Asia, Mexico, and Turkey.

The other debtor group consists of low-income countries such as Nicaragua and Tanzania. Generally shunned by commercial lenders, they borrow mainly from rich-world governments and other official institutions such as the World Bank and the International Monetary Fund.[13] Official creditors barely existed before World War II. Much more than commercial lenders, they are generally willing to keep lending to countries in debt trouble even if most new loans just go toward repaying old ones. Partly as a result, a historically novel form of debt trouble began to afflict many low-income countries by the 1980s—not so much crises as chronic syndromes in which new loans went largely to repaying old.[14]

Rich-world governments have enacted a series of programs since the late 1980s to reduce the debt burden on low-income countries, but the inadequacy of each has been implicitly acknowledged by the launch of the next.[15] At the end of 1999, 47 countries—37 in Africa—met the World Bank's statistical criteria for being low in income and high in debt.[16] Of these, 42 are eligible for the latest program, the Heavily Indebted Poor Countries (HIPC) initiative, which offers by far the most debt relief to date—as much as 55 percent on average for eligible countries.[17]

But even after the current HIPC program, many poor countries will probably owe more than they can pay.[18] Thus creditors are likely to bring forth yet another program to address the

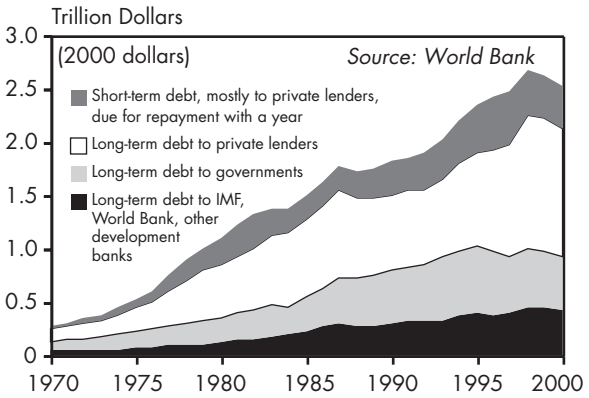

Figure 1: Foreign Debt of Developing and Former Eastern Bloc Nations, 1970–2000

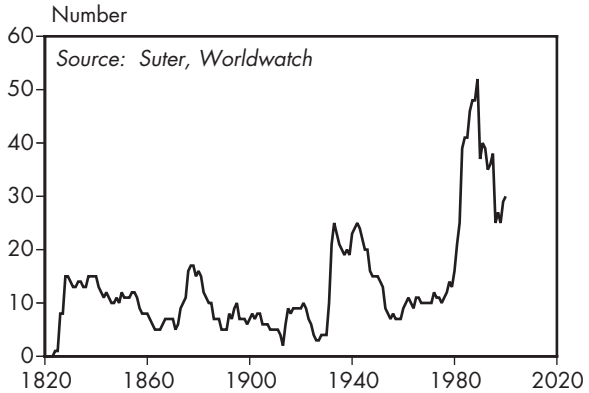

Figure 2: Number of Countries Not Servicing All Their Foreign Debts, 1820–2000

Foreign Debt of Developing and Former Eastern Bloc Nations, 1970–2000

Year	Foreign Debt (trill. 2000 dollars)
1970	0.27
1971	0.29
1972	0.33
1973	0.38
1974	0.43
1975	0.52
1976	0.60
1977	0.75
1978	0.88
1979	1.00
1980	1.10
1981	1.20
1982	1.31
1983	1.36
1984	1.38
1985	1.50
1986	1.61
1987	1.77
1988	1.72
1989	1.74
1990	1.81
1991	1.85
1992	1.89
1993	2.02
1994	2.19
1995	2.35
1996	2.40
1997	2.45
1998	2.66
1999	2.62
2000	2.53

Source: World Bank, *Global Development Finance*, electronic database, 2001.

Metals Exploration Drops Sharply

Payal Sampat

In 2001, mining companies spent just under $2 billion exploring for untapped lodes of metal around the world.[1] (See Figure 1.) This is less than half the amount spent in 1997—a record $4.2 billion.[2] Bruised by the lingering effects of the 1998 Asian financial crisis, low metals prices, and capital shortages, most mining companies have shrunk their exploration budgets and cut operating costs at existing mines.[3]

Gold has traditionally driven exploration budgets: in 1997, two thirds of all exploration was for this yellow metal.[4] But gold prices have dropped by half since 1990 (in 2000 dollars), reaching a 29-year low in 2001 and driving the share of exploration for gold down to 42 percent.[5] Metals such as copper, zinc, and nickel accounted for a greater share of exploration budgets in 2001 than they have in the past, almost 39 percent.[6]

Links: pp. 66, 112

As the quest for new veins of metal accelerated in the mid-1990s, most new exploration took place in the developing world. Between 1991 and 1997, exploration spending expanded six times in Latin America and almost quadrupled in the Pacific region.[7] Although spending on exploration has plummeted dramatically in all regions since then, the developing world still attracts about half of all new money.[8] Latin America remains a leading attraction, drawing 28 percent of investment in 2001.[9] (See Figure 2.) Chile, Peru, Brazil, and Mexico—all of which have courted foreign investors in the last 10 years—lead the list for this region.[10]

Southeast Asia and the Pacific has seen a 72-percent decline in investment, although multinational firms continue to operate and expand existing mines in Indonesia, Papua New Guinea, and other island nations.[11] Mining companies are keen to expand their presence in Africa—which claimed only 14 percent of all spending in 2001—in the quest for diamond and platinum deposits.[12]

The more wealthy mining regions—where most mining companies are headquartered—still maintain a strong foothold. Australia and Canada, the nations that attracted the most investment in 2001, each accounted for 17 percent of exploration spending.[13] The U.S. share, however, shrunk to just 8 percent—exploration there fell 60 percent between 1997 and 2001.[14] This cutback came in response to changes in U.S. mining laws in 2000, but many of the new environmentally favorable rules have since been revised or rolled back.[15]

Although metals serve many useful purposes, the extraction and processing of virgin minerals can impose a sobering toll on people and ecosystems. Most new mining development is taking place in some of the world's most ecologically fragile regions—many of which are located in poor countries desperate for foreign investment. These include a titanium mine in a Madagascar forest that is inhabited by rare lemurs, birds, and 20 indigenous plant species; gold exploration in Peru's Andean cloud forests; and tantalite mining in the Okapi Reserve in the Democratic Republic of Congo, home to the endangered mountain gorilla.[16]

Several studies point out that mining-dependent nations typically have sluggish rates of economic development and some of the highest poverty rates, spurring a debate about whether mining benefits poor people and countries over the long term.[17] One thing seems clear: the poor tend to bear the costs of mining disproportionately. Perhaps as much as 50 percent of gold produced between 1995 and 2015 has or will come from indigenous peoples' lands in places as diverse as Nevada and Papua (formerly Irian Jaya).[18] In Peru, local farmers have protested being displaced by the Tambo Grande mines; communities in Guyana, Papua New Guinea, and Kyrgyzstan, among others, have suffered as mines there have severely contaminated soil and water supplies.[19]

The International Labour Organization calls mining one of the most hazardous occupations. It employs just 1 percent of the global work force but is responsible for 5 percent of all worker deaths on the job—about 40 deaths a day.[20] As mining companies try to reduce operating costs, jobs in mining are in further decline. In 1999 alone, South African mines laid off about 100,000 workers—a third of the total—as operations were mechanized or closed.[21]

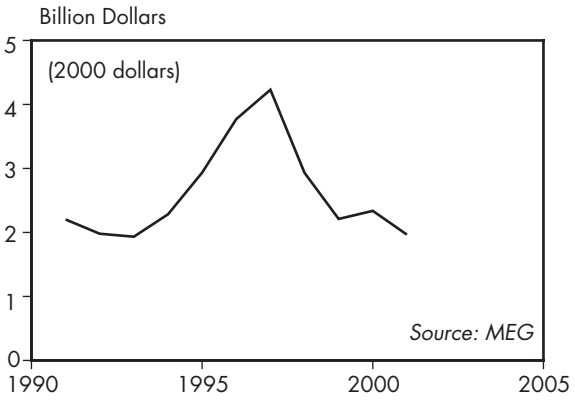

Figure 1: World Metals Exploration Investment, 1991–2001

World Metals Exploration Investment, 1991–2001

Year	Investment (million 2000 dollars)
1991	2,203
1992	1,980
1993	1,934
1994	2,284
1995	2,933
1996	3,771
1997	4,230
1998	2,933
1999	2,212
2000	2,338
2001	1,966

Source: MEG, *Strategic Reports*, 1991–93, and press releases, 1994–2001.

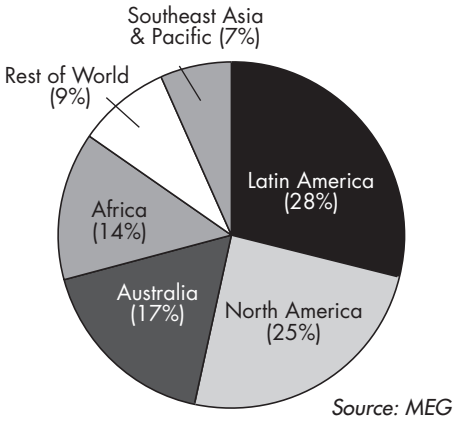

Figure 2: Share of World Metals Exploration Investment by Region, 2001

Metals Production Climbs

Payal Sampat

More than 900 million tons of metals were extracted from the earth in 2000—about 7 percent more than the previous year.[1] (See Figure 1.) In the last 30 years, a total of 24 billion tons of metals have been mined.[2] If this material were loaded onto the largest, 218-ton dump trucks that are used on mine sites, the convoy of trucks lined bumper-to-bumper could circle the globe at the Equator 34 times.[3]

Where does this enormous amount of material go once it is removed from the ground? Most of it works its way into our daily lives, forming buildings, bridges, cars, airplanes, stereos, cell phones, and other goods. Some materials, such as steel in buildings, remain in use for decades; others, such as aluminum cans, may be discarded minutes after use.

Links: pp. 60, 64, 84, 112

About 70 metals are mined for commercial use, including aluminum, cadmium, copper, lead, nickel, raw steel, and zinc. By weight, steel accounts for the bulk of the total—nearly 94 percent.[4]

On average, 148 kilograms of metal were produced per person in 2000.[5] (See Figure 2.) This is significantly smaller than the all-time high of 185 kilograms per person in 1973.[6] The decline reflects the expansion in global population in the last three decades, much of which has taken place in poorer regions, where materials consumption per person is relatively low.

The metals intensity of the global economy—the amount of metals used to generate economic wealth—has declined 45 percent in the last 30 years.[7] (See Figure 3.) This reflects a shift in the global economy as manufacturing and other industries that typically use large amounts of metal have grown at a far slower pace than service industries such as telecommunications and finance.

Mineral ores are unevenly distributed in Earth's crust, with some concentrated in a few regions. One third of the world's copper is extracted in Chile, for instance, while 28 percent of lead comes from China.[8] Metals are often produced in countries that are major consumers as well.[9] China, for example, is the world's largest producer and consumer of steel, while the United States produces and uses more aluminum than any other country.[10] Elsewhere, metals are extracted almost entirely for export—with even the ores sent overseas for processing and refining. For instance, Papua New Guinea and Botswana mine copper ores, but most of the output is exported to non-copper-producing countries such as South Korea and Germany to be refined.[11]

The major industrialized regions—the United States, Canada, Australia, Japan, and Western Europe—with 15 percent of the world's population, together consume 61 percent of all aluminum, 60 percent of lead, 59 percent of copper, and 49 percent of steel.[12] On a per capita basis, the different levels of consumption are especially marked: the average American uses 22 kilograms of aluminum a year, while the average for India is 2 kilograms, and for Africa, just 0.7 kilograms.[13]

For countries that are major importers or exporters of finished goods, the per capita figure may mask or overstate domestic metals use. For example, Taiwan and South Korea rank much higher than any industrial country in their copper consumption, at 29 kilograms and 18 kilograms per person.[14] But most of this feeds their large export markets for electronics and other goods.

Just a few sectors of the economy dominate metals use. In industrial countries, the transportation sector (including vehicle fleets) uses an estimated 70 percent of lead produced each year, 37 percent of steel, 33 percent of aluminum, and 27 percent of copper.[15] Construction is another major player, using 34 percent of steel, 30 percent of copper, 17 percent of lead, and 19 percent of aluminum in industrial nations.[16]

It takes far less energy to mine discarded materials than to extract, process, and refine metals from ore. It takes 95 percent less energy to produce aluminum from recycled materials, for example, than from bauxite ore.[17] Recycling copper takes seven times less energy than processing ore; recycled steel uses three-and-a-half times less.[18] Globally, 29 percent of aluminum and 13 percent of copper come from recycled sources.[19]

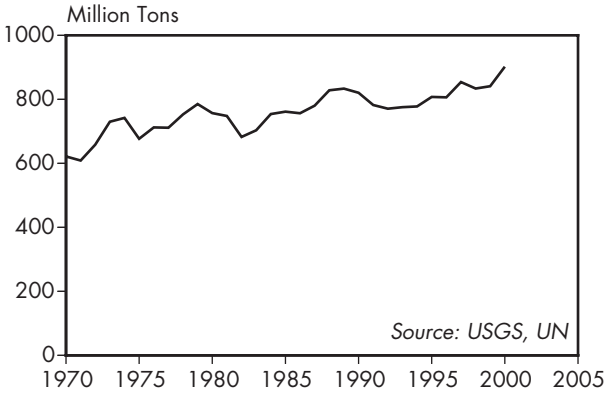

Figure 1: World Metals Production, 1970–2000

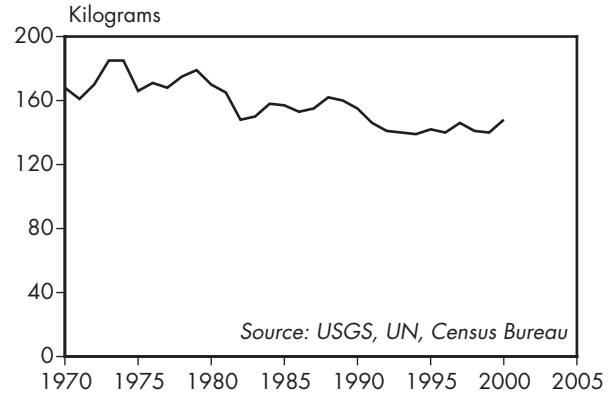

Figure 2: World Metals Use Per Person, 1970–2000

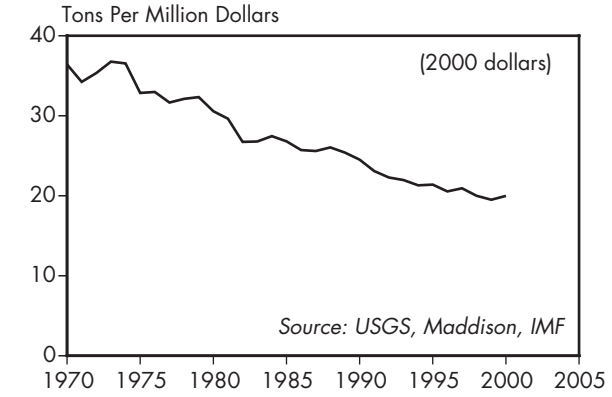

Figure 3: Metals Intensity of Global Economy, 1970–2000

World Metals Production, 1970–2000

Year	Metals Mined (million tons)
1970	621
1971	609
1972	658
1973	730
1974	742
1975	677
1976	712
1977	711
1978	753
1979	785
1980	757
1981	748
1982	682
1983	703
1984	754
1985	761
1986	756
1987	780
1988	828
1989	833
1990	820
1991	782
1992	771
1993	775
1994	778
1995	808
1996	806
1997	854
1998	834
1999	841
2000 (prel)	902

Sources: USGS, *Minerals Yearbook* and *Mineral Commodity Summaries*, various years; United Nations, *Industrial Commodities Statistics Yearbook*, various

Oil Spills Decline

Michael Renner

The amount of oil spilled accidentally in 2000 from tankers, pipelines, wells, storage facilities, and other sources was estimated at 48,600 tons worldwide by the *Oil Spill Intelligence Report* (OSIR).[1] This was the lowest recorded since 1968. The largest amount, some 1.5 million tons, was spilled in 1979.[2] Since 1990, there has been an almost continuous reduction in the quantity of oil spilled.[3] (See Figure 1.)

These figures do not include spills that are the result of warfare or sabotage, however. Historically, three of the top five spill incidents are the result of acts of war.[4] (See Figure 2.) Attacks on oil fields and tankers during the Iran-Iraq war raised the total for 1983 by 46 percent.[5] In 1991, Iraqi troops deliberately released some 840,000 tons of oil from Kuwaiti facilities into the Persian Gulf, causing the largest marine oil spill in history.[6] And in 2000, reports of sabotage by Chechen rebels indicated that 2 million tons of oil had leaked from wells and refineries near Grozny.[7] If confirmed, this would be the largest spill ever.

Links: pp. 38, 94

From 1968 to 2000, there were more than 7,600 civilian incidents with about 10.6 million tons of oil spilled.[8] More than 400 war-related incidents added at least another 3.6 million tons.[9] The top 50 oil spills—just 6 percent of all incidents—account for more than half the total spillage since 1968.[10]

Oil tankers, the leading source of spills, transport some 107 million tons of oil on an average day.[11] OSIR and the International Tanker Owners Pollution Federation provide somewhat conflicting spill data for certain years.[12] (See Figure 3.) In 1968–2000, tankers, barges, and other vessels accounted for about half the total amount of oil spilled.[13] But greater use of double-hulled tankers and other safety measures have significantly reduced both the number of tanker accidents and the quantity of oil spilled.[14]

Collisions and groundings are relatively rare, but can result in large, sometimes massive, spills. The two largest tanker accidents happened off the coast of South Africa, when the *Castillo de Bellver* lost 267,000 tons in 1983, and off Brittany, France, when the *Amoco Cadiz* disgorged 234,000 tons in 1978.[15] The infamous 1989 *Exxon Valdez* incident in Alaska ranks only as the forty-second worst tanker accident in terms of quantity of oil released, although it occurred in a particularly pristine and ecologically vulnerable location.[16]

Almost half of all pipeline spills are the result of aging equipment. Some pipelines are 30–50 years old; others are even older.[17] Niger delta communities in Nigeria have suffered heavily from spills caused by corrosion of antiquated pipelines and by vandalism. Pipeline bursts have killed hundreds of people in recent years.[18]

Sabotage is another cause of pipeline spills. In the last few years rebel groups have attacked pipelines in Algeria, Assam (India), Colombia, Ecuador, Sudan, Turkey, and Yemen.[19] In Colombia, rebel groups bombed pipelines 98 times during 2000, up from 79 times during 1999.[20] Unconfirmed estimates suggest that about 43,000 tons of oil were spilled there in 2000—twice the amount lost due to all non-war pipeline incidents that year.[21]

Some well blowouts are among the biggest spills ever. From June 1979 to February 1980, for example, the Ixtoc exploratory well in the Gulf of Mexico spewed some 476,000 tons of oil, the largest non-war oil spill ever.[22] A production well in Uzbekistan's Fergana Valley spilled 299,000 tons in 1990, and one in Libya lost 143,000 tons in 1980.[23]

The quantity of oil spilled does not necessarily indicate the severity of the impact on the environment. Important factors include the type of oil spilled, weather and climate conditions, the extent to which the oil is recovered or at least contained, how quickly the oil biodegrades and how much of it evaporates, and the proximity to wildlife habitats or environmentally sensitive areas.[24]

Even though much of the oil released by the *Exxon Valdez* in 1989 evaporated or dispersed, for instance, the accident had disastrous results.[25] It killed an estimated 3,500–5,500 sea otters (10–15 percent of the region's total population) and some 300,000–675,000 seabirds.[26] Most wildlife species still have not recovered.

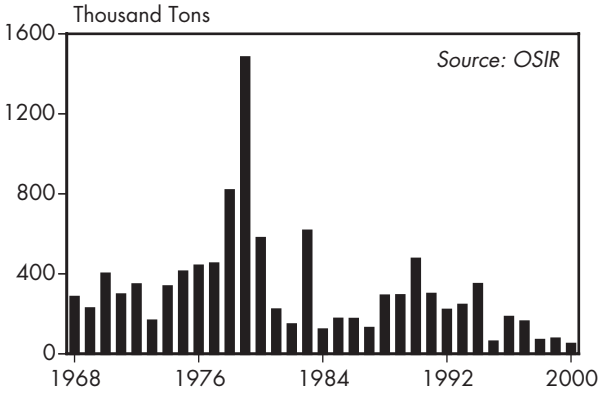

Figure 1: Oil Spills from Civilian Operations, 1968–2000

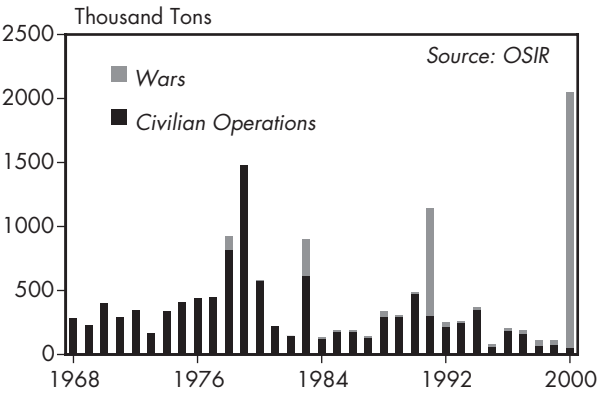

Figure 2: Oil Spills from Civilian Operations and Wars Combined, 1968–2000

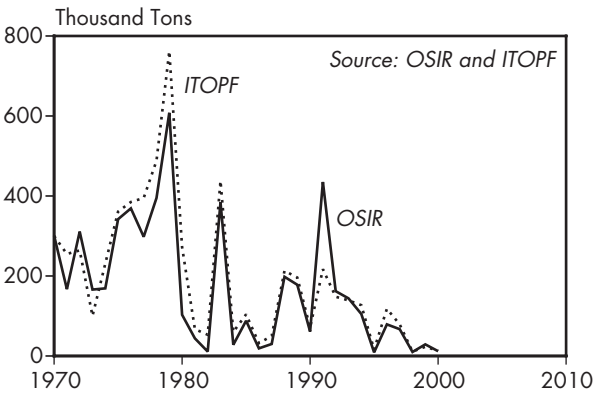

Figure 3: Tanker Oil Spills, 1970–2000

Oil Spills from Civilian Operations, 1968–2000

Year	Oil Spilled (thousand tons)
1968	283.4
1969	226.3
1970	399.9
1971	295.9
1972	346.2
1973	164.8
1974	336.3
1975	410.3
1976	439.6
1977	450.7
1978	816.8
1979	1,481.3
1980	577.9
1981	220.8
1982	146.3
1983	614.6
1984	120.8
1985	174.2
1986	173.3
1987	128.3
1988	290.2
1989	291.9
1990	474.4
1991	298.5
1992	218.9
1993	244.0
1994	347.7
1995	60.2
1996	183.3
1997	160.6
1998	68.2
1999	74.9
2000	48.6

Source: Oil Spill Intelligence Report.

Roundwood Production Rebounds

Janet N. Abramovitz

According to the U.N. Food and Agriculture Organization (FAO), global production of roundwood—the logs that become fuel, lumber, paper, and other wood products—reached a new peak of 3,376 million cubic meters in 1999, the last year for which data are available.[1] (See Figure 1.) Production has topped 3,000 million cubic meters every year since 1983, more than twice the figure in 1950.[2] In the mid-1990s the global total dipped as production in the former Soviet Union fell by about two thirds during the new countries' economic transition.[3]

In 1999, 61 percent of the world's recorded wood harvest came from developing nations.[4] The share produced in industrial nations has declined from 57 percent in 1961 to 39 percent in 1999.[5] (See Figure 2.)

About 55 percent of the roundwood cut today is used directly for fuelwood and charcoal.[6] The other 45 percent becomes "industrial roundwood"—the logs that are cut into lumber and panels for construction purposes or ground into pulp to make paper.[7] Developing countries produce about 89 percent of wood cut specifically for fuel.[8] But these figures are misleading in terms of the importance of wood fuel in industrial countries: where there are large forest products industries, by-products such as wood chips and sawdust are burned to fuel the mills. These add close to 300 million cubic meters of wood to the 173 million used directly for fuel in industrial countries.[9]

Link: p. 104

The industrial roundwood harvest has remained concentrated in just five countries since the 1970s: the United States, Canada, Russia, China, and Brazil. These five produce 58 percent of the world's recorded production. Together the top 10 (adding in Sweden, Finland, Germany, France, and Indonesia) accounted for about 72 percent of production.[10]

Industrial nations produce 73 percent of industrial roundwood, a share that has declined since 1970 as developing nations expanded their output.[11] While production in industrial nations has remained relatively constant since 1970, in developing nations it has doubled.[12] Industrial nations continue to consume a disproportionate share of global production—77 percent of the timber harvested for industrial use is consumed by the 22 percent of the world living in industrial nations.[13] Although the United States uses the most, China is now second.[14]

Production of some industrial wood products has grown more rapidly than others. Between 1961 and 1999, paper production grew by 309 percent.[15] Paper and paperboard now account for the largest single share of industrial wood use, at 40 percent, through wood cut directly for paper and the use of residues from other wood processing mills.[16] Sawnwood, the lumber used for construction and furniture, dropped from 34 percent of production in 1961 to 27 percent in 1999.[17] Total sawnwood production increased by only 18 percent since 1961, and has declined from peak production in the late 1980s.[18] (See Figure 3.) Production of wood panels like plywood (which have replaced sawnwood in some cases) jumped 545 percent since 1961, now accounting for 11 percent of production.[19]

Due to illegal production and trade, output data are reported by governments to the FAO and may not reflect full levels of production. In Indonesia, for example, an independent study by the U.K. Department for International Development found that production was more than double the amount reported by the government.[20] Extensive illegal harvest and trade have also been reported in Brazil, Russia, Cambodia, Liberia, Papua New Guinea, Cameroon, and elsewhere.[21] Growing recognition of this widespread problem is beginning to spur government commitments to combat illegal logging and trade.[22]

The area of commercial forest certified as well-managed has grown substantially in recent years. By the end of 2001, over 25 million hectares had been certified to Forest Stewardship Council (FSC) standards, more than double the area in 1998.[23] While there are FSC-certified forests in 54 countries, 67 percent of the acreage is in Europe and 13 percent is in North America.[24] Wood products originating in

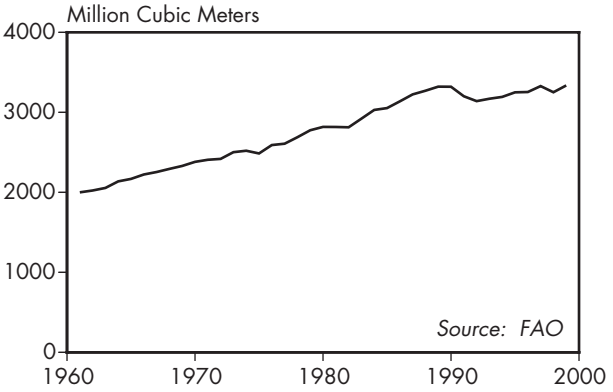

Figure 1: World Roundwood Production, 1961–99

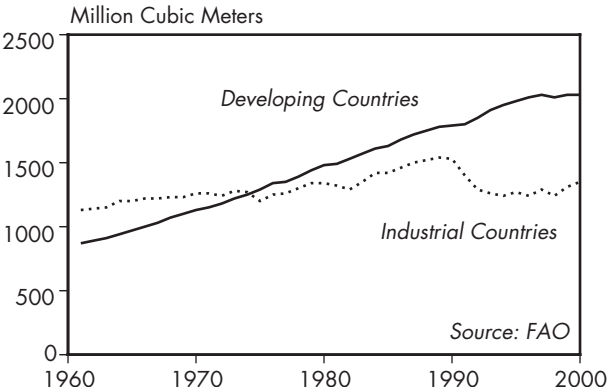

Figure 2: World Roundwood Production, Industrial and Developing Countries, 1961–99

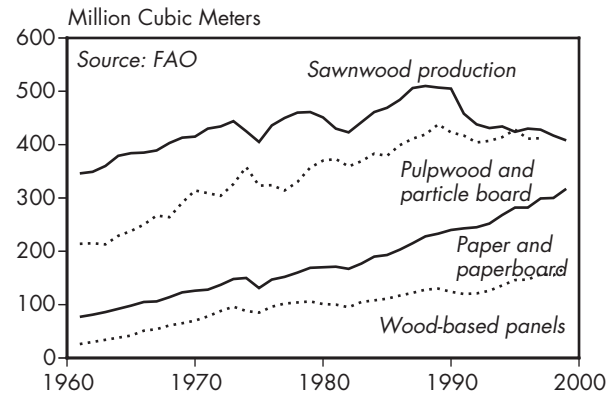

Figure 3: World Industrial Roundwood Production, by Type, 1961–99

World Roundwood Production, 1961–99

Year	Production (million cubic meters)
1961	2,000
1962	2,023
1963	2,055
1964	2,137
1965	2,168
1966	2,223
1967	2,254
1968	2,293
1969	2,330
1970	2,381
1971	2,407
1972	2,418
1973	2,502
1974	2,520
1975	2,486
1976	2,591
1977	2,608
1978	2,689
1979	2,776
1980	2,818
1981	2,817
1982	2,813
1983	2,921
1984	3,030
1985	3,053
1986	3,137
1987	3,224
1988	3,270
1989	3,321
1990	3,320
1991	3,201
1992	3,140
1993	3,170
1994	3,193
1995	3,250
1996	3,254
1997	3,328
1998	3,251
1999	3,336

Source: FAO, *FAOSTAT Statistics Database*, at <app.fao.org>, updated 7 November 2001.

Transportation Trends

Vehicle Production Declines Slightly

Bicycle Production Rolls Forward

Passenger Rail at Crossroads

Vehicle Production Declines Slightly

Michael Renner

According to DRI-WEFA Global Automotive Group estimates, global passenger car production declined 2.7 percent in 2001, to 40 million units.[1] (See Figure 1.) Light truck production also declined slightly, to 15 million.[2] Global passenger car production outpaced sales by about 1.3 million vehicles, but sales of light trucks surpassed production by about 1.7 million.[3] The global passenger car fleet grew to 555 million in 2001.[4] (See Figure 2.)

The global auto industry continues to suffer from substantial overcapacity. Analysts at PricewaterhouseCoopers estimated global capacity to manufacture passenger cars and light trucks in 2001 at 77.3 million units, but only about 70 percent of capacity is in use.[5] At 78 percent, capacity utilization in North America and Western Europe is far higher than elsewhere.[6]

Links: pp. 150, 152

After shedding weight in the 1980s, cars have gotten heavier again in the 1990s, even though manufacturers made increasing use of light materials like plastic and aluminum. A typical U.S. family vehicle weighed 1,619 kilograms (kg) in 1978 and then 1,424 kg in 1990, but 1,501 kg in 2001.[7] The motor vehicle industry's appetite for materials remains considerable, although at least 75 percent of a car's material content ends up being recycled.[8] In the United States, the industry accounted for 33 percent of aluminum use in 2000, up from 17 percent in 1991.[9] In recent years, the industry has accounted for 70–80 percent of U.S. natural rubber consumption, 65–77 percent of lead, 55–64 percent of synthetic rubber, one third of iron, 23 percent of zinc, about 15 percent of steel, and 12 percent of copper.[10]

The industry also uses substantial amounts of energy, but far more is consumed in operating vehicles than in manufacturing them. Advances in fuel efficiency would have led to reduced gasoline consumption from car use had it not been for a variety of offsetting trends such as larger cars and more powerful engines, an ever expanding car fleet, and continuous growth in distances traveled.

The United States has slightly more than one quarter of the world's passenger cars.[11] The fuel economy of new cars improved from just 14.2 miles per gallon (equivalent to 16.6 liters per 100 kilometers) in 1974 to 28.8 miles per gallon in 1988.[12] But instead of additional progress, there has been some backsliding since then.[13] The combined fuel economy of new passenger cars and light trucks reached a high of 26.7 miles per gallon in 1987, but now stands at just 24.7, the second-lowest figure in 20 years.[14]

Since the mid-1980s, fuel efficiency has leveled off or declined in most other industrial countries as well.[15] But fuel economy in Europe (particularly in France and Italy) and Japan remains higher than in the United States, where the popularity of light trucks makes improved efficiency an elusive target.[16] (See Figure 3.) Because European and Japanese fuel economy tests use tougher methods, their results may actually be as much as 18 percent lower than they would be in the United States.[17]

Since the late 1990s, fresh gains in fuel economy have been achieved.[18] In Japan, regulations will likely bring about a rise to about 35 miles per gallon (6.7 liters per 100 kilometers) for new models by 2010.[19] The European Automobile Manufacturers Association has offered a voluntary commitment to reach 41 miles per gallon by 2008.[20]

Even though a recent U.S. National Academy of Sciences panel found that fuel economy could be raised 16–47 percent over the next 10–15 years, U.S. carmakers show little interest.[21] Steven Plotkin of the Argonne National Laboratory expects U.S. fuel economy to be no higher than 25.6 miles per gallon by 2010.[22] A program initiated in 1993 to develop 80-miles-per-gallon cars by 2004 fell short of expectations. It was abandoned by the Bush administration in early 2002 in favor of pursuing hydrogen-based fuel cell cars—which is unlikely to bear fruit for 10–20 years.[23]

Hybrid gas-electric vehicles occupy only a tiny market niche so far, although they get easily twice the fuel economy of a standard car. Toyota is planning to produce 300,00 hybrids a year by 2005, less than 1 percent

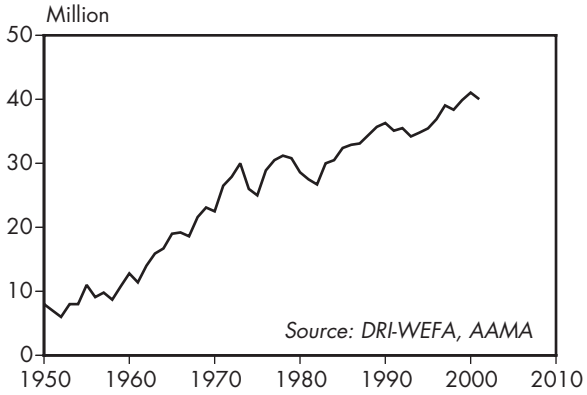

Figure 1: World Automobile Production, 1950-2001

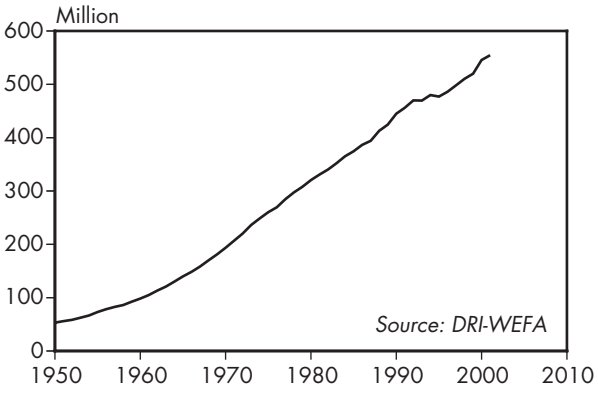

Figure 2: World Passenger Car Fleet, 1950-2001

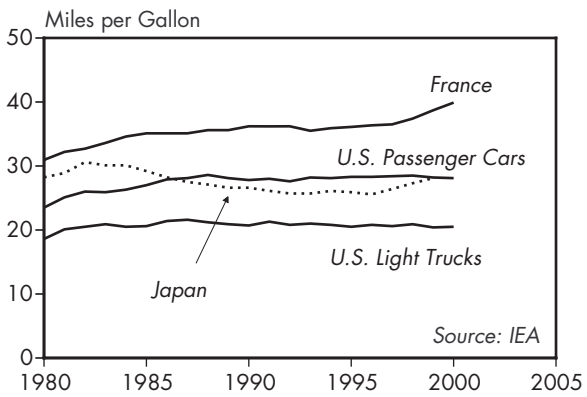

Figure 3: New Car Fuel Economy, Selected Industrial Countries, 1980–2000

World Automobile Production, 1950–2001

Year	Production (million)
1950	8.0
1955	11.0
1960	12.8
1965	19.0
1970	22.5
1971	26.5
1972	27.9
1973	30.0
1974	26.0
1975	25.0
1976	28.9
1977	30.5
1978	31.2
1979	30.8
1980	28.6
1981	27.5
1982	26.7
1983	30.0
1984	30.5
1985	32.4
1986	32.9
1987	33.1
1988	34.4
1989	35.7
1990	36.3
1991	35.1
1992	35.5
1993	34.2
1994	34.8
1995	35.5
1996	36.9
1997	39.1
1998	38.4
1999	39.9
2000	41.1
2001 (prel)	40.0

Sources: DRI-WEFA Global Automotive Group; American Automobile Manufacturers Association.

Bicycle Production Rolls Forward

Gary Gardner

Production of bicycles topped 100 million units in 2000, the last year for which global data can be estimated.[1] (See Figure 1.) The nearly 9-percent increase over 1999, while robust, returns global production only to the levels of the early 1990s.[2] Globally, the industry continues to struggle and to become more concentrated.

Nearly all of the increase in 2000 came from China, where production reached 52 million units, up from 43 million in 1999.[3] For the first time, China accounts for more than half of global output.[4] (See Figure 2.) The other major Asian players—India, Taiwan, and Japan—saw production stagnate or decline.[5] Meanwhile, the European Union, the other major production center, saw output increase by a modest 3.6 percent.[6]

Production in the United States, once a significant source of bicycles, has slipped steadily from 8.5 million units in 1995 to 1.1 million in 2000.[7] But the country strengthened its place as the world's largest market in 2001, with purchases totaling more than 20 million units—one fifth of global production, and 15 percent more than in 2000.[8] The United States now imports more than 95 percent of the bicycles it uses.[9]

Link: p. 152

Indeed, a map of global bicycle flows would reveal bulging arrows from China to the rest of the world, especially the United States, and increasingly anemic arrows emanating from many other producers. Of the roughly 46 countries with bicycle production data for 1995, more than a third have seen steady declines in production since then, even as global production recovered.[10] Production increases have been most notable in low-wage nations such as China, Mexico, and Viet Nam.[11]

Bicycle use is influenced by government policy and changes in technology, among other factors. Municipal leadership in construction and promotion of a 300-kilometer-long network of bicycle paths in Bogota, Colombia, for example, is credited with boosting the cycling share of the city's population from 0.5 percent in 1997 to more than 5 percent today—more than five times the levels found in many car-centric countries such as the United States.[12] Santiago, Chile, is following suit as it undertakes a 30–40 kilometer pilot project with funding from the Global Environment Facility.[13] As a way to combat the city's notorious air pollution, the project could grow over 10 years into a 1,000-kilometer network if city plans are fully implemented.[14]

Such investments can help reduce the dangers of cycling, a major impediment to bicycle use. In surveys in three U.S. cities in the early 1990s, more than half of respondents cited lack of safety as an influential factor in their decisions not to cycle.[15] Indeed, cycling fatalities per kilometer traveled in the United States are 11 times higher than fatalities from driving.[16] By contrast, cycling deaths in the Netherlands and Germany, where cycling-oriented laws and infrastructure are widespread, are about a quarter the level found in the United States.[17]

Emerging technologies could also affect cycling trends. Sales of electric bicycles have grown rapidly since their debut in the early 1990s, jumping by 27 percent in 2001 alone.[18] (See Figure 3.) Though this is less than 1 percent of global bicycle production, growth could continue to be brisk as batteries become lighter and more powerful and as the advantages of electrics become better known. By helping riders to go farther and cover hillier terrain than many would on a conventional bicycle, electrics have the potential to broaden interest in cycling. One industry consultant says it is "entirely possible" that the majority of bikes sold 10 years from now will have an electric drive of some sort.[19]

In summer 2000, a firm called Manhattan Scientifics unveiled an electric bicycle powered by a fuel cell rather than a battery.[20] If successful, it could eliminate the technology's major environmental and performance blemish: dependence on toxic batteries that have short operational lives. This bike runs on hydrogen, the most abundant element in the universe, and a fuel whose only byproduct is water vapor. It is also due to weigh less and run longer before refueling than today's battery-powered electrics.[21] The company expects to

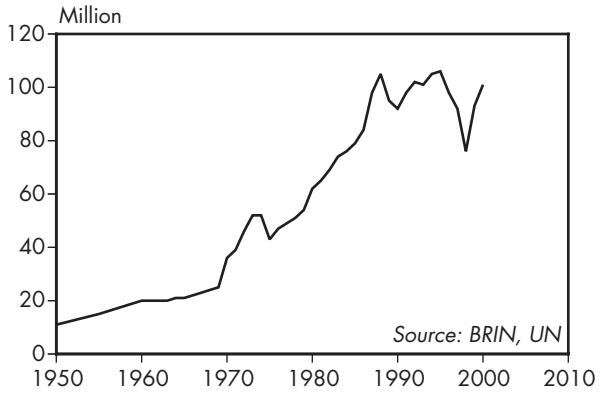

Figure 1: World Bicycle Production, 1950–2000

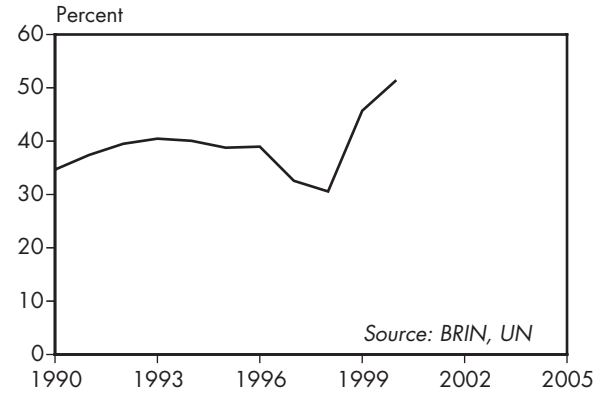

Figure 2: Chinese Bicycle Production as a Share of World Production, 1990–2000

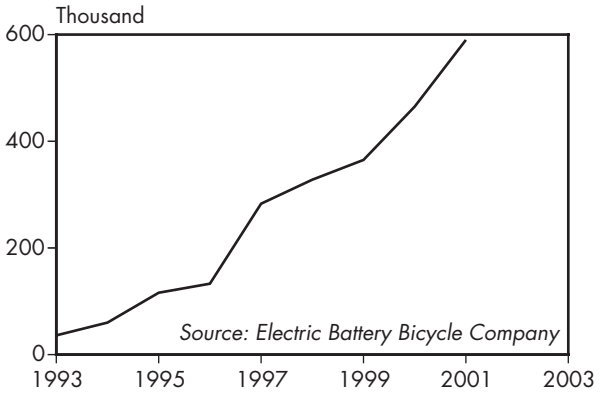

Figure 3: World Electric Bicycle Sales, 1993–2001

World Bicycle Production, 1950–2000

Year	Production (million)
1950	11
1955	15
1960	20
1965	21
1970	36
1971	39
1972	46
1973	52
1974	52
1975	43
1976	47
1977	49
1978	51
1979	54
1980	62
1981	65
1982	69
1983	74
1984	76
1985	79
1986	84
1987	98
1988	105
1989	95
1990	92
1991	98
1992	102
1993	101
1994	105
1995	106
1996	98
1997	92
1998	76
1999	93
2000 (prel)	101

Sources: Bicycle Retailer and Industry News, *Industry Directory 2002;* United Nations, *Industrial Commodity Statistics Yearbook, 1999.*

Passenger Rail at Crossroads

Molly O. Sheehan

Between 1988 and 1999, world rail travel stagnated at about 1.8 trillion passenger-kilometers.[1] (See Figure 1.) As the total volume of passenger travel grew, rail's share decreased in relation to road and air.[2]

The global number masks huge national differences. More than 1 million kilometers of tracks crisscross some 120 nations, but most train travel is in the former Soviet states, India, China, Western Europe, and Japan, which together account for more than 80 percent of all passenger-kilometers.[3] (See Figure 2.)

Links: pp. 74, 152

Railroads in Western Europe and Japan are geared toward passenger service, whereas extensive rail networks in the United States and Canada are used primarily for freight.[4]

The role of railroads in world transport is constantly evolving. After the first train ran in England in 1825, rail grew so rapidly that by 1900 it accounted for close to 90 percent of all passenger traffic in Europe and the United States.[5] Once cars and planes developed markets, however, trains lost passengers. Today, rail is poised for a renaissance as demand for transportation rises, particularly in developing countries, and as industrial nations seek greener alternatives to clogged airports and roads.

Planes make more sense for long distances, and cars, transit, and bicycles for shorter trips. But over 50–1,000 kilometers (30–600 miles), trains with enough passengers can be cheaper, more comfortable, and less polluting, given the high costs of flying large jets short distances and the high per capita fuel use and space required for automobiles.[6]

High-speed rail has begun to fill this niche in Japan and Western Europe.[7] Initially funded in part by World Bank loans, Japan's *shinkansen*, or "bullet train," opened in 1964 and linked Tokyo and Osaka.[8] It has since been expanded and upgraded. When France's fast train, the TGV, debuted in 1981, it cut the trip between Paris and Lyons from four to two hours; within a month, planes lost half their passengers on that route, and car traffic between those cities dropped by a third.[9] Today, passengers on a United Airlines "flight" from Washington, DC, to Lyons connect at the Paris airport to the TGV for the final leg of their journey.[10] Germany's ICE, introduced in 1991, prompted Lufthansa to stop flying between Hannover and Frankfurt.[11] And in 2001, the new Thalys train led Air France to cancel its Paris-to-Brussels flights.[12]

Many of the world's rail passengers live in developing Asia, where rail promises to efficiently connect dense urban centers. China plans to boost its rail network and has lifted restrictions on foreign investors.[13] Between 1997 and 2000, Chinese railways raised speeds three times and started scheduling more overnight trains.[14] Future plans include a high-speed link between Shanghai and Beijing, a distance equal to the combined French and German high-speed tracks.[15] Elsewhere, South Korea is building a high-speed rail link, and Taiwan is planning one as well.[16]

While Japan's private rail network and France's public one both excel, many nations are struggling to find the best formula for them.[17] In the United States, the government subsidized Amtrak to provide national rail service in 1971, but the company has yet to develop the quality of service needed to boost revenues sufficiently.[18] After the United Kingdom divided and sold its state-run network in 1994, serious accidents showed that the new owner, Railtrack, was not maintaining the tracks well; repairs caused huge delays, prompting passengers to flee.[19] The debacle has made officials in countries such as Germany slow their privatization plans.[20] World Bank Railways Adviser Lou Thompson concludes that rail systems would work best if they were publicly defined and supported, but privately operated.[21]

Whether private or public, operators must improve service to achieve rail's people-moving potential. Train travel could be made quicker, for instance, if there were global standards for railway equipment that would ease trans-border travel, as well as advances in technology.[22]

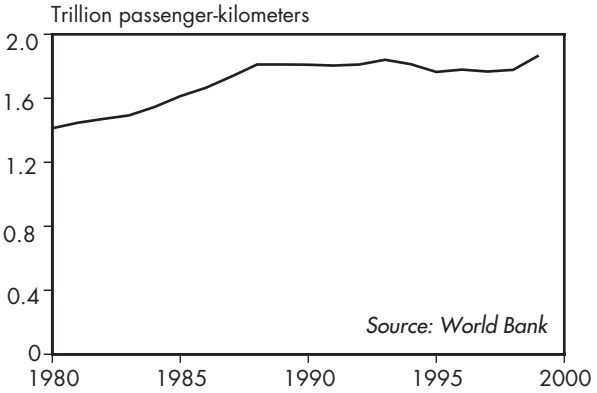

Figure 1: World Passenger Rail Travel, 1980–99

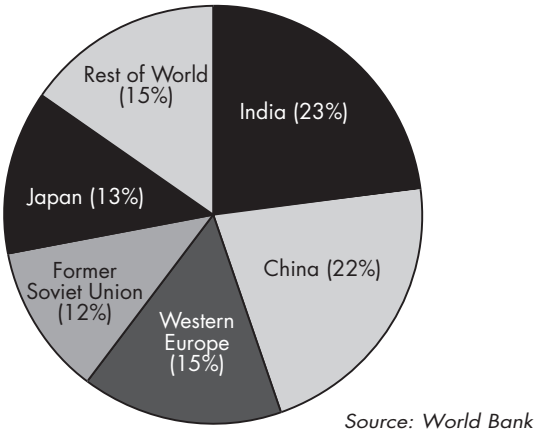

Figure 2: World's Passenger Rail Ridership, by Region or Country, 1999

World Passenger Rail Travel, 1980–99

Year	Passenger-kilometers (trillion)
1980	1.4
1981	1.4
1982	1.5
1983	1.5
1984	1.5
1985	1.6
1986	1.7
1987	1.7
1988	1.8
1989	1.8
1990	1.8
1991	1.8
1992	1.8
1993	1.8
1994	1.8
1995	1.8
1996	1.8
1997	1.8
1998	1.8
1999	1.9

Source: World Bank, "Railways Database"; Louis Thompson, Railways Advisor, World Bank.

Communications Trends

MOHSEN ALLAM , M/MC PHOTOSHARE, WWW.JHUCCP.ORG/MMC

Internet Continues Meteoric Rise

Mobile Phone Use Booms

Internet Continues Meteoric Rise

Payal Sampat

In 2001, about 520 million people used the Internet, linked by a global network of 147 million host computers.[1] (See Figure 1.) The Internet has almost doubled in size since 1999, although since 1996 it has been growing more slowly than it did initially.[2] Today, 1 in every 12 people in the world goes online to get news, send e-mail, buy goods, or be entertained.[3]

The United States, where the Internet was developed, continues to dominate this electronic network. About a third of all people online are American—some 166 million.[4] (See Figure 2.) In the last two years, Japan's Internet users have doubled in size to 47 million.[5] And in China, almost 34 million people used the Internet in 2001, nearly four times more than in 1999.[6] Today, six times more Chinese use the Internet than own cars.[7] South Korea has expanded its online numbers just as rapidly, going from just 6 million in 1999 to 22 million two years later.[8]

Link: p. 112

In nine wired nations, more than half the population uses the Internet.[9] (See Figure 3.) Sweden leads this category, with 63 percent online; Iceland, Denmark, and the Netherlands are also on this list.[10] Most people in Hong Kong, Singapore, and Taiwan go online regularly.[11] In the more populated Asian countries, however, just a small share of people have access to the Internet: 2.6 percent of China, 1 percent of Indonesia, and less than 0.5 percent of India, for example.[12] More people in Singapore use the Internet than in all of Indonesia—a country with 50 times as many people.[13]

One in five Internet users lives in the developing world—about 100 million people.[14] Of the 25 million online in Latin America, nearly half live in Brazil.[15] An additional 4 million are in Argentina, and 3.4 million in Mexico.[16] But most of Africa is left out of this global network, still beleaguered by the lack of infrastructure, particularly telephone lines, and high connection costs. Even today, just 4 million Africans have Internet access—2.4 million in South Africa, and another 600,000 in Egypt—just a little more than the online population of Hong Kong.[17]

English is still the primary language used online, but for the first time ever, in 2001 the majority of people (292 million) using the Internet were non-English speakers.[18] Nearly 32 percent of them use European languages, led by German and Spanish, while 25 percent use Asian languages such as Japanese, Chinese, and Korean.[19] Forecasters estimate that by 2007 Chinese will be the most widely used language on the Internet.[20]

The value of many Internet stocks took a tumble in 2001, dampening the growth of online commercial activity. Globally, e-commerce reached $600 billion in 2001—which is 68 percent more than spent in 2000, but well below levels forecast before the economic downslide.[21] About 40 percent of this total was spent in the United States, and another 10 percent in Japan.[22] In the United States, $4 billion was spent on advertising online in 2001, accounting for some 4 percent of the nation's advertising budget.[23]

At 100 trillion bytes, the World Wide Web stores five times more data than the U.S. Library of Congress—although the quality of information is often dubious.[24] At last count, there were 10 billion pages on the Web, an 11-fold expansion since 1998.[25]

Although the Internet is making only slow inroads in some of the poorest parts of the world, it can be extremely useful when it does get there. Telemedicine projects in Mozambique, Uganda, and Bangladesh have improved medical care in remote and poorly equipped areas. Using low-cost equipment, rural doctors can send X-rays or laboratory results to medical experts at hospitals in larger cities, and get advice about treatment.[26] At 20 learning centers in India and in Morocco, primary school teachers are getting long-distance training over single terminal hookups.[27]

Unfortunately, the wired world is generating piles of hazardous electronic wastes: a computer monitor, for instance, contains four to eight pounds of lead.[28] Some 50–80 percent of used computers, circuit boards, and monitors discarded in the United States are sent to China, India, and Pakistan for recycling and disposal, exposing workers to toxins and poisoning

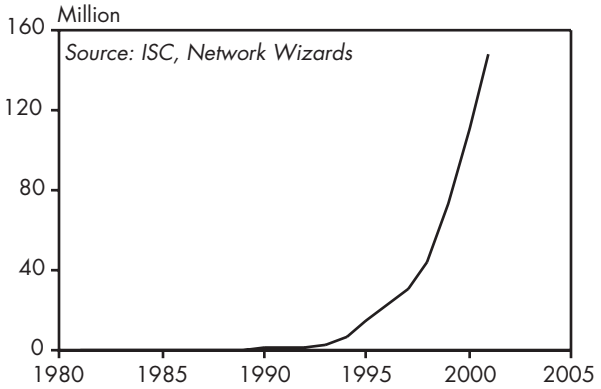

Figure 1: Internet Host Computers, 1981–2001

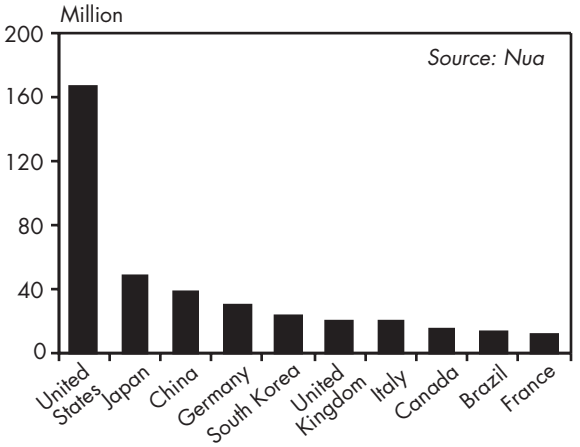

Figure 2: Top 10 Wired Nations, by Number of Internet Users, 2001

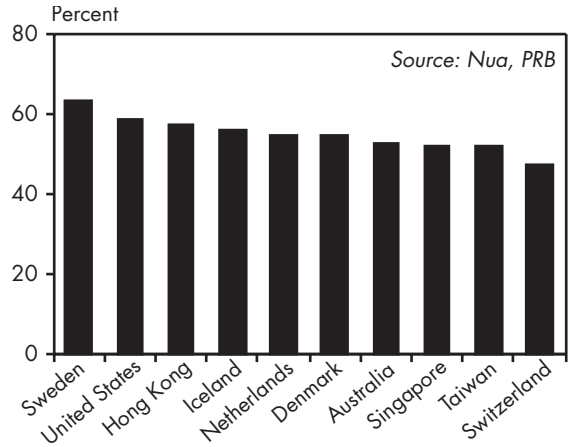

Figure 3: Top 10 Wired Nations, by Percent of Population Online, 2001

Internet Host Computers, 1981–2001

Year	Host Computers (number)
1981	213
1982	235
1983	562
1984	1,024
1985	2,308
1986	5,089
1987	28,174
1988	80,000
1989	159,000
1990	376,000
1991	727,000
1992	1,313,000
1993	2,217,000
1994	5,846,000
1995	14,352,000
1996	21,819,000
1997	29,670,000
1998	43,230,000
1999	72,398,092
2000	109,574,429
2001	147,344,723

Source: Internet Software Consortium and Network Wizards.

Mobile Phone Use Booms

Molly O. Sheehan

The number of cellular or mobile telephone subscribers rose 38 percent to nearly 1 billion in 2001, according to the International Telecommunication Union (ITU), a specialized U.N. agency charged with fostering common global telecom policies.[1] (See Figure 1.) Mobile subscribers worldwide doubled every 20 months during the 1990s.[2]

While most mobile phones are owned by people with access to conventional, fixed-line phone service, for a growing number of people in the developing world they are the sole communications tool.[3] As a result, the cellular phone boom is swelling the total number of people with access to phone service. It took 100 years to connect the first billion people by phone, but only 10 years for the second billion.[4] The ITU forecasts that at some point in 2002, the number of cellular subscribers will surpass the number of fixed-line connections, which stood at 1.045 billion in 2001.[5] (See Figure 2.)

Links: pp. 110, 112

Some 40 percent of the world's mobile phone users are in Europe, and 34 percent are in Asia.[6] The largest manufacturer of mobile phones, Nokia, is based in Finland, where cell phones dominate the economy.[7] As some markets in Western Europe reached saturation in 2001 (see Figure 3), a slowdown in demand caused global shipments of cell phones to decline.[8]

There is still considerable room for growth, however, in the world's largest markets. The United States, with more than 109 million cellular subscribers, had more mobile phones in use than any other nation in 2000 but less than 40 mobiles per 100 people.[9] Contracts that charge subscribers for incoming as well as outgoing calls may have dampened growth.[10]

China was the second largest market in 2000, with 85 million subscribers, but less than 7 mobile phones for every 100 people.[11] The number of mobile subscribers in China grew on average 85 percent a year between 1996 and 1999; China Mobile has more subscribers than any other cellular phone company in the world.[12]

In general, the greatest growth is occurring in developing countries, where prepaid phone cards have become popular for use with mobiles. These reduce the risk to the phone companies and allow people to use cellulars who do not have sufficient credit to qualify for conventional phone service.[13] In Latin America, where prepaid services prevail, the number of new mobile users has exceeded new subscribers to fixed-line services each year since 1997; one in four phone users in the region now relies on a cellular.[14]

In Africa, the number of mobile phones surpassed the number of fixed-line connections in 2001.[15] Four out of five subscribers use prepaid cards.[16] Between 1995 and 2001, the number of mobile networks in Africa grew from 33 to 100, as the number of countries without a mobile network shrunk from 28 to just 6.[17] Although in 1998 only Finland and Cambodia had more mobile subscribers than fixed lines, by the end of 2000 some 38 countries were in this category—and 20 were in Africa.[18]

Technologies and policies that promote cell phone use can benefit poor people. In 2001, a company developed a wind-up mobile phone charger that is well suited to rural areas of the developing world that lack reliable power.[19] Muhammad Yunus, the founder of the Grameen Bank in Bangladesh, believes that loans for small communications businesses can empower people.[20] Since 1997, Grameen Telecom has sold some 2,200 mobile phones to rural entrepreneurs in Bangladesh, mainly women, who in turn sell phone services to their neighbors.[21]

There are drawbacks, however, to increased reliance on mobile phones. For instance, using them while driving poses a hazard on the roads.[22] Discarded cell phones are a growing contributor to electronic waste, as consumers seek the latest technology and some manufacturers introduce disposable models.[23] Finally, researchers continue to ask whether the radio waves emitted by cell phones harm humans, particularly children whose thinner skulls and developing nervous systems make them more vulnerable.[24] In January 2002, the United Kingdom announced several research projects coordinated by the World Health Organization to further investigate this issue.[25]

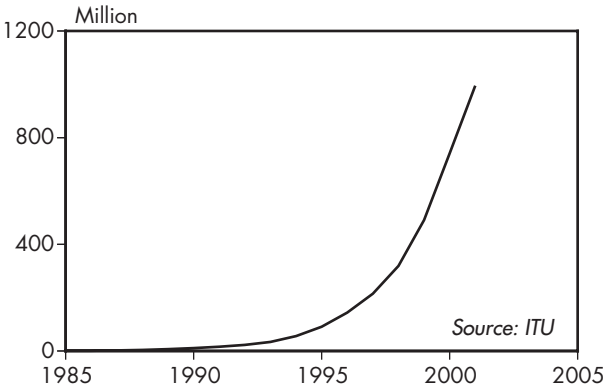

Figure 1: Cellular Telephone Subscribers Worldwide, 1985–2001

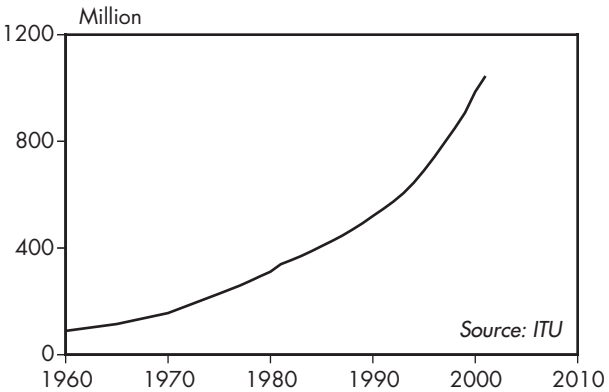

Figure 2: Telephone Lines Worldwide, 1960–2001

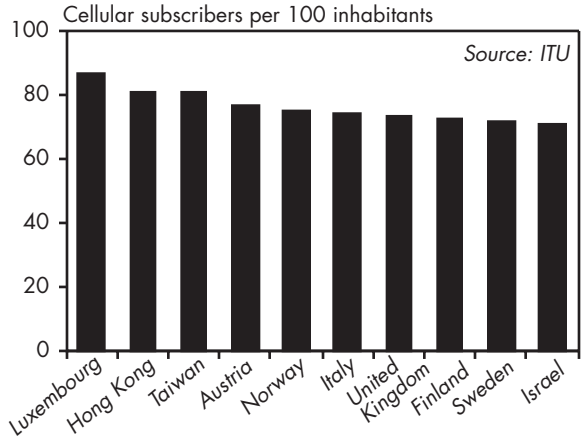

Figure 3: Top 10 Countries with Cellular Phones Per Person, 2000

Telephone Lines and Cellular Phone Subscribers Worldwide, 1960–2001

Year	Telephone Lines	Cellular Phone Subscribers
	(million)	
1960	89	–
1965	115	–
1970	156	–
1975	229	–
1976	244	–
1977	259	–
1978	276	–
1979	294	–
1980	311	–
1981	339	–
1982	354	–
1983	370	–
1984	388	–
1985	407	1
1986	426	1
1987	446	2
1988	469	4
1989	493	7
1990	519	11
1991	545	16
1992	573	23
1993	606	34
1994	646	56
1995	692	91
1996	741	144
1997	781	215
1998	849	319
1999	907	491
2000	986	741
2001 (prel)	1,045	995

Source: ITU, press release, 8 February 2002; ITU, "Cellular Subscribers," 9 January 2002; ITU, *STARS* database.

Health and Social Trends

HARVEY NELSON, M/MC PHOTOSHARE, WWW.JHUCCP.ORG/MMC

Population Growing Steadily

AIDS Passes 20-Year Mark

Population Growing Steadily

Danielle Nierenberg

The world's population swelled to 6.2 billion in 2001—more than double the number in 1950.[1] (See Figure 1.) This represents an increase of 77 million people over the preceding year, roughly the equivalent of another Germany.[2] (See Figure 2.)

More than 95 percent of this growth is occurring in the developing world. And most of the people are added in just a handful of countries—India and China alone account for over one third of the growth.[3]

Africa has the highest growth rate of any region, increasing by 2.4 percent each year.[4] Population there is expected to more than double—from 800 million to 2.3 billion—by 2050.[5] Growth rates in Asia are lower, but they apply to a much larger base.[6] More than half of the world's people—3.7 billion—live in Asia.[7] In South Central Asia, which includes India, Pakistan, Bangladesh, and Afghanistan, population is projected to double from the current 1.5 billion by mid-century.[8]

Link: p. 148

While population in developing nations continues to rise, many industrial nations have low fertility rates. In Armenia, Italy, Spain, the Ukraine, and Russia—where the average woman bears 1.2 children in her lifetime—the low number of births has sparked concern about how these nations will adjust to aging populations and a smaller work force.[9]

The global rate of population growth has actually decreased over the past three decades—from 2.1 percent a year in 1970 to under 1.3 percent today.[10] (See Figure 3.) But this does not mean that population growth is on the decline. In fact, the number of people added to the planet each year is near the all-time high reached in the late 1980s.[11]

In the regions of the world where population continues to grow, the increase is largely caused by a combination of poverty, discrimination and violence against women, and unmet needs for reproductive health care. The United Nations reports that the annual population growth rate in "more developed" nations is just 0.3 percent, compared with 1.62 percent in "less developed" nations.[12] And the "least developed" nations, predominantly in Africa, are growing at 2.5 percent each year.[13]

Rapid population growth makes it hard to increase living standards. Many cities in the developing world have doubled their populations in just the past 15 years, straining their capacity to provide schooling, heath care, and jobs to growing generations.[14]

Although contraceptive use has grown six-fold over the past 40 years—from just 10 percent of couples in 1960 to 60 percent in 2000—there are still barriers preventing women from planning pregnancies.[15] In some sub-Saharan African nations, birth control costs 20 percent of the average income.[16] And sexual violence often leads to unwanted pregnancy—one study in Nicaragua found that abused women are twice as likely as other women to have four or more children.[17]

An estimated 125 million women do not want to be pregnant but are not using any type of contraception.[18] Overall, 350 million women lack any access to family planning services.[19] In addition, the "global gag rule"—the U.S. administration's block on aid to international agencies that advocate or counsel patients about abortion—and a shortage of contraceptives worldwide limit the choices women and couples can make about family size.[20]

This unmet need is likely to grow, exacerbated by growth in the number of young people worldwide and a growing desire to delay childbearing. The largest generation of young people in human history—1.7 billion people aged 10–24—is now reaching reproductive age.[21] Today, 525 million women use contraception, a number projected to reach 742 million by 2015.[22]

But halting population growth is not just about controlling births. Gender inequity in education, politics, and employment prevents women from controlling their own fertility. Only 52 percent of girls in "least developed" nations stay in school after grade 4, and most of the world's illiterates are women.[23] Women are still vastly outnumbered by men at all levels of government.[24]

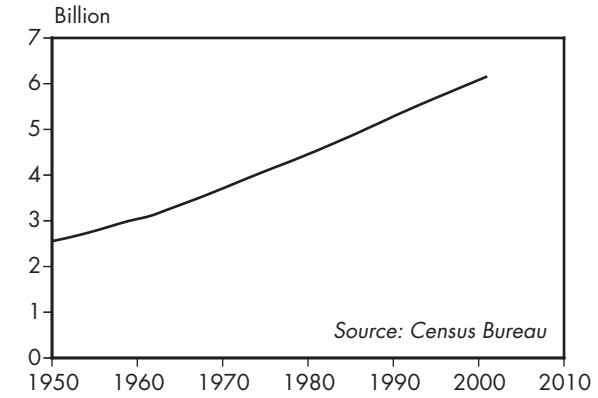

Figure 1: World Population, 1950–2001

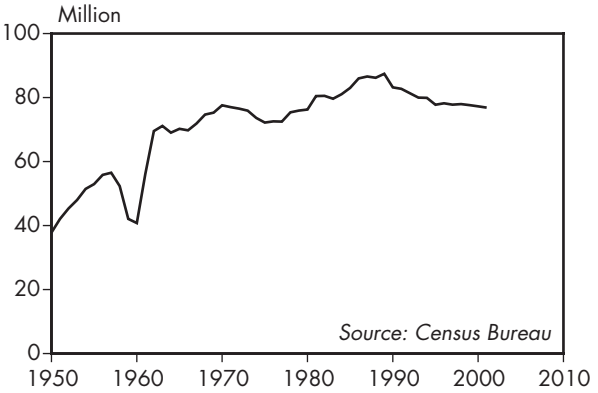

Figure 2: Annual Addition to World Population, 1950–2001

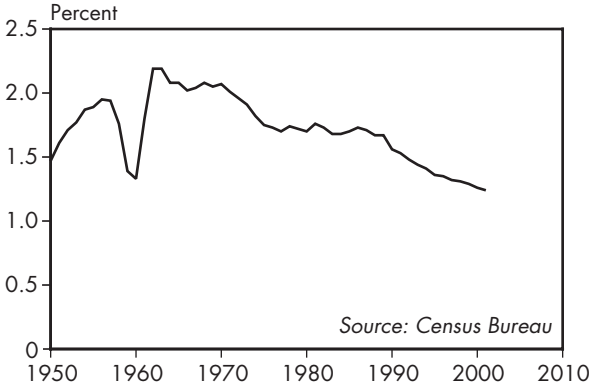

Figure 3: Annual Growth Rate of World Population, 1950–2001

World Population, Total and Annual Addition, 1950–2001

Year	Total* (billion)	Annual Addition (million)
1950	2.555	38
1955	2.780	53
1960	3.039	41
1965	3.346	70
1970	3.708	78
1971	3.785	77
1972	3.862	77
1973	3.939	76
1974	4.015	74
1975	4.088	72
1976	4.160	73
1977	4.233	72
1978	4.305	75
1979	4.381	76
1980	4.457	76
1981	4.533	80
1982	4.613	81
1983	4.694	80
1984	4.774	81
1985	4.855	83
1986	4.938	86
1987	5.024	87
1988	5.110	86
1989	5.196	87
1990	5.284	83
1991	5.367	83
1992	5.450	81
1993	5.531	80
1994	5.611	80
1995	5.691	78
1996	5.769	78
1997	5.847	78
1998	5.925	78
1999	6.003	78
2000	6.080	77
2001 (prel)	6.157	77

*Total at mid-year.
Source: U.S. Bureau of the Census, *International Data Base*, electronic database, Suitland, MD, updated 10 May 2000.

AIDS Passes 20-Year Mark

Ann Hwang

Twenty years after it was recognized as a new disease, AIDS has claimed the lives of almost 25 million people—nearly equivalent to the population of Venezuela.[1] About 40 million more are living with HIV, the virus that causes AIDS. In 2001 alone, 5 million people became infected with the virus and 3 million died.[2] (See Figures 1 and 2.)

Sub-Saharan Africa remains the epidemic's epicenter: one tenth of the world lives there, but they account for nearly three quarters of the world's HIV infections.[3] AIDS is now that continent's leading cause of death.[4] Double-digit infection rates in many southern African countries have lowered life expectancy by 15 years, and in four countries—Botswana, Malawi, Mozambique, and Swaziland—people on average can now expect to die before they turn 40.[5] AIDS is claiming the lives of the continent's teachers, doctors, farmers, workers, and parents. As it does, it not only erases decades of social and economic progress but jeopardizes future growth. Some countries could lose more than 20 percent of their gross domestic product by 2020 due to the effect of AIDS on their work force and productivity.[6]

While infection rates elsewhere have not reached the catastrophic levels found in sub-Saharan Africa, the pace of the pandemic's spread is alarming. In Eastern Europe and Central Asia, the number of infections jumped 33 percent in 2001—from 750,000 to 1 million—fueled largely by the use of injection drugs.[7]

Asia—home to half the world—could become another disease epicenter. In a number of Indian states, more than 3 percent of the population is infected, a level that could spark an explosive disease spread.[8] Similar hot spots are found in China, where HIV is spreading through injection drug use, sexual contact, and, at least in the central provinces, unsanitary blood-selling practices. Some villages where blood-selling was common now have infection rates above 25 percent.[9]

In industrial and developing countries alike, discrimination compounds the suffering of people living with HIV/AIDS. Infected individuals have been fired from their jobs, disowned by their families, and even forcibly sterilized. A survey of 121 countries found that only 21 nations—representing 16 percent of the world's population—have specific laws to protect HIV-positive individuals from discrimination.[10]

In 1984, U.S. Health and Human Services Secretary Margaret Heckler predicted, "There will be a vaccine in a very few years and a cure for AIDS before 1990."[11] Though anti-retroviral therapy has prolonged the lives of many of those infected with HIV, there is still no cure. The therapies themselves have dangerous side effects, such as nerve damage and heart disease. And as HIV mutates, it can evade the drugs' effects and become resistant to treatment. Researchers from the Rand Corporation and the University of California at San Diego recently estimated that half of the HIV patients in the United States have a virus that is resistant to at least one anti-retroviral drug.[12]

In developing countries, where 95 percent of HIV-infected people live, anti-retroviral drugs are nearly impossible to obtain.[13] In sub-Saharan Africa, for example, only 30,000 people—one tenth of 1 percent of those infected—receive the triple anti-retroviral therapy recommended to combat HIV.[14] Despite opposition from pharmaceutical companies, some companies and countries are manufacturing generic versions of anti-retroviral drugs at a fraction of the price of the patented versions. South Africa's Treatment Action Campaign successfully sued the government to increase access to nevirapine, a drug that prevents the transmission of HIV from mother to child.[15]

But even deeply discounted drugs will likely be beyond the reach of most developing countries. And help from the industrial world may be slow in arriving. In April 2001, U.N. Secretary-General Kofi Annan announced the creation of a global fund to combat AIDS, tuberculosis, and malaria. The fund aimed to raise $7–10 billion, but by year's end had received only $2 billion in pledges.[16] And after September 11th, the U.S. Congress slashed its contribution to the new fund from nearly $1 billion to only $200 million—less than a dollar

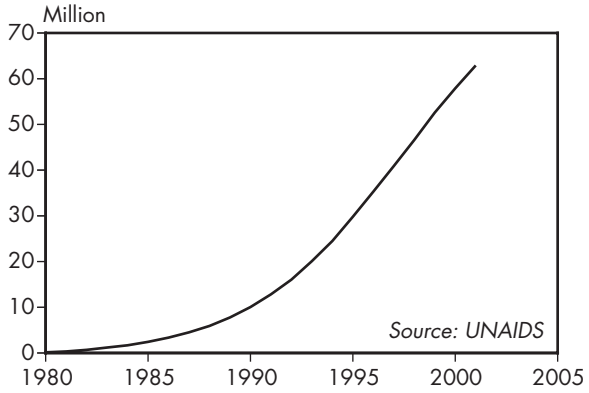

Figure 1: Estimates of Cumulative HIV Infections Worldwide, 1980–2001

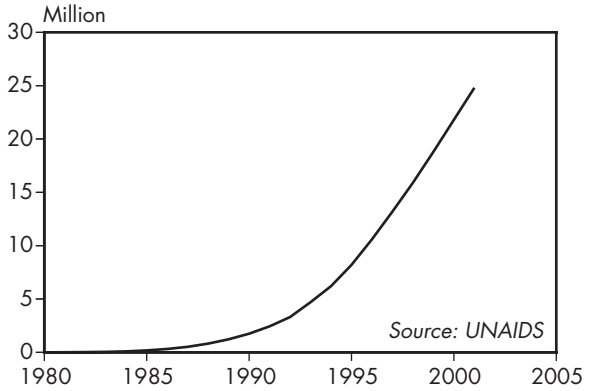

Figure 2: Estimates of Cumulative AIDS Deaths Worldwide, 1980–2001

Cumulative HIV Infections and AIDS Deaths Worldwide, 1980–2001

Year	HIV Infections	AIDS Deaths
	(million)	
1980	0.1	0.0
1981	0.3	0.0
1982	0.7	0.0
1983	1.2	0.0
1984	1.7	0.1
1985	2.4	0.2
1986	3.4	0.3
1987	4.5	0.5
1988	5.9	0.8
1989	7.8	1.2
1990	10.0	1.7
1991	12.8	2.4
1992	16.1	3.3
1993	20.1	4.7
1994	24.5	6.2
1995	29.8	8.2
1996	35.3	10.6
1997	40.9	13.2
1998	46.6	15.9
1999	52.6	18.8
2000	57.9	21.8
2001 (prel)	62.9	24.8

Sources: UNAIDS, *AIDS Epidemic Update: December 2000* and *2001;* Neff Walker, UNAIDS, 20 March 2000.

Military Trends

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Number of Violent Conflicts Declines

Peacekeeping Expenditures Rise Again

Number of Violent Conflicts Declines

Michael Renner

The number of wars worldwide stood at 31 in 2001, down from 35 the previous year, according to AKUF, a conflict research group at the University of Hamburg.[1] (See Figure 1.) In addition, there were 15 "armed conflicts" active in 2001 that were not of sufficient severity to meet AKUF's criteria for war. Combining these two categories, the total number of violent clashes declined slightly—from 47 in 2000 to 46.[2]

The war between Ethiopia and Eritrea ended, and violence in Laos, Chiapas (Mexico), and Nigeria's oil-rich Niger delta subsided.[3] But three conflicts began during 2001: the war against the Taliban regime and the Al Qaeda network in Afghanistan, separatist violence by Albanians in Macedonia, and fighting between Christian and Muslim militias in Nigeria.[4]

Links: pp. 68, 96, 162

The significant decline in the number of conflicts during the 1990s is matched by a decline in the "magnitude" of violence. (The Center for International Development and Conflict Management (CIDCM) at the University of Maryland rates each conflict according to the number of deaths, dislocations, and physical damage wrought.)[5] Likewise, the proportion of countries involved in violent confrontations declined. In 1999, 18 percent of all states were at war, down from 33 percent in 1991.[6]

The September 11th terrorist attacks and the war in Afghanistan overshadowed virtually all other conflicts, and "anti-terrorism" strongly tinted the portrayal and public perception of a number of struggles, including the Israeli-Palestinian confrontation, Russia's fight against Chechen rebels, and the Indian-Pakistani standoff over Kashmir.

Most of the current conflicts are taking place in sub-Saharan Africa, the Middle East, and portions of Asia.[7] And CIDCM finds that countries in these regions "are at serious risk of armed conflict and political instability for the foreseeable future"—mostly because they lack stable and democratic institutions, suffer from a lack of resources, and have limited capacity to address ethnic and other disputes.[8]

It is becoming harder and harder to define and categorize violent conflicts, and not only because information about battles, tactics, motivations, and victims is spotty or unreliable. Armed forces are splintering in many countries even as private or semi-private security forces of various stripes multiply. And violent conflict is often not driven by ideology or the quest for government power but by the motivation to plunder lucrative resources such as diamonds, minerals, oil, and timber. Altogether, about a quarter of the armed conflicts waged during 2000 had a strong resource dimension.[9]

Different definitions and empirical methods among peace research groups lead to somewhat different results, although there is agreement on the broad, overall trends.[10] (See Figure 2.) Of 111 conflicts recorded by the researchers at the Uppsala Conflict Data Project during 1989–2000, 104 were internal (including 9 in which there was also foreign intervention).[11] Only 7 conflicts were interstate wars.[12]

Conflict researchers at the Heidelberg Institute for International Conflict Research in Germany (known as HIIK) cast a wider net than AKUF and the Uppsala group in their assessments of worldwide conflicts. HIIK reports that the number of political conflicts in the world has climbed fairly steadily from 108 in 1992 to 155 in 2001.[13] On the positive side, just 38 of the 155 conflicts were carried out by violent means.[14] (See Figure 3.) And HIIK finds that in more than one third of the conflicts active in 2001, negotiations and other means helped dampen the disputes.[15]

The overall conflict trends since 1990 are encouraging. But taken as a whole, the past century was extraordinarily violent. Milton Leitenberg of the University of Maryland estimates that from 1945 to 2000, some 50–51 million people were killed in wars and other violent conflicts.[16] For the entire twentieth century, he estimates 130–142 million war-related deaths, and a chilling 214–226 million if government killings in non-war situations are included.[17]

Figure 1: Wars and Armed Conflicts, 1950–2001

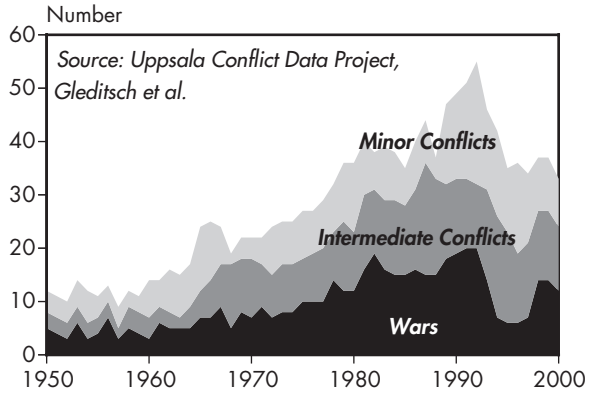

Figure 2: Wars and Intermediate and Minor Conflicts, 1950–2000

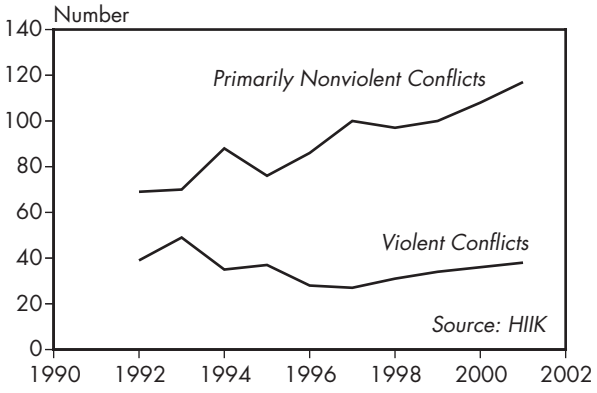

Figure 3: Violent and Nonviolent Conflicts, 1992–2001

Wars and Armed Conflicts, 1950–2001

Year	Wars	Wars and Armed Conflicts
	(number)	
1950	12	
1955	14	
1960	10	
1965	27	
1970	30	
1971	30	
1972	29	
1973	29	
1974	29	
1975	34	
1976	33	
1977	35	
1978	36	
1979	37	
1980	36	
1981	37	
1982	39	
1983	39	
1984	40	
1985	40	
1986	42	
1987	43	
1988	44	
1989	42	
1990	48	
1991	50	
1992	51	
1993	45	62
1994	41	58
1995	36	51
1996	31	49
1997	29	47
1998	32	49
1999	34	48
2000	35	47
2001(prel)	31	46

Source: Arbeitsgemeinschaft Kriegsursachenforschung, Institute for Political

Peacekeeping Expenditures Rise Again

Michael Renner

Expenditures for United Nations peacekeeping operations are expected to continue their rapid upswing, growing from $2.6 billion for the July 2000–June 2001 period to an estimated $2.7–3 billion for July 2001 to June 2002.[1] (See Figure 1.) This means that peacekeeping spending is now edging toward the peak budgets of the mid-1990s.

More than 47,000 soldiers, military observers, and civilian police served in 15 peacekeeping missions active at the end of 2001, up 24 percent from about 38,000 a year earlier.[2] (See Figure 2.) The missions were supported by 12,126 local and international civilian personnel.[3] (In addition to peacekeeping and observer operations, the United Nations also maintained 13 small political and peace-building missions involving about 600 mostly civilian staff; one of these has been working in Afghanistan since 1993.)[4] Since the inception of peacekeeping operations in 1948, a total of 1,706 peacekeepers have died in the line of duty.[5]

Link: p. 94

Ninety countries contributed personnel to the U.N. missions during 2001.[6] Bangladesh and Pakistan scaled up their involvement dramatically; these two countries together currently account for about one fifth of all deployed peacekeepers.[7] Nigeria, India, Jordan, Ghana, Kenya, and Australia are also major contributors. Rounded out by Ukraine and Portugal, the leading 10 sources of personnel provided 58 percent of the total.[8] The five permanent members of the Security Council, by comparison, kept their involvement limited to about 6 percent.[9]

No new missions were initiated or authorized during 2001. On 27 March and 15 December 2001, the United States vetoed resolutions before the U.N. Security Council to establish a U.N. observer force to protect Palestinian civilians in the West Bank and Gaza Strip and to send monitors to help prevent further Israeli-Palestinian violence.[10] The vetoes followed similar votes in December 2000.[11]

U.N. peacekeeping activities and expenditures continued to be dominated by just three operations.[12] About 17,000 peacekeepers—more than a third of the total—are stationed in Sierra Leone alone, where the United Nations is trying to end a decade-long conflict revolving around lucrative diamond resources.[13] Some 8,500 peacekeepers are in East Timor, and about 4,500 in Kosovo.[14] But sizable deployments are also found in southern Lebanon, at the border separating Ethiopia and Eritrea, and in the Democratic Republic of Congo.[15]

Other missions continue at the India-Pakistan border (since 1949), in Cyprus (1964), on the Golan Heights separating Israel and Syria (1974), at the Iraq-Kuwait border (1991), in Western Sahara (1991), in Georgia (1993), in Bosnia (1995), and on the Prevlaka peninsula between Croatia and Serbia (1996).[16]

As of the end of October 2001, U.N. members owed the organization $1.9 billion for peacekeeping operations.[17] (See Figure 3.) The United States accounts for 41 percent of the total unpaid dues, or $787 million.[18] Following payment of some long-standing arrears, this is a significantly lower share than in recent years.[19] With these payments, the United Nations hopes that "for the first time in many years [it] might have a secure basis with which to do business."[20]

In addition to U.N. peacekeeping operations, some three dozen additional missions are being carried out by regional or military organizations, such as NATO, the Organization for Security and Co-operation in Europe, and the Economic Community of West African States, or by ad hoc coalitions of states. Many of them are very small. By far the largest are NATO-led operations in Bosnia, Kosovo, and Macedonia. Together, these Balkan missions deploy about 60,000 soldiers and cost an estimated $8–9 billion annually.[21]

In December 2001, the U.N. Security Council endorsed creation of a British-led International Security Assistance Force to ensure security in Kabul, Afghanistan's capital, following ouster of the Taliban.[22] A force of up to 5,000 soldiers was authorized for a six-month period.

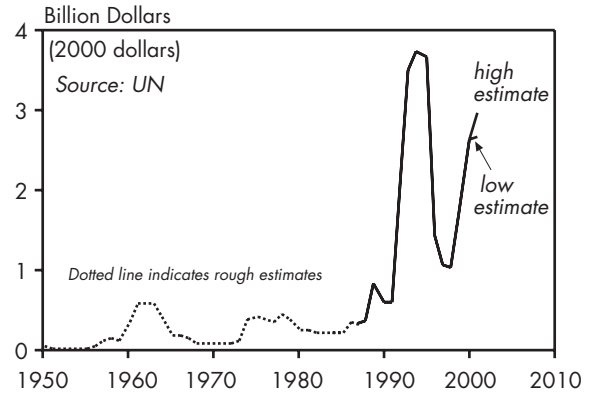

Figure 1: U.N. Peacekeeping Expenditures, 1950–2001

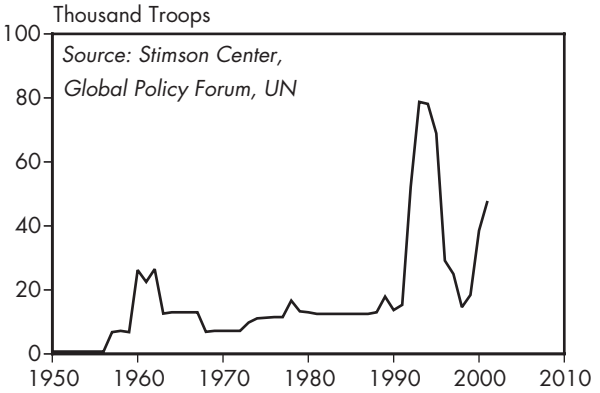

Figure 2: U.N. Peacekeeping Personnel, 1950–2001

Figure 3: Arrears of U.N. Members for Peacekeeping Expenses, 1975–2001

U.N. Peacekeeping Expenditures, 1986–2001

Year	Expenditure (bill. 2000 dollars)
1986	0.344
1987	0.331
1988	0.355
1989	0.815
1990	0.573
1991	0.585
1992	2.058
1993	3.480
1994	3.724
1995	3.668
1996*	1.423
1997*	1.039
1998*	1.037
1999*	1.683
2000*	2.630
2001* (low)	2.650
(high)	2.950

* July to June of following year.
Sources: U.N. Department of Peacekeeping Operations; U.N. Department of Public Information.