

Global Environment

The global nature of many environment and resource issues is evident in the long list of international conventions and agreements agreed to since World War II. The United Nations' Environment Programme's *Register of International Treaties and Other Agreements in the Field of Environment* lists more than 100 agreements (including protocols and amendments) stretching back over five decades.

Most of these conventions and agreements fall into twelve categories: wildlife and biodiversity, marine pollution and resources, marine mammals, fisheries, wetlands, trade in endangered species, land conservation, transboundary air pollution, conservation and management of migratory species, transboundary movements of hazardous wastes, stratospheric ozone, and global climate change. Summaries of all these conventions and agreements (through 1992) are online (<http://sedac.ciesin.org/pidb/register-home.html>).

Wetlands

In 1971, at Ramsar, Iran, wetland protection was the focus of one of the first global environmental treaties. The Ramsar Convention is known formally as the Con-

vention on Wetlands of International Importance Especially as Waterfowl Habitat. The Convention originally focused on waterfowl protection, but has since been broadened to cover multiple aspects of wetlands conservation and freshwater issues.

Ramsar recognizes wetlands as ecosystems that are important for biodiversity conservation and for the benefit of human communities. The Convention's definition of wetlands encompasses five major wetland systems: coastal wetlands (including coral reefs), deltas, tidal marshes, mangrove swamps, wetlands associated with lakes, and wetlands associated with rivers, streams, marshes, swamps, and bogs.

The Ramsar Convention entered into force in 1975; there are currently 110 contracting parties. To join, a country must designate at least one wetlands area that meets the criteria for inclusion on the List of Wetlands of International Importance and agree to implement guidelines for wetlands management. Ramsar commitments are voluntary. There are now over 900 sites covering more than 150 million acres worldwide. The United States, which joined the convention in 1986, has 15 designated Ramsar sites, including well-known areas such as the Chesapeake Bay Estuar-

ine Complex, Everglades National Park, and Delaware Bay Estuary.

Biodiversity

The global loss of genetic and species diversity is occurring at unprecedented rates, threatening to impair the natural infrastructure supporting every human society and economic system. Many factors are contributing to the problem, including land and water degradation, forest conversion, overharvesting of commercial species, and the introduction of non-native species.

Although the total number of species is unknown, UNEP's 1995 Global Biodiversity Assessment concluded that a reasonable estimate is about 14 million, of which about 1.7 million have been scientifically described. The report estimates that between 5 and 20 percent of some groups of animal and plant species could be threatened with extinction in the foreseeable future.

The 1992 Convention on Biological Diversity (CBD) is the main international forum for addressing biodiversity issues. Its three objectives are the conservation of biological diversity, sustainable use of its components, and fair and equitable sharing of any benefits arising from the commercial development of genetic resources. The Convention requires Parties to develop and implement strategies for the conservation, sustainable use and protection of biodiversity, and provides a forum for continued dialogue through annual meetings of the parties.

The CBD came into force in late 1993. Since it was opened for signature in June

1992, 175 of the 183 countries in the United Nations system have ratified or otherwise acceded to it. The United States declined to sign the CBD in 1992 due to concerns with intellectual property rights, technology transfer, and finance provisions. President Clinton signed the CBD in June 1993. The Senate Foreign Relations Committee favorably reported the Convention to the full Senate in June 1994, but the full Senate curtailed consideration of the treaty over concerns about the potential effect of the CBD on land use and agriculture in the United States.

Endangered Species

Although habitat loss is generally considered to be the major reason for the decline in species, the illegal taking of wild specimens for commercial purposes is also a major threat. Some rare and protected species and their parts and derivatives (e.g., skins, shells, horns, leather goods, etc.) are high-value commodities.

In recognition of these problems, the United States in early 1973 convened a conference at the Department of State with 88 participating countries to negotiate a convention to control international trade in threatened species. The Convention on International Trade in Endangered Species of Wild Fauna and Flora, or CITES, was signed by 21 countries in March 1973. The convention entered into force on July 1, 1975; 143 countries are currently parties to the Convention.

CITES lists species on three appendices. Appendix I includes all species threatened with extinction that are or may

be affected by trade. Appendix II includes species that, although not threatened with extinction, may come under threat unless the trade is strictly controlled through a system of permits. Permits for trade are issued only if exporting parties are satisfied that conducting trade does not pose a threat to species survival. Appendix III includes species that any party has placed there because the cooperation of other parties is needed to control or monitor the trade.

International Waters

The degradation of marine, coastal, and river ecosystems is increasingly global in scope and complexity.

For example, many fish stocks are in drastic decline, with three quarters of marine fisheries fully fished, overexploited, depleted, or slowly recovering from collapse. Oversubsidized national fishing fleets are harvesting fish at unsustainable rates, placing both fishery resources and the future of fishing communities at risk.

Many other problems threaten these ecosystems, including a widespread decline in water quality; increasing pressure on water resources for human use; and the loss of watersheds, wetlands, and marine habitats.

The international community has for several decades discussed ways to apply the rule of law to the uses and conservation of the oceans.

The 1982 United Nations Convention on the Law of the Sea (UNCLOS) provides a comprehensive legal framework governing uses of the oceans. It achieved consensus on the nature and extent of

jurisdiction that States may exercise off their coasts: a territorial sea of a maximum breadth of 12 nautical miles and coastal State jurisdiction over fisheries and other resources (e.g., oil and gas) in a 200 nautical-mile Exclusive Economic Zone (EEZ) and on the continental shelf where it extends beyond the EEZ.

The Convention provides for the conservation of living marine resources, including coastal fisheries, straddling stocks (fisheries populations whose range includes both areas of the EEZ and the high seas), and highly migratory species and marine mammals. It also addresses vessel-source pollution, pollution from seabed activities, ocean dumping, and land-based sources of marine pollution.

The United States and other industrialized nations had long objected to the Convention's Part XI, which established a system for regulating the mining of mineral resources from the deep seabed beyond national jurisdiction. A 1994 agreement relating to the implementation of Part XI removed those objections by ensuring that the United States and others will have adequate influence over future decisions on possible deep seabed mining and that the administration of the deep seabed mining regime is based on free market principles. The United States signed the 1994 Agreement and has submitted the Law of the Sea Convention and the Agreement to the Senate for advice and consent.

As of May 1998, there were 125 Parties to the Convention, including the United Kingdom, Japan, Germany, Italy, South Korea, Australia, Russia, China, and France.

Marine Pollution

The problem of marine pollution was recognized prior to World War II and became the subject of international negotiations in the early 1950s. The issue grew in importance with the rapid expansion in the amount of oil transported by tankers. Between the mid-1950s and mid-1970s, the amount of oil transported by sea increased seven-fold and the world's tanker fleet expanded to some 7,000 vessels. OILPOL—the 1954 International Convention for the Prevention of Pollution of the Sea by Oil—was aimed primarily at restricting the amount of oily wastewater that could be discharged in certain areas.

As the demand for maritime oil transportation increased rapidly in the postwar years, the average size of a tanker grew. A single cargo tank on today's large tankers can hold more than twice as much oil as an entire World War II tanker. The large size of tank vessels and major spillage from vessel accidents—such as the grounding and breakup of the *Torrey Canyon* off the Scilly Isles in 1967—stimulated international action to formulate tank vessel design and construction standards aimed at reducing oil outflow following tanker damage.

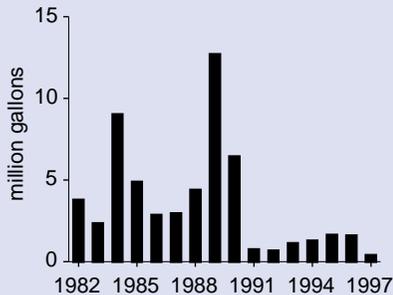
These standards are now incorporated in international conventions, such as MARPOL—the 1973 International Convention on the Prevention of Pollution from Ships, a subsequent 1978 Protocol, and six Annexes—which promotes ship design and equipment that lessen pollution from marine casualties, and provides a means to monitor discharges from

tankers. In addition to preventing pollution by oil, MARPOL was also designed to limit and prohibit other forms of pollution: noxious liquid substances carried in bulk; harmful substances carried in packages, portable tanks, freight containers, or road or rail tank wagons, etc.; sewage from ships; and garbage from ships. It also requires all parties to help reduce pollution by detecting ship violations. The recently negotiated Annex VI deals with air emissions.

The grounding of the *Exxon Valdez* in Prince William Sound in March 1989, and the subsequent spillage of more than 11 million gallons of crude oil into Alaskan waters, resulted in changes in both the character of tank vessel design standards and the manner in which they are formulated. In August 1990, the U.S. Congress promulgated P.L. 101-380, the Oil Pollution Act of 1990 (OPA 90), to minimize oil spills through improved tanker design, operational changes, and greater preparedness. As a result, single-hull tank vessels of 5,000 gross tons or more will be excluded from U.S. waters after 2010 unless they are equipped with a double bottom or double sides, in which case they may be permitted to trade to the United States through 2015, depending on their age. An exemption allows single-hull tankers trading to the United States to unload their cargo offshore at deepwater ports or in designated lightering areas through 2015.

The fact that the United States, as a port state, unilaterally promulgated legislation that applies to all tankers operating in U.S. waters, not just to U.S.-flag vessels, has had a worldwide impact. Following

Figure 11.1 Oil Spills in U.S. Waters by Vessels, 1982-1997



Source: U.S. Department of Transportation, United States Coast Guard. *Pollution Incidents In and Around U.S. Waters -- A Spill/Release Compendium: 1969-1997* (DOT, USCG, Washington, DC, 1999).

the passage of OPA 90, changes in the international regulatory regime in the form of two additions to MARPOL 73/78 mandated a worldwide transition to double-hull vessels or their equivalents.

As a result of these laws and conventions and the development of better methods for controlling the disposal of wastes, the amount of pollution from ships has declined during the last two decades. According to a study by the U.S. National Academy of Sciences, oil pollution from ships fell by about 60 percent during the 1980s, while the number of oil spills has also been greatly reduced. The Academy concludes that the recent reduction in oil spillage in U.S. waters (Figure 11.1) can be attributed to a number of actions: an increased awareness among vessel owners and operators of the financial consequences of oil spills and a resulting increase in attention to policies and procedures aimed at eliminating vessel accidents; actions by port states to ensure the safety of vessels using their ports; increased

efforts by ship classification societies to ensure that vessels under their classification meet or exceed existing requirements; improved audit and inspection programs by charterers and terminals; and the increased liability, financial responsibility, and other provisions of OPA 90.

Coral Reefs

Coral colonies thrive in warm water that is free of sediment and pollution. Because reef-building corals require sunlight for photosynthesis, they are generally found in clear, shallow water, usually 75 feet or less.

In many parts of the world, coral colonies are threatened. Diseases and other phenomena are killing 50-80 percent of the elkhorn coral off South Florida and 90 percent of the coral cover in a Venezuelan national park. Many corals are affected by coral bleaching—disturbances such as temperature extremes, hypersalinity, pollutants, or changes in radiation flux can cause coral to expel symbiotic algae that help nourish the coral, and thus the coral turn white and die.

Formed in 1994, the International Coral Reef Initiative (ICRI) is a partnership of local communities, scientists, conservation groups, resource users, private interests, and governments working to protect and manage coral reef resources, including associated ecosystems such as sea grass beds and mangroves.

With strong U.S. support, ICRI has grown rapidly over the past three years from a small group of founding partners to a large consortium in which over 73 countries participate. International activities

under the Initiative have included a major diplomatic campaign and a series of global and regional workshops. Among its other achievements, ICRI has established a Global Coral Reef Monitoring System, intended to gather baseline data on coral reefs around the world so that thoughtful and informed conservation and sustainable use strategies can be developed.

In June 1998, President Clinton issued Executive Order 13089, which deals with the protection of coral reefs in U.S. waters, including reef systems in the south Atlantic, Caribbean, Gulf of Mexico, and Pacific Ocean. It orders all federal agencies whose actions may affect U.S. coral reef ecosystems to ensure that any actions they authorize, fund, or carry out will not degrade the conditions of such ecosystems. The Order also creates a U.S. Coral Reef Task Force, which is charged with overseeing implementation of the policy. The order is available on the White House website (www.whitehouse.gov).

Desertification

In Africa and elsewhere, vast areas of land are threatened by desertification, a process of land degradation in dryland areas where the earth is especially fragile and there is little or no rainfall. The causes of desertification include both climate variations and human activities, including overcultivation, deforestation, and overgrazing of livestock. In many areas, poverty drives people to overuse their land, which triggers the desertification process.

The Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification,

Particularly in Africa (CCD) was first conceived in 1992 and entered into force in December 1996. President Clinton signed the CCD, which awaits advice and consent in the Senate. The Convention has been ratified by 137 countries.

Recognizing the links between poverty and desertification, the Convention places great emphasis on solving the root causes of desertification by calling for a “bottom-up” approach to desertification prevention efforts that includes active involvement on the part of local communities.

Transboundary Movements of Hazardous Waste

The 1989 Basel Convention on Transboundary Movements of Hazardous Waste controls international trade in hazardous wastes. Under the Convention’s provisions, trade in hazardous wastes cannot take place without the importing country’s written consent or under conditions in which the wastes cannot be handled in an environmentally sound manner.

U.S. ratification efforts stalled due to concerns over an amendment to the Convention to ban all exports of hazardous waste—whether for disposal or recycling—from OECD to non-OECD countries. Although this amendment has not entered into force, concerns were raised that the ban could affect trade in such things as secondary recyclable materials like scrap metal and scrap paper. Since then, the Basel Parties have clarified that secondary recyclable materials such as scrap metal and paper are not covered by the Convention. U.S. agencies are now examining the

possibility of introducing implementing legislation to allow the United States to ratify the Convention.

Stratospheric Ozone

The discovery in the early 1970s of a connection between emissions of a group of chemicals and depletion of the stratospheric ozone layer underscored the realization that some environmental problems are actually global in nature.

Working at the University of California, Sherwood Rowland and Mario Molina discovered that chlorofluorocarbons could drift up to the stratosphere, decay, and, under the influence of intense ultraviolet radiation, release chlorine atoms in the process. In a catalytic chain reaction, the chlorine would aggressively attack ozone molecules, with each chlorine atom triggering the destruction of tens of thousands of ozone compounds.

During the 1980s, the scientific community provided increasing evidence of the linkages between human activities and ozone depletion. International leaders in 1985 agreed to the Vienna Convention on the Protection of the Ozone Layer, and then in 1987 to the Montreal Protocol on Substances that Deplete the Ozone Layer. By 1989, the scientific community had confirmed conclusively that ozone depletion was linked to human activities and posed an immediate threat to human health and the global environment.

The Montreal Protocol on Substances that Deplete the Ozone Layer has been remarkably successful in reducing global production of chlorofluorocarbons (CFCs) (Figure 11.2). Since the treaty was

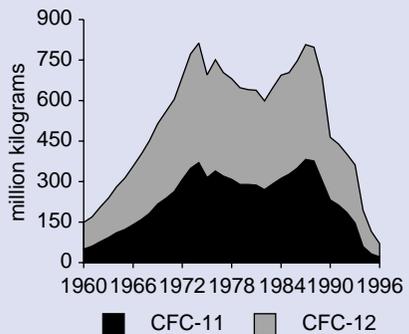
adopted in 1987, global consumption of CFCs has declined more than 70 percent. But long-term success is still not assured. In some developing nations, production of CFCs and other ozone-depleting chemicals is increasing. Production of halons, typically used as fire retardants and 3 to 10 times more destructive to the ozone layer than CFCs, is also rising in some developing nations. (Part III, Table 11.3)

Climate Change

Since the 1950s, scientists have been considering the possibility that human activities could be fundamentally altering the global climate. The theory was that emissions of certain “greenhouse” gases—mainly carbon dioxide, but also methane, nitrous oxide, CFCs, sulfur hexafluoride, hydrofluorocarbons, and perfluorocarbons—were increasing in the atmosphere and working like a blanket by trapping heat.

Several global climate models were run in the 1960s, and DOE began a substan-

Figure 11.2 Annual Global Production of CFCs, 1960-1996



Source: See Part III, Table 11.3.

tial research program on carbon dioxide and climate in 1978. International discussions on climate change began with the first World Climate Conference, sponsored by the United Nations in 1979. Policymakers became seriously interested in the issue in the late 1980s. In 1988, governments agreed to support an international scientific evaluation of climate change and created the Intergovernmental Panel on Climate Change (IPCC) under the supervision of the United Nations Environment Programme and World Meteorological Organization. The IPCC published its first assessment in 1990, which concluded that if current emissions trends continued mean global temperatures would rise at the 0.3 degrees Centigrade per decade.

At the Earth Summit in Rio de Janeiro in 1992, more than 150 governments signed the Framework Convention on Climate Change. Developed countries agreed to the “aim” of returning their greenhouse emissions to 1990 levels by the year 2000. Developing countries agreed to prepare inventories of emissions and strategies to mitigate climate change with financial support from the industrialized nations.

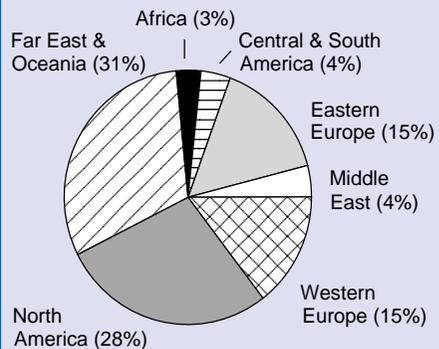
At the end of 1995, the IPCC released its Second Assessment Report. The report concludes that “the balance of evidence suggests that human activities are having a discernible influence on global climate.”

The largely voluntary targets created by the 1992 Framework Convention proved insufficient. By the end of 1997, emissions had increased in all but a few developed nations and prospects for meeting the year 2000 target were poor. In July

1996, the United States announced its support for a framework based on “realistic, verifiable, and binding” medium-term targets. In December 1997, at the third Conference of the Parties to the Framework Convention in Kyoto, Japan, more than 160 nations produced a Protocol to the convention. Under the Protocol, industrialized nations agreed to reduce their aggregate emissions of a “basket” of six greenhouse gases by at least 5 percent below 1990 levels in the period 2008-2012. Further elaboration of other issues, e.g., flexibility mechanisms, were left for the next meeting at Buenos Aires in 1998 and subsequent meetings.

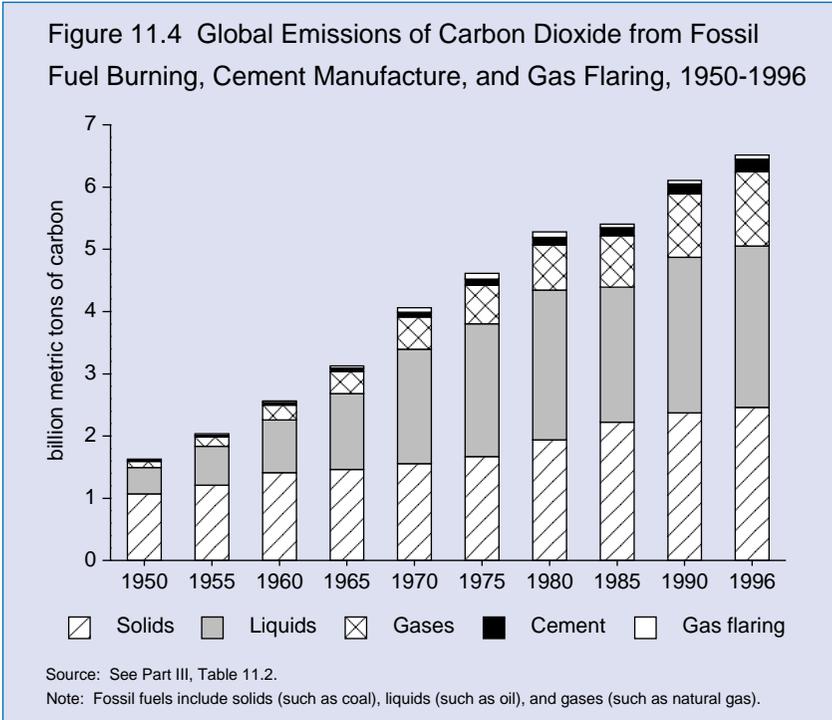
Over the 1986-95 period, world emissions of carbon dioxide from fossil fuel burning and gas flaring (excluding emissions from cement manufacturing) rose from an estimated 5.27 to 6.06 billion metric tons of carbon, or about 15 percent. But trends are quite uneven among regions (Figure 11.3). In the Far East, the

Figure 11.3 Global Carbon Dioxide Emissions by Region, 1995



Source: See Part III, Table 11.1

Notes: Far East & Oceania includes China. North America includes United States, Canada, and Mexico.



combination of population growth, rapid industrialization, and dependence on coal (which produces the highest CO₂ emissions of any fuel) as the primary source of fuel is leading to a rapid increase in CO₂ emissions. Over the 1986-95 period, emissions rose by more than 50 percent. In Africa, population is growing rapidly, but industrialization is occurring slowly, so energy consumption is stable and CO₂ emissions are rising only slightly. In Eastern Europe and the nations of the former Soviet Union, the transition from central planning to market economies resulted in a significant fall in economic output, slowed economic growth, and the shutdown of many inefficient industries. As a result, both energy consumption and CO₂ emissions

declined over the 1986-1995 period in these countries. (Part III, Table 11.1)

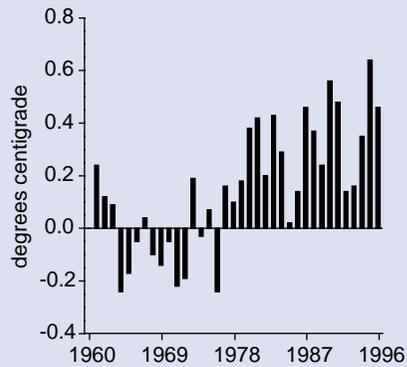
Developed nations account for only about 20 percent of world population but consume about two thirds of the world's energy. But energy use is expected to grow quickly in many parts of the developing world. The developing nations' share of commercial energy consumption could rise to about 40 percent by the year 2010, and their share of CO₂ emissions (excluding emissions from land-use change) to 45 percent of the global total.

The relative carbon dioxide emissions of three major fossil fuels—natural gas, oil, and coal—differ substantially (Figure 11.4). Compared to natural gas, oil emits about 50 percent and coal about 80 percent more CO₂. At present, however, the

energy market is dominated by coal and oil, which together account for about two thirds of global commercial energy production. Gas production has grown by about 46 percent over the 1985-96 period, but provides about 25 percent of global commercial energy production. Coal and oil production are growing at much slower rates, but they have a disproportionate impact on CO₂ emissions. (Part III, Table 11.2)

Since 1860, it is estimated that global CO₂ concentrations have increased from about 280 parts per million to about 360 parts per million today, or about 30 percent. Roughly half of that increase has occurred since 1970 (Figure 11.5). Atmospheric methane concentrations have been increasing in the atmosphere by about 0.6 percent annually and have more than doubled since 1860. Methane has both natural sources (peat bogs, termites, swamps, and other wetlands) and human sources (rice paddies, domestic livestock, landfills, biomass burning, and the production and burning of fossil fuels). About 60 to 80 percent of all methane emissions

Figure 11.6 Global Temperature Anomalies, 1960-1996

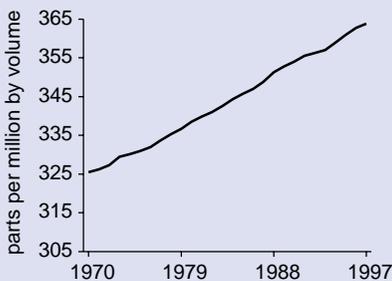


Source: See Part III, Table 11.5.
 Note: Estimates are calculated relative to a 1958-1977 reference period mean.

are of human origin, with fossil fuels accounting for about 20 percent of the total. Methane accounts for about 20 percent of greenhouse warming from human sources. Nitrous oxide, which accounts for about five per cent of the human sources of greenhouse warming, comes from the application of nitrogen fertilizers to agricultural lands, the burning of biomass and fuels, and industrial chemical production. Halogenated compounds such as CFCs, which contain fluorine, chlorine, bromine, or iodine, account for about 10 percent of warming from human sources. (Part III, Table 11.4)

Using a global network of 63 radiosonde stations, the NOAA Air Resources Laboratory has calculated surface temperatures and thickness-derived temperature anomalies over the globe (Figure 11.6) and several global regions during the 1958-96 period. These estimates have been calculated relative to a 1958-77 reference period mean. For the

Figure 11.5 Global CO₂ Concentrations, 1970-1997



Source: See Part III, Table 11.4.
 Note: CO₂ = Carbon dioxide. Data are from the Mauna Loa Observatory, Hawaii.

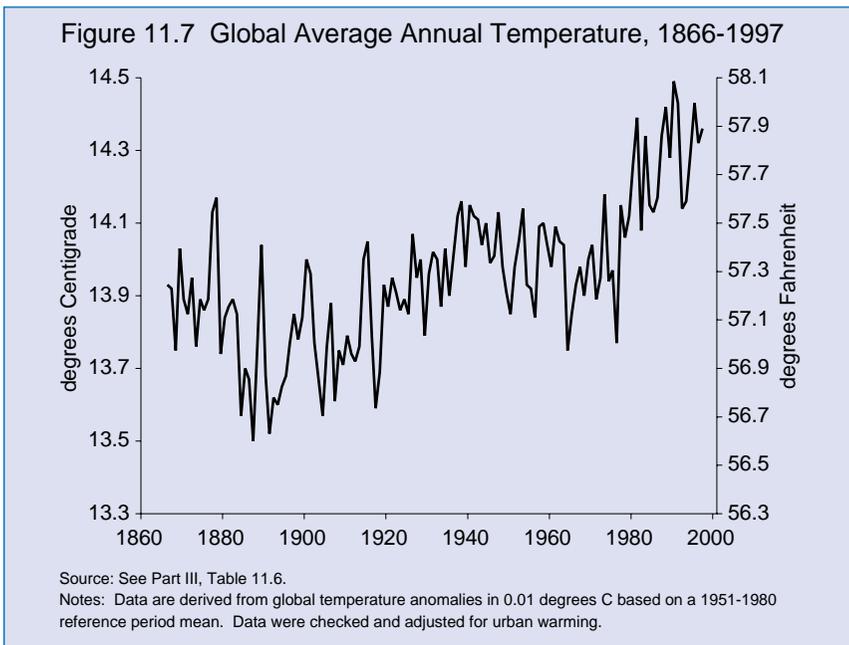
globe as a whole, the data show that temperatures have been consistently and substantially above the reference period in the 1980s and 1990s. (Part III, Table 11.5)

Another source of global surface air temperature data is the Global Historical Climatology Network which consists of rural and small town meteorological stations, and urban meteorological stations adjusted such that their long-term trend matches that of rural neighbors. The data are analyzed by NASA Goddard Institute for Space Studies (GISS) to provide a measure of the changing global surface temperature with monthly resolution for the period since the mid-1800s, when a reasonably global distribution of meteorological stations was established. On an absolute scale, these data show that the average surface temperature of the Earth has increased by about 1.0 degrees

Fahrenheit over the last century (Figure 11.7). The thirteen warmest years this century have all occurred since 1980, with 1997 the warmest on record. The higher latitudes have warmed more than the equatorial regions. (See Part III, Table 11.6)

ONLINE RESOURCES

Many institutions offer information related to global environmental issues. One good general source is the United Nations Environment Programme (<http://www.unep.org>). This site offers information on the state of the global environment, on countries and regions, and on environmental legal instruments. UNEP's environmental links page (<http://www.unep.org/unep/newlink.htm>) provides links to the UN Common



System, to ministries of environment, to networks such as INFOTERRA, and elsewhere.

At the U.S. Department of State, the Bureau of Oceans and International Environmental and Scientific Affairs maintains a valuable website (<http://www.state.gov/www/global/oes/index.html>). This site includes fact sheets on numerous global environmental conventions, including MARPOL, RAMSAR, CITES, the Law of the Sea, the Basel Convention, and the Convention on Desertification. The site also can steer users to related websites of interest.

The Center for International Earth Science Information Network (CIESIN) site at Columbia University, which is federally supported, provides both data and textual information resources on a variety of global environmental issues (<http://www.ciesin.org>).

Another important site is the Global Environment Facility (GEF), which is the financing arm for the climate change and biodiversity conventions. GEF (<http://www.gefweb.org>) provides information about financing, GEF reports, and links to other sites.

The International Institute for Sustainable Development (<http://www.iisd.ca>) has a links page (<http://www.iisd.ca/linkages>) that leads to the Earth Negotiations Bulletin, IISD's reporting service on ongoing international negotiations on climate change, ozone, biodiversity, desertification, global forests, etc. The World Resources Institute (<http://www.wri.org>) also provides news and data on global environmental issues. WRI recently released a *Guide to Global Environmental*

Statistics which is an electronic directory to statistical programs of environmental relevance aimed at helping people quickly find the environmental statistics and knowledgeable contacts they seek (<http://www.wri.org/sdis/global-g/index.html>).

Climate Change

The Framework Convention on Climate Change (<http://www.unfccc.de>) provides voluminous information on the convention. The site provides a series of tables on anthropogenic emissions of CO₂, CH₄, and N₂O, plus data on per capita emissions, total primary energy supply by energy type, and projected anthropogenic emissions (<http://www.unfccc.de/resource/iuckit/fact30.html>).

The Intergovernmental Panel on Climate Change (IPCC) (<http://www.ipcc.ch>) is another significant source of information. The IPCC is organized into three working groups: Working Group I concentrates on the climate system; Working Group II on impacts and response options; and Working Group III on economic and social dimensions. The IPCC released its *Second Assessment Report* in 1995 and continues to produce Technical Papers and develop methodologies for use by Parties to the Climate Change Convention. Many of these reports are listed online (<http://www.ipcc.ch/pub/reports.htm>), including a special report on the regional impacts of climate change (<http://www.ipcc.ch/pub/sr97.pdf>).

The IPCC has begun a Data Distribution Centre (http://ipccddc.cru.uea.ac.uk/ipcc_ddc.html) that provides a consistent set of up-to-date scenarios of changes in

climate and related socioeconomic and environmental factors for use in climate-impact assessments. Researchers who wish to download the scenario data, which cannot be used for commercial purposes, are required to register with the IPCC.

In the United States, the Department of Energy's Energy Information Administration provides reports on national emissions of greenhouse gases. *Emissions of Greenhouse Gases in the U.S. 1997* (<http://www.eia.doe.gov/oiaf/1605/gg98rpt/preface.html>) is EIA's 6th annual edition of the U.S. greenhouse gas emissions inventory report. This report presents estimates of U.S. anthropogenic (human-caused) emissions of carbon dioxide, methane, nitrous oxide, halocarbons, and criteria pollutants for 1997. A detailed discussion of the emission coefficients for fossil fuels used in the 1997 report can be found in Appendix A of the 1987-92 report.

Other U.S. government sites include DOE/ORNL's Carbon Dioxide Information Analysis Center (CDIAC) (<http://cdiac.esd.ornl.gov>); NASA Goddard Institute for Space Studies (GISS) (<http://www.giss.nasa.gov/data/update/>); the U.S. Global Change Research Information Office (<http://www.gcrio.org>); and the Global Change Data and Information System (<http://www.gcdis.usgcrp.gov>).

EPA and NOAA also maintain valuable sites on climate change issues. EPA's global warming site (<http://www.epa.gov/oppeoe1/globalwarming>) includes material that describes the problem and what we know about it, the potential seriousness of the problem now and in the future, and some of the actions currently underway

to ameliorate the problem. NOAA provides information about climate variability, climate models, climate and weather extremes, and other issues (<http://www.ncdc.noaa.gov/pw/cg/decadal.html>).

EPA has done extensive work on cost-effective opportunities to mitigate the negative effects of climate change. In cooperation with the Lawrence Berkeley National Laboratory (LBNL), EPA's Office of Atmospheric Research has recently completed a study on opportunities for domestic investments in technology that can both save money and reduce greenhouse gas emissions (<http://enduse.lbl.gov/Projects/GHGcosts.html>). In addition, EPA's Energy Star programs (<http://www.epa.gov/energystar>) are specifically designed to reduce greenhouse gas emissions through voluntary initiatives that also save money for both consumers and businesses.

Biodiversity

The Convention on Biological Diversity website (<http://www.biodiv.org>) provides information about the history of the convention, key thematic areas, scientific and technical advice, and upcoming meetings and events. The site includes the articles of the convention and the ratification list.

Another important site is the World Conservation Union (IUCN) (<http://www.iucn.org>). IUCN publishes numerous reports on threatened and endangered species. *The 1996 IUCN Red List of Threatened Animals* includes for the first time an assessment of the conservation status of all known mammal and bird species. It includes articles about new

categories of threat, information on the sources and quality of data, and two guest essays. The actual list of threatened animals is in a searchable database maintained by the World Conservation Monitoring Centre. IUCN also has issued *The Red List of Threatened Plants* and *The World List of Threatened Trees*.

At the World Bank (<http://www.worldbank.org>), under themes/biodiversity, information is available about bank projects, partnerships, and publications. As of October 1998, biodiversity lending totaled \$956 million for 101 projects or components in 56 countries. Of the total, \$619 million represents borrowing and another \$337 represents grants from the Global Environment Facility or the Brazil Rain Forest Trust Fund.

Ozone Depletion

Information about the science of ozone depletion, regulations in the U.S. designed to protect the ozone layer, and other topics are listed at a site maintained by EPA's Stratospheric Protection Division (<http://www.epa.gov/ozone/index.html>).

Information about the Montreal Protocol can be found at the Ozone Secretariat (<http://www.unep.org/unep/secretar/ozone/home.htm>). The site includes information about the status of ratification of the Montreal Protocol, the protocol's financial mechanism, current and upcoming activities, common questions about ozone, and useful links. Information about the protocol's control measures and non-compliance procedures is available as well (<http://www.unep.org/unep/secretar/ozone/issues.htm>).

The executive summary of *Scientific Assessment of Ozone Depletion: 1994* (<http://www.al.noaa.gov/WWWHD/pubdocs/WMOUNE94.html>) was prepared by 295 international scientific experts and provides an up-to-date assessment of ozone depletion science.

As part of its information clearinghouse services for developing countries, UNEP's OzonAction Programme has recently released its fifth version of the OzonAction Diskette, a self-contained, Windows-based database system that enables target users in developing countries to research and solve technical and policy problems related to ODS phase-out (<http://www.unepie.org/ozat/aboutus/oaicdv5.html>).

The Technology and Economic Assessment Panel (TEAP) of the Montreal Protocol maintains a website (<http://www.teap.org>). The site has several categories, including aerosols, economics, foams, halons, methyl bromide, process agents, refrigeration, and solvents. The site provides technical information about the alternative technologies that have been investigated and employed to eliminate use of CFCs and halons. All reports, notes, and other materials are available for downloading in PDF format.

Water

The World Bank website on water (<http://www.worldbank.org>, under development themes/water) is organized along four main themes: hydropower; water supply and sanitation; water resources management in rural development (including agricultural irrigation and drainage) and environmental dimensions of water

resources management (freshwater, coastal and marine, inter-basin water transfers, and regional programs).

Under water supply and sanitation, a section on publications includes a long list of studies and reports on water demand and financing, handpumps, utilities and public/private participation, participation and gender, wastewater management and reuse, water resources management and conservation, and industrialized country experience. Many publications can be ordered free of charge. Under the environmental dimensions of water theme, there is a useful

links page that can take researchers to other sites dealing with issues such as integrated coastal management and coral reefs.

Another valuable site is maintained by the Stockholm Environment Institute (<http://www.sei.se/seihq.html>). The UN and SEI recently produced the *Comprehensive Assessment of the Freshwater Resources of the World*. Information about this report is available at the SEI website. SEI also maintains an interactive "Water Forum" on global water issues.

SELECTED RESOURCES

Climate

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Wilson, E.O., *The Diversity of Life* (Belknap Press, Cambridge, MA, 1992).

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World Resources Institute, IUCN, UNEP, *Global Biodiversity Strategy* (WRI, IUCN, UNEP, Washington, DC, 1992).

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Stockholm Environment Institute, *Comprehensive Assessment of the Freshwater Resources of the World* (SEI, Stockholm, 1997).

Ozone

Sebastian Oberthur, *Production and Consumption of Ozone-Depleting Substances, 1986-1995* (Deutsche Gesellschaft für Technische Zusammenarbeit, Bonn, Germany, 1997).

World Meteorological Organization, *Scientific Assessment of Ozone Depletion: 1994* (WMO, Geneva, 1995).

CORE DATA

Table 11.1 World Population, Energy Consumption, and Energy-Related Carbon Dioxide Emissions by Region, 1986-1995

Table 11.2 Global Emissions of Carbon Dioxide from Fossil-Fuel Burning, Cement Manufacture, and Gas Flaring, Five-Year Intervals, 1950-1960, and Annually, 1961-1996

Table 11.3 Global Production and Atmospheric Release of Chlorofluorocarbons, 1960-1996

Table 11.4 Global Atmospheric Concentrations of Greenhouse and Ozone-depleting Gases, 1970-1997

Table 11.5 Global and Regional Surface Temperature Anomalies, 1960-1996

Table 11.6 Annual Average Global Temperature, 1866-1997