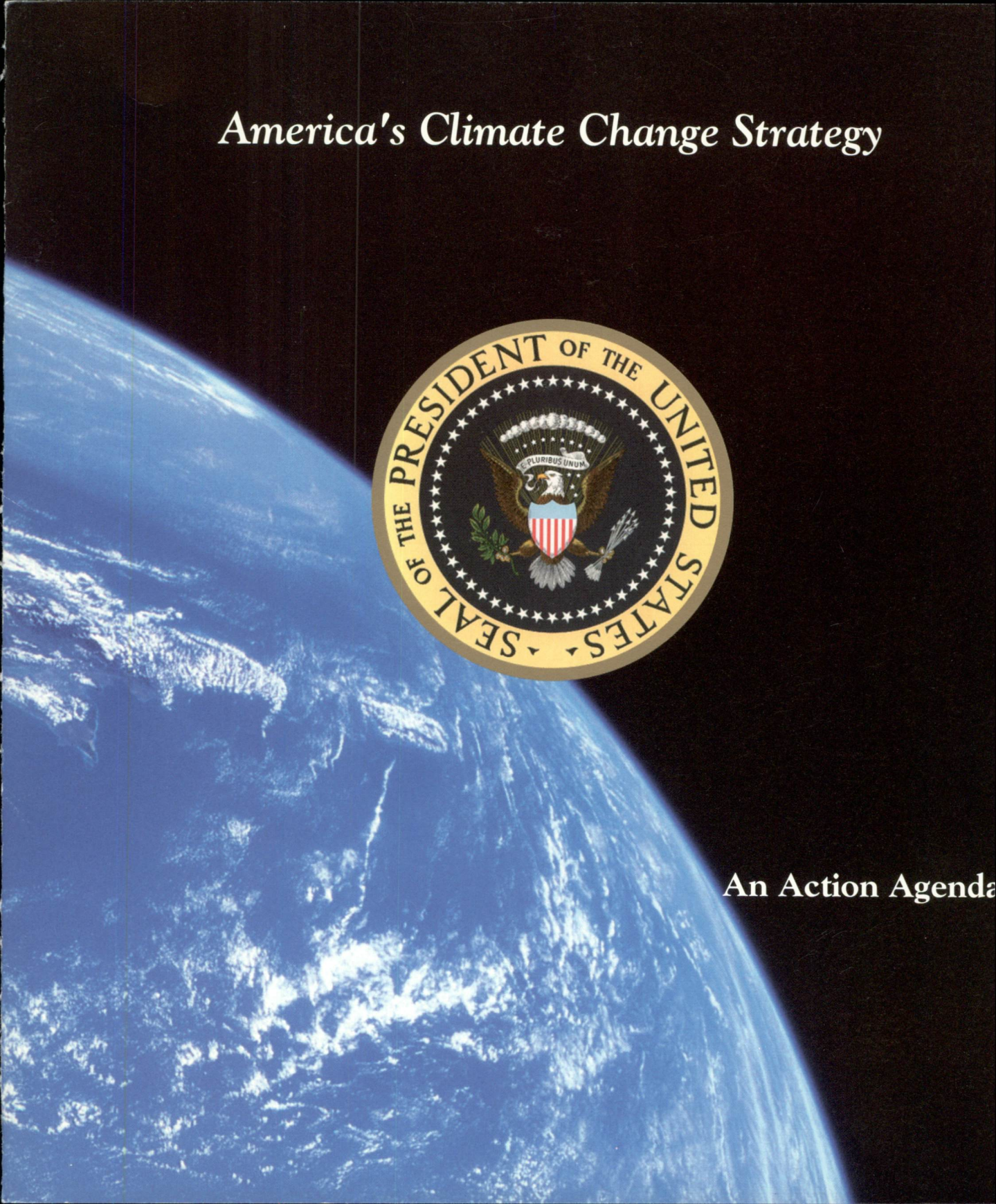
America's Climate Change Strategy



An Action Agenda

CLIMATE CHANGE: Comprehensive Approach

Gases


H2O


CO2

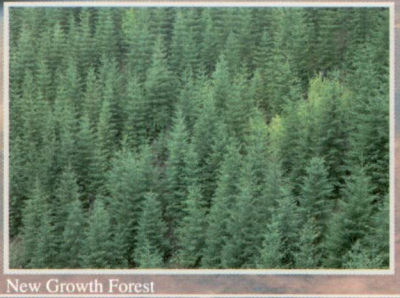

CH4


COS


N2O

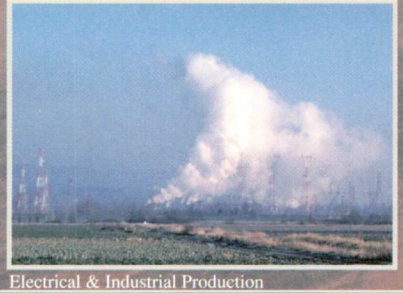
Sinks

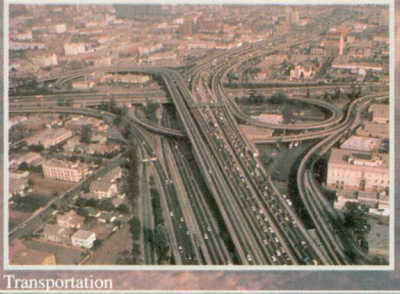

Rainforest

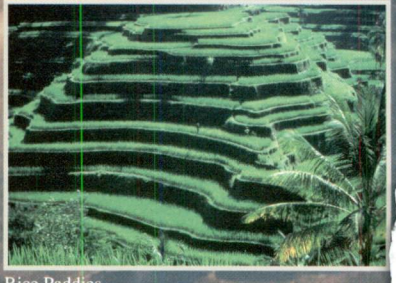

New Growth Forest


Old Growth Forest

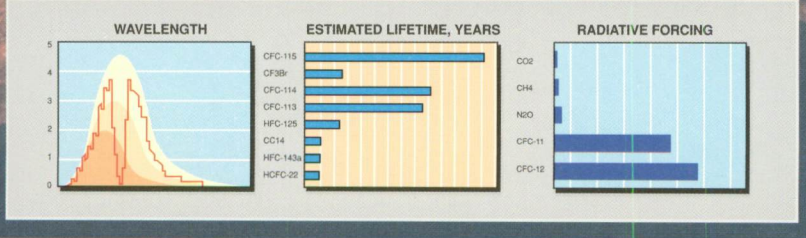
Sources


Electrical & Industrial Production


Transportation


Rice Paddies

Global Warming Potential Index



LEADERSHIP AND ACTION

President Bush has established the comprehensive strategy for action and leadership outlined on the following pages. This strategy flows from his commitment to responsible stewardship of our planet, which includes the promotion of economic growth and sound environmental policies. It is built upon a series of actions which will have broad ranging benefits—from curbing air pollution, to conserving energy, to restoring forest lands—and which will help curb net greenhouse gas emissions.

The U.S. believes that any successful global climate change strategy must be:

- ***comprehensive***, incorporating all relevant greenhouse gases, their sources and sinks;
- ***long term***, taking into account the full range of social, economic, and environmental consequences of proposed actions for this and future generations;
- ***flexible***, built on many diverse actions (including market incentives) and readily adjustable as knowledge is improved through a robust research and development program; and,
- ***integrated***, designed to involve all nations and dynamically reflect and incorporate each nation's unique circumstances into the development of a truly global response strategy.

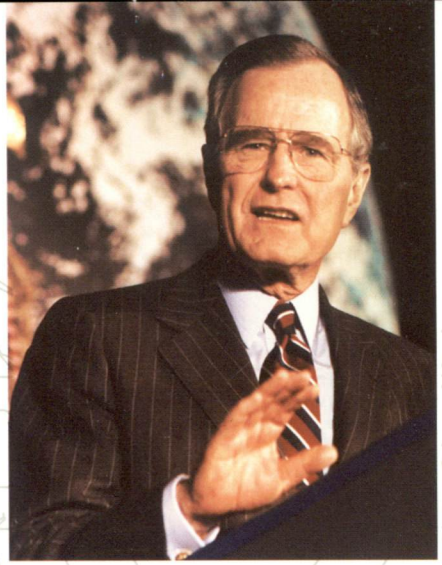
The actions which are currently included in the U.S. Climate Change Strategy will result in U.S. greenhouse gas emissions in the year 2000 being equal to or below the 1987 level. In addition, the U. S. has essentially stabilized its emissions of carbon dioxide (CO2) over the last 15 years despite a growth in economic output of about 50 percent. During this same period, global carbon dioxide emissions have increased substantially.

This U.S. Strategy for Climate Change includes many specific actions:

- eliminating stratospheric ozone-depleting compounds which are also strong greenhouse gases;
- directly controlling various greenhouse gases and their precursors which are also air pollutants;
- reducing utility and other industrial emissions in a way that strongly encourages energy efficiency;
- increasing forest greenhouse gas sinks;
- encouraging energy efficiency in such areas as buildings, appliances, and lighting; and
- increasing the use of renewable and non-fossil sources of energy.

Integral to the U.S. Climate Change Strategy is the world's largest program of research and development:

- to increase our scientific and economic understanding of climate change and to provide a sound knowledge base for making major policy decisions; and,



- to develop and to accelerate the adoption of economically sound, environmentally beneficial, and energy efficient technologies.

In total, the U.S. proposes to invest over 2 billion dollars in these R&D efforts next year alone.

In August 1990, the Intergovermental Panel on Climate Change (IPCC) declared in its Overview: "A comprehensive strategy addressing all aspects of the problem and reflecting environmental, economic, and social costs and benefits is necessary."

The President of the United States has established such a comprehensive strategy. The United States, today, is working to curb emissions, promote economic growth, and exercise leadership in meeting our shared responsibilities as stewards of the planet.

The United States is taking action.

GOAL: *To establish the scientific basis for National and International policy making relating to natural and human—induced changes in the global Earth system.*

particularly the climate aspects. This is to be complemented by a program of economics research to better understand the economic factors and consequences of global change and various mitigation and adaptation strategies. It is the intent of the US/GCRP to provide leaders of government with the best possible scientific and economic information as inputs to environmental policy decisions.

The highest priorities for the US/GCRP in FY 1992 are to:

1. Enhance scientific research efforts that seek to *reduce the scientific uncertainties* identified during the IPCC scientific and impact assessments.

Specifically, the USGCRP research will focus on understanding the processes affecting:

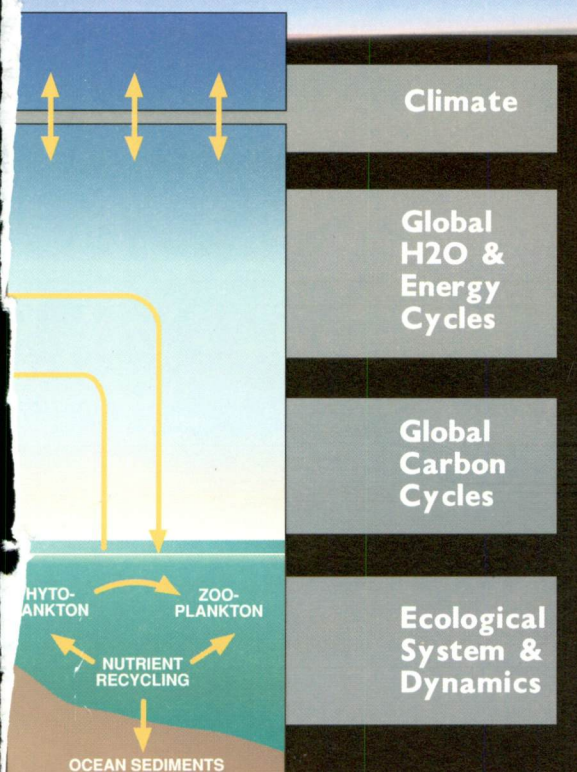
- *changing concentrations of greenhouse gases* which are implicated in future global warming predictions;
- *clouds and radiative balance* which strongly influence the magnitude of climate change at global and regional scales;
- *oceans* which influence the timing and patterns of climate change;
- *land–surface hydrology* which affects regional climate change and water availability;
- *polar ice sheets* which affect predictions of global sea level changes; and
- *ecological dynamics* wh impacted by and respo change.

2. Enhance scienti economic *research to sup* development and imple *comprehensive approach t* gas emissions reductions focus on:

- *sources and sinks of gre*
- *development of a quant* radiative forcing; and
- development and use models to *generate pre scenarios* that cover m greenhouse gases and economic sectors.

The ultimate goals US/GCRP are to (1) Ob predictive understandin interactive physical, che biological, geological, a processes that regulate n human–induced change Earth system and, (2) Pr scientific and economic national and internation policy–making related t the global environment regional impacts.

INTEGRATING THEMES FOR RESEARCH



OBJECTIVES

- Establish an integrated, comprehensive long-term program of documenting the Earth system on a global scale.
- Conduct a program of focused studies to improve our understanding of the physical, geological, chemical, biological, and social processes that influence Earth system processes and trends on global and regional scales.
- Develop integrated conceptual and predictive Earth system models.

international response strategies.

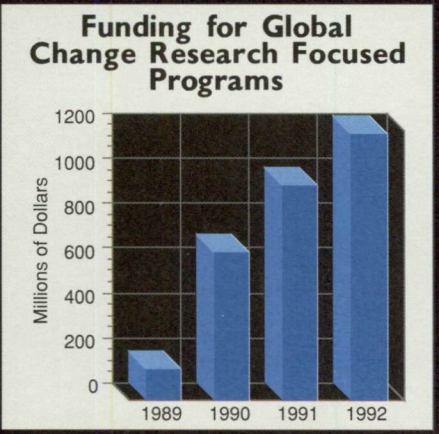
The U.S. Global Change Research Program (US/GCRP) has been developed as a central component of the United State's approach to global change, and more specifically to address the uncertainties identified by the IPCC.

In FY 1992, the U.S plans to invest almost $1.2 billion in this Program, which virtually doubles the U.S. commitment to the research program of the US/GCRP since it was initiated in FY 1990 (see chart below).

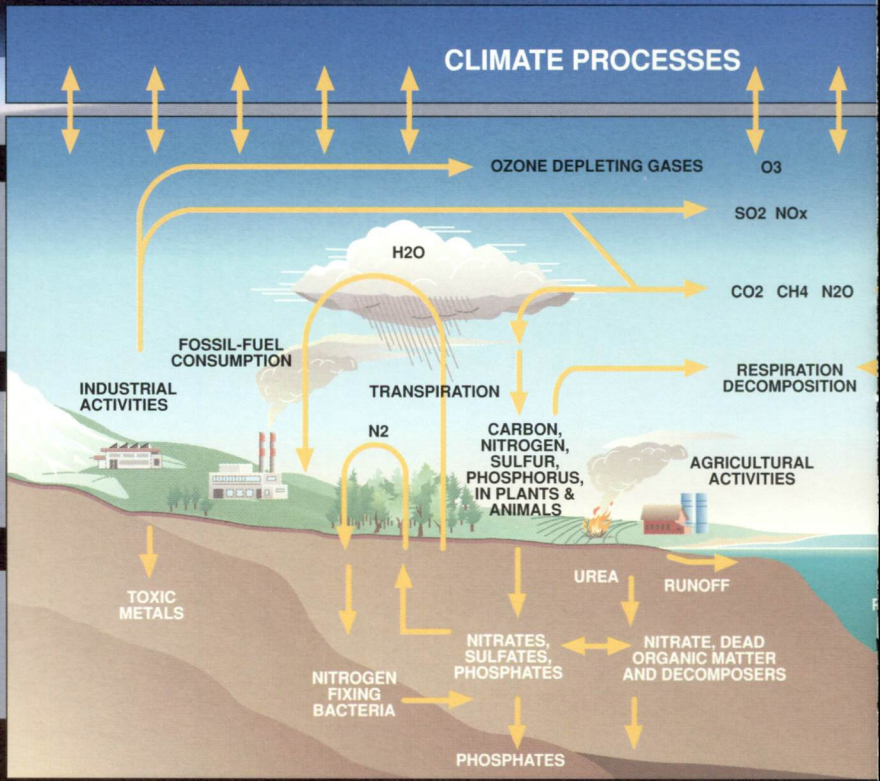
provides about 50% of the financial support, is coordinated through United Nations scientific bodies (i.e., WMO, IOC, and UNEP), and through the International Council of Scientific Unions (ICSU).

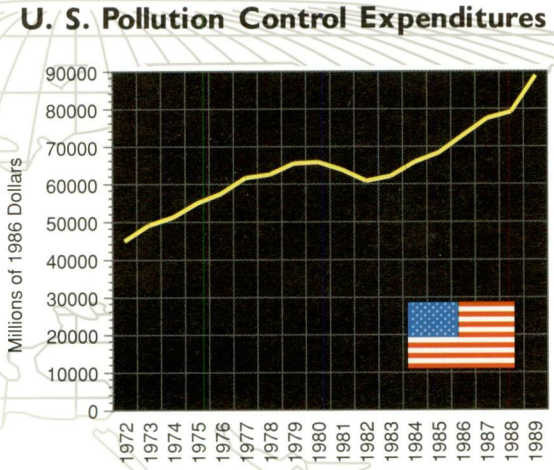
observations, with a full scale Earth Observing System (EOS) in full operation by 1998.

The central task of the US/GCRP is to develop predictive understanding of the Earth's systems processes,



Source: U.S. Office of Management & Budget



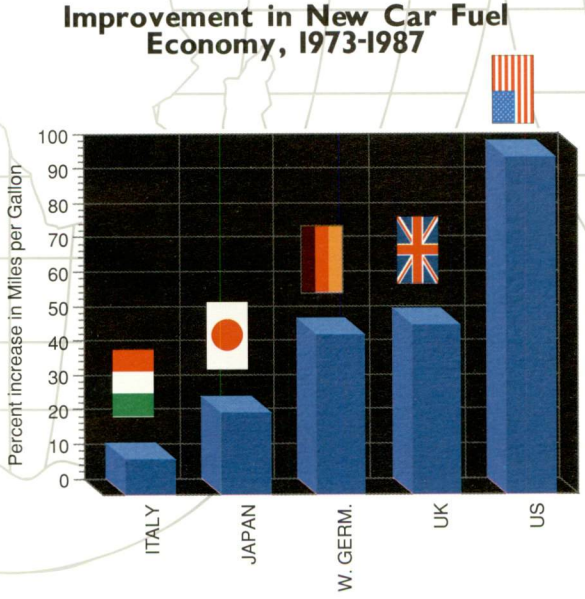


From EPA, "Environmental Investments: the Cost of a Clean Environment", July 6, 1990 draft.

CHART 28

United States' declines in emissions of volatile organic compounds, carbon monoxide, CFCs, and, to some degree, the stabilization of carbon dioxide emissions over the period from the early 1970's to the present can be attributed, in part, to U. S. investment to protect and to clean up the environment. U. S. spending for all pollution control purposes over the period is shown in Chart 29. It has grown by 100 percent from 1972 to 1989. It is expected to continue growing. Enactment of the Clean Air Act Amendments of 1990 alone is estimated to increase U.S. pollution control expenditures by an additional $25 billion a year when fully implemented.

U. S. pollution control spending has historically been larger compared to the country's Gross Domestic Product than spending by other countries for which data is available.



Source: same as chart 27.

CHART 29

TRENDS: *Transportation*

Population density in the United States is 5 to 10 times less than in many of the other G-7 countries (Chart 26). With such a low density, the U. S. spatial spread between work and home naturally increases transportation use per capita. Distribution of economic activities across a wide continent requires substantial energy consumption for moving people and freight long distances. Transportation energy consumption per capita is highest in the United States and Canada and substantially lower in the G-7 countries with high population densities.

New car fuel efficiencies in the United States are now roughly even with those of most of the other G-7 countries (Chart 27), despite much more demanding U. S. emissions and auto safety standards. The U. S. 1987 miles per gallon ratio was 28.3, within a relatively narrow range from Japan at 27.7 to the United Kingdom at 31.8. The U. S. from 1973 to 1987 increased its new car fuel economy by almost 100 percent (Chart 29).

Population Density per Square Mile, 1988

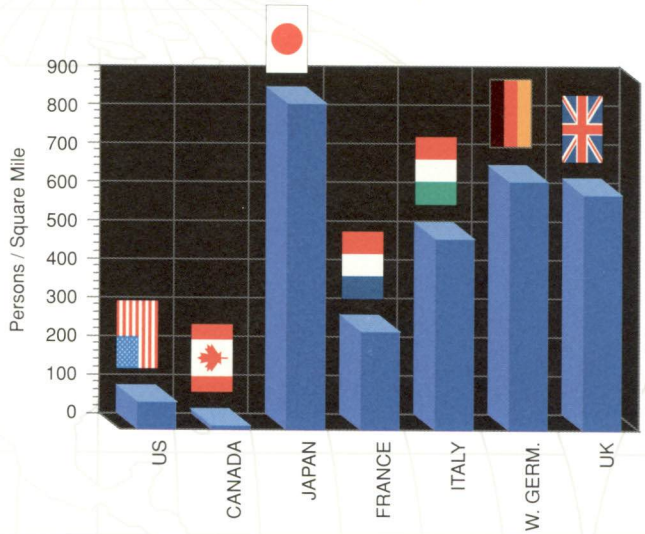


CHART 26

Population from OECD, "National Accounts 1960-1988" Vol 1 (Paris, 1990)
Area from Pharos Books "The World Almanac and Book of Facts 1990", (New York, 1989)

New Car Fuel Efficiency

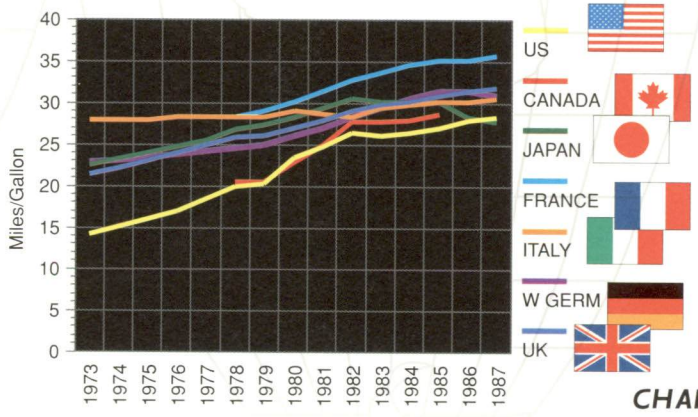


CHART 27

From OECD, "Energy Conservation in IEA Countries" (Paris 1987); IEA country submissions; and Lawrence Berkeley Laboratory (French amounts)
Conversion factors: 3.785 liters per gallon, 1.609 kilometers per mile.

Energy consumption per unit GDP in the U.S. is comparable to other G-7 countries.

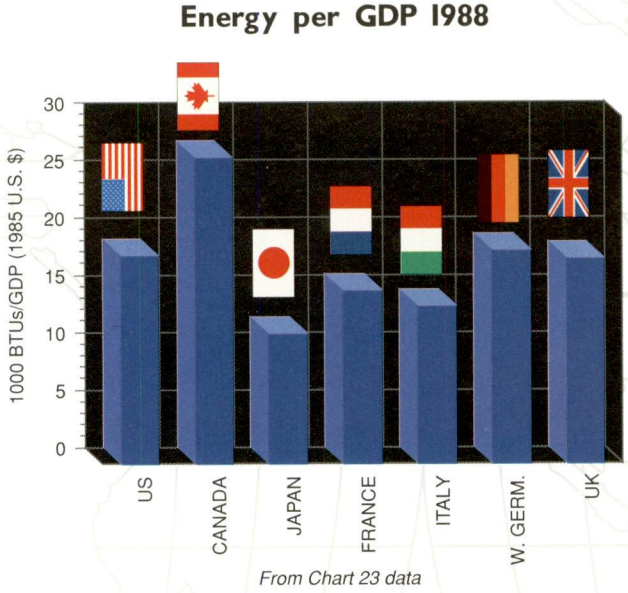


CHART 25

TRENDS: *Energy Intensity*

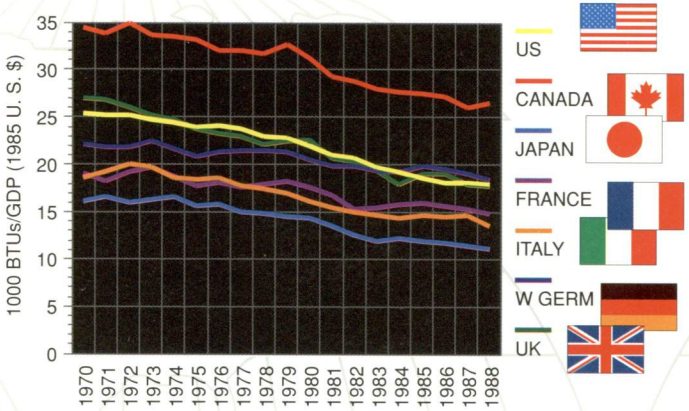
Chart 23 compares United States energy consumption per unit of gross domestic product (GDP) with Canada, Japan, France, Italy, West Germany and the United Kingdom—the other G-7 countries.

As shown in Chart 23, the United States has improved its energy use/GDP ratio since 1970, averaging an annual improvement of 2 percent per year. In 1988 the U. S. used only 70.9 % as much energy per unit of GDP as it used in 1970.

The United States' rate of improvement in the industrial energy use/gross product orginating (GPO) ratio has been greater than most other G-7 countries, averaging close to 3 percent per year since 1977 (Chart 24).

Since the early 1970s, the United States has improved its heating efficiency on an energy used per square foot per degree day basis. The U.S. used in 1987 only 68.4% of the energy used per square foot in 1972. Today, U.S. energy use in dwellings per square foot per degree day is much lower than most other G-7 countries.

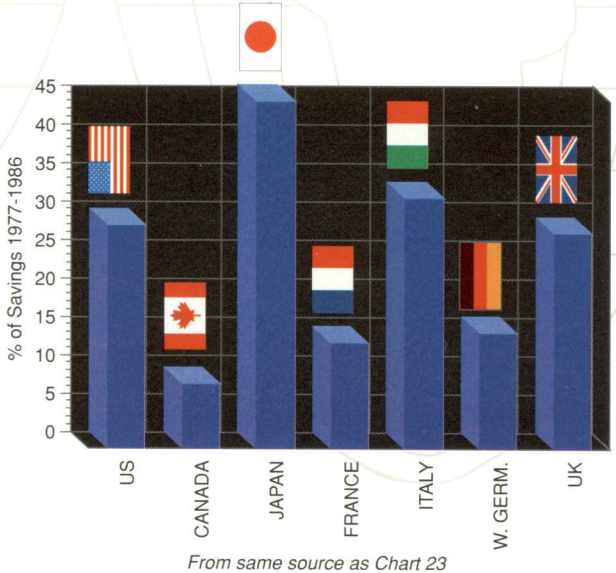
Energy Consumption per Unit of GDP



Total Consumption in Quads from International and Contingency Information Division, Statistics Branch, Energy Information Administration
GDP in 1985 $ from "National Accounts 1960-1988", OECD (Paris 1990)

CHART 23

Savings in Energy per GPO ('77-'86)



From same source as Chart 23

CHART 24

Trends in Carbon Dioxide Emissions

U. S. and High Emissions Growth Countries

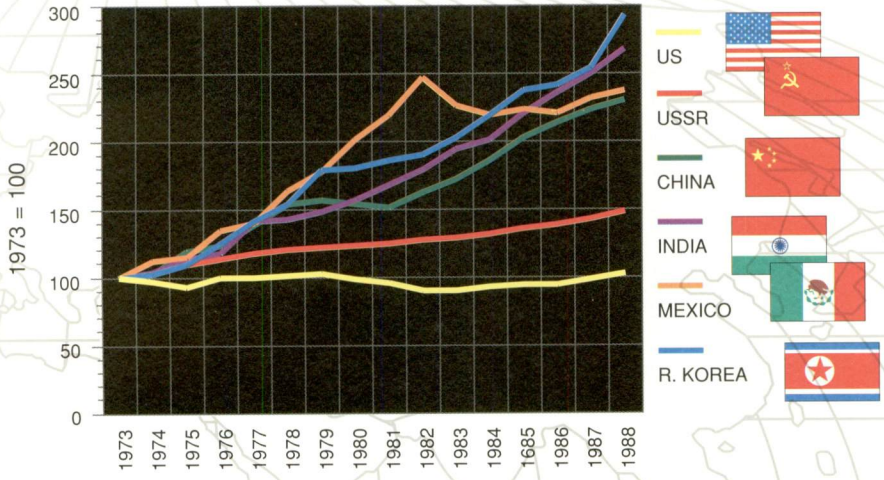


CHART 21

Chart 21 compares the U. S. trend to countries which have experienced substantial growth in emissions.

Calculated from data in DOE, "Trends '90, A Compendium of Data on Global Change", August 1990

Trends in Carbon Dioxide Emissions

U. S. and G-7 Countries

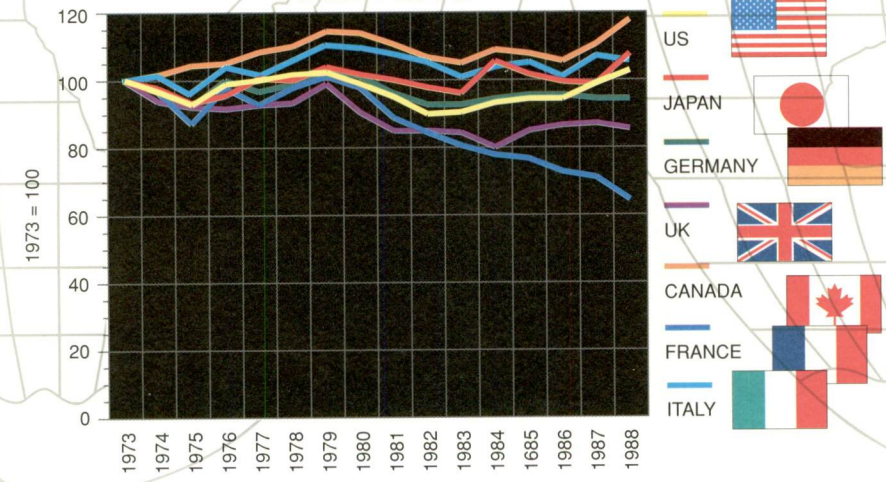


CHART 22

Chart 22 compares the U. S. trend to industrial countries which have experienced moderate growth or decline in emissions.

Calculated from data in DOE, "Trends '90, A Compendium of Data on Global Change", August 1990

TRENDS: *CO2 Emissions*

United States emissions in 1988 were only 2.7% above the 1973 level, despite the fact that real U. S. Gross Domestic Product (GDP), in 1985 dollars, grew by 48 percent over that period.

A key unanswered question about responding to the climate change issue is how to achieve economic growth in developing countries and economic reform in formerly centrally-planned countries without massive increases in greenhouse gas emissions.

It is important to remember that anthropogenic emissions of CO2 contribute about 4% of the total global CO2 flux.

Charts 21 and 22 compare the recent U. S. emissions trend with countries which contain most of the world's population. Those in Chart 21 have trends of rapidly growing CO2 emissions, and are likely to have substantial emissions growth in the coming decades.

Growth in CO2 Emissions and U.S. GDP

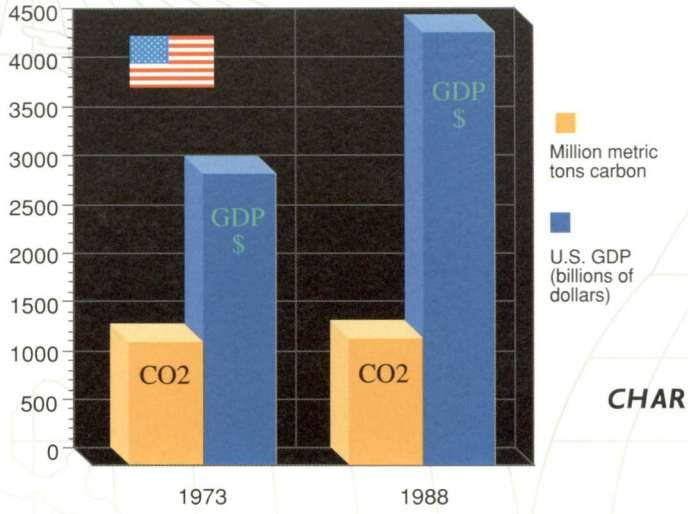


CHART 19

Source DOE Trends '90; OECD National Accounts, 1960-1988, (Paris 1990)
GDP deflators 1982=100 Source 1990 Economic Report

Emissions of CO2 Per Unit of GDP, 1988

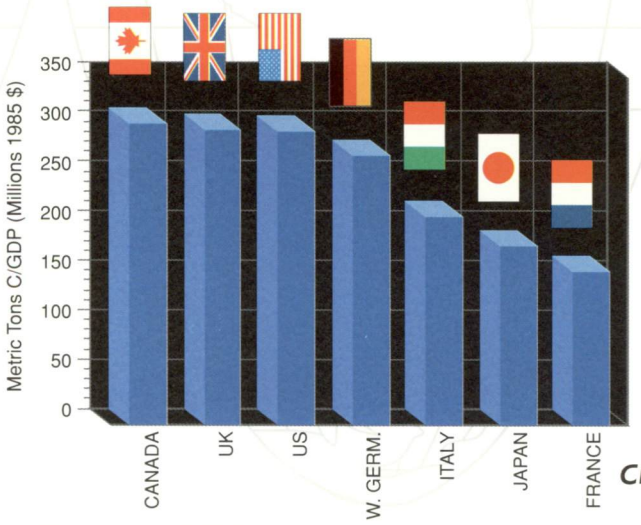


CHART 20

Emissions from DOE, "Trends '90, A Compendium of Data on Global Change", August 1990.
GDP from OECD, "National Accounts 1960-1988", (Paris 1990)

Conservation and Renewable R&D

The U.S. is funding a large research and development program for conservation and renewable energy. In Fiscal Year 1992, this effort is increased by 18 percent to a level of $495 million, which represents an increase of over 50% since 1989.

In the long run, an adequate response to climate change will involve the use of new technologies that conserve energy or that provide energy without causing greenhouse gas emissions. These technologies will be needed in all of the economy's sectors.

The Administration is proposing to initiate, in the fiscal year 1992 budget, a new joint auto industry-government consortium to develop a battery for electric vehicles. Improved batteries could extend vehicle range to 120 to 200 miles. Fuel-cell-powered electric vehicles offer the potential to achieve up to 50 percent efficiencies.

R&D for energy efficiency in transportation includes work on high temperature internal combustion engines, gas turbine engines, fuel cells and a new initiative for electric vehicles. Air transportation energy efficiency work includes research in hybrid laminar flow, composite materials, improved terminal operations, and improved air traffic control.

An initiative to address the problem of combustion emissions in waste-to-energy plants is being started. Further, alternative-fuel vehicle demonstration and a scale-up of a wood-to-ethanol process are being initiated.

Industrial energy efficiency R&D includes funding for more efficient steel, aluminum, and paper processes. A scale-up and test of the use of concentrated solar energy to detoxify liquid wastes is also planned.

Building energy efficiency research focuses on the interactions of energy systems, and the efficient use of advanced window technologies and building materials to control light and heat entering a building.

Total FY 1992 funding for research in new energy technologies is over $900 million.

Accelerate the transfer of photovoltaic technology to U.S. commercial production:

Recent laboratory research has achieved photovoltaic efficiencies of over 30%. With such efficiencies and improved manufacturing, today's $4-5 prices per peak watt could be cut in half.

The U.S. will start an intensive effort with industry to understand potential improvements in photovoltaic processes. Industry joint ventures to provide practical solutions and maximize transfer of results will be encouraged. The U.S. will also provide cost-shared technical assistance to adapt manufacturing improvement techniques to specific processes. By the year 2000, greenhouse gas emission reductions will begin to phase in at 500,000 metric tons of carbon equivalent.

Expand nuclear energy capacity:

As the Nation enters the 1990s, nuclear power is the second largest source of U.S. electricity, providing almost 20 percent of America's electricity needs, and nuclear power causes no greenhouse gases.

Because of the availability of nuclear power the nation is able to avoid the use of large amounts of fossil fuels. In terms of the displacement of fossil fuels, nuclear power can be thought of as reducing utility emissions of carbon dioxide—a major greenhouse gas—by 20 percent, or approximately 128 million tons, annually in the U.S. In effect, then, nuclear energy plants reduce overall U.S. emissions of carbon dioxide by nine percent. Worldwide, nuclear energy reduces these emissions by more than seven percent.

A comprehensive strategy for nuclear energy is being developed as a part of the National Energy Strategy and is supported in the President's Fiscal Year 1992 budget. This strategy includes:

- Developing advanced light water reactors that will incorporate passive safety features in a standardized (modular) design. This will reduce the time needed to license new plants, while assuring that safety issues are adequately addressed. The U.S. is currently supporting first-of-a-kind engineering work that will assist companies in their efforts to have the Nuclear Regulatory Commission certify the safety of standardized designs;
- Conducting research and development on advanced reactor concepts with safety features that go beyond even the standardized designs ("to be intrinsically safe") currently before the Nuclear Regulatory Commission. High temperature gas cooled reactors use specially coated fuel elements that will not fail even under the high temperatures that could occur in an accident. Liquid metal reactors use liquid sodium as the heat exchange medium. Researchers have demonstrated that these new reactor types can shut themselves down safely under conditions that would be extremely serious for present-day reactors;
- Reforming the nuclear licensing process through consolidation of the redundant aspects of the construction and operating licensing processes, without compromising nuclear safety concerns; and,
- Developing a long-term solution to the nuclear waste problem by developing a permanent repository, and possibly an interim retrievable storage facility.

DOE is funding programs that are supporting growth in nuclear energy capacity and the life extension of many currently operating plants. According to analysis done for the National Energy Strategy, support from DOE is expected to result in adding new nuclear capacity by 2000, which would result in further reductions in greenhouse gas emissions.

Increase transportation use of alternative fuels.

Use of oxygenated fuels, such as ethanol, can reduce urban smog levels and emissions of CO2 and carbon monoxide.

U.S. research has demonstrated the technical feasibility of the processes to produce ethanol from non-food domestic resources such as wood or herbaceous crops.

The U.S. will expand current research programs in alternative fuels to include cost-shared joint ventures aimed at reducing the cost of ethanol from non-food resources. This effort will be coordinated with industry vehicle and engine development programs.

Expand national energy audit capabilities and use.

Industry, with some 350,000 separate establishments, uses 24.7 quads of energy annually. Many options exist for low-cost quick payoff energy saving investments, but smaller firms often lack the information, expertise, and specialized resources to do energy audits of their plants.

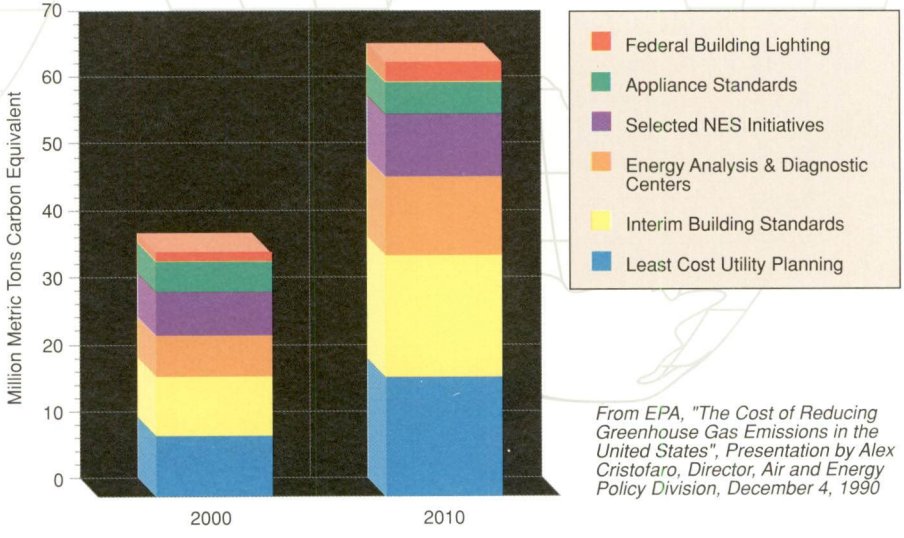
The U.S. will increase its program to train engineers in energy audit and diagnostic methods from the current 13 engineering schools to 40 nationwide in the year 2000. This will reduce greenhouse gas emissions in the year 2000 by 6 million metric tons carbon equivalent.

More efficient lighting in federal facilities.

Twenty-five percent of federal agency energy use is for lighting of facilities. However, lack of adequate flexibility for facility managers and restrictive procurement practices have slowed adoption of efficient new technologies.

The U.S. will identify energy savings options in Federal facilities. Project plans, procurement methods, and financing options will be developed to overcome the barriers to improve lighting efficiency. This will reduce greenhouse gases in the year 2000 by 1.4 million metric tons carbon equivalent.

U.S. Savings in Emissions From Initiatives in Energy Efficiency and Renewables.



From EPA, "The Cost of Reducing Greenhouse Gas Emissions in the United States", Presentation by Alex Cristofaro, Director, Air and Energy Policy Division, December 4, 1990

CHART 17

ENERGY INITIATIVES: *Efficiency*

The Administration is currently developing and will announce shortly a National Energy Strategy that will further contribute to the greenhouse gas emissions reductions cited here. Certain National Energy Strategy initiatives have been included in some of the calculations in this document.

The U.S. strategy for action includes a number of other energy efficiency measures beyond those in the Clean Air Act.

More efficient new appliance standards.

Large appliances account for over two thirds of home energy usage, excluding space heating. In the past three years the U.S. has imposed energy efficiency standards on many of the most energy-intensive appliances, including refrigerator/freezers, clothes washers, dryers, and dishwashers. These standards should achieve annual energy savings of 7-8% relative to projected use by the year 2000, and 14-15% relative to projected use by the year 2010.

The imposition of appliance standards has already resulted in a reduction of greenhouse gas emissions. As older appliances are replaced with new, environmentally friendly models, the greenhouse gas reductions will increase dramatically. By the year 2000, the U.S. anticipates an annual reduction of 4.4 million tons of carbon equivalent from projected greenhouse gas emission due to these standards; the annual reduction will increase to 4.9 million tons of carbon equivalent in 2010.

Level Playing Field Between Electricity Supply and Demand Reduction.

In some cases utilities can meet demands for energy services without any additional greenhouse gas emissions by investing in energy efficiency rather than by increasing electricity supply. Utilities in only 15 states are now fully able to recover costs from such investments. Absent such efficiency measures, new capacity requirements by the year 2000 are projected at more than 100,000 MW.

The U.S. will work with the States to identify regulatory barriers that discourage utility investment in cost effective energy efficiency. Utility planning techniques will be developed to consider all alternatives and their costs. The U.S. will provide training, information dissemination, and other types of technology transfer activities. These actions will reduce greenhouse gas emissions in the year 2000 by 9 million metric tons carbon equivalent.

Encourage use of energy efficient building standards.

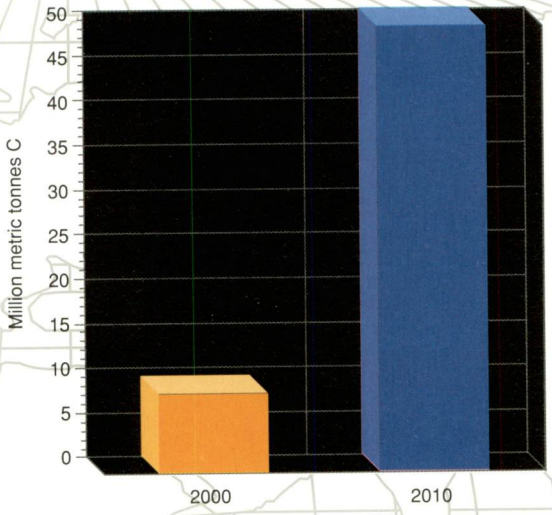
Both the U.S. and the private sector have developed standards that would achieve 20-25% energy savings in buildings. They could save $5 billion over 20 years from the new buildings built in a single year.

The U.S. will promote voluntary use of these standards through training programs, design manuals and computer-aided design systems. It will encourage State and local governments to use the standards in their building codes. These actions to encourage adoption of the most energy efficient modern technology in residential and commercial building will reduce greenhouse gas emissions in 2000 by 8.2 million metric tons of carbon equivalent.

Use of the modern standard in public housing assistance programs will reduce greenhouse gas emissions by 800,000 metric tons carbon equivalent in 2000.

Reductions in Carbon Dioxide Emissions

From Tree Planting Initiative

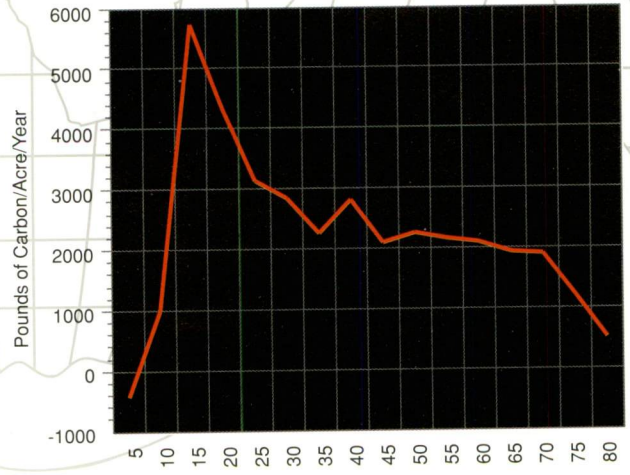


From EPA, "The Cost of Reducing Greenhouse Gas Emissions in the United States", Presentation by Alex Cristofaro, Director, Air and Energy Policy Division, December 4, 1990

CHART 15

Tree Planting Initiative

Example Carbon Sequestration by Age of Stand (Cutover)



Source: U. S. Forest Service

To put the power of trees as "sinks" into perspective, consider the example of an acre of improved stock of southern pine planted on a high quality site in the southeastern U. S. In the 15th year after planting these trees would take up between 5700 and 6200 pounds of carbon per acre. While the amount taken up declines thereafter as the trees mature, additional carbon continues to be taken up. *(See Chart 16)*

CHART 16

ENHANCING NATURAL SINKS

The term "sinks" of greenhouse gases is meant to include human and natural activities, processes, and phenomena that remove greenhouse gases from the atmosphere or reduce their atmospheric lifetimes. Examples include forests, soils and oceans. The IPCC recognized the importance of sinks in a report of its Response Strategies Work Group (RSWG): "The RSWG reviewed potential measures for mitigating climate change...These measures include those which limit emissions from greenhouse gas sources (such as energy production and use), those which increase the use of natural sinks (such as immature forests and other biomass) for sequestering greenhouse gases, as well as those measures aimed at protecting reservoirs such as existing forests."

Reforestation

The President has included in both his FY 1991 and FY 1992 Budgets a major, multiyear reforestation proposal to plant one billion trees per year on 1.5 million acres and to improve forest management practices. This initiative will encompass cities and towns across America, as well as rural, private, non-industrial forest lands. It comes in addition to reforestation which Federal agencies and private companies normally perform on lands under their jurisdiction.

One purpose of this initiative is to improve the condition of private, non-industrial forest lands which now are often in poor condition due to low levels of management and investment. Improving these lands will increase benefits from soil protection, wildlife, wood products, and recreation.

This initiative also will have climate change benefits through the carbon which growing trees (sinks) remove from the air and store both as plant tissue and in the soil. The estimates of carbon removed from the atmosphere by the trees to be planted under the initiative are 9 million metric tons of carbon annually by the year 2000, growing to 50 million tons per year by 2010. (See Chart 15)

Global Forest Convention

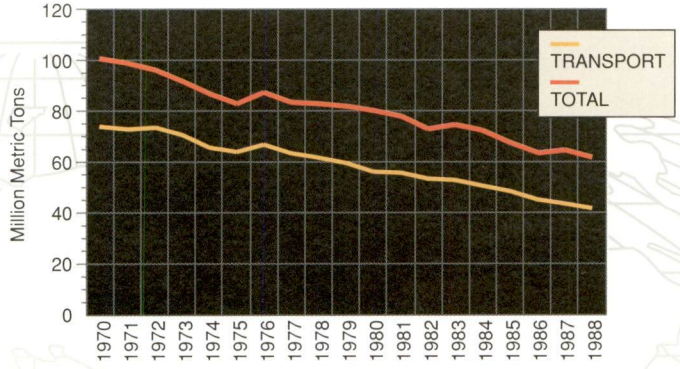
The President proposed at the Summit of Industrialized Nations in July 1990 at Houston to begin negotiations as expeditiously as possible on a global convention on forests, aiming for completion and signing by 1992.

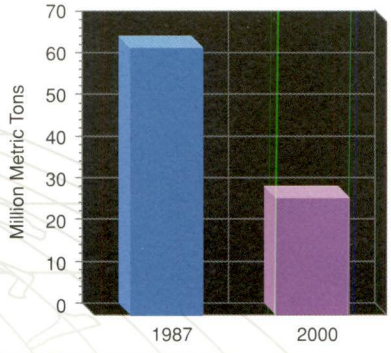
The world's forests absorb carbon dioxide as well as provide many benefits in the form of timber and fiber, soil and water protection, biodiversity, wildlife habitat, recreation and other valuable outputs. They provide the habitat for some 80% of the planet's remaining unknown and unspecified gene pool—a completely irreplaceable and potentially enormously valuable heritage for all humankind. Temperate zone forests are being damaged by air pollution stresses and tropical forests are being rapidly lost.

The U.S. believes that the forest convention should emphasize market-based mechanisms and flexibility to achieve sound, sustainable forest use, to improve the health and vigor of forests, to encourage reforestation, and to increase the value of forests as sources of income and jobs. In addition, increasing the productivity of activities using the land base can minimize deforestation.

Areas suggested for international cooperation and joint action include: reforestation and rehabilitation; research and monitoring; education, training, and technical assistance; reform of the Tropical Forestry Action Plan; reduction of air pollution; bilateral and multilateral assistance; debt-for-nature swaps; and removal of harmful subsidies.

Trends in Emissions of Carbon monoxide, 1970-1987,





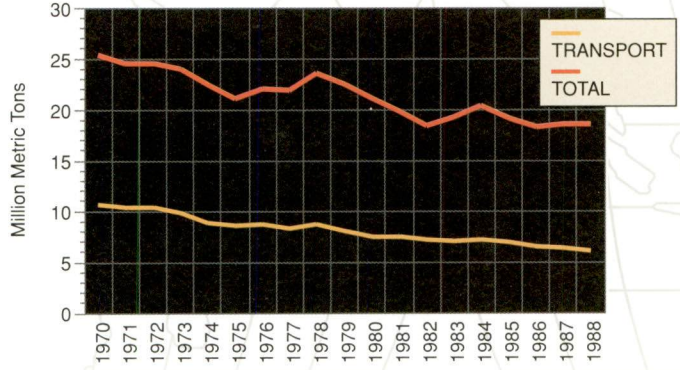
Source: U.S. EPA

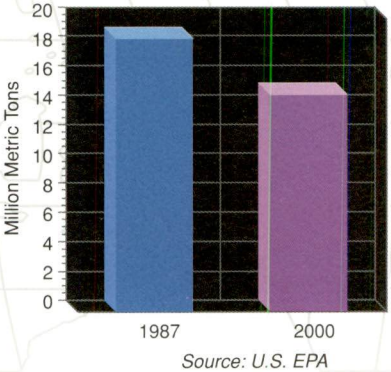
CHART 9

From EPA, "National Air Pollution and Emission Estimates, 1940-1982" Feb. 1984
EPA, "National Air Quality and Emissions Trend Report, 1988" March 1990.
EPA, "National Air Quality and Emissions Trend Report, 1987" March 1989.

CHART 8

Trends in Emissions of Reactive Volatile Organic Compounds 1970-1987





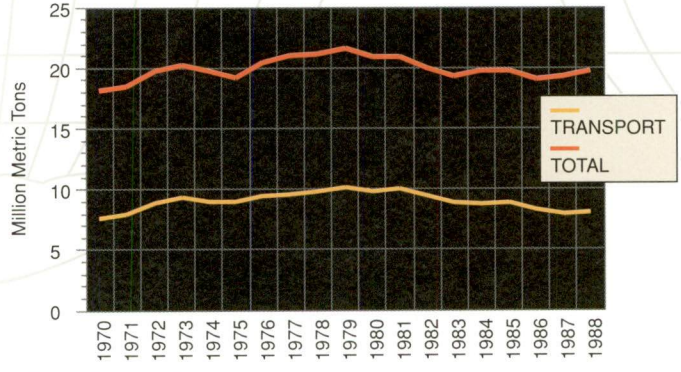
Source: U.S. EPA

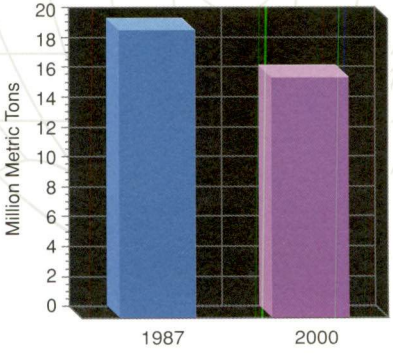
CHART 11

From same sources as Chart 8

CHART 10

Trends in Emissions of NOx





Source: U.S. EPA

CHART 13

From same sources as Chart 8

CHART 12

THE 1990 CLEAN AIR ACT AMENDMENTS

The 1990 Clean Air Act Amendments, signed by the President in November 1990, will achieve substantial reductions of greenhouse gases and their chemical precursors. The Act will reduce U.S. emissions of volatile organic compounds, carbon monoxide, and nitrogen oxides, which will curb tropospheric ozone levels, in addition to reducing emissions of the more familiar pollutants such as sulfur dioxide. When converted into equivalent units of carbon emissions, taken together, these reductions will amount to a 16% decrease in greenhouse gases from these affected sources between the years 1987 and 2000. Moreover, the Act will result in direct carbon dioxide reductions due to more efficient electricity generation.

Electric Utilities

The most dramatic reductions will come from electric utilities. Under the Act, utilities, which must reduce sulfur dioxide (SO2) emissions by 10 million tons below 1980 levels, are given the flexibility to choose how to achieve these reductions. Utilities are thus free to choose cost-effective conservation measures to achieve compliance. This powerful conservation stimulus should sharply reduce carbon dioxide (CO2) emissions from this sector.

Further, the Act requires utilities to reduce their nitrogen oxide emissions by two million tons from projected levels under the acid rain provisions. These provisions also contain strong incentives for both electric utilities and industrial sources to adopt advanced, energy efficient technologies that will lower overall emissions, including carbon dioxide. The Act is also expected to induce oil-burning utilities to switch to natural gas, which produces less greenhouse gas emissions than does oil.

Smog Reductions

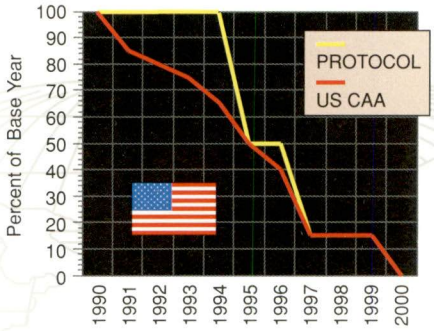
Substantial reductions in either greenhouse gases or their chemical precursors also will result from new controls on stationary and mobile sources mandated by the new Act in order to bring cities into attainment of national air quality standards. A wide variety of stationary sources of volatile organic compounds will be required to reduce emissions by adding controls or by changing production processes. Newly tightened automobile emission standards will further reduce emissions of hydrocarbons, carbon monoxide, and nitrogen oxides, and new controls on gasoline evaporation will greatly cut volatile organic emissions. In addition, gasoline itself will be reformulated to reduce its volatility, thus reducing volatile organic emissions at the source. In total, these various requirements of the Act will result in a sharp and steady drop in U.S. tropospheric ozone, which is a key greenhouse gas.

Cleaner Fuels & Cleaner Cars

The Act will dramatically expand the introduction of clean-burning alternative fuels into the U.S. transportation sector. Several large states and the fleets of America's major cities are expected to introduce fuels and vehicle technology which will emit fewer greenhouse gases. Beginning in model year 1994, new tailpipe emissions standards for hydrocarbons, carbon monoxide, and nitrogen oxides will be phased-in. Auto manufacturers will also have to reduce refueling emissions. Gasoline volatility will be reduced and cleaner fuels will be required in the nine cities with the worst ozone problems and in 41 areas during the winter months when carbon monoxide standards are exceeded. A clean fuel car pilot program in California will use combinations of vehicle technology and cleaner fuels to meet tight standards. Twenty-six areas will have to limit emissions from centrally-fueled fleets of 10 or more vehicles.

Regulations also are being proposed under the new source performance standards of the Clean Air Act to require capture of pollutant gases which are given off by landfills. The purpose of the regulations is to capture air toxics and volatile organic compounds which are the chemical precursors of the greenhouse gas ozone. Methane also will be captured and, if it is not economic to be processed, it will be flared. Greenhouse gas emissions in the year 2000 will be reduced by approximately 40 million tons of carbon equivalent.

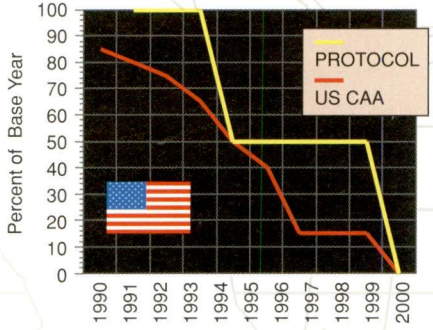
Phase-Out of Major CFCs



From Article 2A - 2E, Montreal Protocol text and Title 6 of the Clean Air Act Amendments of 1990
CAA did not apply in 1990

CHART 3

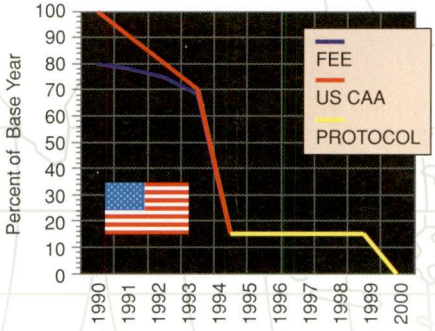
Phase-Out of Halons



From Article 2A - 2E, Montreal Protocol text and Title 6 of the Clean Air Act Amendments of 1990

CHART 4

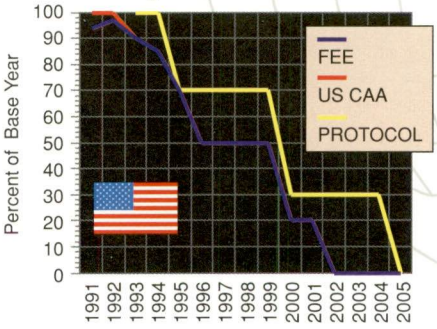
Phase-Out of Carbon Tetrachloride



From Article 2A - 2E, Montreal Protocol text and Title 6 of the Clean Air Act Amendments of 1990
Production estimates under the User Fee are based on Treasury Department estimates

CHART 5

Phase-Out of Methyl Chloroform

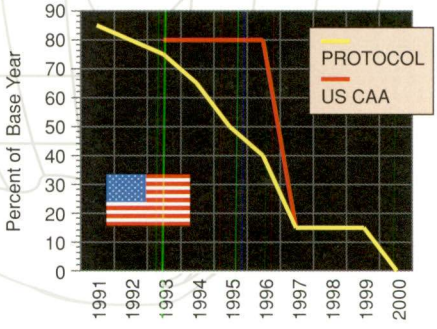


From Article 2A - 2E, Montreal Protocol text and Title 6 of the Clean Air Act Amendments of 1990
Production estimates under the User Fee are based on Treasury Department estimates

CHART 6

CHART 7

Phase-Out of Other CFCs



From Article 2A - 2E, Montreal Protocol text and Title 6 of the Clean Air Act Amendments of 1990

PHASING OUT CFC's

The United States has long taken a leadership role in addressing the problem of stratospheric ozone depletion. In 1978, the U. S. banned the use of CFCs as propellants in spray can products. Such use was considered a low value use which could be forgone given the potential damage which it was believed CFCs might be causing. Most other countries continued to use CFCs as propellants.

At the London Meeting of Parties to the Montreal Protocol, the U. S. supported a complete world-wide phase-out of CFCs, halons, and certain other ozone-depleting substances such as carbon tetrachloride and methyl chloroform. The Protocol was amended to achieve that objective.

BEYOND THE MONTREAL PROTOCOL

The U. S. has enacted legislative provisions in the recent Clean Air Act amendments which will phase out U. S. production and consumption of these ozone-depleting compounds more quickly than the amended Montreal Protocol provisions. (See charts opposite)

For each and every one of these compound groups and gases, the Clean Air Act reduces the allowed U. S. production and consumption between now and the final phase-out date substantially below what the Protocol permits. (For example, see Chart 3 regarding CFC production)

Between now and the phase-out deadlines, the U. S., under the mandates of the Clean Air Act, must reduce U.S. production below what is permitted by the Montreal Protocol by at least the following amounts:

"Cumulative Near-term Reductions in Clean Air Act Below the Montreal Protocol"

Major CFCs	19%
Halons	32%
Other CFCs	22%
Carbon Tetrachloride	13%
Methyl Chloroform	20%

THE U.S. IS AHEAD OF SCHEDULE

In addition to the more restrictive phase-out schedules required by the Clean Air Act, the 1989 Budget Reconciliation Act enacted a tax on ozone-depleting chemicals during the period of phase-out. The tax rates for each compound are its ozone-depleting potential (ODP) multiplied by $1.37 per pound in 1990 and 1991, $1.67 in 1992, $2.65 in 1993 and 1994, and an increase of an additional $0.45 in each year after 1994.

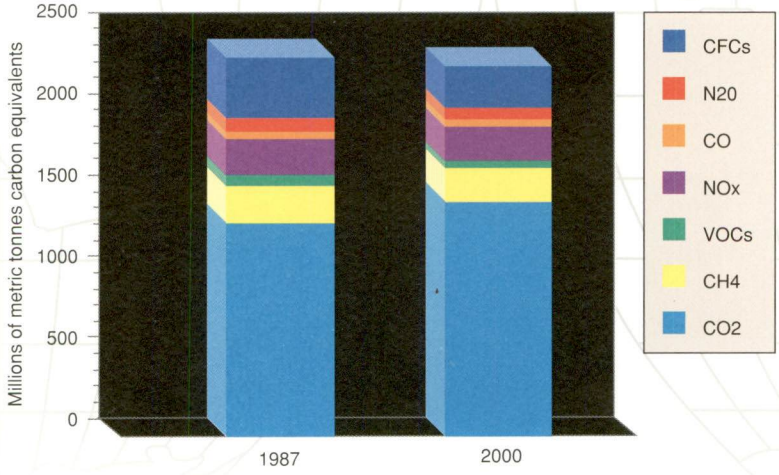
This tax has already helped to reduce U. S. CFC production in the 12-month period ending June 30, 1990 to 23% below the levels permitted by the Montreal Protocol and other U.S. law.

While these actions by the United States are justified by their benefits relating to stratospheric ozone depletion, they are also very highly significant for climate change. CFCs, halons, and carbon tetrachloride are extremely powerful greenhouse gases, thousands of times more powerful than carbon dioxide.

The actions which are currently included in the U.S. Climate Change Strategy will result in U.S. greenhouse gas emissions in the year 2000 being equal to or below the 1987 levels.

Alternative Model For Projected U.S. Greenhouse Gas Emissions

(With Current Policy Commitments)
Based on Jorgenson/Wilcoxen (1990) Model



From EPA, "The Cost of Reducing Greenhouse Gas Emissions in the United States", Presentation by Alex Cristofaro, Director, Air and Energy Policy Division, December 4. 1990

CHART 2

THE BOTTOM LINE

Implementation of the President's Comprehensive Climate Change Strategy will result in United States greenhouse gas emissions in the year 2000 being equal to or below 1987 levels.

The specific actions which will contribute to this result include:

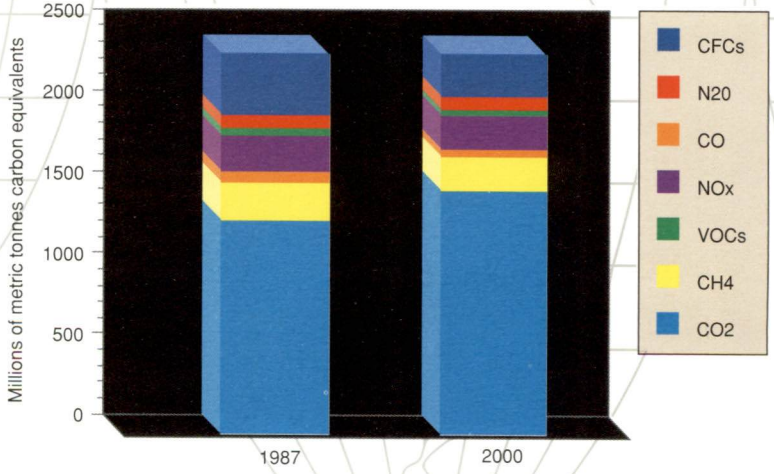
- Phasing out CFCs and many other ozone-depleting compounds which are also greenhouse gases;
- Putting a permanent ceiling on sulphur dioxide emissions at sharply reduced levels and allowing freedom of choice in meeting the ceilings, thereby encouraging energy efficiency and reducing greenhouse gas emissions. Under the recently enacted Clean Air Act Amendments, utilities were given the flexibility to make reductions by any means—a powerful incentive for energy saving measures;
- Reducing, under the Clean Air Act, air pollutants which are either greenhouse gases themselves or greenhouse gas precursors (volatile organic compounds, carbon monoxide and nitrogen oxides);
- Initiating a program to plant a billion trees a year and to make other forest improvements, thereby enhancing sinks;
- Implementing a number of programs aimed directly at speeding the adoption of energy efficient technologies and practices in homes and businesses; and,
- Promoting the use of, and accelerating research into, non-fossil fuel energy sources such as solar, nuclear, and alternative fuels.

The results of these currently planned U.S. actions are illustrated by Chart 1, which shows projected U. S. greenhouse gas emissions for the year 2000. The estimate is based on calculations made by the U.S. Environmental Protection Agency.

Chart 2 shows an alternative estimate based upon a different economic model prepared by researchers at Harvard University.

Projected U.S. Greenhouse Gas Emissions

(With Current Policy Commitments)
Based on IPCC CO2 Baseline Estimate



From EPA, "The Cost of Reducing Greenhouse Gas Emissions in the United States", Presentation by Alex Cristofaro, Director, Air and Energy Policy Division, December 4. 1990

CHART 1

THE COMPREHENSIVE APPROACH TO CLIMATE CHANGE

The science and economics of human interactions with the global climate involve multiple trace gases affected by activities in every sector of human society. Each of these greenhouse gases is emitted from a variety of sources and is trapped or affected by "sinks" in different ways. Each gas has a different residence time in the atmosphere, a different ability to trap heat, and different potential impacts on the environment. What is important in addressing future climate change is the total and cumulative effect of all gases—all sources and all sinks.

In November 1990, the government ministers at the Second World Climate Conference (SWCC) declared: "We recommend that in the elaboration of response strategies, over time, all greenhouse gases, sources, and sinks be considered in the most comprehensive manner possible ..."

The "Comprehensive Approach"* has several advantages:

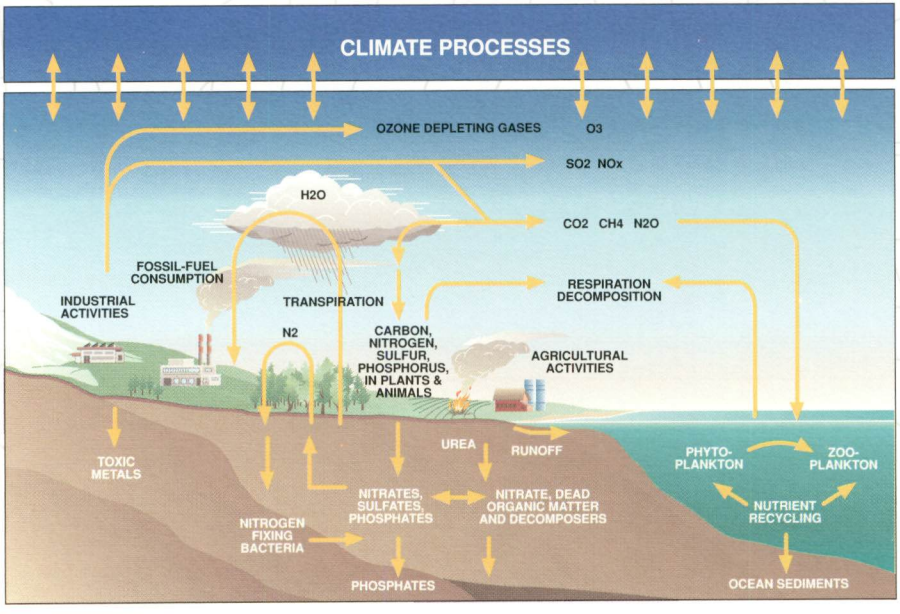
- It provides flexibility for each nation to develop a diverse, innovative, cost-effective mix of measures to meet its global responsibilities in a manner tailored to its own domestic circumstances;
- It is designed to employ the results of integrated scientific and economics research on a comprehensive basis, leaving no important variable omitted;
- It maximizes the benefits to the environment and to humanity from each investment; and
- It accounts for all greenhouse gases, insuring that choices do not reduce one gas but inadvertently increase another.

The relative benefit from a unit reduction in the net emissions of each greenhouse gas can be approximated by a measure of "global warming potential" (GWP) based on the radiative behavior of the gas in the atmosphere. The Intergovernmental Panel on Climate Change (IPCC) has calculated such a relative measure, giving carbon dioxide a value of one (1) and expressing all other gases in terms of carbon dioxide equivalents. This "index" enables a comparison of the contributions of different gases, incorporating both sources and sinks.

The comprehensive approach should inform the development of scientific and economics research, monitoring, technology development, and each country's action plan for dealing with global change. The costs of achieving a given reduction in the added greenhouse effect will vary from gas to gas and will vary depending on which sources or which sinks of any given gas are affected. Using the Comprehensive Approach, for example, maximum reduction in net climate impact—and therefore maximum benefit to the environment—can be achieved for any given level of investment.

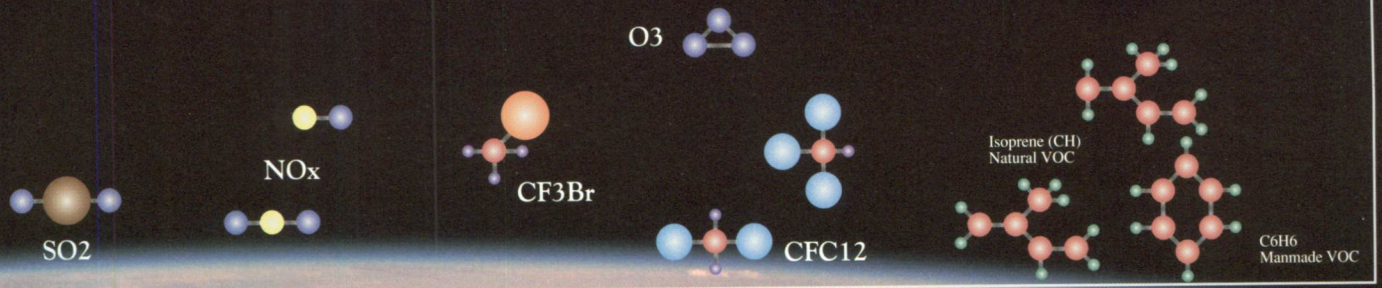
If response strategies were designed to apply piecemeal to one greenhouse gas or economic sector, economic actors could simply adjust to such narrowly focused regulation by shifting to unregulated activities that could continue to contribute to potential climate change.

A comprehensive approach, on the other hand, matches the scientific, economic, and environmental nature of the whole climate system.



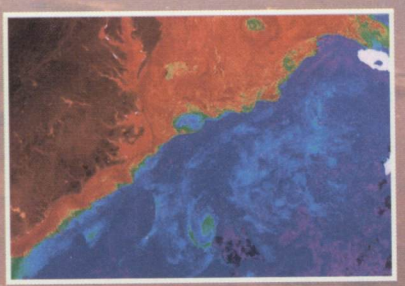
* A larger report on "A Comprehensive Approach to Addressing Potental Climate Change", prepared by a U.S. Interagency Task Force is available on request.

"What is important in addressing future climate change is the total and cumulative effect of all gases—all sources and all sinks."




Coastal Marsh


Watershed Ecosystems


Ocean Phytoplankton Concentrations


Irrigated Land


Burning Rainforest


Tundra

GAS	Instantaneous Radiative Forcing per KG (rel. to CO2)	Atmospheric Residence Years (estimated)	Relative Radiative Forcing Potential over Years		
			20	100	500
CO2	1	120	1	1	1
CH4	58	10	63	21	9
N2O	206	150	270	290	190
CFC-11	3970	60	4500	3500	1500
CFC-12	5750	130	7100	7300	4500

Source: IPCC Scientific Assessment, 1990, Tables 2.3, 2.8

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