HCR 56

SENATE COMMITTEE REPORT

DATE: 3/27/90 FURTHER: Finance

DATE TURNED INTO OFFICE: 4/30/90

Resources Committee considered CSHCR 56 (Resources) am

Relating to global climate change.

and recommended:

[ ] replace with _____ CS _____ [ ] same title
[ ] or adopt _____ CS _____ [ ] new title
[ ] technical title change (HB only)

[ ] attached amendment(s)
[ ] _____ letter of intent adopted

[✓] do pass

[ ] do not pass

[ ] no recommendation

[ ] individual recommendations

[ ] further referral to _____

ATTACHES NEW FISCAL NOTE(S): Dept/Date:

[ ] fiscal note(s) _____

[ ] zero fiscal note(s) _____

[ ] appropriation-no fiscal note

APPROVES PREVIOUS: Dept/Date:

[ ] fiscal note(s) _____

[✓] zero fiscal note(s) _____

[ ] Governor's bill w/fiscal note

SIGNING DO PASS:

OTHER RECOMMENDATIONS:

Chair: Signature and Recommendation

STATE OF ALASKA
1989 LEGISLATIVE SESSION

BILL VERSION: CS HCR 56 (RES)
PUBLISH DATE: 3/2/90

FISCAL NOTE

REQUEST:

Revision Date:
Title: Global Warming

Agency Affected: All Agencies
BRU:

Sponsor: Rep. Koponen
Requester: House Resources Committee

Components:

EXPENDITURES/REVENUES: (Thousands of Dollars)

OPERATING	FY 89	FY 90	FY 91	FY 92	FY 93	FY 94
PERSONAL SERVICES	0	0	0	0	0	0
TRAVEL	0	0	0	0	0	0
CONTRACTUAL	0	0	0	0	0	0
SUPPLIES	0	0	0	0	0	0
EQUIPMENT	0	0	0	0	0	0
LAND & STRUCTURES	0	0	0	0	0	0
GRANTS, CLAIMS	0	0	0	0	0	0
MISCELLANEOUS	0	0	0	0	0	0
TOTAL OPERATING	0	0	0	0	0	0
CAPITAL	0	0	0	0	0	0
REVENUE	0	0	0	0	0	0

FUNDING: (Thousands of Dollars)

GENERAL FUND	0	0	0	0	0	0
FEDERAL FUNDS	0	0	0	0	0	0
OTHER	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0

POSITIONS:

FULL-TIME	0	0	0	0	0	0
PART-TIME	0	0	0	0	0	0
TEMPORARY	0	0	0	0	0	0

ANALYSIS: (Attach a separate page if necessary)

Prepared by: House Resources Committee
Division: Representative Curt Menard
Phone: 4944
Date: 2/28/90

Approved by Commissioner:
Agency:
Date:

Distribution (by preparer):
Legislative Finance
Legislative Sponsor
Requester
Office of Management and Budget
Impacted Agency(ies)

page ___ of ___

Alaska State Legislature
Representative Niilo Koponen
House District 21

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Juneau, Alaska 99811
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Fairbanks, Alaska 99701
(907) 456-8172

Sponsor Statement

CSHCR 56(RES) AM
Relating to Global Climate Change

This resolution was introduced to begin the process of addressing the serious and complicated problem of global climate change from human activities.

While the national and international governments and agencies work to address global policy initiatives, many states and local governments are instituting action on their own, believing time is of the essence. In addition, national organizations of state governments and legislators are developing national strategies.

Because day to day pressures preclude us from dealing with such issues in depth, this resolution will begin the process of evaluation and identification needed for informed decision making.

GLOBAL CLIMATE CHANGE INITIATIVE

In recent months, we have all had the opportunity to read about a variety of environmental issues that are appearing to have serious long term ramifications - the greenhouse effect, ozone depletions, acid rain, etc. The cause for most of these serious issues are caused by human activities. These activities include burning of fossil fuels, manufacture and use of ozone depleting chemicals, some agricultural practices, etc.

While international and national interests work to address global policy initiatives, many states and local governments are instituting action on their own, since time is of the essence. National organizations of state governments and legislators are working on national policies.

Enclosed is HCR 56, a resolution that requests the State of Alaska to get moving on the issue, along with some backup materials organized into national, state, and local/regional sections.

While day to day political realities preclude legislators from in depth work on this long term issue, it is still a critical issue that must be addressed if we are to avoid future costs and impacts upon our society that will far exceed the cost of doing something now.

We ask for your support and involvement.

For further information, you can contact:

Tanana Chiefs Conference, Inc.
122 First Avenue
Fairbanks, Alaska 99701
907-452-8251 or
1-800-478-6822
FAX 451-8936

Attention:

Gary Newman, Director
Energy and Housing Services

Introduced: 2/12/90
Referred: Resources

6-2253A

BY REP. KOPONEN, Boyer, Davidson, Ellis, Finkelstein, Wallis, Brown, Gruenberg

IN THE HOUSE

HOUSE CONCURRENT RESOLUTION NO. 56

IN THE LEGISLATURE OF THE STATE OF ALASKA

SIXTEENTH LEGISLATURE - SECOND SESSION

Relating to global warming.

BE IT RESOLVED BY THE LEGISLATURE OF THE STATE OF ALASKA:

WHEREAS there is evidence that the activities of humans are rapidly increasing the amount of greenhouse gases in the upper atmosphere through the burning of fossil fuels and are destroying the ozone layer through the use of CFC's and other chemicals; and

WHEREAS the evidence is that the increase of these gases and the destruction of the ozone layer will lead to rapid warming of our climate; and

WHEREAS rapid warming of our climate will lead to major environmental damage to ecosystems and improvements upon the land; and

WHEREAS the people of Alaska have ample opportunities to reduce their use of fossil fuels and ozone-destroying chemicals and to better their standard of living through increased efficiency and available energy conservation technology; and

WHEREAS investigating what can be done now will reduce the future high cost of mitigating the likely damages that will result; and

WHEREAS the State of Alaska should take a lead role in this issue for the protection of the health, safety, and welfare of its citizens; and

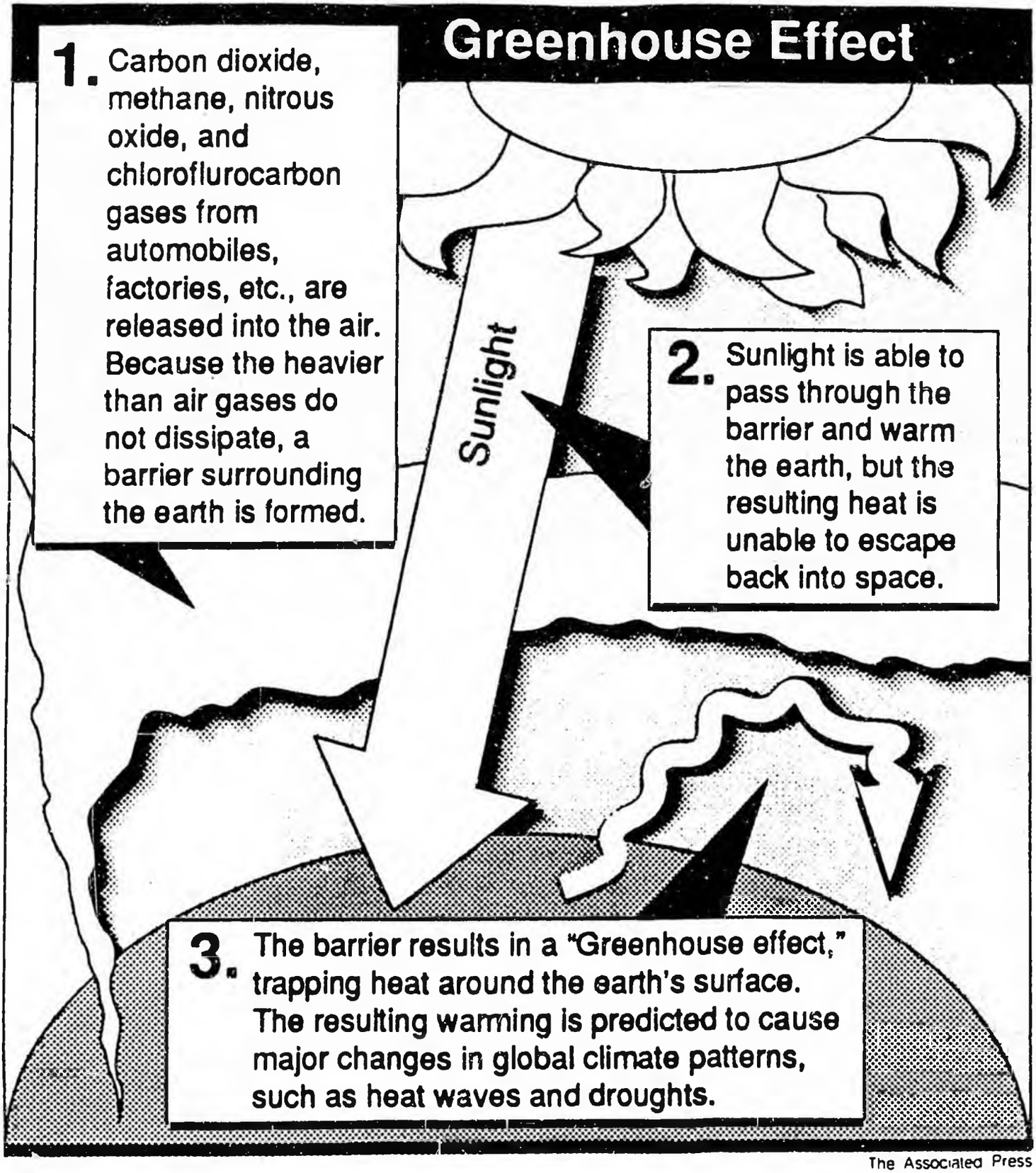
WHEREAS the National Governors Association and the National Conference of State Legislatures are investigating potential actions that states may take to reduce global warming and are preparing recommendations for a national policy with regard to global climate change; and

WHEREAS the governor of the State of New Jersey has issued an executive order charging state entities in New Jersey to pursue policies and

conduct activities so as to reduce the threat of global warming;

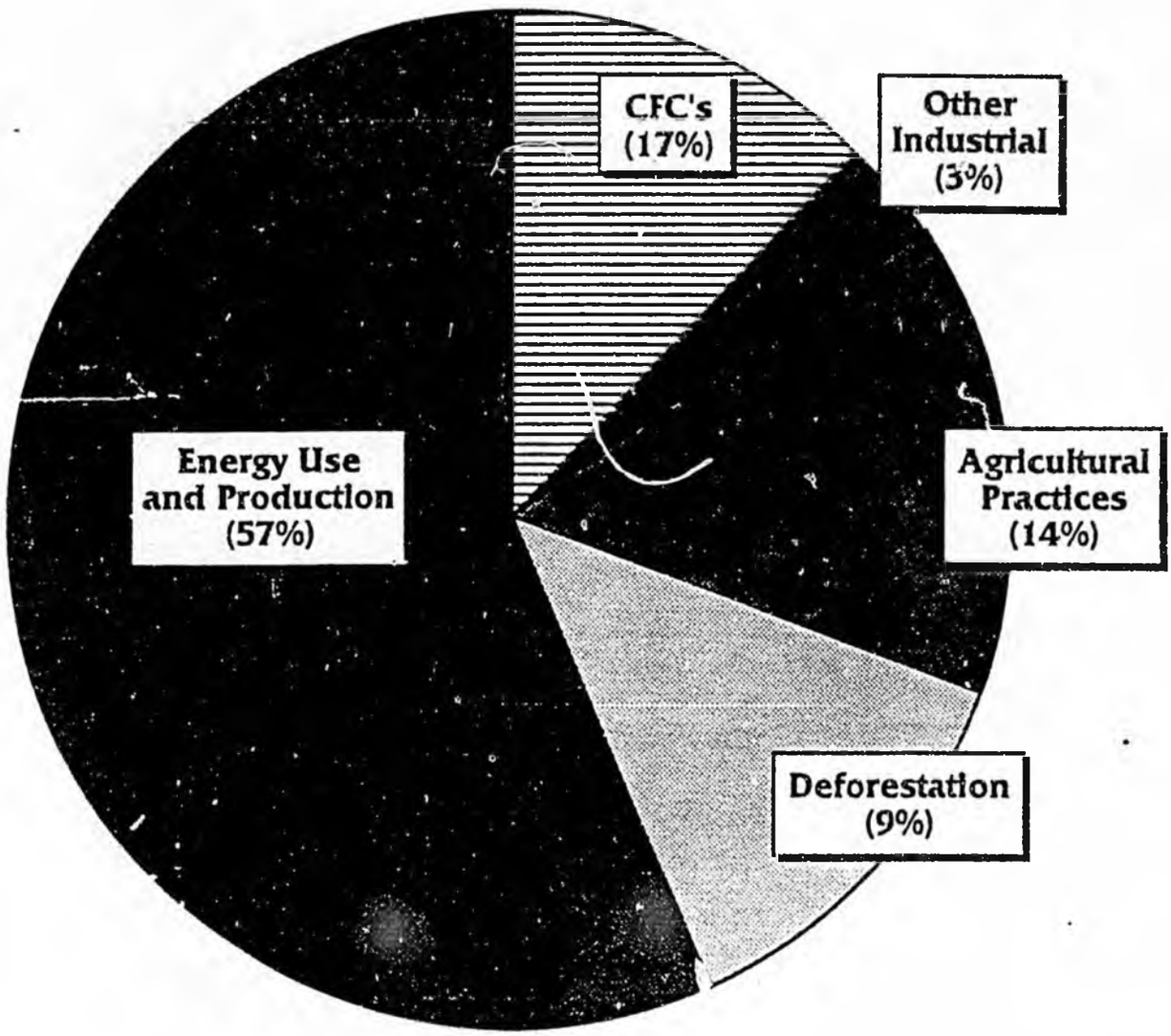
BE IT RESOLVED by the Alaska State Legislature that the governor is respectfully requested to investigate possible state policies and procedures that can be implemented to determine how the state can most effectively combat the problem of global warming.

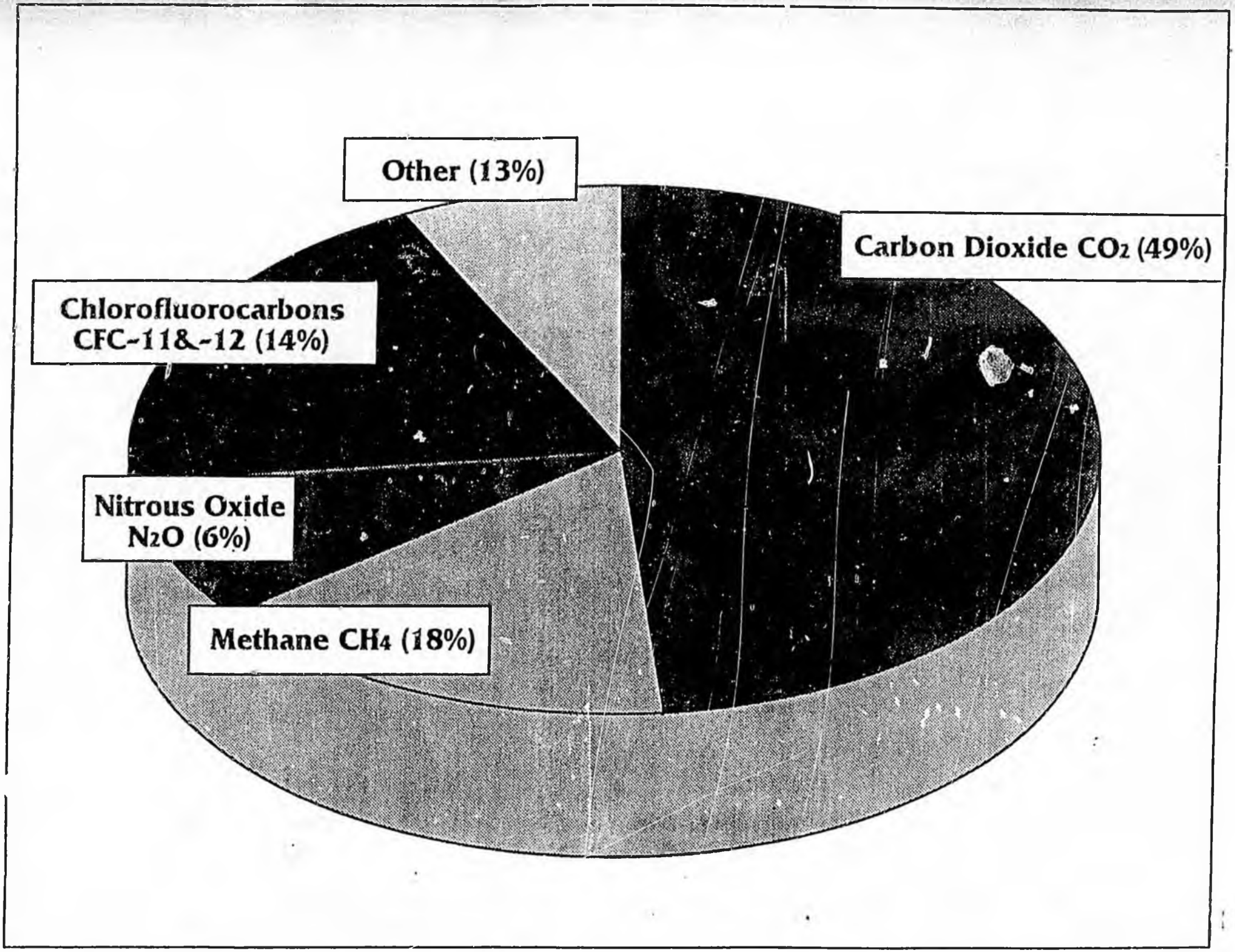
Greenhouse Effect



The Associated Press

Activities Contributing to Global Warming




Other (13%)
Carbon Dioxide CO_2 (49%)
Chlorofluorocarbons CFC-11&-12 (14%)
Nitrous Oxide N_2O (6%)
Methane CH_4 (18%)

GLOBAL WARMING IMPACTS UPON ALASKA

Certain human activities on earth are creating an imbalance on our planet known as "*Global Warming*" or the "*Greenhouse Effect*". This is a phenomenon where we are adding certain gases into the atmosphere and actually warming the earth and creating an imbalance in the earth's biological systems.

While the scientific community does not fully understand all of the details, from what we know now, **it is imperative that we take action now**, since **if we wait** until the predicted dire consequences occur, **it will be too late.** This is a complex and global issue that calls for action at all levels of society. It is said that it takes a lot of drops to fill a bucket. We must all do what we can.

The Governor's Blue Ribbon Commission is intended to start the process for Alaska to do its part in reducing our contribution to global warming. With our cold climate, we contribute more carbon dioxide per capita. In addition, the temperature increase in the arctic will be greater and felt sooner than in temperate climates. More precipitation is also anticipated.

Manmade contributions to global warming come from the following sources:

° 1. Carbon dioxide	Fossil fuel burning, deforestation	49%
° 2. Methane	Agriculture, fertilizers	18%
° 3. Chlorofluorocarbons	Foam insulations, refrigerants, aerosols	14%
° 4. Nitrous oxides	Combustion bi-products, manufacturing	6%
° 5. Other greenhouse gases	Combustion, manufacturing	13%

Impacts from rapid (3-9 degrees in 50 years) increase in temperature

- Raising of water levels through melting of polar ice
- Melting of permafrost
- High fluctuations in weather patterns
- Loss of plant and animal habitats due to inability to adapt to rapid change.

Impacts on communities

- River and sea level increase leading to increased flooding and loss of coastal land and low lands adjacent to rivers.
- Foundations of structures, roads, airports, water and sewer and other improvements threatened.
- Loss of subsistence livelihood through loss of habitat.

Examples of what can be done now to reduce the impact

- Apply least cost planning to new capital projects.
- Increased energy efficiency of heated structures including heating systems and appliances.
- Increased efficiency of diesel electrical generation. Co- generation of fuels, waste heat recovery, fuel substitutions, alternative and renewable fuel source development.
- Promoting methods of increasing efficiency in all modes of transportation.
- Sustainable yield harvesting of timber. Increased tree planting where feasible (trees absorb carbon dioxide).
- Re-cycling of waste products, such as aluminum cans, bottles, newspaper, etc.
- Working with congressional members toward national recognition and action on the problem.
- Education of our children on the problems and solutions (they will pay for our inaction).

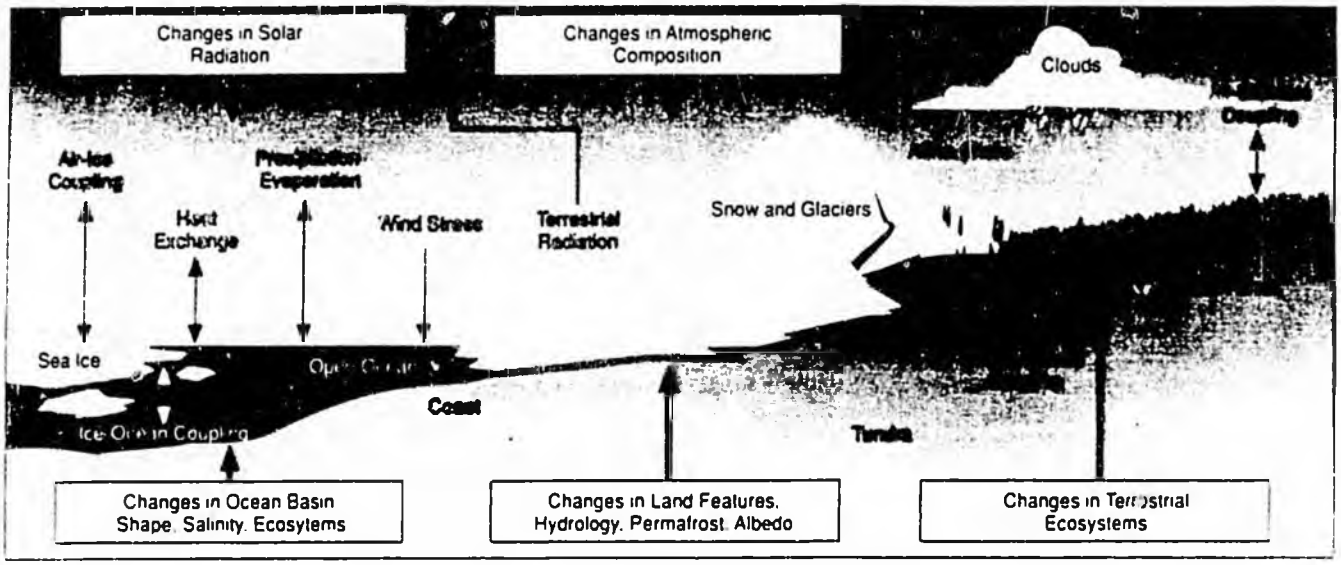
Immediate benefits of doing something now

- Reducing impact of global warming.
- Increased health safety and comfort in operating heated structures and electrical appliances.
- Decreased cost in operating heated structures and electrical appliances.
- Reduced cost and increased life in operation of moving vehicles.
- More affordable housing.
- Productive local jobs.
- Increased standard of living, less time and money spent on energy.
- Assured source of wood (in forested areas).
- Increased capacity of landfills.
- Sustained ecosystem for fish and game.

PROPOSAL FOR A

POLAR CENTER FOR GLOBAL CHANGE STUDIES

UNIVERSITY OF ALASKA FAIRBANKS



Affiliated Research Units:
(including Federal agencies on the UAF campus)

Agricultural and Forestry Experiment Station
Geophysical Institute
Institute of Arctic Biology
Institute of Marine Science
Institute of Northern Engineering
Institute of Northern Forestry
U.S. Geological Survey

OCTOBER 1989

Ad-Hoc

CENTER STEERING COMMITTEE
(appointed by the Vice Chancellor for Research)

Chair: Gunter Weller, Professor, Geophysical Institute

Co-Chair: William S. Reeburgh, Professor, Institute of Marine Science

Members:

AGRICULTURE/FORESTRY
- Keith VanCleve, Professor, Forest Sciences
- Glenn Juday, Asst. Prof., Forest Sciences

BIOLOGY/WILDLIFE
- Stephen F. MacLean, Professor, Biology/Wildlife
- Joshua P. Schimel, Asst. Prof., Biology/Wildlife

ENGINEERING
- Douglas Kane, Professor, Civil Engineering
- Douglas Goering, Asst. Prof. Mechanical Engineering

GEOPHYSICS
- Thomas E. Osterkamp, Professor, Geophysics
- Gunter Weller, Professor, Geophysics

MARINE SCIENCE
- William S. Reeburgh, Professor, Marine Science
- H. Joseph Niebauer, Professor, Marine Science

SOCIAL SCIENCE
- Gerald A. McBeath, Professor, Political Science

Staff: Laura Lee McCauley, Office of Vice Chancellor for Research

SUMMARY

An ad-hoc committee of University of Alaska Fairbanks faculty located in five UAF colleges and schools proposes the establishment of a Polar Center for Global Change Studies at UAF, to provide a framework for developing, coordinating and implementing interdisciplinary research initiatives on global change, which are presently beyond the scope of any individual research institute. The focus of these studies will be on the high latitudes, which the University through its location and expertise is uniquely qualified to address. UAF, building upon the strength of its existing research institutes, has an opportunity to contribute to both national and international research programs in this area.

This proposal reviews the need for interdisciplinary Earth system research at high latitudes, the rationale for implementing a center within the University to facilitate such research, the purpose and functions of the proposed Center, a plan for implementing the Center, and budget requirements for the remainder of this fiscal year and the next.

We believe that the Center should be based on the concept of the NSF Science and Technology Centers, namely "to exploit opportunities in science and technology where the complexity of the research problems or the resources needed to solve these problems require the advantages of scale, duration, and/or equipment and facilities that can only be provided by a campus-based research center." We hope that the Center will provide a lively, stimulating, intellectual atmosphere which will foster and conduct innovative research on all aspects of global change and will take advantage of the new, greatly expanded opportunities in this area over the next decade or more.

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Attachment

1. Currently funded Global Change-related research activities at UAF
2. New positions needed (tentative list)
3. Letter from Institute of Northern Forestry

INTRODUCTION

A consensus on the need to come to grips with a number of growing problems of the global environment has been evolving rapidly over the past few years among scientists, the public, and decision makers. Driving this consensus is the realization that in the span of a single human generation, the Earth's life-sustaining environment is expected to change more rapidly than it has over any comparable period of human history. Much of this change will be of our own making. Increasing atmospheric concentrations of greenhouse gases, due in part to the burning of fossil fuels, may significantly alter our climate. Agriculture, forestry and other land-use practices, industrial activities, waste disposal, and transportation have altered terrestrial and coastal ocean ecosystems, thus affecting, for example, biological productivity, water resources, and the chemistry of the global atmosphere. These fundamental changes, evident also in the decline of stratospheric ozone and in acid precipitation, transcend the traditional boundaries of scientific disciplines.

Contemporary advances in technology, such as the ability to observe the earth from space and the rapidly accelerating capabilities for data handling, numerical modeling, and telecommunications, make it possible to study the whole globe. These capabilities, coupled with our growing understanding of the components of the Earth system -- the atmosphere, oceans, soil and solid earth, and biota -- and the physical, chemical, and biological processes that link them, permit, for the first time, an integrated and interdisciplinary approach to Earth system studies.

The ground swell of commitment is most evident in the formulation of the International Geosphere-Biosphere Program of the International Council of Scientific Unions and the U.S. Global Change Research Program, the U.S. national contribution to the international program. These are programs of fundamental research that are unprecedented in terms of disciplinary breadth, multinational involvement, and the promise for practical benefit through understanding the coupling between the physical and biogeochemical processes that together determine the climate and environment of the earth.

The goal of the U.S. Global Change Research Program is: "To gain a predictive understanding of the interactive physical, geological, chemical, biological, and social processes that regulate the total Earth system and, hence, establish the scientific basis for national and international policy formulation and decisions relating to natural and human-induced changes in the global environment and their regional impacts." The strategy for

implementing the U.S. Global Change Research Program calls for identification of scientific objectives, the integration of traditional scientific disciplines, and the establishment of new coordination mechanisms.(1) The president's FY 1990 budget proposed a funding level of $191.5 million for the U.S. program.

Given the goals of the U.S. Global Change Research Program it is clear that attention should first be concentrated on those sensitive regions of the globe where anticipated changes will be greatest.(2) The Arctic is a region characterized by one of the most extreme environments of the planet, where limited sunlight, extreme temperature excursions, and a short growing season impose harsh constraints on terrestrial and marine ecosystems. Sea ice, snow cover, glaciers, tundra, permafrost, boreal forests, and peatlands are each a sensitive indicator of global change, susceptible to subtle variations in sunlight, surface temperature, ocean heat transport, air and ocean chemistry, and the particulate loading of the atmosphere.

Polar lands and oceans are more than passive indicators of change in the coupled earth system, however.

- The basic circulation patterns of the global atmosphere are fixed by arctic and antarctic boundary conditions through pole- equator temperature differences;

- high-latitude air/ice/ocean interactions play an important role in determining regional and global climate and ocean circulation patterns; and

- arctic air/land interactions -- particularly those involving peatlands and permafrost -- involve potentially important sources and sinks of trace gases and of elements key to life.

Biological activity in arctic lands and in the euphotic zone of the Arctic and Antarctic Oceans may reflect coupling of orbitally induced variations in insolation, global carbon dioxide abundance, and surface temperature. Global warming induced by the greenhouse effect will be particularly felt in polar regions, most likely resulting in changes in extent of sea ice, increased thawing of permafrost, and melting of polar ice masses, with profound societal impacts around the globe. These are just a few of the reasons why the polar regions are particularly appropriate for scientific emphasis in the U.S. Global Change Research Program.(3)

These challenges impose new requirements on the way that research in the earth and biological sciences will be planned, organized, and executed.

- A first requirement is that today's scientists begin to work together at a new and unprecedented level of interaction: in planning, in execution of field programs, in the analysis and interpretation of data, and in the building of coupled models of the environment.

- Associated with this is a need for education, and perhaps also reeducation of scientists who work in these fields to develop the expertise to address global change issues.

- A third requirement is for communication and effective coordination between relevant programs and research activities.

- A fourth requirement is for continued public education and information dissimination to decision makers.

Both the international and national programs call for the development of regional research centers for global change studies to facilitate regional collaboration and research on global change issues, with special emphasis on those aspects of processes that manifest themselves distinctly in that region. These centers will be charged with assimilating, synthesizing, and interpreting regional data sets for integration into global-scale synthesis and modeling efforts. They will also extract the relevant regional component from global model output. In this way, these centers can provide to resource managers and decision makers information of particular importance to the region.

RATIONALE

Within the context of the regional research centers for global change studies we have a unique opportunity to contribute to the goals of the U.S. research program, the State of Alaska, and the University by enhancing existing research activities and developing new and relevant scientific and educational initiatives.

Present research activities at high latitudes addressing global change can be summarized under four broad headings:

- Detection and monitoring of global change
- Study of system interactions and feedbacks
- Study of biological responses to global change
- Study of socio-economic impacts

University of Alaska Fairbanks (UAF) research activities address these topics and their implications for the high latitudes, and represent roughly $6 million annually in research dollars (Attachment 1). The main strength of UAF research expertise is in the areas of geophysics, marine science, and arctic biology and can provide an excellent starting point from which to build a more comprehensive and interdisciplinary program.

As the U.S. Global Change Research Program notes, the success of the program is dependent on achieving disciplinary integration. This means drawing upon the strengths of existing and separate fundamental disciplines, which building the interdisciplinary approaches that an integrated Earth picture demands. True interdisciplinary research is described by Stephen Schneider of NCAR as blending inextricably the techniques and intellectual cultures of two or more disciplines throughout the research effort, rather than bringing into juxtaposition research results arrived at along disciplinary lines. A university research community is the ideal setting for effectively fostering interdisciplinary collaboration, communication, and research.

While there is presently considerable relevant research activity at UAF, it is largely the result of individual initiative and is undertaken with a disciplinary focus. However, the size and flexibility of the research community at UAF will lend itself well to the need for cross-disciplinary and interdisciplinary activities, provided there is a framework to cultivate these activities. Such a framework could be provided by a center which will provide a means of

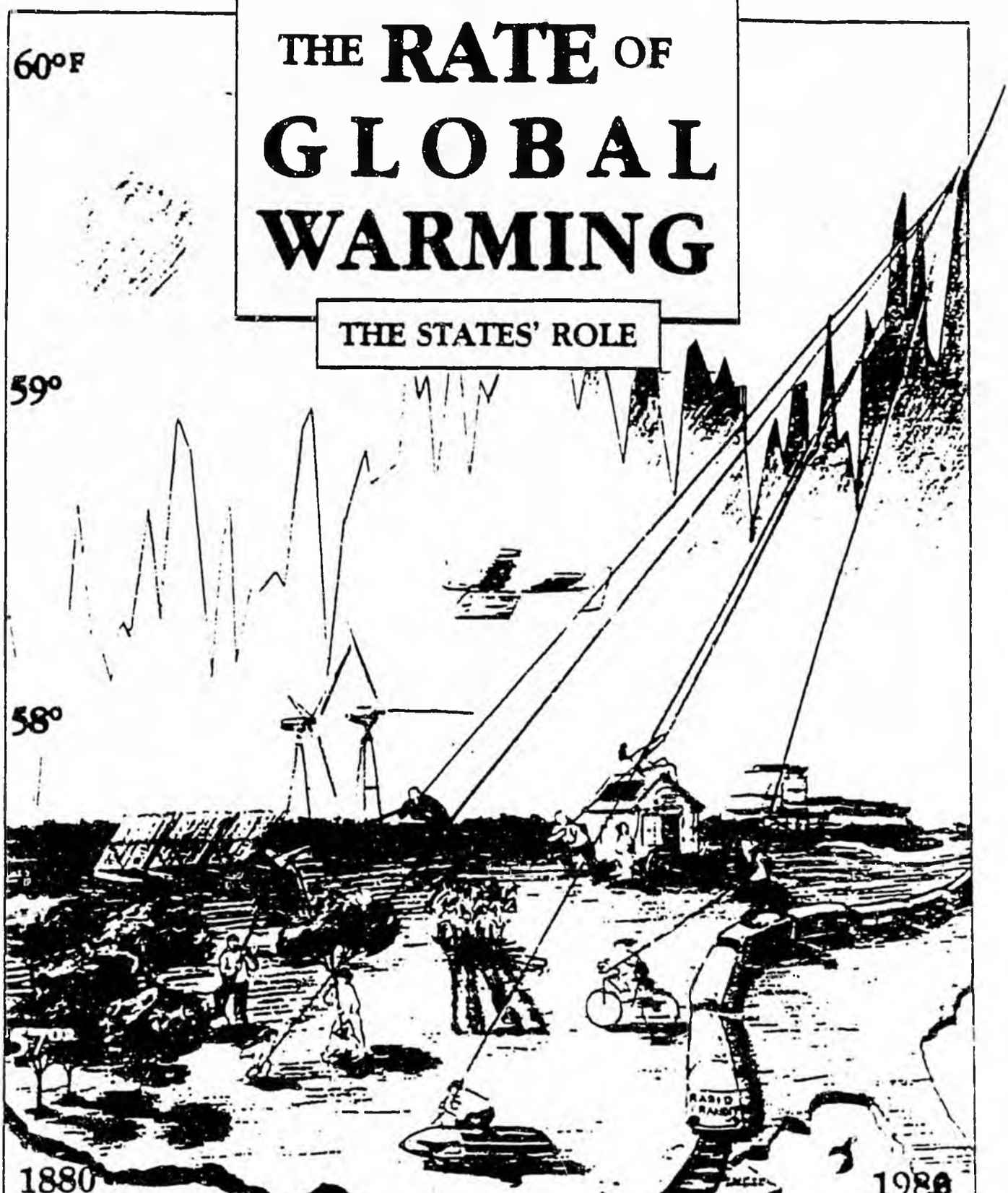
identifying and addressing crucial needs for enhancing current capabilities. This document proposes the establishment of such a Center for Global Change Studies at UAF, with a focus on the polar regions.

Several U.S. universities have taken organizational steps to address global change problems. The Center for Global Change at the University of Maryland, the Earth System Science Center at Pennsylvania State University and the Institute for the Study of Earth, Oceans and Space at the University of New Hampshire are in operation now. Plans for similar centers are underway at the University of Michigan, University of California San Diego and Irvine campuses, and many others are on the drawing board.

We expect that the UAF Center would provide a framework and mechanism for pioneering the way interdisciplinary research is done in the polar regions. It would also provide a mechanism for more efficient use of facilities and resources, with a greater scientific and practical return for the investment. Other possible benefits include increased visibility for the State of Alaska and the University, and a mechanism for providing key information from a regional standpoint for state officials to consider in making policy decisions.

REDUCING THE RATE OF GLOBAL WARMING

THE STATES' ROLE



RENEW AMERICA

REDUCING THE RATE OF GLOBAL WARMING

THE STATES' ROLE

Prepared By:
Sheila Machado
Rick Piltz

November 1988

Renew America is a non-profit, tax-exempt educational organization dedicated to the efficient use of all natural resources. Renew America provides individual citizens, state agencies and private organizations with information to assist grassroots change to ensure a clean, safe and livable environment for future generations. For further information on Renew America or to obtain additional copies of this report, contact: Renew America, 1001 Connecticut Avenue, N.W., Suite 719, Washington, DC 20036 (202)466-6880. See page 33 for ordering information.

Executive Summary

Record-breaking temperatures during the summer of 1988 were reported on front pages across the country and made the "greenhouse effect" a household term. The long heat wave parched farmlands from New Mexico to Pennsylvania and from Idaho to South Carolina. For the South it was a second year of drought conditions. In the Midwest crop yields were rated from poor to very poor. In New England the heat wave drove electric consumption to a new high.

There is much debate about the relationship between the heat wave-drought conditions and the greenhouse effect, but certain facts stand out—the earth has warmed to a record level, and the four or five warmest years of this century have been in the 1980s.

Scientists believe that a warming of the global climate, due to man-made emissions of heat-trapping greenhouse gases, is almost certain and may have already begun. Unless this warming trend is halted, or radically slowed, it will produce a host of profound and irreversible ecological disturbances in the coming decades.

According to a forthcoming U.S. Environmental Protection Agency (EPA) report to Congress, unchecked global warming would have severe ecological and economic effects in the United States. More than just long, hot summers are in store. Sea levels will rise due to warming of the ocean, and polar ice caps may melt. As a result, coastal lowlands will be flooded. Climate changes will create unpredictable crop yields, stress on water resources, and economic dislocation. Averting such a disaster will require significant changes in public policy and uses of technology. More than just a strengthening of government regulations on air pollution, the changes require a fundamental transformation of our energy-supply system.(1)

There is no single, simple technological "fix" that will eliminate the greenhouse threat. Substituting nuclear power for fossil fuels may only result in a costly process of trading one set of environmental problems for another. Dealing with the challenge effectively will require a

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multiplicity of actions, and broad cooperative efforts—international, national, state and local, public and private. The actions we take in the United States will be critical.

With five percent of the world's population, the United States is responsible for roughly 20 percent of the global greenhouse effect. The United States is the single largest contributor to the atmospheric buildup of carbon dioxide (CO_2) from the burning of fossil fuels—coal, oil, and natural gas—in power plants, motor vehicles, industrial processes, and buildings.

Of the greenhouse gases, CO_2 makes the largest contribution—about half—to global warming. Substantially cutting CO_2 emissions is a crucial, and achievable, approach to the goal of stabilizing the atmospheric chemistry. At the same time, reducing fossil fuel consumption can help ease the problems of acid rain and ground-level ozone pollution.

The keys to reducing our use of fossil fuels are to implement major, across-the-board improvements in energy efficiency, and to make a transition to an energy system based on solar and other renewable non-fossil energy resources. Switching from coal and oil to natural gas in generating electricity would reduce CO_2 emissions in the short-term. How the federal government proceeds in dealing with the greenhouse effect will set a model for other nations.

There is an especially important role for the states. Most major federal environmental-protection laws rely heavily on the states for implementation, especially for compliance monitoring and enforcement. Many states already have laws and programs in place that can serve as building-blocks for a more aggressive strategy to reduce emissions of greenhouse gases. Some states have also played a pioneering role in developing creative approaches to promoting energy conservation and renewable energy.

Global warming confronts us with extraordinary challenges: How do we effectively cope with a phenomenon that we have barely begun to experience—one which could completely alter our environment and shake our society to its foundations in the 21st century? How do we develop public understanding, make institutional decisions and commit the necessary resources to slow the rate of global warming?

Meeting these challenges will require farsighted and skillful leadership. The United States has a fundamental responsibility to provide this leadership through the actions of its public officials and private citizens.

This is the first report that attempts to track and quantify individual state carbon dioxide emissions contributing to the greenhouse effect, as well as state policies that may help reduce the rate of global warming. Information on other greenhouse gases is not yet available on a state-by-state basis. This report is not intended to be a comprehensive study of the problem, but an early indicator of possible nuts-and-bolts solutions based on current knowledge.

The information in the matrices shows indicators of the problem in each state, as well as information on current state policies and programs that could help reduce the rate of climate change. In a future report as additional information on greenhouse gases becomes available, we intend to rank states to show which are taking action to reduce emissions. We realize that state-by-state variations in emissions of greenhouse gases are due to a complex combination of economic and other factors, so caution

The keys to reducing our use of fossil fuels are to implement major, across-the-board improvements in energy efficiency, and to make a transition to an energy system based on solar and other renewable non-fossil energy resources.

should be used in interpreting the data in a comparative context.

We encourage comments from readers that will improve our information base for doing a fair evaluation.

Some of the indicators are:

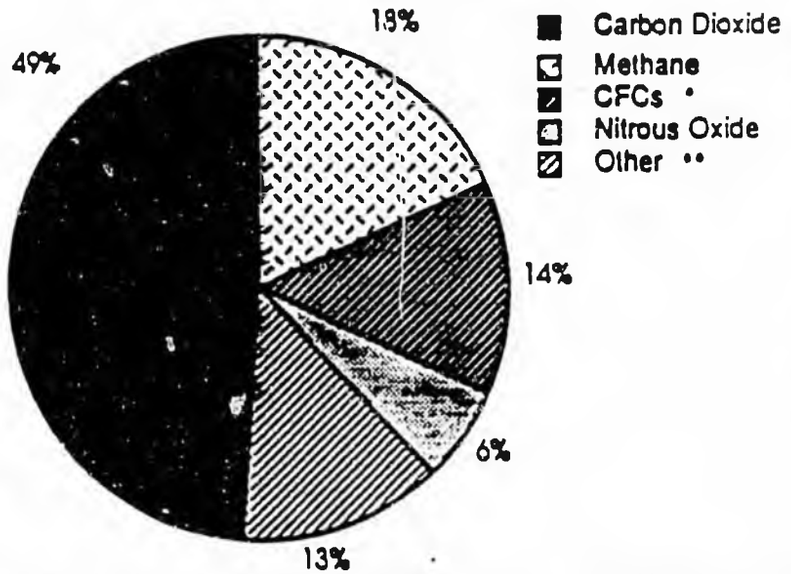
- From 1976 to 1986, 42 states reduced their petroleum emissions, but 38 states increased their coal emissions.
- Eighty million Americans in 30 states now live in areas that exceed EPA ozone-pollution standards.
- Electric power plants contribute 33.4 percent of total U.S. carbon emissions from fossil fuels. At least ten states have substantial statutory authority and policies requiring that utilities use least-cost planning and investment practices.
- Fifteen states offer alternative energy tax credits.
- Transportation contributes 31.8 percent of total U.S. carbon emissions from fossil-fuel use. Sixteen states fund ridesharing programs. Seven states have state public transportation technical assistance programs independent of the federal Urban Mass Transportation Act (UMTA).

States can initiate action and provide models of effective programs, but a strong federal presence is required to ensure that all states implement effective policies. Increasing federal fuel-efficiency standards for cars and trucks is critical, and on other issues new federal legislation must provide incentives and deadlines for timely action in all states.

Moving expeditiously to reduce emissions of greenhouse gases will provide a wide array of benefits. Those steps can simultaneously strengthen the economy, lead to an efficient, renewable energy system, reduce our dependence on imported oil, give us an edge in technological innovation, reduce acid rain and other forms of air pollution, protect the stratospheric ozone layer, create new forests, reduce soil erosion, and promote a sustainable agriculture. On the other hand, failure to take the steps necessary to stabilize the earth's atmospheric chemistry could lead to an extraordinary combination of disasters.

Global warming is an unprecedented challenge to policymakers all over the world and the stakes are extremely high. Although a great deal is yet to be learned about global climate change, we know enough now to begin to take straightforward actions that will produce long-term benefits.

Estimated Relative Contributions to The Greenhouse Effect in the 1980s



Note: The first four gases listed are long-lived and mix well in the atmosphere, so their concentrations and greenhouse contributions can be measured fairly accurately. The 'other' category is more uncertain because the gases are short-lived and their concentrations vary from one area to another.

Source: James Hansen, et al., *Journal of Geophysical Research* 8/20/88

* CFC-11 and CFC-12.

** Tropospheric ozone and other halocarbons.

WHY WE HAVE A WARMING TREND

When carbon dioxide and certain other gases are released into the atmosphere they surround the earth like a blanket, trapping the heat from the sun--this is the "greenhouse effect." The higher the concentration of greenhouse gases the more the temperature increases. Scientists have long anticipated the climate-warming trend, mainly due to the increased burning of fossil fuels—coal, oil, and natural gas.

The emission rate for each of the greenhouse gases has been increasing, as has their concentration in the atmosphere. The exact rate and amount of future warming is uncertain. But the average temperature of the earth is now warmer than at any time since record keeping started in the 19th century. The rate of warming appears to have accelerated in the past decade. (2)

Scientists estimate that a combined concentration of greenhouse gases equivalent to a doubling of pre-industrial carbon dioxide levels will produce an average global increase in temperature ranging from 1.5 to 5.5°C (2.7-9.9° F). Because of the delayed effects of the existing greenhouse gases, the earth is already committed to a few degrees of warming over the next 40-60 years. (3)

A temperature change of this magnitude occurred at the end of the last Ice Age, about 15,000 years ago, when a 5°C shift totally remapped the global ecosystem, completely changing the location of various types of forests. The global warming now underway is predicted to bring about changes far more rapidly than the changes that occurred at the end of the last Ice Age. Although it is not yet possible to predict how specific local areas will be affected, the changes in climate that will accompany this continuous warming are predictable in general. (4)

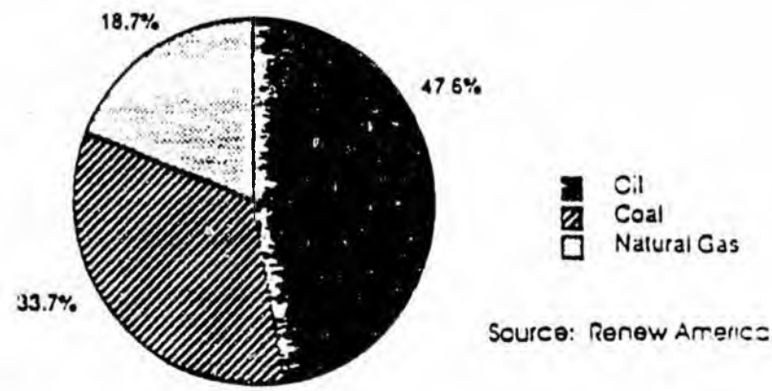
WHAT WILL HAPPEN?

In the United States, longer, hotter summers are expected. Sea water will expand as it warms, increasing sea levels by several feet and threatening coastal cities and developed areas, as well as causing the loss of beaches and wetland habitats. Polar ice caps may melt, causing even more massive flooding. Forests will die off on an unprecedented, region-wide scale. Warming will deplete fresh water resources through evaporation and cause soil to dry up. Farming patterns will be disrupted, with major losses in some parts of the country. Agricultural pests may spread northward into new regions.

In addition, wildlife habitat will be destroyed, and extinction of species could increase. Air quality will deteriorate. Rainfall patterns will change, and the frequency of extreme weather conditions will increase. Human mortality will probably increase. Some scientists believe there will be nonlinear, "quantum-leap" effects that will produce currently unpredictable, globally disruptive surprises. (5)

A great deal of our economy and infrastructure—our human settlement patterns, industry, food-production system, water-supply and flood-control systems — assumes a stable climate and a constant sea level. Noting "the close links between our society, the environment, and climate," an upcoming EPA report to Congress concludes that the findings of its study:

Figure 1
1986 U.S. Estimated Carbon Emissions by Fuel Type
(as percent of U.S. total emissions from fossil fuels)



Source: Renew America

"...collectively suggest a world that is different from the world that exists today....The landscape of North America will change in ways that cannot be fully predicted. The ultimate effects will last for centuries and will be irreversible. Strategies to reverse such impacts on natural ecosystems are not currently available." (6)

THE GREENHOUSE GASES

- **Carbon dioxide**
- **Chlorofluorocarbons and Halons**
- **Methane**
- **Nitrous oxide**
- **Tropospheric ozone**

Carbon Dioxide—Mainly a Fossil Fuel Problem

Carbon dioxide contributes about half to the impact of all greenhouse gases. While CO_2 is essential to life–without it altogether the earth would freeze–if the natural CO_2 balance is disturbed, the atmosphere overheats. Human activity adds CO_2, primarily through the burning of fossil fuels in transportation, electricity generation, industrial manufacturing, and heating of buildings. The quantity of carbon-dioxide emissions attributable to the burning of fossil fuels in the United States, and in each state, can be estimated using available data and formulas.

Figure 1 summarizes 1986 total U.S. carbon emissions by fossil-fuel type. Oil—including motor fuel, heating oil, and oil used in industrial processes — makes the largest overall contribution to the CO_2 build-up.

The 1986, 1976, and 1966 "Carbon Emissions from Fossil Fuels" matrices provide data on total state-by-state emissions, and the amount and percentage from each fossil-fuel type—oil, coal, and natural gas (See pp. 6, 19-21). The combustion of each fossil fuel varies in its emissions of carbon per unit of energy released. Coal releases the most CO_2 to produce a given amount of energy and natural gas the least. (Following standard practice, the matrices express emissions data in terms of tons of carbon, rather than CO_2. One ton of CO_2 contains 12/44 ton of carbon.)

The 1986 Carbon Emissions Matrix reveals wide variation among states in total emissions, with Texas having the highest total (154.87 million metric tons) and Vermont the lowest (1.31 million).

In West Virginia, coal accounts for 77 percent of the state's total carbon emissions, while in California coal's contribution is just one percent. Natural gas accounts for 41 percent of Louisiana's carbon emissions, while oil is the leading contributor in Hawaii (99 percent).

The 1986 Carbon Emissions Matrix also shows that states vary widely in their tonnage of carbon emissions per million dollars of gross state product (the total value of goods and services produced in the state). In general, the states with the higher emission rates on this indicator are those with the most coal-based electricity generating systems, or those with a heavy concentration of petrochemical plants. Those with a lower ratio of carbon emissions to economic product tend to have few coal-fired power plants.

A comparison of the 1986, 1976, and 1966 Carbon Emissions matrices shows that the 1275 million tons of U.S. total emissions from burning of fossil fuels in 1986 was 28 percent higher than the total in 1966. This increase was due to a substantial increase in consumption of both oil and coal. Over the most recent ten year period, the trend is more encouraging. Total carbon emissions were reduced by five percent from 1976 to 1986, as 42 states reduced their petroleum emissions. This reduction was slowed by increasing coal emissions in 38 states.

Carbon dioxide is the only greenhouse gas for which it is possible to calculate state-by-state emissions from fossil fuels. No federal agency or independent organization has broken down emissions of other greenhouse gases by state. However, the available carbon emissions data suggest how far the states still have to go in reducing fossil fuel burning.

1986 Carbon Emissions from Fossil Fuels

	Total Emissions (million metric tons)	Emissions from Oil (million metric tons)	Emissions from Coal (million metric tons)	Emissions from Natural Gas (million metric tons)	Emissions from Oil (% of total)	Emissions from Coal (% of total)	Emissions from Natural Gas (% of total)	Tons Carbon/ $Million GSP
	1	2	3	4	5	6	7	8
Alabama	28.99	9.50	16.50	2.99	32.8	56.9	10.3	527
Alaska	7.96	4.69	0.30	2.97	58.9	3.8	37.3	407
Arizona	15.16	6.27	7.39	1.50	41.4	48.7	9.9	285
Arkansas	14.62	6.11	5.62	2.89	41.8	38.4	19.8	462
California	85.23	61.47	1.07	22.69	72.1	1.3	26.6	160
Colorado	16.53	6.35	7.36	2.82	38.4	44.5	17.1	279
Connecticut	10.35	8.68	0.52	1.15	83.9	5.0	11.1	147
Delaware	4.51	2.38	1.65	0.48	52.8	36.6	10.6	385
Florida	43.55	27.83	11.46	4.26	63.9	26.3	9.8	245
Georgia	35.51	14.12	17.30	4.09	39.8	48.7	11.5	345
Hawaii	4.40	4.36	0.00	0.04	99.1	0.0	0.9	228
Idaho	2.73	2.01	0.22	0.50	73.6	8.1	18.3	207
Illinois	55.04	21.94	19.64	13.46	39.9	35.7	24.5	263
Indiana	49.13	14.76	28.68	5.69	30.0	58.4	11.6	579
Iowa	16.03	6.51	6.54	2.98	40.6	40.8	18.6	366
Kansas	18.20	7.52	6.29	4.39	41.3	34.6	24.1	429
Kentucky	30.01	8.81	18.72	2.48	29.4	62.4	8.3	565
Louisiana	51.73	26.11	4.29	21.33	50.5	8.3	41.2	695
Maine	4.43	4.17	0.22	0.04	94.1	5.0	0.9	256
Maryland	17.60	8.49	6.86	2.25	48.2	39.0	12.8	230
Massachusetts	21.70	16.48	2.50	2.72	75.9	11.5	12.5	188
Michigan	47.12	17.03	20.27	9.82	36.1	43.0	20.8	308
Minnesota	17.75	9.24	5.02	3.49	52.1	28.3	19.7	235
Mississippi	13.51	7.65	2.72	3.14	56.6	20.1	23.2	424
Missouri	27.44	11.18	12.78	3.48	40.7	46.6	12.7	329
Montana	6.32	2.42	3.32	0.58	38.3	52.5	9.2	520
Nebraska	7.96	3.73	2.75	1.48	46.9	34.5	18.6	300
Nevada	7.25	2.70	4.04	0.51	37.2	55.7	7.0	373
New Hampshire	3.58	2.80	0.62	0.16	78.2	17.3	4.5	193
New Jersey	31.21	24.08	1.95	5.18	77.2	6.2	16.6	202
New Mexico	12.01	3.90	6.04	2.07	32.5	50.3	17.2	509
New York	49.57	32.57	6.31	10.69	65.7	12.7	21.6	137
North Carolina	29.78	13.23	14.55	2.00	44.4	48.9	6.7	295
North Dakota	10.39	2.25	7.76	0.38	21.7	74.7	3.7	968
Ohio	67.21	20.78	35.74	10.69	30.9	53.2	15.9	382
Oklahoma	21.37	7.79	5.44	8.14	36.5	25.5	38.1	429
Oregon	7.28	6.17	0.07	1.04	84.8	1.0	14.3	176
Pennsylvania	65.57	23.66	32.90	9.01	36.1	50.2	13.7	357
Rhode Island	2.42	2.02	0.02	0.38	83.5	0.8	15.7	159
South Carolina	14.78	6.74	6.59	1.45	45.6	44.6	9.8	330
South Dakota	2.94	1.89	0.72	0.33	64.3	24.5	11.2	300
Tennessee	28.72	10.80	15.15	2.77	37.6	52.8	9.6	397
Texas	154.87	78.60	29.03	47.24	50.9	18.7	30.5	510
Utah	9.88	3.73	4.72	1.43	37.8	47.8	14.5	412
Vermont	1.31	1.22	0.02	0.07	93.1	1.5	5.3	152
Virginia	23.35	13.09	7.56	2.10	56.6	32.4	9.0	224
Washington	16.20	12.89	1.57	1.74	79.6	9.7	10.7	209
West Virginia	28.42	4.80	21.89	1.73	16.9	77.0	6.1	1179
Wisconsin	22.04	8.76	9.26	4.02	39.7	42.0	18.2	287
Wyoming	11.63	2.09	8.41	1.13	18.0	72.3	9.7	996
TOTAL	1275.30	606.96	430.35	238.01	47.6	33.7	18.7	336

(See pp. 22-23 for explanatory notes)

The best way to reduce carbon dioxide emissions from fossil fuels is to: 1) reduce fossil-fuel use through increases in end-use energy efficiency; 2) replace fossil-fuel combustion with alternative, renewable fuel sources; and 3) shift the fossil-fuel mix from higher to lower carbon-dioxide-emitting fuels.

Deforestation is also a major contributor of carbon dioxide to the atmosphere, through the burning and decay of trees. Planting trees can reverse this process and help reduce CO_2 levels. Forestry alone cannot solve the CO_2 problem, but it could play a significant role.

Figure 2 summarizes 1986 U.S. carbon emissions from various sectors—electricity generation, transportation, industrial/commercial, and residential.

Reducing the CO_2 build-up must be the main focus of state action to slow global warming. States have numerous possible tools for accomplishing this (For more discussion, see the "What States Can Do section of this report).

Chloroflourocarbons — Air Conditioners and Refrigerators

In contrast to other greenhouse gases, chlorofluorocarbons (CFCs) and the related bromine-containing compounds the halons, are not natur[illegible] present in the atmos[illegible]ere. CFCs have been manufactured during the past 50 years for use as solvents, refrigerator fluids, aerosol propellants, hospital sterilants, and foam packaging. Halons are used predominantly in fire extinguishers and firefighting practices. CFCs and halons destroy the life-protecting stratospheric (upper-atmospheric layer) ozone shield, allowing more harmful ultraviolet radiation into the lower atmosphere.

CFCs are used in an estimated 90 million car and truck air conditioners, 100 million refrigerators, air conditioners in 45 million homes and most buildings, and 30 million freezers.(7)

In 1987 representatives of most of the industrialized nations signed the Montreal Protocol, an agreement to cut CFC production in half by 1998. In 1988, the U.S. Congress ratified this pledge. However, in a September 1988 report, EPA concluded that, even with full worldwide participation in the Montreal Protocol, the concentration of ozone-depleting chemicals would at least double during the next 87 years—a phenomenon that would have very disturbing implications both for the stratospheric-ozone shield and for global warming. (8)

Simply put, the use of chlorofluorocarbons and halons must be eliminated absolutely as quickly as possible. Their ozone-depleting effects can be reduced in the short term through the use of alternative products. Currently, four states—Maine, Vermont, Massachusetts, and Rhode Island—ban or restrict the purchase of polystyrene (styrofoam) products. Massachusetts filed the nation's first lawsuit to stop the excessive emissions of CFCs.

States could also take the lead in using regulatory measures or economic incentives to promote CFC recovery and recycling, especially from refrigerators and automobile air conditioners. Recycling centers could be set up in cooperation with industry. (9) (Chlorofluorocarbons/Methane Matrix, p. 24)

Methane — Landfills, Cows, and Rice Paddies

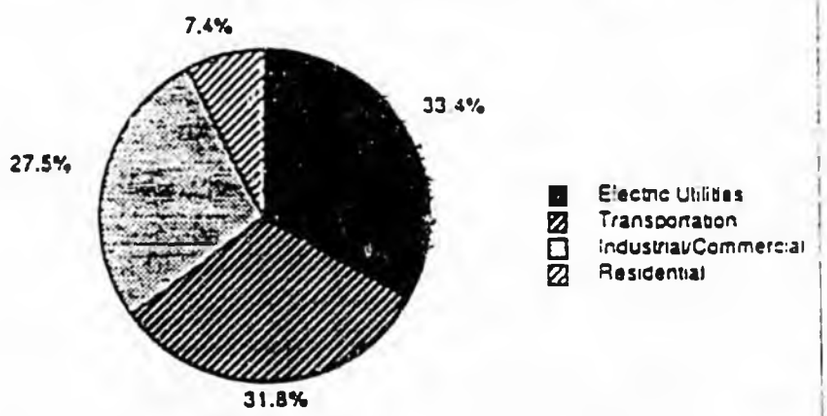
Methane is generated mainly by the bacterial decomposition of organic matter, particularly in flooded rice fields, wetlands, the digestive systems of certain animals, and landfills. Wood and agricultural waste-burning, pipeline leaks, and coal mining also contribute. Methane emissions are not well-documented, but are linked to population growth and agricultural and economic development.

Landfill gas consists of about 50 percent methane and is produced by the decomposition of solid waste. Recovering methane from landfills can reduce emissions, but not all landfills are suited for methane recovery, and further research is needed to document methane emissions. EPA lists 7,608 municipal waste landfills in the United States. Currently, 20 states have a total of 65 privately operated landfill recovery projects. (Chlorofluorocarbons/Methane Matrix, p. 24)

Nitrous Oxide — Fertilizer and Fossil Fuels

The sources of and amounts of nitrous oxide (N_2O) emissions are not fully understood. Some types of fossil-fuel combustion may be significant sources. Biomass burning, land conversion for agriculture, and nitrogen fertilizer use also affect N_2O levels. Recent research indicates that deforestation may be a significant future source of emissions. It may be possible to limit nitrous oxide emissions through combustion controls. Changes in fertilizer application practices and stopping deforestation could also slow the rate of N_2O emissions.

Figure 2
1986 U.S. Carbon Emissions by Sector
(as percent of U.S. total emissions from fossil fuels)



Source: Renew America

Tropospheric Ozone — Gasoline and Auto Emissions

Tropospheric (ground-level) ozone is toxic, and contributes to the greenhouse effect. Tropospheric ozone is produced as a result of chemical reactions among volatile organic compounds (VOCs) and nitrogen oxides (NOx). VOCs are a broad class of organic gases, such as vapors from gasoline and solvents. Nitrogen oxides come primarily from auto emissions and power plants, as well as gas stations, industrial fuel consumption, paint fumes, and dry cleaners.

Ozone air pollution is a public-health problem. Recent clinical studies show that concentrations of ozone are linked to long-term lung damage and, as with cigarette smoking, the effects build up over time. Eighty million Americans now live in areas that exceed EPA ozone-pollution standards.

The Ozone Scorecard Matrix (see p. 25) lists the 62 metropolitan areas in non-attainment for ozone based on their ozone levels from 1984-1986. As a consequence of the expiration of the Clean Air Act deadline for ozone-level attainment, EPA imposed a ban on the construction or expansion of air-polluting industries in the Los Angeles and Chicago areas. Thirteen additional areas may face similar action by early in 1989. EPA has given formal notice to 35 states to revise their implementation plans for ozone attainment.

The chemicals that react to produce tropospheric ozone, NOx and VOCs, are also among the principal components of the chemical reactions that produce acid rain, which threatens forests and aquatic ecosystems. Along the Appalachian Mountain chain the acidity of cloud moisture is ten times greater than at lower elevations, and about 100 times greater than that of unpolluted precipitation. (10)

As with acid rain, the transport of ozone over large distances threatens vegetation and crops. Extensive tree-damage and mortality due to ozone have been documented in pine forests in California and in the eastern states. Crop productivity is also impaired; an estimated $5 billion in annual crop losses can be attributed to air pollution. (11)

The Reforestation Matrix (see p. 31) shows that five states already have acid rain deposition-control programs: New York, Massachusetts, New Hampshire, Wisconsin, and Minnesota. But the heaviest acid-rain polluting states have yet to take action.

The Air Pollution Budgets Matrix (see p. 29) shows both

Electricity

	1	2	3	4	5	6	7
	Emissions from Electric Utilities (% of total emissions)	% Emissions from Coal	% Emissions from Natural Gas	% Emissions from Oil	# of Coal Plants/ Planned Additions	Least-Cost Provisions	Wind Energy Programs
Alabama	46.1	44.95	0.07	0.03	41/3	*	
Alaska	8.9	1.38	6.16	1.38	5/0	*	
Arizona	44.3	41.09	3.03	0.20	12 / 3	*	
Arkansas	40.0	37.00	2.94	0.07	5/0	**	
California	8.6	0.00	7.77	0.80	0/0	***	S/O
Colorado	42.2	41.74	0.42	0.06	31/3	*	
Connecticut	26.5	4.83	0.10	21.55	1/0	**	
Delaware	44.8	33.92	0.67	10.20	5/0	*	
Florida	43.0	25.07	5.60	12.35	27/2	***	
Georgia	45.9	45.51	0.23	0.17	38/1	*	
Hawaii	31.6	0.00	0.00	31.59	0/0	*	P/O
Idaho	0.0	0.00	0.00	0.00	0/0	**	
Illinois	30.7	29.49	0.16	1.02	63/0	***	S/O
Indiana	40.6	40.48	0.04	0.08	83/1	**	
Iowa	34.6	34.44	0.12	0.06	57/0	***	
Kansas	35.0	33.74	1.15	0.11	20/1	*	
Kentucky	54.8	54.72	0.03	0.10	59/2	*	
Louisiana	15.9	7.98	7.71	0.15	6/0	*	
Maine	12.0	0.00	0.00	11.96	0/0	***	
Maryland	32.2	28.64	0.17	3.41	13/1	**	
Massachusetts	30.4	10.92	1.01	18.43	9/0	**	S/P
Michigan	34.1	33.62	0.11	0.42	84/0	*	
Minnesota	25.1	24.96	0.11	0.06	53/2	**	S/T
Mississippi	25.5	19.02	5.18	1.26	9/0	*	
Missouri	43.0	42.82	0.07	0.11	50/1	**	
Montana	50.5	50.32	0.16	0.00	6/0	**	P/O
Nebraska	32.9	32.54	0.25	0.13	15/0		
Nevada	57.0	54.76	1.38	0.83	8 / 1	***	
New Hampshire	32.7	17.32	0.00	15.36	5/0	**	P/O
New Jersey	10.9	5.58	1.73	3.56	9/0	**	
New Mexico	52.4	49.79	2.50	0.06	13/2	**	
New York	25.1	8.07	3.97	13.03	28/0	**	
North Carolina	43.4	43.22	0.07	0.13	47/0	**	
North Dakota	54.8	54.67	0.00	0.10	14/1	*	
Ohio	42.6	42.27	0.01	0.10	130/1	**	
Oklahoma	37.3	23.54	13.71	0.05	10 / 1	*	
Oregon	0.0	0.00	0.00	0.00	1/0	***	
Pennsylvania	40.5	37.84	0.02	2.65	65/0	**	
Rhode Island	7.4	0.00	0.00	7.44	0/0	*	
South Carolina	33.5	33.29	0.14	0.07	24/0	**	
South Dakota	20.7	20.75	0.00	0.00	6/0	*	
Tennessee	43.7	43.59	0.00	0.10	37/0		
Texas	28.2	17.57	10.55	0.06	32/16	***	
Utah	39.4	39.17	0.00	0.20	18/2	*	
Vermont	1.5	0.76	0.00	0.76	0/0	***	
Virginia	22.7	20.17	0.04	2.53	22/0	**	
Washington	8.3	8.33	0.00	0.00	2/0	**	
West Virginia	67.4	67.28	0.00	0.14	33/0	*	
Wisconsin	36.6	36.34	0.14	0.14	61/0	***	
Wyoming	65.3	65.26	0.00	0.09	19/0	*	
Total	33.4	28.22	3.01	2.17	1276/44		

Electricity Matrix Notes

Column 1 - Carbon emissions from the production of electricity by electric utilities as a percent of the state's total carbon emissions. The data are calculated from the energy input at electric utilities for oil, coal, and natural gas.
Source for fuel consumption: "State Energy Data Report: Consumption Estimates 1960-1986," Energy Information Administration, U.S. Department of Energy, 1988. Also refer to the "Key" on p.22.

Columns 2, 3, 4 - Percent of carbon emissions from electric utilities by fuel type.
Source for fuel consumption: "State Energy Data Report: Consumption Estimates 1960-1986," Energy Information Administration, U.S. Department of Energy, 1988. Also refer to "Key" on p. 22.

Column 5 - Number of Coal Plants Operating/Planned Additions through 1996.
Note: Planned additions does not imply approval by state utility regulatory commissions.
Source: Inventory of Power Plants in the United States 1986, Energy Information Administration, Table 16, pgs 21-27.

Column 6 - Least Cost Provisions and Regulations
"***" = comprehensive regulatory authority and policies in place which require integrated planning and investment process for utilities. "**" = state has made some progress toward least-cost planning process and has some control over utility investment. "*" state has made little progress in implementing policies and authority to encourage least-cost strategies.
Source: Critical Mass Energy Project, "Least-Cost Electrical Planning: Is There Really a State Movement?," December 1985; see also "A Brighter Future, State Actions in Least Cost Electrical Planning," Energy Conservation Coalition, Washington, DC, December 1987.

Column 7 - Wind Energy Programs
"S/O" = State operating wind farms. "S/P" = State in the process of setting up wind farm. "S/T" = State is testing small wind turbines for possible implementation. "P/O" = Private development of wind farm in place.
Source: Tom Gray, American Wind Energy Association, phone conversation 10/7/88.

the federal and state and local contributions to fiscal 1988 air pollution budgets in each state.

WHAT STATES CAN DO

While a great deal of study is needed on greenhouse gases, there are practical actions states can take to reduce carbon dioxide emissions by promoting energy-efficiency and renewable energy alternatives in electricity generation, transportation, and other sectors, as well as through reforestation practices.

Electricity

Electricity generation is a major contributor to the carbon dioxide build-up—33 percent of the U.S. total carbon emissions from fossil fuels come from electric power plants. Of this amount, 84 percent comes from coal-fired plants, which account for 28 percent of total U.S. carbon emissions. There are 1276 coal-fired power plants in the United States, with 44 more planned by utilities power-plant fuel leases the most [illegible] duce a given amount of energy.

[The state-by-state carbon emissions data in the Electricity Matrix reflect where the electricity is generated, not necessarily where it is put to end-use. Thus, in cases when a state imports power produced in a neighboring state, the data assign the carbon emissions to the state with the power plant that produced them.]

Switching to natural gas would reduce CO_2 emissions during a transition period while we convert to renewable fuels. In the long-term, it is imperative that we make this transition to an electricity-generating system based on renewable alternatives to fossil fuels, including solar, geothermal, wind, biomass, and hydroelectric power.

Some energy industry analysts claim that nuclear power offers a practical solution to global warming, because nuclear plants do not emit greenhouse gases. However, in extricating society from the threat of global warming, it is critical not to trade one set of problems for another. The nuclear option is less safe environmentally, as well as less economical, than a policy geared to energy-efficiency and renewable energy sources.

The threat of accidents from nuclear plants, as well as the still-unsolved problem of managing nuclear waste, continue to raise fundamental concerns about nuclear power. To attempt to replace current fossil-fuel plants with the equivalent generating capacity of nuclear power would be prohibitively expensive and time-consuming.

The nuclear-power industry has suffered major setbacks in most countries, including the United States. No new nuclear plants have been ordered in the United States since 1979, and 108 plants have been cancelled, including all of those ordered after 1974. Nevertheless, nuclear power advocates and federal officials remain committed to the nuclear option, and have been planning for a resurgence in construction of nuclear plants in the 1990s.

Energy Elegance

Since the 1970s, improvements in U.S. energy efficiency have been contributing far more in reducing fossil-fuel consumption, at a small fraction of the cost, than has been contributed by additions to nuclear-power capacity. Existing technologies and various practical measures, if deployed effectively, have the potential to radically reduce the carbon-dioxide build-up, while simultaneously strengthening the economy with cost-effective energy-efficiency investments. At the same time, substantially reducing energy demand will ease a transition to a renewable system. In 1978, federal officials estimated that 20 percent of the nation's energy supply could come from renewable energy sources by the year 2000.

The United States can benefit from these changes without waiting for other nations to act. The changes need not be draconian—high-efficiency energy technology and practices will actually save money, while better positioning the nation in the global marketplace.

Although reducing coal consumption will require coordinated state and federal efforts, state energy-efficiency policies and standards will make it possible to cut back on electricity use and thus slow the rate of global warming. Among the policy options are:

- "least-cost" planning for utilities;
- projects to generate electricity from renewable resources;
- joint state/utility energy-efficiency projects;
- stronger energy-efficiency standards for buildings;
- performance-based tax credits for conservation and renewable energy; and
- rebates for purchases of energy-efficient cars, appliances, and lighting.

Promoting least-cost utility services was a policy first adopted in the Pacific Northwest in 1980. The least-cost objective is to provide heating, cooling, lighting, and motor power at the lowest cost, and to incorporate energy-efficiency in the evaluation of cost-effectiveness. The Electricity Matrix shows that at least ten states have substantial statutory authority and policies requiring that utilities use least-cost planning and investment practices. (12)

California provides an outstanding model of the use of least-cost utility planning. As the result of adopting, under pressure, a plan to invest in energy-efficiency improvements, including utility-financed building weatherization, cogeneration, and voltage controls, as well as wind and solar power, California Pacific Gas and Electric was able to supply electricity to its customers at a higher profit without building $20 billion worth of coal

and nuclear plants it had previously planned. (13)

The Electricity Matrix also identifies four states that are operating or testing wind turbines, or are in the process of setting up a wind farm, while three states have private wind-farm operations.

The State/Utility Joint Energy Efficiency Projects Matrix (see p. 27) identifies 24 states that have joint energy-efficiency projects with utilities, including projects to conserve energy in residential and commercial buildings, industry, and agriculture. The projects, funded in part by federal energy programs, are diverse. Most offer energy-efficiency services, such as energy audits, and financial incentives to install energy-efficiency improvements. Some provide technical assistance and loans to businesses, while others support research and demonstration projects.

About one-third of CO_2 emissions from fossil fuels come from fuel consumed directly (that is, not including electricity use) in industry, commerce, and residences, for such purposes as heating of buildings and in manufacturing processes.

The Residential/Industrial/Commercial Matrix (see p. 26) shows eight states with substantial energy-efficiency building codes. Many others have set minimal requirements for new buildings. Nationwide, states have weatherized less than ten percent of low-income homes, though the matrix indicates that the figures are higher in most of the northern states. In some cases states have taken initiatives that became the basis for nationwide changes. For example, in 1984 California adopted appliance energy-efficiency standards for refrigerators and freezers. The federal government followed California's lead in passing the 1987 National Appliance Energy Conservation Act, which sets standards to be in effect by 1990 for refrigerators, freezers, water heaters, dishwashers, ranges, and clothes washers and dryers. It is projected that, by the year 2000, these standards will result in enough energy conservation to supplant the need for 22,000 megawatts of new generating capacity, the equivalent of 22 large power plants.

The appliance standards paved the way for the passage of nationwide fluorescent lamp-ballast standards in June 1988. Again the states were ahead of the federal government, with ballast standards in place in California, Connecticut, New York, Massachusetts, and Florida by the end of 1987. Studies show that fluorescent lighting accounts for ten percent of the nation's electricity consumption, while all lighting uses about 20-25 percent (the equivalent of nearly half of all the electricity produced from coal). An ordinary incandescent light bulb uses five times as much energy as a comparable fluorescent lamp. Massachusetts is the only state adopting energy-efficiency standards for commercial and industrial lamps.(14)

Fifteen states offer alternative energy tax credits, which are examined in the State Energy Tax Credits Matrix (see p. 28). These include, for example, credits for investments in solar water heaters, passive solar systems, photovoltaics, wind systems, biomass, geothermal, and hydroelectric energy. This number of states was much larger several years ago. Following the lead of the federal government, many states added alternative energy tax credits starting in the late 1970s. However, with the sharp curtailment of support for government initiatives to promote conservation and solar energy under the current Administration, it has been common for states to allow tax credits for renewables to expire over the past several years. The matrix shows that alternative energy tax credits currently in place will expire in the next few years unless action is taken to continue them.

Future state tax credits and other economic incentives should be performance-based. They should be carefully designed to derive the maximum energy-efficiency improvements and renewable-energy development per dollar invested, to ensure that such tax incentives are not abused, as they have been to some extent in the past.

An additional source of support for state energy conservation programs is the "oil-overcharge" funds that were allotted to the states. This money was obtained by the federal government from the oil companies because of price overcharges by the

Transportation

	Transportation Emissions (% of total) 1	Motor Gasoline Emissions (% of total)[1] 2	State Funding/ Public Transportation 3	Rideshare Funding 4	T. A. Program 5	R & D $ 6	55 mph Limit 7	HOV Lanes 8	I/M Programs 9	I/M Standards 10
Alabama	23.5	16.5	417							
Alaska	36.4	6.4							C	Y/Y
Arizona	38.7	25.7	12,017					U	C	Y/L
Arkansas	27.9	19.5	321							
California	57.7	33.7	537,872	(a		Y		Y	C	Y/Y
Colorado	33.1	22.6						Y	C	Y/L
Connecticut	38.3	31.8	76,159			Y	55		S	Y/N
Delaware	25.6	17.6	7,464	43	Y		55		C	N/N
Florida	44.8	30.9	9,834	417				Y		
Georgia	34.4	22.2	156,845			Y			C	N/Y
Hawaii	57.2	18.4					55	Y		
Idaho	57.6	39.3							C	N/L
Illinois	25.6	20.2	173,015	30	Y				C	N/N
Indiana	21.9	12.5	15,915			Y			C	Y/N
Iowa	26.4	19.3	3,572	117		Y				
Kansas	28.6	15.7								
Kentucky	21.9	14.4	902						C	N/Y*
Louisiana	23.7	10.0	3,522						C	N/L
Maine	44.9	31.1	400							
Maryland	36.2	27.6	211,949	82			55		C	N/N
Massachusetts	35.1	26.9	300,673	300			55		S	N/L
Michigan	26.5	20.9	98,354	345	Y	Y			C	N/N
Minnesota	37.1	25.8	24,628					U	N	Na
Mississippi	38.4	21.4	11							
Missouri	32.4	23.7	1,077						C	N/Y
Montana	25.0	15.6	70							
Nebraska	34.9	21.6	1,400							
Nevada	31.4	17.3	368						C	N/Y
New Hampshire	38.3	31.9	25	7					C	Na
New Jersey	49.9	26.7	131,180				55	Y	S	Y/N
New Mexico	28.7	15.5	1,600						C	Na
New York	33.2	28.2	1,041,147		Y	Y	55	Y	C	N/L
North Carolina	34.4	25.5	1,645	60		Y			C	N/Y
North Dakota	12.6	7.6								
Ohio	22.9	17.0	33,534		Y	Y			C	Na
Oklahoma	29.5	19.2	212	86					C	N/Y
Oregon	58.1	42.0	9,271						C	Y/Y
Pennsylvania	23.2	16.3	343,190				55	Y	C	Y/N
Rhode Island	46.2	38.3	11,551				55		S	N/N
South Carolina	36.5	27.2	1,142	11		Y				
South Dakota	40.3	29.4								
Tennessee	31.7	21.6	7,600	500		Y			C	Y* N
Texas	25.8	13.7	4,888					Y	C	N/Y
Utah	28.3	18.2	24,080	70					C	N/L
Vermont	57.0	46.3	270		Y					
Virginia	44.0	28.7	53,959	670	Y	Y		Y	C	N/N
Washington	60.2	29.6	85,736	205				Y	C	Y/N
West Virginia	9.4	6.7	1,231							
Wisconsin	28.4	21.9	47,854						C	N/N
Wyoming	10.7	5.9	74							
U.S.	31.8	20.5	3,436,974	2,943						

Transportation Matrix Notes

Column 1 - Carbon emissions from the transportation sector as a percent of the state's total carbon emissions. The data are calculated from the transportation sector's fuel consumption of both oil and natural gas.
Source for fuel consumption: "State Energy Data Report: Consumption Estimates 1960-1986," Energy Information Administration, U.S. Department of Energy, 1988. Also refer to "Key" page 22.

Column 2 - Carbon emissions from the transportation sector for motor gasoline consumption as a percent of the state's total carbon emissions.
Source for fuel consumption: "State Energy Data Report: Consumption Estimates 1960-1986," Energy Information Administration, U.S. Department of Energy, 1988. Also refer to "Key" on p. 22.

Column 3 - State Funding/Public Transportation FY '86-87
State financial assistance in the form of revenues generated by a state-level tax and returned to local entities in the form of grants from the state. This form of assistance requires annual or biennial appropriation by the state legislators. Includes indirect financial assistance in the form of state-level taxes retained at the local level for transit purposes. This form of assistance does not show up on the state budget.
Source (Columns 3 - 6) : "1987 Survey of State Involvement in Public Transportation," American Association of State Highway and Transportation Officials; Washington, DC.

Column 4 - Rideshare Funding ($000s) - FY '87
Note: CA (a) - Included in public transit funds (separate data not included).

Column 5 - Technical Assistance Program/Public Transportation FY '87
State public transportation technical assistance program independent of the Urban Mass Transportation Act (UMTA).

Column 6 - Research & Development /Public Transportation FY '87
State provides matching funds for federal research and demonstration mass transportation projects and/or has mass transit demonstration or research program independent of the UMTA.

Column 7 - States that have maintained 55 mph speed limit.
Source: Institute for Highway Safety, Washington, DC, 7/11/88.

Column 8 - High Occupancy Vehicle (HOV) Lanes
"Y" = selected use of HOV lanes. "U" = HOV lanes under construction.
Source: "The Effectiveness of High-Occupancy Vehicle Facilities," Institute of Transportation Engineers, Washington, DC, 1988. And phone update with Larry King, U.S. Department of Transportation, 10/20/88.

Column 9 - Inspection/Maintenance (I/M) Auto Emissions Program
"C" = county/citywide; "S" = statewide; "N" = new 1989
Source (Columns 9 - 10) : "Critical Analysis of the Federal Motor Vehicle Control Program," NESCAUM (Northeast States for Coordinated Air Use Management), July, 1988.

Column 10 - (I/M) Tight Standards/Underhood Inspection
"Y" = Yes; "N" = No; "Na" = Not available; "L" = Limited; "*" = applies to some counties/cities but not to others. Note: Tight emissions standards and underhood inspection assessment by Mike Walsh in "Critical Analysis of the Federal Motor Vehicle Control Program."

companies between 1973 and 1981, when price controls were in effect. State governments have received roughly $3 billion so far, which they are putting into new or existing energy programs (see Oil Overcharge Funds Matrix, p. 29).

The largest portion of the settlement resulted in the distribution to the states of $2.1 billion received from Exxon Corporation, earmarked for five programs designed to assist energy consumers—the Low-Income Weatherization Assistance Program, the Low Income Home Energy Assistance Program, the State Energy Conservation Program, the Energy Extension Service, and the Institutional Conservation Program (also referred to as the Schools and Hospitals Weatherization Program). The Oil Overcharge Funds Matrix indicates the total amount allocated to each state, as well as the amounts approved so far specifically for energy-conservation programs. These funds represent a one-time distribution of resources, which states can use to meet vital needs. (15)

Transportation—Cars, Cars, Cars

Transportation is a major contributor to the carbon-dioxide buildup, accounting for 31.8 percent of total U.S. carbon emissions from fossil-fuel use. The Transportation Matrix shows carbon emissions from the transportation sector--cars, buses, trucks, trains, and airplanes--as a percentage of each state's total emissions.

Cars and light trucks are now the single largest oil-using subsector in the U.S. economy. There are now nearly 120 million cars on the nation's roads, 2.5 million more than in 1986. The Transportation Matrix also shows each state's carbon emissions from motor gasoline as a percent of total emissions.

Since the oil-price shock of 1979, fuel economy gains have held transportation oil use steady despite the increasing number of vehicles on the road. But now that energy-efficiency measures have been scaled back, oil consumption is rising again. In the first quarter of 1988, transportation oil use grew by more than six percent.

In October, 1988, the U.S. Department of Transportation rolled back the Corporate Average Fuel Economy (CAFE) standards for passenger cars from 27.5 to 26.5 miles per gallon. While increasing fuel efficiency is an important way to reduce CO_2 emissions, lowering the standard takes a step backward.

The national average fuel economy of 14.2 mpg for all motor vehicles, including trucks (estimates based on U.S. Department of Transportation 1986 data) can and must be dramatically improved. The State Miles Per Gallon Matrix (see p. 30) shows the 1986 average fuel economy for all motor vehicles in each state. The figures on vehicle miles of travel are calculated estimates based on data submitted by the states. Inferences about variation from one state to another should be drawn carefully. But it is clear that there is a great deal of room for improvement in every state.

Some cars now on the market get more than 45 mpg; prototypes get more than 60. If we increased the average fuel economy of new cars in the United States to 45 mpg and of light trucks to 35 mpg by 1995, the net result would be a savings of oil of 1.9 million barrels per day by the year 2000. This is more than six times the projected average daily oil production from the Arctic National Wildlife Refuge (ANWR) over a 30-year period. In fact, such achievable improvements could save more than the combined production of oil from Alaska, plus the offshore Pacific Coast and Atlantic Coast reserves.

In addition, alternatives to oil, such as hydrogen and ethanol (alcohol fuel) must be seriously considered. Over time, it will be necessary to make a transition to an energy system relying almost entirely on renewable sources, including renewable liquid fuels for transportation.

State and local officials continue to plan for more automobile traffic and additional freeways. But it is clear that efforts are needed to reduce the use of the automobile with public transportation incentives, as well as further study and use of

alternative modes of transportation, such as light rail, train, and bicycle.

States can reduce gasoline consumption and auto emissions through support for public transportation alternatives. The Transportation Matrix shows state funding provided to local governmental entities for public transportation. Seven states have state public transportation technical assistance programs independent of the federal Urban Mass Transportation Act (UMTA). Twelve states provide matching funds for federal research and demonstration mass transportation projects and/or have mass-transit research or demonstration programs independent of UMTA.

States can also act to improve efficiency and reduce emissions from automobiles. For example, the Transportation Matrix identifies 16 states that fund ridesharing programs, and shows funding levels. Nine states have maintained the 55 mph speed limit. Nine states have high-occupancy-vehicle lanes. Four states have statewide inspection and maintenance programs for motor-vehicle exhaust-emission systems, and 29 states have city- or county-wide programs.

Reforestation — The Carbon Dioxide Sink

Trees remove carbon dioxide from the atmosphere through photosynthesis. When trees are cut or burned, or when they decay, the CO_2 they contain is released into the atmosphere. The current rapid destruction of tropical rainforests is a major contributor to the greenhouse effect. Reforestation, on the other hand, can increase storage of CO_2, offsetting emissions from fossil fuel burning.

The Reforestation Matrix (see p. 31) shows the forest land area in each state, the percentage of the state that is made up of forest land, and the increase or decrease in forest land area over the past decade.

The matrix also shows the area planted in trees in each state as part of the federal Conservation Reserve Program (CRP). Enacted as part of the Food Security Act of 1985 (the Farm Bill), the CRP provides a great opportunity for reforestation. Under this program, farmers are paid a fee to remove highly erodible cropland from production for at least ten years and plant it with a soil-conserving crop, primarily grasses and trees.

The CRP has been hailed as the greatest tree-planting program in the nation's history, although tree-planting has fallen short of the original goals set forth in the 1985 Farm Bill, i.e., that 12.5 percent of the total enrolled CRP acres be converted to trees. In 1987, a record-breaking three million acres of trees were planted in the United States, one million of which were attributable to the CRP program. Most of the reforestation is taking place in the South and Mid-Atlantic states, where soil and climate conditions are conducive to growing commercially valuable softwood species. One possible approach would be to require new carbon dioxide sources, such as electricity generating plants, to establish enough new forest land to offset their CO_2 emissions. Such a policy could simultaneously promote the expansion of Conservation Reserve acreage, reduce soil erosion, improve wildlife habitat, and enhance recreational opportunities, as well as stimulate energy-efficiency investments and research on cheaper methods to reduce CO_2 buildup. The practical implications of CO_2 offsets as a state policy approach require further investigation. (16)

Urban tree-planting, too, can offset fossil fuel emissions of CO_2, as can the use of light-colored surfaces–for example, making parking-lot surfaces light-colored. Planted strategically, trees can also shade buildings and pavement, thus cooling "heat islands" and reducing energy demand. A tree that provides shade can indirectly cause reductions in CO_2 emissions equivalent to 15 times the amount of CO_2 the tree alone can absorb.

One acre of trees can absorb an estimated four tons of carbon annually, the amount released by burning 1000 gallons of gasoline. The American Forestry Association has launched a nationwide "Global ReLeaf" campaign to encourage Americans to plant 100 million trees in their communities by 1992. This could save U.S.ratepayers an estimated $3-4 billion annually while offsetting 18 million tons of carbon emissions. (17)

TEXT NOTES

1. U.S. Environmental Protection Agency, *The Potential Effects of Global Climate Change on the United States*, Draft Report to Congress, Executive Summary, Oct. 1988.

The U.S. Environmental Protection Agency will soon be releasing two reports to Congress on global warming. The first will deal with potential effects on the U.S. ecosystem of global climate change, and will probably be available in January 1989. The second will deal with policy options for stabilizing greenhouse emissions, and should be available shortly thereafter. A limited number of copies will be available to the public through EPA. Write: Environmental Protection Agency, Office of Policy, Planning, and Evaluation, Attn: Dennis Tirpak, PM-220, 401 M Street, S.W., Washington, D.C. 20460.

The reports will also be available from the U.S. Government Printing Office, or may be obtained through the office of one of your congressional representatives.

2. Testimony of G.M. Woodwell, Woods Hole Research Center, and James E. Hansen, NASA Goddard Institute for Space Studies, before the U.S. Senate Committee on Energy and Natural Resources, June 23, 1988; EPA, Office of Policy, Planning, and Evaluation, October 27, 1988.

3. Woodwell, June 23, 1988. Different sources estimate somewhat varying ranges.

4. Testimony of Dr. Stephen Schneider, National Center for Atmospheric Research, before the U.S. House Subcommittee on Water and Power Resources, Sept. 27, 1988.

5. EPA, October 1988; Schneider, Sept. 27, 1988.

6. EPA, October 1988, p.7.

7. Douglas G. Cogan. *Stones in a Glass House: CFCs and Ozone Depletion*. Investor Responsibility Research Center, Washington, D.C., 1988.

8. "EPA Urges Halt in Use of CFCs," *Washington Post*, Sept. 27, 1988.

9. Environmental Defense Fund, *Protecting the Ozone Layer: What You Can Do*, New York, N.Y., 1988.

10. James J. MacKenzie and Mohamed T. El-Ashry, "Killer Air," *Washington Post*, Sept. 29, 1988.

11. MacKenzie and El-Ashry, Sept. 29, 1988.

12. William U. Chandler et al., *Energy Efficiency: A New Agenda*. American Council for an Energy-Efficient Economy Washington, D.C., 1988, p.37

13. Michael Oppenheimer, "Safe Energy Options: Best Hope for Global Warming." Safe Energy Communications Council, Washington, D.C., 1988.

14. Alan B. Durning, "The Coalfield Overhead," *World Watch*, July-Aug., 1988, p.7.

15. "State Uses of Exxon and Stripper Well Oil Overcharge Funds," National Consumer Law Center, Washington D.C., 1988.

16. Daniel J. Dudek, *Offsetting New* CO_2 *Emissions*. Environmental Defense Fund, September 1988.

17. Art Rosenfeld, Lawrence Berkeley Laboratory, Berkeley, CA, Oct. 21, 1988; American Forestry Association, "Global ReLeaf News," Oct. 12, 1988. Also see Sandra Postel, "A Green Fix to the Global Warming," *World Watch*, Sept.-Oct. 1988.

A Note On The Data Sources

The data in this report are drawn from a variety of sources. In each case we have used what we believe to be the best data available.

Covering all 50 states systematically, applying the same criteria to each state, gives the data a somewhat generic quality. At times the most recent information is two or three years old. Data supplied by the states to federal agencies can have varying levels of accuracy. Adequate data may not be available for all states on a given subject. If you know of additional sources of national data on the issues discussed in this report, we would appreciate hearing from you.

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1986 Carbon Emissions from Fossil Fuels

	Total Emissions (million metric tons)	Emissions from Oil (million metric tons)	Emissions from Coal (million metric tons)	Emissions from Natural Gas (million metric tons)	Emissions from Oil (% of total)	Emissions from Coal (% of total)	Emissions from Natural Gas (% of total)	Tons Carbon/ $Million GSP
	1	2	3	4	5	6	7	8
Alabama	28.99	9.50	16.50	2.99	32.8	56.9	10.3	527
Alaska	7.96	4.69	0.30	2.97	58.9	3.8	37.3	407
Arizona	15.16	6.27	7.39	1.50	41.4	48.7	9.9	285
Arkansas	14.62	6.11	5.62	2.89	41.8	38.4	19.8	462
California	85.23	61.47	1.07	22.69	72.1	1.3	26.6	160
Colorado	16.53	6.35	7.36	2.82	38.4	44.5	17.1	279
Connecticut	10.35	8.68	0.52	1.15	83.9	5.0	11.1	147
Delaware	4.51	2.38	1.65	0.48	52.8	36.6	10.6	385
Florida	43.55	27.83	11.46	4.26	63.9	26.3	9.8	245
Georgia	35.51	14.12	17.30	4.09	39.8	48.7	11.5	345
Hawaii	4.40	4.36	0.00	0.04	99.1	0.0	0.9	228
Idaho	2.73	2.01	0.22	0.50	73.6	8.1	18.3	207
Illinois	55.04	21.94	19.64	13.46	39.9	35.7	24.5	263
Indiana	49.13	14.76	28.68	5.69	30.0	58.4	11.6	579
Iowa	16.03	6.51	6.54	2.98	40.6	40.8	18.6	366
Kansas	18.20	7.52	6.29	4.39	41.3	34.6	24.1	429
Kentucky	30.01	8.81	18.72	2.48	29.4	62.4	8.3	565
Louisiana	51.73	26.11	4.29	21.33	50.5	8.3	41.2	695
Maine	4.43	4.17	0.22	0.04	94.1	5.0	0.9	256
Maryland	17.60	8.49	6.86	2.25	48.2	39.0	12.8	230
Massachusetts	21.70	16.48	2.50	2.72	75.9	11.5	12.5	188
Michigan	47.12	17.03	20.27	9.82	36.1	43.0	20.8	308
Minnesota	17.75	9.24	5.02	3.49	52.1	28.3	19.7	235
Mississippi	13.51	7.65	2.72	3.14	56.6	20.1	23.2	424
Missouri	27.44	11.18	12.78	3.48	40.7	46.6	12.7	329
Montana	6.32	2.42	3.32	0.58	38.3	52.5	9.2	520
Nebraska	7.96	3.73	2.75	1.48	46.9	34.5	18.6	300
Nevada	7.25	2.70	4.04	0.51	37.2	55.7	7.0	373
New Hampshire	3.58	2.80	0.62	0.16	78.2	17.3	4.5	193
New Jersey	31.21	24.08	1.95	5.18	77.2	6.2	16.6	202
New Mexico	12.01	3.90	6.04	2.07	32.5	50.3	17.2	509
New York	49.57	32.57	6.31	10.69	65.7	12.7	21.6	137
North Carolina	29.78	13.23	14.55	2.00	44.4	48.9	6.7	295
North Dakota	10.39	2.25	7.76	0.38	21.7	74.7	3.7	968
Ohio	67.21	20.78	35.74	10.69	30.9	53.2	15.9	382
Oklahoma	21.37	7.79	5.44	8.14	36.5	25.5	38.1	429
Oregon	7.28	6.17	0.07	1.04	84.8	1.0	14.3	176
Pennsylvania	65.57	23.66	32.90	9.01	36.1	50.2	13.7	357
Rhode Island	2.42	2.02	0.02	0.38	83.5	0.8	15.7	159
South Carolina	14.78	6.74	6.59	1.45	45.6	44.6	9.8	330
South Dakota	2.94	1.89	0.72	0.33	64.3	24.5	11.2	300
Tennessee	28.72	10.80	15.15	2.77	37.6	52.8	9.6	397
Texas	154.87	78.60	29.03	47.24	50.8	18.7	30.5	510
Utah	9.88	3.73	4.72	1.43	37.8	47.8	14.5	412
Vermont	1.31	1.22	0.02	0.07	93.1	1.5	5.3	132
Virginia	23.35	13.69	7.56	2.10	58.6	32.4	9.0	274
Washington	16.20	12.89	1.57	1.74	79.6	9.7	10.7	209
West Virginia	28.42	4.80	21.89	1.73	16.9	77.0	6.1	1791
Wisconsin	22.04	8.76	9.26	4.02	39.7	42.0	18.2	287
Wyoming	11.63	2.09	8.41	1.13	18.0	72.3	9.7	996
TOTAL	1275.30	506.96	430.35	238.01	47.6	33.7	18.7	336

1976 Carbon Emissions from Fossil Fuels

	Total Emissions (million metric tons)	Emissions from Oil (million metric tons)	Emissions from Coal (million metric tons)	Emissions from Natural Gas (million metric tons)	Emissions from Oil (% of total)	Emissions from Coal (% of total)	Emissions from Natural Gas (% of total)
	1	2	3	4	5	6	7
Alabama	29.68	10.56	15.80	3.32	35.6	53.2	11.2
Alaska	4.52	2.89	0.34	1.29	63.9	7.5	28.5
Arizona	12.06	6.00	3.49	2.57	49.8	28.9	21.3
Arkansas	11.22	7.59	0.09	3.54	67.6	0.8	31.6
California	92.85	64.82	1.66	26.37	69.8	1.8	28.4
Colorado	15.31	6.75	4.62	3.94	44.1	30.2	25.7
Connecticut	12.39	11.41	0.03	0.95	92.1	0.2	7.7
Delaware	4.54	3.76	0.50	0.28	82.8	11.0	6.2
Florida	37.85	30.02	3.54	4.29	79.3	9.4	11.3
Georgia	26.89	14.38	8.68	3.83	53.5	32.3	14.2
Hawaii	4.48	4.48	0.00	0.00	100.0	0.0	0.0
Idaho	3.63	2.54	0.38	0.71	70.0	10.5	19.6
Illinois	71.96	33.30	21.50	17.16	46.3	29.9	23.9
Indiana	49.96	17.46	26.50	6.00	34.9	53.0	12.0
Iowa	17.01	8.30	4.23	4.48	48.8	24.9	26.3
Kansas	16.97	7.93	1.83	7.21	46.7	10.8	42.5
Kentucky	28.08	9.13	15.40	3.55	32.5	54.8	12.6
Louisiana	56.10	25.85	0.00	30.25	46.1	0.0	53.9
Maine	5.28	5.23	0.02	0.03	99.1	0.4	0.6
Maryland	20.13	11.88	6.12	2.13	59.0	30.4	10.6
Massachusetts	27.34	25.00	0.10	2.24	91.4	0.4	8.2
Michigan	54.17	23.51	17.90	12.76	43.4	33.0	23.6
Minnesota	21.89	11.58	5.55	4.56	53.4	25.6	21.0
Mississippi	12.31	8.35	1.06	2.90	67.8	8.6	23.6
Missouri	28.96	12.82	11.70	5.44	42.8	39.1	18.2
Montana	5.36	3.23	1.05	1.08	60.3	19.6	20.1
Nebraska	8.76	4.61	1.34	2.81	52.6	15.3	32.1
Nevada	6.07	2.27	2.78	1.02	37.4	45.8	16.8
New Hampshire	3.87	3.25	0.51	0.11	84.0	13.2	2.8
New Jersey	34.62	28.12	1.76	4.74	81.2	5.1	13.7
New Mexico	11.67	3.94	3.43	4.20	34.1	29.6	36.3
New York	74.09	56.39	9.08	8.62	76.1	12.3	11.6
North Carolina	28.17	14.10	13.60	1.47	48.3	46.6	5.0
North Dakota	5.10	2.23	2.28	0.59	43.7	44.7	11.6
Ohio	81.84	25.64	41.30	14.70	31.4	50.6	18.0
Oklahoma	19.36	8.33	0.04	10.99	43.0	0.2	56.8
Oregon	7.56	6.04	0.15	1.37	79.9	2.0	18.1
Pennsylvania	85.15	32.72	42.00	10.43	38.4	49.3	12.2
Rhode Island	3.03	2.73	0.00	0.30	90.1	0.0	9.9
South Carolina	14.22	7.78	4.27	2.17	54.7	30.0	15.3
South Dakota	3.49	2.00	0.93	0.56	57.3	26.6	16.0
Tennessee	28.14	11.02	14.00	3.12	39.2	49.8	11.1
Texas	131.36	67.61	5.65	58.10	51.5	4.3	44.2
Utah	8.54	4.02	2.54	1.98	47.1	29.7	23.2
Vermont	1.66	1.60	0.01	0.05	96.4	0.6	3.0
Virginia	24.47	17.62	5.05	1.80	72.0	20.6	7.4
Washington	15.20	10.96	2.03	2.21	72.1	13.4	14.5
West Virginia	29.28	5.24	21.80	2.24	17.9	74.5	7.7
Wisconsin	23.38	11.23	7.59	4.57	48.0	32.4	19.5
Wyoming	8.43	2.78	4.47	1.18	33.0	53.0	14.0
TOTAL	1330.23	701.02	339.00	290.21	52.7	25.5	21.8

1966 Carbon Emissions from Fossil Fuels

	Total Emissions (million metric tons)	Emissions from Oil (million metric tons)	Emissions from Coal (million metric tons)	Emissions from Natural Gas (million metric tons)	Emissions from Oil (% of total)	Emissions from Coal (% of total)	Emissions from Natural Gas (% of total)
	1	2	3	4	5	6	7
Alabama	23.09	5.09	14.57	3.43	22.0	63.1	14.9
Alaska	1.89	1.30	0.41	0.18	68.8	21.7	9.5
Arizona	5.45	2.78	0.18	2.49	51.0	3.3	45.7
Arkansas	7.70	3.57	0.00	4.13	46.4	0.0	53.6
California	71.66	42.10	1.29	28.27	58.7	1.8	39.5
Colorado	9.65	3.97	2.72	2.96	41.1	28.2	30.7
Connecticut	12.36	8.27	3.40	0.69	66.9	27.5	5.6
Delaware	3.59	2.34	0.97	0.28	65.2	27.0	7.8
Florida	20.79	15.89	1.75	3.15	76.4	8.4	15.2
Georgia	15.41	7.52	4.42	3.47	48.8	28.7	22.5
Hawaii	2.83	2.83	0.00	0.00	100.0	0.0	0.0
Idaho	2.57	1.64	0.37	0.56	63.8	14.4	21.8
Illinois	61.86	22.71	26.76	12.39	36.7	43.3	20.0
Indiana	42.32	12.47	24.15	5.70	29.5	57.1	13.5
Iowa	12.53	5.92	3.13	3.48	47.2	25.0	27.8
Kansas	12.40	5.20	0.34	6.86	41.9	2.7	55.3
Kentucky	18.26	5.45	10.64	2.17	29.8	58.3	11.9
Louisiana	29.16	11.40	0.00	17.76	39.1	0.0	60.9
Maine	3.45	3.26	0.18	0.01	94.5	5.2	0.3
Maryland	17.93	8.00	8.46	1.47	44.6	47.2	8.2
Massachusetts	22.98	16.50	2.80	1.68	80.5	12.2	7.3
Michigan	47.38	16.04	22.40	8.94	33.9	47.3	18.9
Minnesota	16.50	8.43	4.28	3.79	51.1	25.9	23.0
Mississippi	7.53	3.45	0.02	4.06	45.8	0.3	53.9
Missouri	18.71	8.85	4.76	5.10	47.3	25.4	27.3
Montana	3.32	2.15	0.14	1.03	64.8	4.2	31.0
Nebraska	6.15	2.87	0.49	2.79	46.7	8.0	45.4
Nevada	2.02	1.23	0.27	0.52	60.9	13.4	25.7
New Hampshire	2.34	2.04	0.24	0.06	87.2	10.3	2.6
New Jersey	31.71	22.42	5.91	3.38	70.7	18.6	10.7
New Mexico	6.73	2.28	0.92	3.53	33.9	13.7	52.5
New York	70.08	42.61	18.26	9.21	60.8	26.1	13.1
North Carolina	20.83	10.07	9.49	1.27	48.3	45.6	6.1
North Dakota	3.26	1.91	0.90	0.45	58.6	27.6	13.8
Ohio	67.04	17.67	35.46	13.91	26.4	52.9	20.7
Oklahoma	11.98	5.55	0.02	6.41	46.3	0.2	53.5
Oregon	6.02	4.87	0.16	0.99	80.9	2.7	16.4
Pennsylvania	78.02	24.41	43.59	10.02	31.3	55.9	12.8
Rhode Island	2.88	2.37	0.26	0.25	82.3	9.0	8.7
South Carolina	9.33	4.57	3.32	1.44	49.0	35.6	15.4
South Dakota	2.28	1.75	0.13	0.40	76.8	5.7	17.5
Tennessee	18.59	6.13	9.08	3.38	33.0	48.8	18.2
Texas	86.78	37.55	0.69	48.54	43.3	0.8	55.9
Utah	6.12	2.79	1.97	1.36	45.6	32.2	22.2
Vermont	1.27	1.21	0.05	0.01	95.3	3.9	0.8
Virginia	21.48	10.04	9.65	1.79	46.7	44.9	8.3
Washington	10.08	8.02	0.28	1.78	79.6	2.8	17.7
West Virginia	19.08	3.54	12.98	2.56	18.6	68.0	13.4
Wisconsin	20.57	8.05	9.25	3.27	39.1	45.0	15.9
Wyoming	3.47	1.54	1.03	0.90	44.4	29.7	25.9
TOTAL	999.38	454.57	302.58	242.23	45.5	30.3	24.2

1976 Carbon Emissions from Fossil Fuels

	Total Emissions (million metric tons)	Emissions from Oil (million metric tons)	Emissions from Coal (million metric tons)	Emissions from Natural Gas (million metric tons)	Emissions from Oil (% of total)	Emissions from Coal (% of total)	Emissions from Natural Gas (% of total)
	1	2	3	4	5	6	7
Alabama	29.68	10.56	15.80	3.32	35.6	53.2	11.2
Alaska	4.52	2.89	0.34	1.29	63.9	7.5	28.5
Arizona	12.06	6.00	3.49	2.57	49.8	28.9	21.3
Arkansas	11.22	7.59	0.09	3.54	67.6	0.8	31.6
California	92.85	64.82	1.66	26.37	69.8	1.8	28.4
Colorado	15.31	6.75	4.62	3.94	44.1	30.2	25.7
Connecticut	12.39	11.41	0.03	0.95	92.1	0.2	7.7
Delaware	4.54	3.76	0.50	0.28	82.8	11.0	6.2
Florida	37.88	30.02	3.54	4.29	79.3	9.4	11.3
Georgia	26.89	14.38	8.68	3.83	53.5	32.3	14.2
Hawaii	4.48	4.48	0.00	0.00	100.0	0.0	0.0
Idaho	3.63	2.54	0.38	0.71	70.0	10.5	19.6
Illinois	71.96	33.30	21.50	17.18	46.3	29.9	23.9
Indiana	49.96	17.46	26.50	6.00	34.9	53.0	12.0
Iowa	17.01	8.30	4.23	4.48	48.8	24.9	26.3
Kansas	16.97	7.93	1.83	7.21	46.7	10.8	42.5
Kentucky	28.08	9.13	15.40	3.55	32.5	54.8	12.6
Louisiana	56.10	25.85	0.00	30.25	46.1	0.0	53.9
Maine	5.28	5.23	0.02	0.03	99.1	0.4	0.6
Maryland	20.13	11.88	6.12	2.13	59.0	30.4	10.6
Massachusetts	27.34	25.00	0.10	2.24	91.4	0.4	8.2
Michigan	54.17	23.51	17.90	12.76	43.4	33.0	23.6
Minnesota	21.69	11.58	5.55	4.56	53.4	25.6	21.0
Mississippi	12.31	8.35	1.06	2.90	67.8	8.6	23.6
Missouri	29.96	12.82	11.70	5.44	42.8	39.1	18.2
Montana	5.36	3.23	1.05	1.08	60.3	19.6	20.1
Nebraska	8.76	4.61	1.34	2.81	52.6	15.3	32.1
Nevada	6.07	2.27	2.78	1.02	37.4	45.8	16.8
New Hampshire	3.87	3.25	0.51	0.11	84.0	13.2	2.9
New Jersey	34.62	28.12	1.76	4.74	81.2	5.1	13.7
New Mexico	11.57	3.94	3.43	4.20	34.1	29.6	36.3
New York	74.08	56.39	9.06	8.62	76.1	12.3	11.6
North Carolina	29.17	14.10	13.60	1.47	48.3	46.6	5.0
North Dakota	8.10	2.23	2.28	0.59	43.7	44.7	11.6
Ohio	81.84	25.64	41.30	14.70	31.4	50.6	18.0
Oklahoma	19.36	8.33	0.04	10.99	43.0	0.2	56.8
Oregon	7.56	6.04	0.15	1.37	79.9	2.0	18.1
Pennsylvania	85.15	32.72	42.00	10.43	38.4	49.3	12.2
Rhode Island	3.03	2.73	0.00	0.30	90.1	0.0	9.9
South Carolina	14.22	7.78	4.27	2.17	54.7	30.0	15.3
South Dakota	3.49	2.00	0.93	0.56	57.3	26.6	16.0
Tennessee	28.14	11.02	14.00	3.12	39.2	49.8	11.1
Texas	131.36	67.61	5.65	58.10	51.5	4.3	44.2
Utah	8.54	4.02	2.54	1.98	47.1	29.7	23.2
Vermont	1.66	1.60	0.01	0.05	96.4	0.6	3.0
Virginia	24.47	17.62	5.05	1.80	72.0	20.6	7.4
Washington	15.20	10.96	2.03	2.21	72.1	13.4	14.5
West Virginia	29.28	5.24	21.80	2.24	17.9	74.5	7.7
Wisconsin	23.39	11.23	7.59	4.57	48.0	32.4	19.5
Wyoming	8.43	2.78	4.47	1.18	33.0	53.0	14.0
TOTAL	1330.23	701.02	339.00	290.21	52.7	25.5	21.8

Key to Formulas Used in Calculating Carbon Emissions in 1986, 1976, and 1966 Carbon Emissions Matrices

The conversion factors used to determine carbon emissions from the burning of fossil fuels (oil, coal, natural gas) and the non-oxidized fuel constants were supplied by Dr. Gregg Marland from Oak Ridge National Laboratory, Oak Ridge, Tennessee. (1)
The conversion factor for motor gasoline was provided by Dr. Irving Mintzer from World Resources Institute, Washington, DC. (2)

STEP 1

Conversion factors of carbon emissions from direct combustion of fossil fuels.
Oil (Crude/heating oil) = 19.9 kilograms carbon (kgC)/10^9 joules (j)
Motor Gasoline = 18.9 kgC/10^9 j
Coal = 24.12 kgC/10^9 j
Natural gas = 13.8 kgC/10^9 j

STEPS 2 & 3

To convert joules to Btu (British thermal units) multiply above figures by 1.054 x 10^3 j/Btu to get new conversion factors compatible with U.S. Department of Energy (DOE) consumption (Btu) data. Convert kgC to metric tons of carbon (t/C) by multiplying by 1 metric ton/10^3 kg.

Oil (Crude/heating oil) = $\frac{20.98\ t/C}{10^9\ Btu}$

Motor Gasoline = $\frac{19.9\ t/C}{10^9\ Btu}$

Coal = $\frac{25.42\ t/C}{10^9\ Btu}$

Natural gas = $\frac{14.55\ t/C}{10^9\ Btu}$

STEP 4

Multiply by constants to account for non-oxidized fuel. (3) Note: There is no constant for motor gasoline since it is assumed that gasoline in fully oxidized in combustion.

Oil = .918
Coal = .982
Natural gas = .98

STEP 5

Multiply by DOE 1986 energy consumption data to get million tons of carbon emissions by state. (See Column 1 of the 1986 Carbon Emissions Matrix for data.)

Sources:
(1) Conversion factors for oil, coal and natural gas from "Carbon Dioxide Emission Rates for Conventional and Synthetic Fuels," Gregg Marland, *Energy*, V.8, N.12, 1983.
(2) Conversion factor for gasoline from testimony by Dr. Irving Mintzer before the Committee on Environment and Public Works, U.S. Senate, Sept. 16, 1988.
(3) Non-oxidized combustion factors supplied by Gregg Marland, Oak Ridge National Laboratory per phone conversation 9/22/88.

Estimated Carbon Emissions from Fossil Fuels
1986, 1976, 1966 Matrix Notes

Column 1 - Total Carbon Emissions - Each state's total carbon emissions from oil, coal, and natural gas expressed in million metric tons. Column 1 is the sum of columns 2 (oil), 3 (coal), and 4 (natural gas).

Column 2 - Carbon Emissions from Oil - The data indicate the estimated amount of carbon emitted in million metric tons from the combustion of oil (including crude and heating oil, excluding asphalt and road oil). Note that the conversion factors for oil and motor gasoline vary therefore two calculations are necessary to obtain total carbon emissions from the combustion of oil.

Reference: Calculate state carbon emissions from the combustion of oil, using U.S. Department of Energy (DOE) 1986 energy consumption data* as follows (example uses 1986 Alabama data):

$$.241 \text{ quad } (10^{15}) \text{Btu} \times \frac{20.98 \text{ t/C}}{10^9 \text{ Btu}} \times .918 = 4.64 \times 10^6 = 4{,}640{,}000 \text{ metric tons carbon}$$

Reference: Calculate the carbon emissions from each state's combustion of motor gasoline using DOE 1986 energy consumption data* as follows (example uses 1986 Alabama data):

$$244 \text{ quad } (10^{15}) \text{Btu} \times \frac{19.9 \text{ t/C}}{10^9 \text{ Btu}} = 4.86 \times 10^6 = 4{,}860{,}000 \text{ metric tons of carbon.}$$

Total carbon emissions from oil (add carbon emissions from oil and motor gasoline) = 9.5×10^6 metric tons carbon or 9,500,000 metric tons.

Column 3 - Carbon Emissions from Coal - The data indicate the estimated amount of carbon emitted in million metric tons that results from each state's combustion of coal.

Reference: Calculate the carbon emissions from each state's consumption of coal, using DOE 1986 energy consumption data* as follows (example uses 1986 Alabama data):

$$.661 \text{ quad } (10^{15}) \text{ Btu} \times \frac{25.42 \text{ t/C}}{10^9 \text{ Btu}} \times .982 = 16.5 \times 10^6 = 16{,}500{,}000 \text{ metric tons carbon}$$

Column 4 - Carbon Emissions from Natural Gas - The data indicate the estimated amount of carbon emitted in million metric tons from the combustion of natural gas.

Reference: Calculate the carbon emissions from each state's combustion of natural gas, using DOE 1986 energy consumption data* as follows (example uses 1986 Alabama data):

$$.210 \text{ quad Btu} \times \frac{14.55 \text{ t/C}}{10^9 \text{ Btu}} \times .98 = 2.99 \times 10^6 = 2{,}990{,}000 \text{ metric tons carbon}$$

* Source: "State Energy Data Report: Consumption Estimates 1960-1986," Energy Information Administration, U.S. Department of Energy, 1988.

Column 5 - Carbon Emissions from Oil as a % of Total Emissions (refers to Cols. 1 and 2).

Column 6 - Carbon Emissions from Coal as a % of Total Emissions (refers to Cols. 1 and 3).

Column 7 - Carbon Emissions from Natural Gas as a % of Total Emissions (refers to Cols. 1 and 4

Column 8 -Tons of Carbon/Gross State Product (million dollars) - These figures were computed from the total carbon emissions (see column 1) and 1986 State gross products (GSP). Note: Column 8 appears only on the 1986 Carbon Emissions Matrix.
Source: (GSP), U.S. Dept. of Commerce, "Survey of Current Business," V.68, N. 5, May 1988.

Chloroflourocarbons/Methane

	CFC Policies	# Municipal Landfills	Recovery Operations
	1	2	3
Alabama		122	2
Alaska		179	
Arizona		96	
Arkansas		84	
California	C	400	18
Colorado		122	1
Connecticut		91	
Delaware		3	
Florida		126	3
Georgia		198	3
Hawaii		19	
Idaho		95	
Illinois		168	4
Indiana		96	
Iowa		83	
Kansas		124	
Kentucky		107	1
Louisiana		93	1
Maine	S	294	
Maryland		42	1
Massachusetts	S	203	2
Michigan		58	1
Minnesota		105	1
Mississippi		108	
Missouri		106	
Montana		129	
Nebraska		42	
Nevada		107	
New Hampshire		70	
New Jersey		73	3
New Mexico		213	
New York	C	304	7
North Carolina		124	
North Dakota		100	
Ohio		149	1
Oklahoma		123	
Oregon		127	
Pennsylvania		135	6
Rhode Island	S	11	3
South Carolina		80	
South Dakota		55	
Tennessee		120	1
Texas		926	4
Utah		112	
Vermont	S	69	
Virginia		147	
Washington		118	
West Virginia		141	
Wisconsin		933	2
Wyoming		78	
TOTAL		7 508	65

Chloroflourocarbons (CFCs)/Methane Matrix Notes

Column 1 - CFC Policies (bans or restrictions on various products containing CFCs).
S = state policy; C= county/city
Source: "Protecting the Ozone Layer: What Can You Do," Environmental Defense Fund, Washington, DC, 1988.

Column 2 - Lists the Number of Municipal Waste landfills.
Source: U.S. EPA, "List of Municipal Waste Landfills, December 1986, Compiled from EPA's State Subtitle D Program Census."

Column 3 - Landfill Gas Recovery Projects (private and municipal). Data include facilities in operation and those projected to be completed in 1989.
Source: *Waste Age*, Landfill Gas Survey, March 1988, p.167 .

Tropospheric Ozone Scorecard

	Highest Ozone Level (ppm)*	Avg. # of Days Above Ozone Std. Each Year
ALABAMA		
Birmingham	0.14	NA
ARIZONA		
Phoenix	0.14	4
CALIFORNIA		
Bakersfield	0.16	29
Fresno	0.16	21
Los Angeles	0.35	154
Modesto	0.16	12
Sacramento	0.18	9
San Diego	0.22	11
San Francisco	0.15	6
Santa Barbara	0.16	2
Stockton	0.15	8
Visalia	0.14	6
Yuba City	0.14	3
COLORADO		
Denver	0.12	1
CONNECTICUT		
Greater State	0.18	14
FLORIDA		
Jacksonville	0.14	3
Miami	0.13	2
Tampa	0.13	2
GEORGIA		
Atlanta	0.16	5
ILLINOIS		
Chicago	0.17	5
INDIANA		
Indianapolis	0.13	2
KENTUCKY		
Lexington	0.13	2
Louisville (a)	0.16	5
LOUISIANA		
Baton Rouge	0.16	4
Iberville	0.13	2
Lake Charles	0.13	1
Point Coupee	0.13	3
St. James	0.13	4
MAINE		
Gardiner	0.12	1
Hancock Cnty.	0.12	2
Knox County	0.13	2
Portland	0.14	4
York County	0.15	7

	Highest Ozone Level (ppm)*	Avg. # of Days Above Ozone Std. Each Year
MARYLAND		
Baltimore	0.15	6
MASSACHUSETTS		
Boston	0.15	3
New Bedford	0.16	5
Worcester	0.14	2
MICHIGAN		
Muskegon	0.13	3
MISSOURI		
Kansas City (a)	0.13	2
St. Louis (a)	0.16	6
NEW HAMPSHIRE		
Portsmouth (a)	0.13	1
NEW JERSEY		
Atlantic City	0.17	5
NEW YORK		
New York (a)	0.20	19
NORTH CAROLINA		
Charlotte (a)	0.13	2
OHIO		
Cincinnati (a)	0.14	1
Cleveland	0.14	3
OKLAHOMA		
Tulsa	0.13	2
OREGON		
Portland	0.14	1
PENNSYLVANIA		
Allentown-Beth	0.13	2
Philadelphia	0.17	7
RHODE ISLAND		
Providence	0.18	9
TENNESSEE		
Memphis (a)	0.13	2
Nashville	0.14	4
TEXAS		
Beaumont-P.A.	0.15	5
Dallas-Ft Worth	0.16	12
El Paso	0.16	12
Longv.-Marshall	0.11	1
Houston	0.20	19
WEST VIRGINIA		
Huntington (a)	0.14	3
WISCONSIN		
Milwaukee	0.15	4
UTAH		
Salt Lake City	0.16	5

Source: U.S. EPA 8/27/87

The 62 metropolitan areas in non-attainment for ozone, based on ozone levels from 1984-86

Note: (a) = area

*Represents 4th highest measured ozone level, since ozone standard of .12 ppm in a one-hour period can be exceeded only once each year.

Residential/Industrial/Commercial

	Emissions Ind./Comm. (% of total)	Emissions Residential (% of total)	% Low Income Homes Weatherized	State Bldg. Codes
	1	2	3	4
Alabama	28.2	3.4	6.33	
Alaska	50.0	4.8	18.39	
Arizona	14.1	3.0	7.09	
Arkansas	26.8	5.2	10.60	
California	25.1	8.5	2.90	Y
Colorado	17.1	7.8	12.90	
Connecticut	17.0	18.3	9.87	
Delaware	22.6	6.0	11.74	
Florida	10.3	1.8	0.90	Y
Georgia	15.1	4.6	4.86	
Hawaii	10.6	0.5	12.33	
Idaho	34.5	7.7	30.01	
Illinois	31.0	12.8	7.69	
Indiana	31.7	5.7	14.83	
Iowa	28.7	10.3	19.66	
Kansas	30.1	6.2	12.83	
Kentucky	18.9	4.2	13.16	
Louisiana	58.6	1.9	2.77	
Maine	25.8	16.5	26.21	
Maryland	21.7	9.8	9.42	
Massachusetts	17.4	17.1	7.78	Y
Michigan	26.3	13.2	11.37	
Minnesota	25.0	12.8	36.42	Y
Mississippi	32.0	4.1	5.34	
Missouri	16.3	8.4	16.43	
Montana	19.3	5.2	36.87	
Nebraska	23.0	9.2	20.44	
Nevada	8.0	3.6	10.81	
New Hampshire	13.9	14.8	20.28	
New Jersey	25.2	14.0	6.43	
New Mexico	16.7	4.0	16.64	
New York	23.2	18.6	9.62	Y
North Carolina	17.2	4.9	5.78	Y
North Dakota	29.3	3.4	44.98	
Ohio	25.6	9.1	11.46	
Oklahoma	27.8	5.3	7.12	
Oregon	24.1	7.6	10.10	
Pennsylvania	28.1	10.1	16.93	
Rhode Island	21.3	24.8	16.76	
South Carolina	25.7	4.1	6.03	
South Dakota	26.0	12.2	23.09	Y
Tennessee	21.9	2.9	8.98	
Texas	43.8	2.2	3.07	
Utah	23.1	8.8	18.36	
Vermont	18.9	22.1	26.43	
Virginia	25.5	7.7	7.66	
Washington	26.3	5.3	8.73	
West Virginia	20.5	2.4	14.80	
Wisconsin	22.9	12.1	15.05	Y
Wyoming	21.5	2.2	18.09	
	27.5	7.4	9.48	

Residential/Industrial/Commercial Matrix Notes

Column 1 - Carbon emissions from the industrial/commercial sectors as a percent of the state's total carbon emissions. The data are calculated from the industrial/commercial sectors' fuel consumption of oil, coal, and natural gas.

Source for fuel consumption: "State Energy Data Report: Consumption Estimates 1960-1986," Energy Information Administration, U.S. Department of Energy, 1988. Also refer to "Key" on p. 22.

Column 2 - Carbon emissions from the residential sector as a percent of the state's total carbon emissions. The data are calculated from the residential sector's fuel consumption of oil, coal, and natural gas.

Source for fuel consumption: "State Energy Data Report: Consumption Estimates 1960-1986, Energy Information Administration, U.S. Department of Energy, 1988. Also refer to "Key" on p. 22.

Column 3 - Percent of low income residences that have been weatherized from the U.S. Department of Energy Weatherization Assistance Program (WAP).

Note: The number of low income homes weatherized is a cumulative total from 1977 to 1987. Source: U.S. Dept. of Energy, Residential and Commercial Conservation Programs, 8/16/88. The total number of low income homes eligible for weatherization is based on the 1980 U.S. Census. Source: U.S. Dept. of Health and Human Services.

Column 4 - State Building Code Provisions

Note: Although many states have minimal requirements for energy efficiency in new buildings, those with the most substantial standards are included here.

Source: National Conference of States on Building Codes and Standards (NCSBCS), Herndon, Virginia, 1986.

State/Utility Joint Energy Efficiency Projects

	Residential	Low-Income	Commercial	Non-Profit	Industrial	Agricultural
	1	2	3	4	5	6
Alabama						
Alaska						
Arizona	Y					
Arkansas						
California		Y				
Colorado						
Connecticut	Y		Y	Y		
Delaware						
Florida						
Georgia	Y	Y		Y		
Hawaii						
Idaho						
Illinois				Y		
Indiana						
Iowa	Y	Y	Y	Y	Y	Y
Kansas						
Kentucky						
Louisiana						
Maine	Y					
Maryland						
Massachusetts	Y		Y		Y	
Michigan	Y	Y	Y	Y	Y	Y
Minnesota		Y				
Mississippi						
Missouri						
Montana		Y				
Nebraska	Y	Y	Y	Y	Y	Y
Nevada						
New Hampshire						
New Jersey	Y	Y	Y	Y	Y	Y
New Mexico						
New York	Y	Y	Y	Y	Y	Y
North Carolina	Y	Y	Y	Y	Y	Y
North Dakota						
Ohio		Y				
Oklahoma		Y				
Oregon	Y	Y	Y	Y	Y	
Pennsylvania		Y				
Rhode Island	Y		Y			
South Carolina						
South Dakota						
Tennessee	Y	Y	Y	Y	Y	Y
Texas	Y					
Utah						
Vermont						
Virginia						
Washington	Y	Y	Y	Y	Y	
West Virginia						
Wisconsin		Y				
Wyoming						

State and Utility Joint Energy Efficiency Projects (JEEP) Matrix Notes

Column 1 - "Y" indicates a state/utility JEEP in the residential sector.

Column 2 - "Y" indicates a state/utility JEEP in the low income sector.

Column 3 - "Y" indicates a state/utility JEEP in the commercial sector.

Column 4 - "Y" indicates a state/utility JEEP in the non-profit sector.

Column 5 - "Y" indicates a state/utility JEEP in the industrial sector.

Column 6 - "Y" indicates a state/utility JEEP in the agricultural sector.

Source: Alliance to Save Energy, "Examples of Energy Efficiency Projects Jointly Operated by States and Utilities," August, 1988.

Note: The list of projects is not exhaustive, but indicates the range of joint projects that are currently being conducted. It serves as a partial list of initial programs. The projects are funded in part by federal energy programs (Weatherization Assistance Program, Institutional Conservation Program, and Low Income Home Energy Assistance Program).

State Energy Tax Credits

STATE	ELIGIBLE TECHNOLOGIES	CREDIT	MAXIMUM CREDIT	EXPIRES
California	Active/Passive Solar, Photovoltaic (PV)	10% commercial	none	1/1/89
Delaware	Solar Hot Water Systems	$200 credit	$200/residential	none
Hawaii	Active/Passive Solar, PV, Wind Heat Pump Water Heaters	15% residential/commercial	no limit	12/31/92
Idaho	Active/Passive Solar, Renewable Energy Systems	100% deduction/residential only (must be taken over 4 years) 40% first year; 20% following 3 years	$5000 residential per tax year	none
Massachusetts	Active Solar, PV, Wind	35% residential in 1988 25% residential, 1989-90 15% residential, 1991	$1000 residential	12/31/91
Michigan	Active Solar, PV, Wind Water [illegible] Heat Pumps Hydro	30% first $2000 residential only for all tech.	$1050 residential	12/31/88
New Jersey	Solar	6% sales tax, other grants are available		10/31/88*
New Mexico	Solar & Wind	25% equipment	$1500 in 1988	12/31/88
North Carolina	Solar Solar Wind Hydro Methane gas Ethanol gas Wood burning conversion Cogeneration	25% res/comm 20% industrial 10% res/comm 10% res/comm 10% res/comm 20% res/comm 15% res/comm 10% res/comm	$1,000 $8,000 $1,000 $5,000 $2,500 no limit no limit no limit	none none none none none none none none
North Dakota	Active/Passive Solar, Wind, Geothermal	15% res/comm (5% per year for 3 years)	no limit	none
Oklahoma	Active/Passive Solar, Wind, PV	45 % residential in '88 40% residential in '89 35% residential in '90 30% commercial	$10,000 residennal no limit commercial	12/31/90
Oregon	Active/Passive Solar, Wind Geothermal, Hydro	25% 1st $1000 in '88 & '89 35% comm. over 5 years	$1000 residential $3.5 million comm.	12/31/89 12/31/90
Rhode Island	Active/Passive Solar Wind Hydro	10% res/comm 10% res/comm 10% res/comm	$1000 residential $1500 commercial $50,000res/comm	6/30/90
South Carolina	Solar, Wind, Hydro, Wood, Biomass, other qualified renewable energy tech.	25% res/comm	$1000 res/comm	none
Utah	Solar, Hydro, PV, Wind, Biomass	25% residential 10% commercial	$1500 residential $25,000 commercial	12/31/90
	Source: NATAS, "State Energy Tax Credit Summary" (compiled from State contacts) and phone update with K. Dennehy (NATAS) 9/23/88.		* Extension under review	

1988 Air Pollution Budgets/Oil Overcharge Funds

	State and Local Air Pollution Budgets ($000s) 1	Federal Air Pollution Budgets ($000s) 2	Oil Overcharge State Allocation ($000s) 3	Oil Overcharge Funds for EES, SECP, ICP ($000s) 4	Oil Overcharge Funds for WAP ($000s) 5
Alabama	1.835	1.639	32.192	16.166	2.900
Alaska	751	813	8.272	2.490	4.000
Arizona	3.162	1.527	21.566	17.921	2.000
Arkansas	647	785	25.950	13.658	2.100
California	92.380	7.882	194.717	51.442	0
Colorado	4.562	1.605	22.716	18.057	5.554
Connecticut	3.451	1.872	34.900	5.143	0
Delaware	552	612	9.945	3.422	2.000
Florida	6.241	2.059	98.115	39.467	153
Georgia	2.415	1.160	46.625	19.088	9.774
Hawaii	1.215	357	14.482	12.927	1.600
Idaho	302	622	8.691	4.648	2.340
Illinois	5.362	5.040	96.106	6.347	37.000
Indiana	2.468	2.703	51.431	18.783	0
Iowa	401	950	27.424	14.872	3.175
Kansas	416	925	23.958	6.455	994
Kentucky	3.222	1.600	27.439	0	5.249
Louisiana	1.935	1.283	51.536	3.035	6.000
Maine	1.221	752	15.094	7.950	4.800
Maryland	2.532	1.741	36.416	6.049	23.689
Massachusetts	1.340	2.507	70.341	15.000	28.733
Michigan	4.685	3.497	70.991	12.315	12.989
Minnesota	1.720	1.469	36.066	18.203	5.500
Mississippi	518	667	28.379	21.113	5.000
Missouri	1.814	2.078	41.516	20.014	14.333
Montana	451	957	9.585	3.797	3.200
Nebraska	235	631	15.505	3.721	0
Nevada	1.237	667	8.767	1.178	1.984
New Hamashire	302	730	9.798	8.146	660
New Jersey	5.062	3.280	75.433	22.973	0
New Mexico	900	1.081	13.693	4.200	4.486
New York	7.372	5.193	159.875	107.861	34.053
North Carolina	3.242	1.849	47.030	6.975	7.400
North Dakota	188	533	7.721	2.283	1.813
Ohio	7.566	4.345	79.740	10.375	34.624
Oklahoma	740	1.225	28.234	9.168	5.197
Oregon	2.509	2.065	20.722	6.838	12.447
Pennsylvania	7.537	4.987	96.804	12.478	0
Rhode Island	300	625	8.005	5.059	893
South Carolina	1.544	1.170	25.188	1.774	0
South Dakota	157	470	7.502	9.932	1.000
Tennessee	2.853	2.072	34.603	12.994	22.500
Texas	13.939	5.119	157.187	40.903	1.750
Utah	609	1.188	12.454	3.223	1.500
Vermont	242	477	5.005	1.950	1.758
Virginia	3.847	2.089	53.377	6.897	10.200
Washington	3.379	2.844	32.122	15.676	7.698
West Virginia	754	1.130	12.503	1.192	2.184
Wisconsin	2.944	2.006	38.967	0	10.922
Wyoming	560	491	8.874	102	2.000
Total	213.573	93.367	2.060.162	554.257	348.152

FY '88 Air Pollution Control Budgets/Exxon Overcharge Funds

Column 1 - FY '88 Air Pollution Control Budgets: State and local contributions ($000s) Source (columns 1 and 2): U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards Air Quality Management Division. Research Triangle Park, NC, 10/7.8

Column 2 - FY '88 Air Pollution Control Budgets: Federal contribution including FY '87 carryover and unexpended funds ($000s). Source: See Column 1.

Exxon Oil Overcharge Funds (Columns 3 -5) Funds received by the States from settlement of the Exxon oil overcharge case may be used by the States under one or more of the energy conservation grant programs administered by the Dept. of Energy

Column 3 - Total State Allocation of Oil Overcharge Funds ($000s). Source (cols. 3-5): U.S. Dept. of Energy, Office of State and Local Assistance Programs, 9/22.88

Column 4 - Oil Overcharge Funds Approved for Energy Extension Service (EES), State Energy Conservation Program (SECP), and the Institutional Conservation Program (ICP). The figures, expressed in $000s, are cumulative totals from March 1986 to Sept. 1988. Source: See Column

Column 5 - Oil Overcharge Funds Approved for Weatherization Assistance Program (WAP). The figures, expressed in $000s, are cumulative totals from March 1986 to September 1988. Source: See Column 3.

State Miles Per Gallon

	1 Estimated State MPG	2 Vehicle Miles Traveled (millions)	3 Gallons Motor Fuel Use (000s)
Alabama	14.3	34,003	2,378,826
Alaska	12.8	4,008	313,365
Arizona	11.8	22,665	1,920,968
Arkansas	11.7	17,555	1,506,274
California	15.7	214,913	13,671,898
Colorado	14.9	26,382	1,766,814
Connecticut	15.3	24,068	1,571,167
Delaware	14.9	5,762	386,611
Florida	13.7	87,273	6,380,298
Georgia	14.1	56,833	4,043,074
Hawaii	18.9	6,927	368,506
[redacted]	[redacted]	[redacted]	[redacted]
Illinois	13.7	74,144	5,398,459
Indiana	12.4	40,780	3,290,247
Iowa	12.4	20,413	1,646,257
Kansas	13.1	19,821	1,509,013
Kentucky	13.3	29,252	2,201,426
Louisiana	11.9	29,861	2,512,473
Maine	14.1	10,022	711,570
Maryland	15.1	35,208	2,327,090
Massachusetts	15.1	40,745	2,701,906
Michigan	15.6	71,961	4,624,070
Minnesota	14.9	33,806	2,270,846
Mississippi	12.7	19,226	1,517,459
Missouri	12.9	41,571	3,214,541
Montana	14.1	7,737	547,584
Nebraska	12.9	12,630	975,538
Nevada	12.7	7,966	626,446
New Hampshire	14.9	7,913	531,966
New Jersey	14.1	55,350	3,929,915
New Mexico	13.5	13,171	978,146
New York	14.5	94,716	6,519,533
North Carolina	14.1	52,866	3,751,030
North Dakota	12.2	5,632	460,453
Ohio	14.4	81,348	5,641,266
Oklahoma	14.5	30,833	2,125,806
Oregon	14.7	22,741	1,544,366
Pennsylvania	14.6	77,636	5,313,800
Rhode Island	12.6	5,429	431,162
South Carolina	13.9	28,250	2,025,805
South Dakota	12.9	6,236	483,614
Tennessee	12.6	39,521	3,130,831
Texas	14.0	148,348	10,579,296
Utah	13.4	12,100	900,442
Vermont	16.3	4,778	293,686
Virginia	15.6	51,726	3,318,366
Washington	15.3	35,993	2,354,252
West Virginia	14.1	13,181	936,814
Wisconsin	15.9	38,428	2,414,994
Wyoming	12.1	5,373	443,256
U.S.	14.2	1,634,953	129,062,931

State Miles Per Gallon Matrix Notes

Column 1 - Estimated State MPG
Based on 1986 gallons of gasoline consumed and vehicle miles traveled as shown in columns 2 and 3. These figures include [redacted] trucks and buses.
Source: "Highway Statistics 1986," U.S. Department of Transportation (DOT), Washington, DC.

Column 2- Vehicle Miles Traveled (millions)
Source: "Highway Statistics 1986," TableVM-2, U.S. DOT, Washington, DC.

Column 3 - Motor Fuel Use (thousands of gallons)
Source: "Highway Statistics 1986," Table MF-21, U.S. DOT, Washington, DC.

Reforestation

	Acid Rain Programs	Forest Land Acres (000s)	% State Land Forested	Change in Forest Acres 1977-87 (000s) (% Change)	CRP Acres in Trees (% of Total Enrolled Acres)	Reforest Mgmnt.
	1	2	3	4	5	6
Alabama	2	21,725	67%	+364 (2%)	225,197 (52%)	****
Alaska		129,045	36%	No Data	0 (0%)	*
Arizona	2	19,384	27%	+891 (5%)	*0	**
Arkansas	2	16,987	51%	- 1204 (7%)	76,582 (49%)	*
California	2,4	39,381	39%	-771 (2%)	652 (.4%)	*****
Colorado	2	21,338	32%	-933 (4%)	636 (.03%)	**
Connecticut	2	1,815	59%	-45 (2%)	*0	*
Delaware		398	33%	+6 (2%)	116 (26%)	**
Florida	2	16,549	48%	- 490 (3%)	84,388 (91%)	***
Georgia		23,907	65%	- 1349 (5%)	470,392 (92%)	****
Hawaii		1,748	43%	-238 (12%)	0 (0%)	**
Idaho	2	21,818	41%	+ 92 (0%)	1048 (.1%)	****
Illinois	2	4,265	12%	+ 455 (12%)	8463 (2%)	***
Indiana	2	4,439	19%	+ 497 (13%)	4677 (2%)	***
Iowa		1,562	4%	+ 1 (0%)	6,923 (.5%)	***
Kansas		1,358	3%	+ 14 (1%)	2,080 (.09%)	nd
Kentucky	2	12,256	48%	+ 96 (1%)	1,802 (.5%)	**
Louisiana		13,883	49%	- 675 (5%)	33,445 (43%)	**
Maine	2	17,710	[illegible]	- 5 (0%	1690 (6%)	**
Maryland	2,4	2,632	42%	- 21 (1%	844 (12%)	***
Massachusetts	1,2	3,097	62%	+ 145 (5%	10 (40%)	****
Michigan	*,2	18,220	50%	-1050 (5%)	6,476 (5%)	***
Minnesota	1,2	16,583	33%	- 126 (1%)	32,691 (2%)	****
Mississippi		16,693	55%	- 22 (0%	298,861 (55%)	***
Missouri	2	12,523	28%	- 353 (3%)	4,183 (.3%)	***
Montana	2	21,910	24%	- 649 (3%)	1,188 (.05%)	***
Nebraska		722	1%	- 307 (30%)	1,686 (.15%)	**
Nevada	2	8,928	13%	+ 1245 (16%)	0 (0%)	***
New Hampshire	1,2	5,021	88%	+ 8 (0%)	*0	**
New Jersey	2	1,985	43%	+ 57 (3%)	0 (0%)	**
New Mexico	2	18,526	24%	+ 467 (3%)	0 (0%)	****
New York	1,2	18,775	62%	+ 1557 (9%)	2,130 (5%)	**
North Carolina	2	18,891	61%	- 1152 (6%)	60,226 (58%)	***
North Dakota	2	460	1%	+ 39 (9%)	747 (.04%)	*
Ohio	2	7,397	28%	+1251 (20%)	5,797 (4%)	***
Oklahoma		8,971	20%	+ 458 (5%	528 (.05%)	**
Oregon	2	28,055	46%	- 1755 (6%)	1,078 (.2%)	*
Pennsylvania	*,2,3	16,997	59%	+ 172 (1%	1,613 (3%)	**
Rhode Island	2	399	60%	- 5 (1%	*0	*
South Carolina		12,257	64%	+ 8 (0%	164,629 (80%)	***
South Dakota		1,690	3%	- 12 (1%	795 (.08%)	**
Tennessee	2	13,258	50%	- 98 (1%	18,337 (5%)	*
Texas		23,330	14%	+ 51 (0%	10,740 (.3%)	***
Utah	2,3	16,234	31%	+ 677 (4%	0 (0%)	**
Vermont	*,2	4,479	76%	- 32 (1%	0 (0%)	**
Virginia		15,968	63%	- 449 (3%)	20,651 (42%)	***
Washington	2,4	21,856	51%	- 1325 (6%)	1,010 (.1%)	***
West Virginia		11,942	78%	+ 274 (2%)	21 (4%)	**
Wisconsin	1,2	15,319	44%	+ 412 (3%)	29,561 (7%)	***
Wyoming	2,3	9,963	15%	- 62 (1%)	8 (.003%)	**

Reforestation Matrix Notes

Column 1 - Acid Rain Control Programs
"1" designates that the state has an acid rain deposition control program in place. "2" designates that the state participated in EPA STAR (State Acid Rain) Program which involves research, policy analysis and EPA cooperation with States to analyze implementation issues. "3" designates that the State Governor has appointed a research task force. "4" designates that the state legislature has mandated research programs. "5" designates that state has sulfur dioxide emissions controls.
Sources: "Acid Rain: The View From the States," p. 100 and p. 118. Phone conversation with Brian McLean, EPA STAR Program, 9/29/88. "Summary of Acid Rain Laws," State and Territorial Air Pollution Program Administrators, December 1986.

Column 2 - Total Forest Land Area, 1987 (thousands of acres)
Source: U.S. Department of Agriculture (USDA), Forest Service, "Analysis of the Timber Situation in the U.S. 1989-2040 (Draft)."

Column 3 - Percent of State Land Area Covered by Forests
Source: [illegible]

Column 4 - Change in Total Forest Land Area, 1977-1987(thousands of acres).
Numbers may not be precise due to some changes in forest land classification. Sampling errors will also be greater in states with small forestland acreages. Alaska's numbers are not comparable over time due to significant improvements in recent inventories, which have identified some 10 million new acres of forestland.
Source: USDA, Forest Service, "Analysis of the Timber Situation in the United States, 1952-2030 and 1987-2040."

Column 5 - Acres of Farmland Planted to Trees through the Conservation Reserve Program (CRP), May 1988, and the percent this represents of the total acreage enrolled in each state in the CRP. "0 indicates that a state had no acres enrolled in the CRP.

In the program, farmers are paid a fee to remove highly erodible cropland from production for a least 10 years and to cover the land with a soil-conserving crop, such as trees, legumes, or grasses. The CRP has been hailed as the greatest tree planting program in the history of the Nation, yet tree planting has fallen short of the original goals set forth in the1985 Farm Bill, i.e. that 12.5% of the the total enrolled CRP acres be converted to trees.
Source: USDA Agricultural Stabilization and Conservation Service, May 1988.

Column 6 - Reforestation Management
Score given to states based on the management mechanisms used to promote natural and artificial reforestation on private forestland. A score of 5* is highest and 1* lowest. "nd" = no data. (1) Management mechanisms included are educational programs, voluntary guidelines, financial and tax incentives, and legal regulations. States that used a combination of these mechanisms were ranked higher, with legal regulation, tax and financial incentives receiving greater weight. (2)
Sources: (1) Ranking by Rick Magder, Renew America, Washington, DC, October 1988.
(2) Paul Ellefson, University of Minnesota professor of forest economics and policy, unpublished state-by-state survey for "State Forest Practice Regulation in the United States: Administration, Cost and Accomplishments," 1986.

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CFC SUBSTITUTES: Candidates pass early toxicity tests

Three leading candidates to replace ozone-depleting chlorofluorocarbons (CFCs) have shown no significant toxicity in short-term tests, thus clearing one major hurdle on the road to commercialization. However, the compounds still must undergo two-year inhalation studies to see if they cause cancer.

The urgent need to find CFC alternatives is underscored by the latest news from Antarctica: The "ozone hole" has returned with a vengeance. Atmospheric scientists have determined that chlorine from CFCs is the primary factor in the seasonal loss of stratospheric ozone that has been recurring each Antarctic spring for a decade.

This year, data both from a National Aeronautics & Space Administration satellite and from balloons launched from the ground show ozone over Antarctica is being chewed up at a rapid rate similar to that of 1987, the worst year on record. That year, 50% of Antarctic ozone—essentially all ozone in the lower stratosphere—was destroyed during September and October.

Unlike the fully halogenated CFCs they are designed to replace, the three compounds that have just cleared preliminary toxicity tests—HCFC-123 ($CHCl_2CF_3$), HCFC-141b (CH_3CCl_2F), and HFC-134a (CH_2F-CF_3)—all contain hydrogen atoms. HFC-134a does not contain any chlorine atoms. The hydrogens make the compounds susceptible to oxidation in the lower atmosphere, before they can carry chlorine into the stratosphere.

The toxicity studies were conducted by the Program for Alternative Fluorocarbon Toxicity Testing (PAFT), a consortium of 15 CFC producers who in 1988 decided to pool their resources to speed development of CFC alternatives. The effort was spearheaded by Du Pont and ICI, who dominate the world CFC market and are leading the race to produce alternatives.

In a battery of toxicological tests, high concentrations of the potential alternatives produced only mild effects similar to those demonstrated by existing CFCs, which are widely regarded as essentially nontoxic. Among other findings, the substitutes caused no birth defects or significant skin or eye irritation.

"We expected them to be safe and they are," says C. Anthony McCain, program manager of Du Pont's Freon products division. The long-term carcinogenicity studies will all be initiated by the end of 1989, he says, and the results likely will be available in 1992 or 1993.

The toxicity data will be published in the open literature, McCain says. Meanwhile, the consortium has already submitted the results of the first round of studies to the Environmental Protection Agency.

HCFC-123 and HFC-134a are on EPA's inventory of existing chemicals, compiled in 1979 under the Toxic Substances Control Act (TSCA). That means those compounds can be produced and used without an EPA safety review unless the agency imposes a "significant new use" rule, which it has not done as yet. HCFC-141b, however, is considered a new chemical under TSCA, and companies must submit a premanufacture notification to EPA 90 days before they begin to produce it.

ICI last week announced plans to build an HFC-134a plant in St. Gabriel, La., in addition to one being designed for Runcorn, England. Du Pont has begun work on an HFC-134a plant in Corpus Christi, Tex. HFC-134a likely will replace CFC-12 (CCl_2F_2) in auto air conditioners and refrigerators.

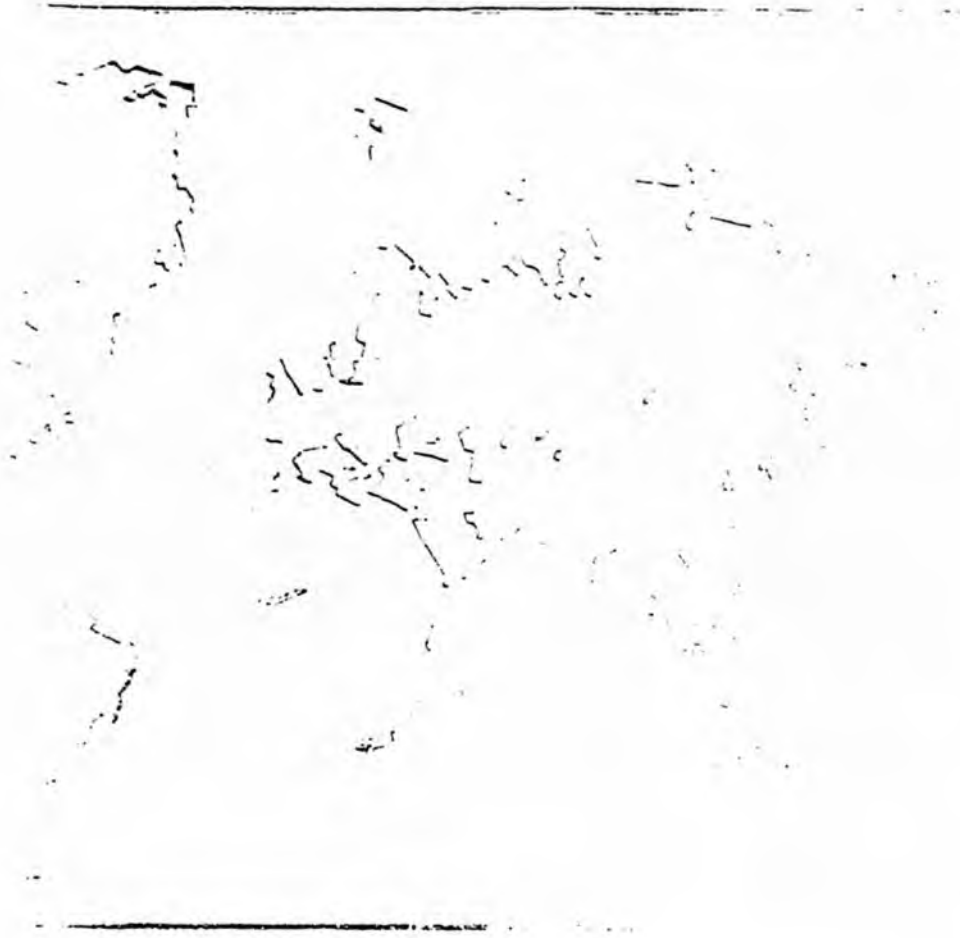
Du Pont also is building an HCFC-123 plant in Maitland, Ontario, and is converting an existing facility at Montague, Mich., to produce HCFC-141b. Those compounds are likely substitutes for CFC-11 (CCl_3F) in foam-blowing applications. None of these plants is expected to be in production for at least two years.

Pamela Zurer

Likely candidates to replace CFCs contain hydrogen

Compound	Major uses	Atmospheric lifetime, years[a]	Ozone-depletion potential[b]	Development status
HFC-134a (CH_2FCF_3)	Potential substitute for CFC-12 in refrigeration, auto air conditioners	21	0	Commercial-scale plants announced by ICI, Du Pont
HCFC-123 ($CHCl_2CF_3$)	Potential substitute for CFC-11 in plastic foam, chillers	1.9	0.016	Commercial-scale plant announced by Du Pont
HCFC-141b (CH_3CCl_2F)	Potential substitute for CFC-11 in plastic foam	8.9	0.061	Commercial-scale plant announced by Du Pont
HCFC-22 ($CHClF_2$)	Home air-conditioning, foam food containers	20	0.053	In commercial use

a Calculated lifetime from Lawrence Livermore National Laboratory 1-D atmospheric model. b Calculated relative to CFC-11, which is assigned a value of 1.0, using the same model.



New Jersey **Global Climate Change Initiative**

Dear Concerned Resident:

New Jersey is a nationally recognized leader in environmental protection. Time and again, our innovative programs have been used as a model by other states and the federal government.

The Global Climate Change Initiative outlined in this document is the most recent example of that innovation and leadership.

In recent months, scientists from around the world have concluded that human activities may be irrevocably changing our climate and our environment. They have warned that we must act now to reduce both the rate and magnitude of these changes — or suffer the consequences.

In New Jersey we listened to those experts. While no single state, nor any one nation, can solve these problems alone, we are prepared to take the first step. But we also recognize that if our effort is to be successful, we must work together in our communities, in our states, and across our borders.

Our Initiative adopts a series of goals and strategies that will help the State government do its part to reduce the threat of global climate change and to prepare for its effects. It is a cooperative effort that was developed jointly by ten of our executive agencies and that will affect operations of the entire government.

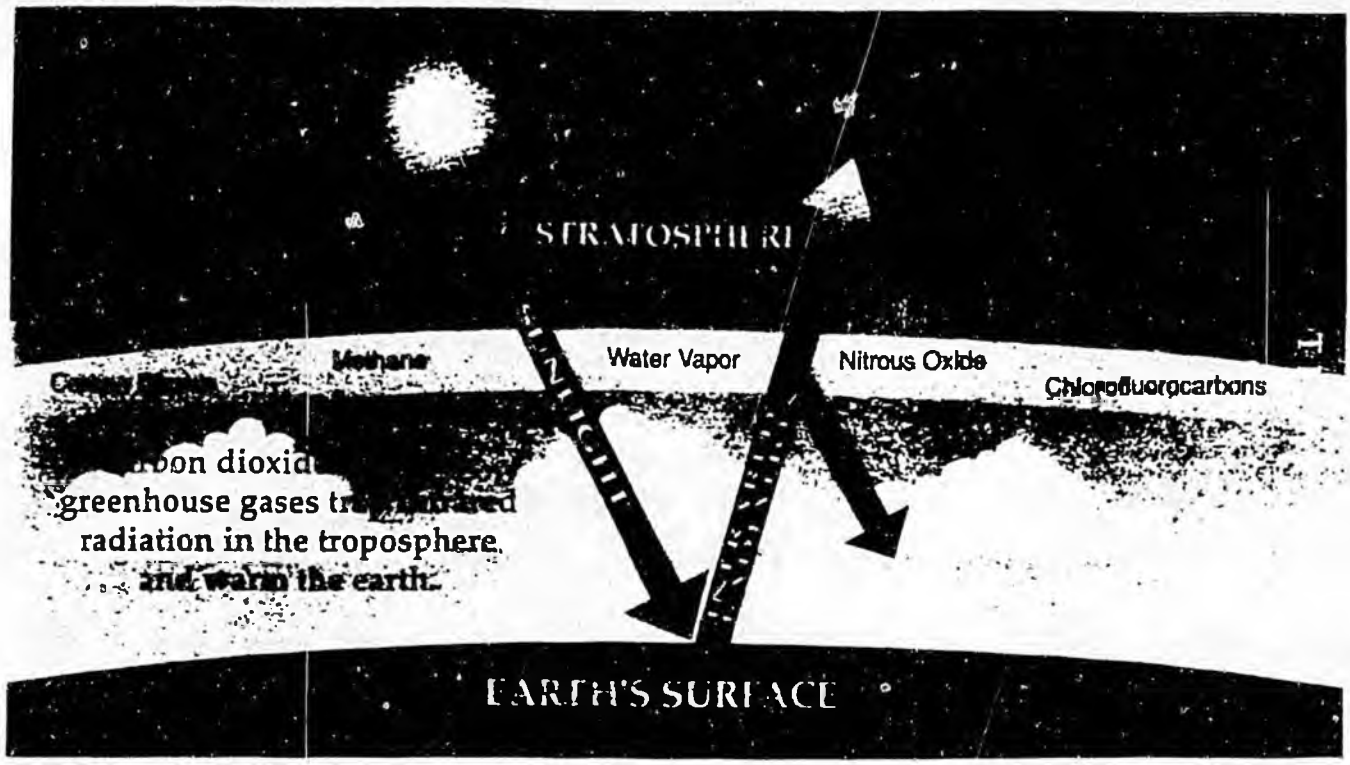
In addition, it will encourage the participation of all New Jerseyans. Whether using less energy more efficiently, recycling more of the things we now throw away, or simply using our own market choices to purchase products that don't degrade the environment. each of us has a role to play.

There is an old adage that " everyone is talking about the weather, but no one is doing anything about it." If our scientists' projections are correct, we all will be talking a lot more about the weather in the future. But in this case we <u>can</u> do something about it. And in New Jersey we <u>are</u> doing something about it.

Sincerely,

Tom Kean

Thomas H. Kean
Governor, State of New Jersey



THE "GREENHOUSE EFFECT" AND OZONE DEPLETION: CAUSES AND EFFECTS

Stratospheric ozone. Chlorofluorocarbons. Anthropogenic greenhouse gases. These are big words with bigger implications, but their meaning is simple: we have changed our environment for the worse; now it is time to change our ways for the better.

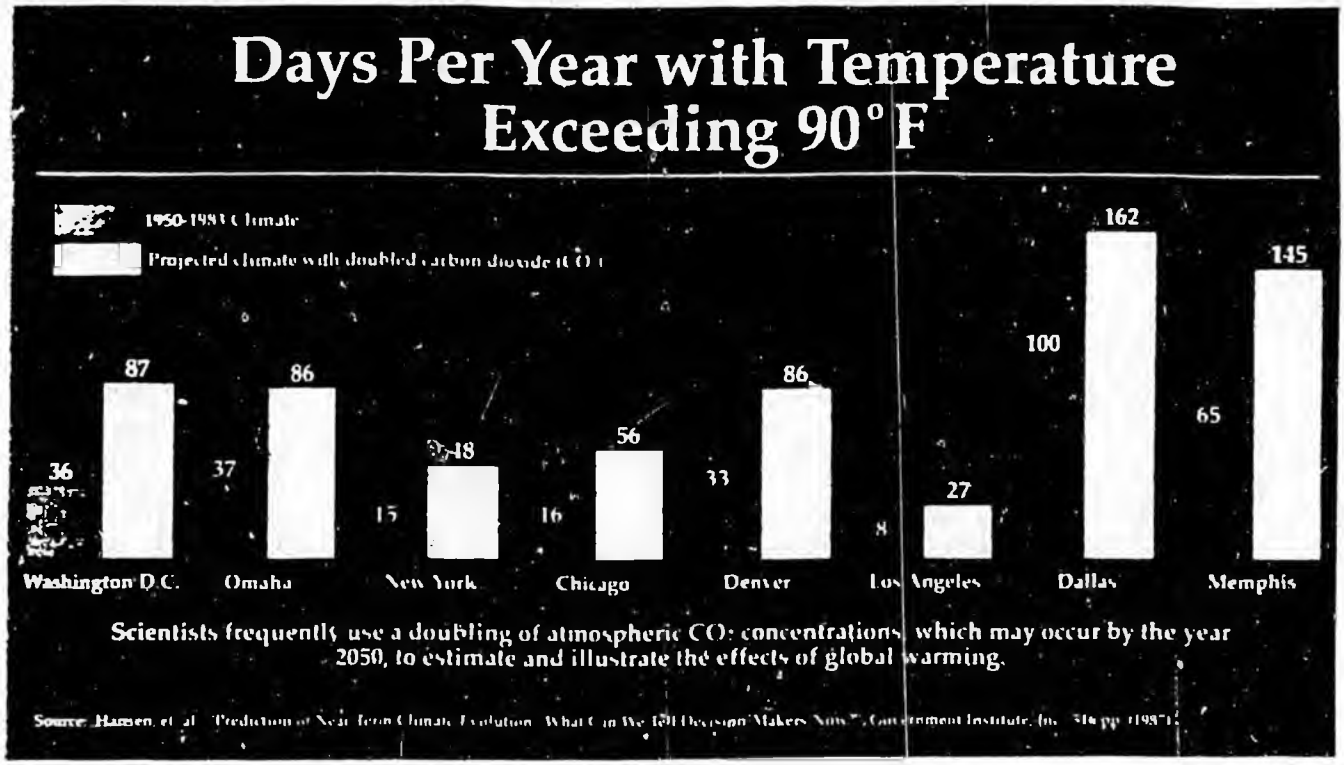
Two of the main culprits in changing the global environment are the "greenhouse effect" and destruction of the stratospheric ozone layer. Neither would pose a threat, however, were it not for the fact that human activities — from farming to flying — are greatly exacerbating them.

The "greenhouse effect" is one of the most well-established theories in climatology. Gases and water vapor in the atmosphere trap sunlight re-radiated from the Earth much the way a greenhouse traps heat. Without some "greenhouse effect," the Earth would be, like Mars, a frozen wasteland. But if we continue to increase the amounts of greenhouse gases, such as carbon dioxide, chlorofluorocarbons (CFCs), methane, and nitrous oxide, in the atmosphere, the planet might begin to resemble Venus —uninhabitably hot.

Since the last Ice Age ended approximately 10,000 years ago, the Earth's climate has been relatively stable. The warm, moist weather of the current inter-glacial period is ideally suited for a vast array of plant, animal, and, perhaps most significantly, human life. While humans have colonized most of the world in the past 7,500 years, it is only in the last century that we have begun pouring wastes into the air and water in quantities that threaten global consequences.

> **Human activities — from farming to flying — are dramatically changing our environment.**

In fact, most experts agree that projected increases in global temperature will continue until a substantial reduction in emissions of greenhouse gases is achieved. An ever-growing body of evidence confirms that even if the increases in greenhouse gas emissions were stopped today, those gases already in the atmosphere would cause significant warming over the next 60 years.



Effects of Global Climate Change

Rising Temperature
Hotter summers
Droughts
Hurricanes

Rising Sea Levels
Storm damage
Beach erosion
Flooding

Health Effects
Skin cancer
Heat stress
Respiratory illnesses
Reduced immune response

Ecological Effects
Major shifts in habitat
Species extinctions
Loss of coastal wetlands

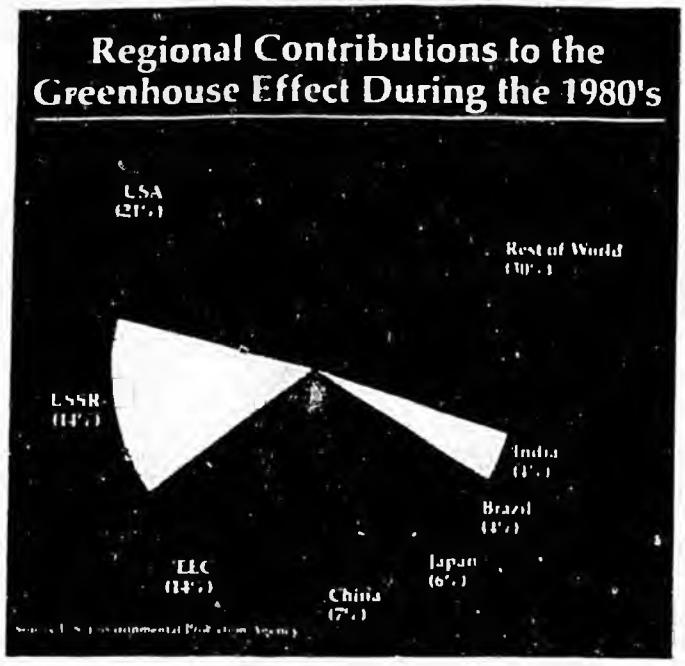
Current climate models predict that average global temperatures will rise between 3 and 10° F by 2050 if rapid growth of greenhouse gases continues. This may not sound like a very big change until one considers that at the peak of the last Ice Age — 18,000 years ago — average global temperatures were only 9° F colder than they are today. Thus, even an increase of a few degrees can have serious ramifications, including:

- dangerously hotter summers, with a likelihood of more frequent and severe droughts;
- drastic changes in the range and distribution of many plants and animals, with significant implications for food production, forestry, and habitats;
- more extreme precipitation and floods, and more intense tropical and coastal storms;
- thermal expansion of the oceans and likely melting of polar ice that would raise sea levels and inundate coastal regions, which currently are home to 40% of the world's population; and
- an increase in heat related deaths, particularly among infants and the elderly.

Ozone depletion is caused by emissions of CFCs and halons. These chemicals are commonly used as the coolant in air conditioners, as blowing agents in insulating foams, as cleaning agents in electronic assembly operations, and in fire extinguishers (halons). They are extremely stable, which allows them to rise into the upper atmosphere where they react with sunlight to destroy ozone molecules.

While ozone at ground level is a pollutant, in the upper atmosphere it provides a critical shield against damaging ultraviolet radiation. If this ozone shield is even partially destroyed, doctors and scientists warn that there will be a substantial increase in cases of skin cancer, cataracts, and possibly damage to the immune system. In fact, each one percent decrease in the ozone layer can raise skin cancer rates by as much as 3 to 5 percent.

In recent years, huge ozone holes have formed over the Antarctic in late winter. Less drastic, but still significant depletion may exist in the Arctic Region as well. Earlier this year, scientists found that 50 percent of the ozone had been destroyed in a 10 million square mile area over Antarctica. Although no such holes have been discovered at lower latitudes, overall global ozone levels have declined measurably. In addition, when the Antarctic hole breaks up in the early spring it can further reduce ozone levels by several percent over populated regions of Australia, New Zealand, and Africa.



WHAT CAN NEW JERSEY DO?

The problems created by a rapidly changing climate are global in scope, but local in cause and effect. For example, the burning of coal in Newcastle and Beijing affects the residents of Newark and Bayonne. On the other hand, these problems are not caused by any one nation or activity, but by the cumulative effects of the millions of actions that we engage in every day. In the past, our actions have exacerbated the problems; in the future, they can contribute to the solutions.

Scientists tell us that the evidence is mounting, and it is convincing enough that we should act now to reduce both the rate and magnitude of climate change — or suffer the consequences. But even that will not be enough to prevent some level of climate change that will result from past emissions. Therefore, we must also take specific steps to prepare for and adapt to the changes that will occur.

New Jersey is in a unique position to take up this challenge. As the Nation's most densely populated state, we can lead the way in building more efficient homes, offices, and factories. We can encourage people to drive less and use public transit more. And we can reduce the use of ozone-depleting CFCs.

Yet that is just the beginning. We must also inititate a broad based research, education, and planning effort to ensure that we are prepared to meet each challenge as it arises. With hundreds of miles of treasured shoreline and billions of dollars in public and private investment along our coast, which may be inundated by rising seas or battered by more intense hurricanes, we cannot afford to wait.

> "Each of us must act to prevent global climate change and ozone depletion, beginning right here in New Jersey."
>
> — Governor Thomas H. Kean

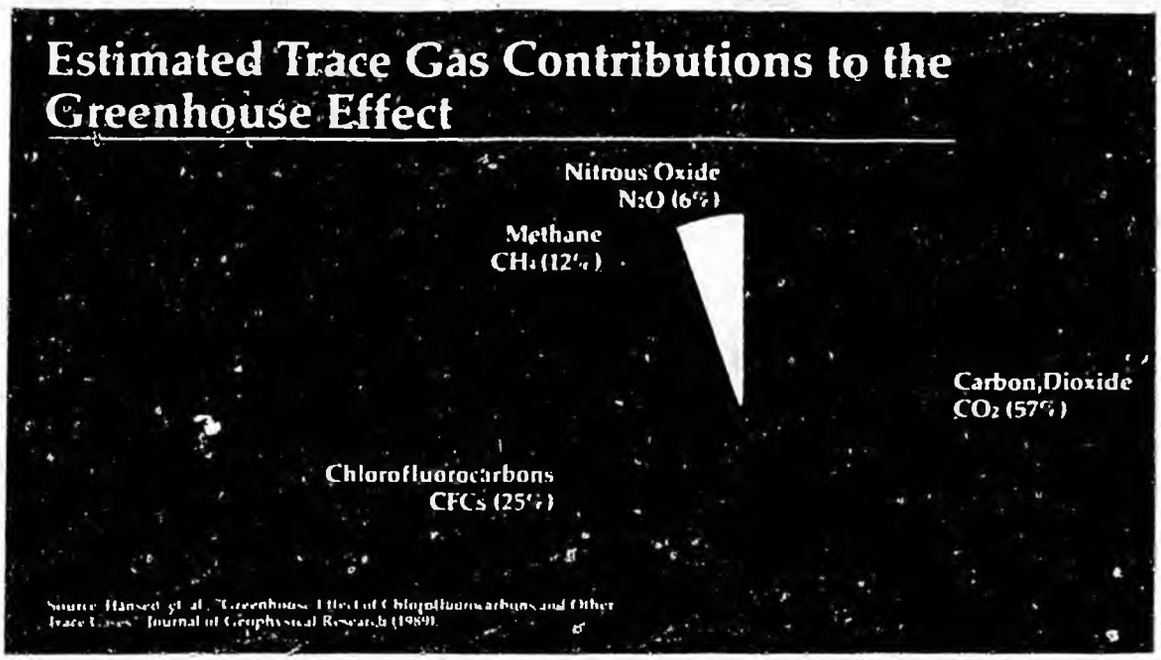
The goals and strategies outlined here are the first phase of New Jersey's effort to develop and implement policies that will help solve the problems caused by global climate change. We cannot solve these problems alone. But New Jersey can provide the leadership and initiative that will begin that process while at the same time making our businesses and industries more competitive in an ever-changing world.

Goals

Reduce New Jersey's emissions of greenhouse gases;

Prepare for anticipated effects of climate change; and

Involve and educate all New Jerseyans



Of the four major greenhouse gases — carbon dioxide (CO_2), CFCs, methane, and nitrous oxide — accurate state-by-state emissions figures exist only for CO_2. In 1986, fossil fuel burning in New Jersey was responsible for pouring 35 million tons of carbon into the atmosphere, the 12th highest level in the nation.

Carbon dioxide, by far the largest contributor to the greenhouse effect, may be the most difficult to reduce. It is released whenever fossil fuels are burned to produce electricity, power motor vehicles, or heat our homes. Thus, energy conservation is a crucial component of any climate change strategy.

Although CFCs constitute only a small fraction of the Earth's atmosphere, reducing — and ultimately eliminating — their production and use is also critical to easing the threat of global climate change. Not only are these chemicals the primary cause of stratospheric ozone depletion, but they are also powerful greenhouse gases — each CFC molecule can absorb up to 25,000 times as much radiation as a molecule of CO_2.

Under the Montreal Protocol on Substances that Deplete the Ozone Layer, which went into effect in January 1989, the U.S. is committed to a 50% reduction in CFC production and use by July 1, 1999. New evidence suggests that much larger reductions and an eventual phaseout of CFCs are needed.

Achieving this goal will require industries that produce and use CFCs to work together to develop safe, effective alternatives. Heating and air conditioning equipment will have to be redesigned, as will manufacturing processes, such as those used to assemble electronic circuit boards, so that CFCs are no longer needed. Finally, in the short term, those who repair and maintain equipment, including motor vehicle air conditioners, that contains CFCs should use machines, called "vampires" that recover, cleanse, and recycle the chemicals.

In many cases, the equipment and technologies that will reduce CFC and greenhouse gas emissions already exist and can be used if appropriate information and technical assistance are made available. Implementation of the following strategies will help achieve those reductions in New Jersey.

Strategies

Reduce energy and CFC use by state government

Consider regulatory steps to reduce energy and CFC use

Plant trees

Study sea-level rise

Create greenways

Improve public education

Strategy: Reduce Energy Consumption and [illegible] Use by State Gov[illegible]

Almost all of New Jersey's energy needs are supplied by fossil fuels: coal, oil, and natural gas. In 1987, petroleum alone accounted for 53 percent of the State's energy supplies, while natural gas and coal provided an estimated 21 percent and 13 percent respectively.

On the demand side, the transportation sector uses 36 percent of the energy consumed in the State and is the single largest source of greenhouse gases. The remainder of our energy needs are divided fairly evenly between residential, commercial, and industrial users.

Therefore, our efforts must focus both on conserving energy as well as using it more efficiently in transportation, electric power generation, heating, air conditioning, and lighting. The following specific actions will be taken by State government to accomplish these objectives.

State Buildings

The construction, purchase, lease, renovation, operation, and maintenance of all State buildings and other major facilities will be based on lifecycle costing and state-of-the-art design.

Cost-effective state-of-the-art efficiency standards will be adopted for replacing heating, ventillation, and air conditioning (HVAC) systems in all State buildings.

Cost-effective state-of-the-art efficiency standards will be adopted for relamping State buildings.

Opportunities for using cogeneration in new or renovated State facilities will be investigated. Cogeneration is the production of electric power and thermal energy from the same fuel source. This combined heat and electrical production means more useful energy is extracted from the original fuel source than if a conventional power plant or boiler were used. In State facilities, thermal energy can be used either to heat or cool a room or to generate hot water. Investment in cogeneration could substantially reduce energy expenses and the burden they place on the State budget.

Bulk purchases of natural gas for use in State facilities will be investigated. The cost savings potentially available from wholesale gas purchases may be sufficient to fund the conversion of oil-fired facilities to gas, which would result in a net reduction in the emissions of CO_2, a major greenhouse gas.

WHAT IS LIFECYCLE COSTING?

Lifecycle costing is a way of minimizing costs and saving energy at the same time. Since energy-efficient products may be more expensive initially, many people hesitate to purchase the car with better gas mileage, the more efficient furnace, or the home with more insulation. However, since efficient products lower energy bills over their entire useful life, the money saved can make up for the higher initial cost many times over.

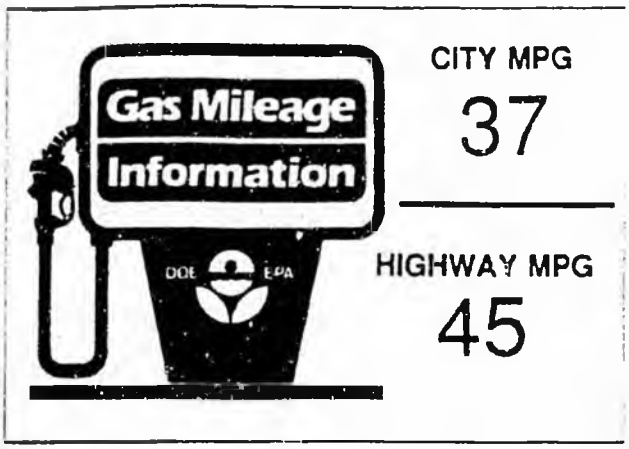
Example: A standard 23 cubic foot refrigerator costs $600, but uses $265 worth of electricity per year. A more efficient model costs $700, but uses only $183 worth of electricity ($82 less per year). The extra cost to purchase the more efficient model ($100) is paid back in just over 14 months and, over the 15 year lifetime of the refrigerator, the net savings for the more efficient model are more than $1100.

...a Products

State purchases of recycled products will be expanded, and additional information on the availability of recycled products will be developed. The energy saved by recycling one ton of aluminum is equal to the energy produced from 1638 gallons of oil! If all of the aluminum used in the US each year were recycled, we would save more than 16 times the amount of oil that will go into the Strategic Petroleum Reserve in 1990 — at a savings of $5 billion.

But the recycling process is not complete unless and until there is a market for the remanufactured products. As one of the largest consumers of recyclable products, State governments are in a position to stimulate those markets. Already, New Jersey purchases substantial quantities of recycled paper and plastic products. Under our new Initiative, we will expand our efforts to use State government buying power to encourage manufacturers to produce still more recyclables.

Opportunities for maximizing recycling of pavement will be investigated.



EPA mileage ratings will be used in purchasing new State motor vehicles in order to improve overall fleet efficiency.

Maintenance of State vehicles will be improved to increase mileage and decrease emissions.

Opportunities for using alternate fuels in the State motor vehicle fleet will be investigated.

Carpooling, vanpooling, and mass transit use by State employees will be encouraged.

Release of CFCs while servicing State motor vehicle air conditioners will be reduced or eliminated.

Acquisition for State buildings of air conditioners that do not use CFCs will be investigated.

State acquisition of products that use CFCs as a blowing agent will be reduced or eliminated.

Fire suppression systems that do not use halons will be investigated.

Strategy: Encourage Energy Conservation and Reductions in Greenhouse Gas Emissions

Although State government can lead by example in the effort to reduce greenhouse and ozone-depleting gases, others can help, too. The majority of the energy consumed in New Jersey is in the private sector — nearly half in the residential and industrial sectors alone. Thus, additional measures that provide incentives to businesses and homeowners to conserve energy and to limit emissions of greenhouse gases must complement the State's own efforts.

The energy and construction industries offer outstanding opportunities for institutionalizing energy conservation practices. Once in place, these measures will guarantee energy savings throughout the life of a home, factory, or office building.

Traditionally, utilities have been allowed to profit only from the construction of facilities that produce or distribute more electricity, gas, or water. When a utility spends money to encourage customers to conserve energy, however, it can only recover that initial investment — without a profit. This regulatory structure creates a bias in favor of expensive, new power plant construction and against more economic conservation programs.

New regulatory approaches must be adopted that will allow utilities to profit by reducing demand as well as by increasing supply if we are to give conservation programs a better chance for success. In addition, regulators should work with utilities to increase the information available to ratepayers regarding their use of energy. Such knowledge is critical if homeowners and businesses are to make informed decisions about efficiency improvements.

Long term savings can easily justify the initially higher costs of many energy conservation measures. However, those initial costs often prevent New Jersey's urban residents,

as well as those who rent their homes, from taking advantage of the energy savings. By providing low interest loans and grants to help overcome the initial hurdle of higher costs, the State could help our residents not only save energy but lower their utility bills as well. The State will use funds received from federal oil overcharge litigation settlements to establish a new program that makes financial and technical assistance available for permanent energy conservation measures in urban and low income areas.

Building contractors in New Jersey, like many other states, must comply with the Building Officials and Code Administrators (BOCA) construction standards. Therefore, changes to the BOCA code that promote conservation, while not requiring unconventional construction techniques, would result in energy savings in New Jersey and across the nation.

Finally, one of the few methods for improving fuel efficiency and reducing emissions from vehicles already on the road is through inspection and maintenance (I/M) programs. Strengthening the State's I/M program would improve mileage while substantially lowering emissions of greenhouse gases and other pollutants, particularly in older vehicles, which tend to be dirtier and less fuel efficient.

The State will take the following actions to encourage energy conservation and reductions in greenhouse gas emissions.

Market incentives will be provided for utilities to develop more effective conservation programs.

Programs designed to provide energy use and conservation information to ratepayers, including those purchasing new homes and commercial properties, will be expanded.

A State Energy Conservation Bank will be established, using petroleum overcharge settlement funds, to provide financial and technical assistance for energy conservation measures in low income and urban areas.

A forum of regional utility commissioners will be convened to discuss strategies for encouraging a transition to a more efficient and less polluting power pool.

Adoption of a national building code that puts a greater emphasis on energy conservation, while relying upon conventional building techniques, will be encouraged.

Options for improving the State Motor Vehicle Inspection and Maintenance Program (I/M) to reduce emissions from pre-1981 vehicles will be evaluated. The evaluation will include consideration of the impact of I/M Program revisions on low-income drivers.

Consider ... Steps to ... CFC Use

... State's efforts to reduce its ... be supplemented by reduc... the private sector. In order to ... reductions, New Jersey is ... doption of the following actions.

... and recycling of CFCs would ... uring servicing and at disposal ... cle air conditioners, building ... rs, and refrigerators.

... CFCs for home servicing of ... air conditioners would be ...

... motor vehicle air conditioners ... lant would be prohibited.

... of CFCs and ozone-depleting ... uld be restricted and reclama... required.

Strategy: Maximize the Number of Trees In New Jersey

Trees play an important role in efforts to combat the "greenhouse effect" because they absorb carbon dioxide, the most prominent greenhouse gas. In fact, depending on the species, each acre of trees can remove 1-7 tons of carbon from the atmosphere per year. Since fossil fuel burning in New Jersey emits nearly 35 million tons of carbon per year into the atmosphere, an essential element of the State's global climate change program is implementation of an aggressive tree planting campaign and, where possible, avoiding deforestation. In particular, the program would include the following elements.

Tree plantings around existing State facilities and on vacant State properties will be increased.

Trees will be replanted whenever and wherever State activities result in their removal.

A program will be developed to maximize tree-planting on State highways, consistent with adequate safety and visibility.

GOAL: PREPARE FOR ANTICIPATED EFFECTS OF CLIMATE CHANGE

While the steps outlined above will help New Jersey reduce the amount of greenhouse and ozone-depleting gases getting into our atmosphere, more remains to be done. Past emissions may have committed the world to a 2 - 3° F temperature increase — an increase that could have dramatic implications for the way we live. Therefore, the preventive measures must be complemented by strategies that will help us adapt to a changing climate.

Strategy: Understand Impacts of Sea Level Rise

Warmer temperatures will cause the oceans to expand and mountain glaciers and part of the Greenland ice shelf to melt. Scientists are now projecting that sea levels will rise from one to seven feet by the year 2100.

The result: increased flooding and storm damage, accelerated shoreline erosion, and saltwater intrusion into rivers, bays, aquifers, and wetlands. The more severe storms that are expected to accompany a warming of the oceans will exacerbate these effects at the expense of coastal communities and important fish and wildlife habitat.

New Jersey's shores are particularly susceptible to erosion because they are low, flat, and composed of highly erodible sand and gravel. In such areas, every foot of increase in the sea level can move the shoreline inland between 100 and 1000 feet.

Any actions taken to mitigate or adapt to rising sea levels will be extremely expensive and may provide only temporary relief. A study of New Jersey's Long Beach Island found that, depending on the method used, the cost of protecting developments from a six-foot rise in sea level could range from $800 million to nearly $8 billion!

In order to better cope with rising oceans, nine states, including New Jersey, already prohibit new construction at the shore within the area subject to erosion during the next 30 - 60 years. These and other approaches should be reviewed in a regional context.

A research program will be initiated to study sea level rise and other coastal changes and to understand their effects on coastal facilities and residents.

Policies will be developed to respond to predicted changes in sea level in consultation with the general public and affected governmental entities.

Strategy: Continue Expansion of Greenway Policy

Projected changes in climate and sea level will force plants and animals to adapt at much faster rates than at any other time in history. As temperature and rainfall patterns change, the habitats of many plants and animals will shift. Without the ability to migrate, many species may be wiped out, at least regionally. We must take steps to ensure that the plant and animal species that depend on these important ecosystems for survival are not threatened with extinction.

The State's Greenway program will continue to be expanded in order to provide corridors for plant and animal migration.

GOAL: EDUCATE AND INVOLVE ALL NEW JERSEYANS

Reducing the threat of global climate change, or adapting to its effects, requires cooperation locally, nationally, and internationally. The small changes that each of us can make in our daily routines — car pooling or using mass transit, recycling, or conserving water and energy in our homes — may not seem like much. But taken together they form the building blocks of an unprecedented effort to protect the natural bounty we've grown to love and cherish.

Strategy: Improve Public Education About the Causes and Effects of Global Climate Change

Educating New Jerseyans about the causes and effects of global climate change is a critical first step to implementing the policies and programs outlined in this document. The following measures will help ensure that we take that step.

Teachers, administrators, and boards of education will be encouraged to infuse environmental education activities into their curricula in order to increase awareness of climate change issues.

Colleges and universities that train teachers will be asked to incorporate environmental education activities into their methods courses.

Conferences and academic research related to climate change issues will be sponsored and encouraged in cooperation with Rutgers, the University of Medicine and Dentistry of New Jersey, the Environmental and Occupational Health Sciences Institute, and the Hazardous Substance Management Research Center.

Implementation of the Department of Agriculture's Low Input/Sustainable Agriculture Program will be continued to ensure that agricultural producers have access to information about energy efficient, environmentally sound production methods.

The NJ Department of Transportation will work with local transportation management agencies (TMAs) to increase awareness of climate change issues.

EXECUTIVE ORDER

Under New Jersey's Constitution, State government is charged with providing for the "protection, security, and benefits" of its citizens. Executive Order 219, signed by Governor Kean on October 23, 1989, fulfills that obligation by requiring all departments, agencies and offices of State government, including State universities and colleges, to take steps to reduce the State's contribution to global climate change and ozone depletion.

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EXECUTIVE ORDER NO. 219

WHEREAS, a scientific consensus exists that emissions of certain gases, including carbon dioxide, methane, nitrous oxide, chlorofluorocarbons (hereinafter "CFCs"), and halons are causing significant changes in the composition of the Earth's atmosphere; and

WHEREAS, a scientific consensus also exists that these emissions are likely to cause significant changes in the Earth's climate, including overall warming, increased drought, an increase in the intensity of hurricanes and other major storms, as well as increased incidence of harmful ultraviolet radiation; and

WHEREAS, these climatic changes are predicted to result in increases in sea levels, geographic shifts in the habitats of many plants and animals, and the extinction of potentially large numbers of species; and

WHEREAS, reductions in emissions of these gases can diminish the overall magnitude and rate of climatic change, as well as reduce the depletion of stratospheric ozone; and

WHEREAS, energy conservation can achieve significant reductions in emissions of carbon dioxide, a necessary byproduct of the combustion of fossil fuels and a major contributor to global climate change; and

WHEREAS, protection of the social, economic and environmental interests of the citizens of New Jersey requires the State to implement policies and regulatory practices that will serve the dual purpose of reducing such emissions and of facilitating adaptation to those changes that are predicted to occur; and

WHEREAS, the public's understanding of the causes of global climate change and ozone depletion and possible responses thereto is essential to ensuring that appropriate steps are taken; and

NOW, THEREFORE, I, THOMAS H. KEAN, Governor of the State of New Jersey, by virtue of the authority vested in me by the Constitution and by the Statutes of this State, do hereby ORDER and DIRECT:

1. State entities shall foster energy conservation to the maximum extent practical, in order to reduce emissions of carbon dioxide and other gases that contribute to global climate change.

a. All State entities with responsibility for constructing, purchasing, leasing, operating or maintaining capital facilities and equipment shall employ state-of-the-art equipment for efficient heating, ventilation, air conditioning and lighting, and in other major energy using applications, where such equipment or techniques will result in lower costs over the lifetime of the equipment.

b. All State entities exercising regulatory authority over actions that directly or indirectly relate to the production or consumption of energy, shall review their policies and regulatory practices to ensure that they provide maximum incentives designed to conserve energy and increase reliance upon sources of energy that contribute fewer emissions of those gases responsible for global climate change.

2. All State entities that use or purchase CFCs and halons or that use, purchase, or maintain equipment that contains CFCs or halons, shall investigate the use of all practicable and safe alternatives to those compounds and ensure that emissions and losses of those compounds, including those occurring during maintenance, are reduced to the maximum extent practicable.

3. The Department of Environmental Protection shall investigate the feasibility of regulatory controls to reduce the use and release of CFCs and halons in New Jersey and make recommendations for any necessary regulatory or legislative action.

4. All State entities with responsibility for the maintenance of State property shall promote the absorption of carbon dioxide by maximizing the planting of trees and ensuring at least one-for-one replacement (either on-site or elsewhere) for trees lost as a result of construction or other activity which requires or results in loss of trees.

5. All State entities with responsibility for policies or regulations affecting the location, construction or maintenance of public or private facilities (including residential developments) shall:

a. Ascertain the degree to which those facilities will be affected by predicted changes in sea level; and

b. Develop policies, in consultation with the general public and other governmental entities, to respond to such predicted changes in sea level.

6. All State entities with responsibility for the purchase or protection of land for the purposes of open space protection or related objectives shall, as appropriate, undertake such acquisition or protection activities in a manner that furthers the creation of corridors of linked public and private open spaces known as "greenways," which aid the adaptation of natural systems by providing corridors for migration as climatic conditions change.

7. All State entities shall review their programs designed to facilitate public awareness of environmental issues and revise such programs to ensure, to the maximum extent practicable, the effective communication of information that will enhance the public's understanding of the basic processes involved in global climate change, the causes of such change, and possible approaches to reducing and adapting to such change.

8. This Order shall take effect immediately.

Tom Kean

/s/ Thomas H. Kean
GOVERNOR

The New Jersey Climate Change Initiative is a cooperative effort developed by the following agencies:

Board of Public Utilities
Department of Agriculture
Department of Community Affairs
Department of Corrections
Department of Environmental Protection
Department of Higher Education
Department of Human Services
Department of Law & Public Safety
Department of Transportation
Department of Treasury
Governor's Office of Policy and Planning

12/89
Design- Dilip Kane Office of Communications & Public Education
Charts- Robert Cieszkowski

Bush says work on global warming must not hurt economy

ANC DAILY NEWS 2/6/90

By H. JOSEF HEBERT
The Associated Press

WASHINGTON — President Bush called Monday for balancing economic and environmental concerns when dealing with global warming, prompting environmentalists to accuse him of siding with industry and avoiding a [illegible] world problem.

Bush, speaking to an international conference on the threat of a world "greenhouse" effect, said "our policies must be consistent with economic growth." And he suggested that in some areas of the debate "politics and opinion have outpaced the science."

Environmentalists at the conference suggested the problem was not scientific but a lack of U.S. leadership in dealing with the issue. One participant called Bush's comments "a gross disappointment."

On Capitol Hill, Sen. Albert Gore Jr., D-Tenn., a frequent critic of Bush's stand on global warming, said the president was "moving as slow as molasses" on the issue when many scientists already are convinced decisive action is needed.

But the president, addressing the Intergovernmental Panel on Climate Change, said nations must strike a bargain between curbing pollution that is causing a warming of the earth and maintaining economic growth.

Arguing that key scientific questions have yet to be answered, Bush suggested it was too early to unleash an action plan aimed at specific pollution reductions as many environmentalists — and some European countries — have said is required.

Later at the White House, presidential spokesman Marlin Fitzwater said Bush does not believe it is "time for a call to arms" on the global warming issue, but "time for a call to research and to find out more about it."

"Our goal continues to be matching policy commitments to emerging scientific knowledge — and a rebalancing of environmental protection to the continued benefits of economic development," said Bush.

The remarks brought a subdued reaction from many of the participants at the international conference sponsored by the United Nations and attended by representatives from some 60 nations.

Delegates from some European countries, including Norway, Denmark and Sweden, have argued that enough scientific knowledge has been accumulated to warrant a commitment from industrial nations to at least stabilize carbon dioxide pollution at current levels over the next decade.

Scientists are concerned that the accumulation of man-made pollutants, largely carbon dioxide from the burning of fossil fuels, is creating a serious global problem.

Like a greenhouse, the pollution traps heat and reflects it back to earth, causing a warming of the globe. While there is little dispute that greenhouse gases are increasing, there remains disagreement within the scientific community as to how severe the warming will become and what effect it might have on the earth.

If the pollutants are left unchecked, many scientists expect the earth's temperature to rise by 4 to 9 degrees by the middle of the next century, perhaps causing coastal flooding and droughts in interior regions.

On the other hand, reducing greenhouse gases would require major shifts from the use of coal, oil and natural gas, which are mainstays for a broad range of industries. Industrial leaders have raised concerns that if pollution controls are imposed too quickly, there could be severe economic disruption.

Daniel Becker of the Sierra Club said of Bush's speech, "It was a gross disappointment. There was more talk in the speech about economics than about the environment."

Stewart Boyle of the Association for the Conservation of Energy in Great Britain said Bush's remarks demonstrated "a leadership crisis" on the global warming issue at the White House. "About the only thing we can say about it is he turned up" at the conference, said Boyle.

In his speech, Bush said he is determined to "produce policies that work" and suggested some of his critics "may be tempted to exploit legitimate concerns for political positioning."

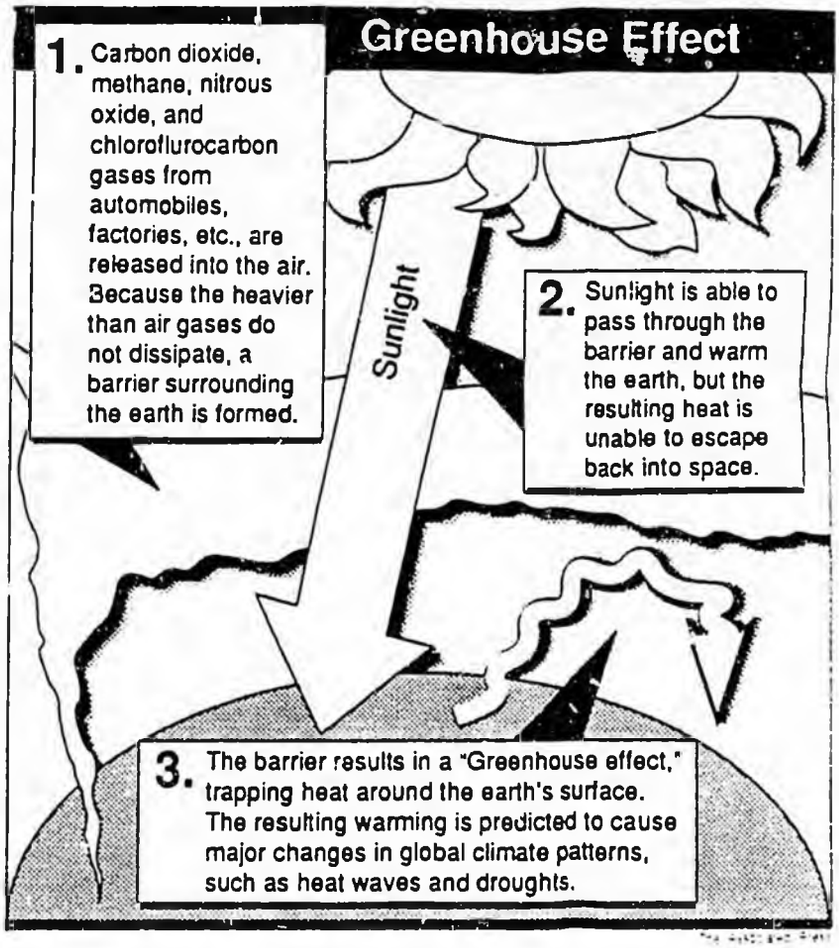
Bush's address became a focus of controversy even before the conference opened when White House Chief of Staff John Sununu was reported to have ordered changes in the text to mute U.S. concerns about global warming. Sununu acknowledged making changes, but said the final version reflected the views of the president.

During a campaign appearance in Michigan on Aug. 31, 1988, then-candidate Bush endorsed unilateral action to deal with greenhouse pollution, declaring: "Those who think we're powerless to do anything about the greenhouse effect are forgetting the White House effect."

He continued in his campaign remarks: "As president I intend to do something about it. In my first year in office I will convene a global conference on the environment at the White House. ... We will talk about global warming and we will act."

No such conference has been held, although Bush on Monday announced he is calling a meeting at the White House this spring to bring together top environmentalists, economists and ecologists to grapple with the global warming issue.

> *"It was a gross disappointment"*
>
> — Sierra Club's Daniel Becker



done in reaching the export decision. He quoted Canadian Minister of Energy, Mines and Resources Jake Epp as recently having said "Canada does not offer limitless quantities of cheap gas."

Pierce also chastised DOE for not having deferred the decision until it completed its national energy strategy, a document not expected until December 1990.

WATKINS, REILLY SAY ENVIRONMENT KEY PART OF NATIONAL ENERGY PLAN

Alternative energy sources, conservation, technologies for cleaner burning of fossil fuels and what the government can do to encourage their use was the focus of pre-Christmas DOE hearing to address the environmental issues surrounding energy development and use. Environmental Protection Agency Administrator William Reilly joined Energy Secretary James Watkins at the Dec. 14 hearing in Atlanta, part of a series of fact-finding sessions held across the country to help develop a national energy strategy.

Both Reilly and Watkins focused on the need for a so-called "fuel neutral" energy policy, and were looking for suggestions on ways the government could promote a balanced opportunity for all sources of energy. They appeared to be looking for ways to allow the market to drive the energy industry while encouraging federal controls on air emissions, particularly carbon dioxide.

Reilly wanted to know why caps on emissions were incentives for some utilities and disincentives for others, while Watkins wanted to know how earlier administrations had gone wrong and actually encouraged utilities to retain older power plants rather than replace them with newer, cleaner technologies. "We have encouraged companies to hang onto old, polluting facilities. The controls we've been using have worked in the opposite direction of what we wanted," Watkins said of regulations that have led utilities to retrofit and repower old power plants rather than accept new technologies that produce fewer toxic byproducts. "We must look at how we can encourage the use of new technologies rather than remediation techniques," he said.

Linda Stuntz, deputy under secretary for policy, planning and analysis at DOE, added, "Give us ideas on what we could do to encourage utilities to get the old powerplants out."

There was no doubt that Reilly and Watkins agreed pollution prevention, not simply pollution control, is a key issue, and that they consider r&d for new technologies for both fossil and renewable fuels a priority along with promoting conservation, recycling and waste reduction.

Both men stressed the need to eliminate waste at the source. Reilly noted that the U.S. generates two to three times as much waste as West Germany or Japan, and said there are opportunities available to reduce waste and they will be an important part of the nation's energy policy.

Reilly outlined what he called a hierarchy of priorities for waste elimination — process changes; safer substitutes for certain substances; recycling waste that cannot be eliminated; and minimizing waste that cannot be eliminated or recycled. Watkins agreed saying, "The waste management area must be a part of the strategy, and will be made a part of the strategy."

J. Michael Davis, DOE's assistant secretary for conservation and renewable energy wanted to know the main obstacles to recycling and waste reduction.

Ben Yamagata, executive director of the Clean Coal Technology Coalition, explained that clean coal technology is a method of pollution prevention, not simply pollution control. Scrubbers, he said, create another pollution problem by producing wet sludge.

Least-cost planning was another area that received much attention. Reilly noted that utilities seem to lack the incentive to use least-cost methods. H. Boyd Pettit, vice chairman of the Southern States Energy Board said for least-cost methods to be a valuable asset, utilities need more than state incentives, they need federal incentives.

Stuntz wanted to know what is actually achievable in the least-cost area and over what period of time, as well as what barriers are present.

Reilly also wanted to know why caps on emissions are not viewed as incentives. Witnesses agreed that the caps as they are now designed, particularly the trading feature, discriminate against states and utilities that have made the strongest effort to reduce emissions, while rewarding those who have done little.

The issue of global warming received some, but not much attention. Watkins said the U.S. needs to make no apologies for its efforts in that area. "We are making investments and we are serious about the issue. The scientific disputes are natural and we must listen to both sides and let the debate evolve," he said. Watkins also said he thought more research is needed on ways to neutralize the effect of carbon dioxide rather than focusing entirely on ways to reduce it.

Watkins said that it disturbs him that when discussing energy options, the debate fails to focus on the real potential of fossil fuels versus alternatives. "We need a perspective," he said. "We need to

know what is actually possible and when it can come on line. We need to lay it all out in a time line."

Although witnesses included representatives of such mainstream energy producers as Texaco, many panel members stressed the pursuit of alternative energy production including biomass and renewable and waste recovery sources.

Southern States' Pettit championed waste-to-energy technology as an alternative energy source, and told Reilly and Watkins that waste-to-energy programs deserve further research. "The federal government must provide leadership for making use of environmental opportunities in energy development."

Nick Fedoruk, executive director of the Energy Conservation Coalition, said biomass technologies could be more competitive in the fuels market with more research. Even Texaco's general manager for corporate planning, Clement Malin, said that company is searching for cleaner alternatives, and currently is incinerating sewage sludge as a co-feedstock with coal to produce an environmentally safer fuel. — *Mary Buckner Powers, Atlanta*

COMMISSION, IN FINAL REPORT, SEES NO COOL-DOWN BENEFITS FROM MRS

Employing a temporary storage facility to cool radioactive wastes prior to permanent disposal would offer few benefits and could actually complicate efforts to isolate wastes safely at DOE's proposed underground repository in Nevada, an independent review commission has concluded.

In its final report to Congress, the three-member Monitored Retrievable Storage (MRS) Review Commission said it "sees no compelling reason to alter its original position . . . by recommending extended spent fuel cooling periods." The panel's charter expired Dec. 31.

The panel was asked in November by the Senate Energy Committee to examine the advantages interim storage would provide by offering a "cooling down" period for spent reactor fuel. Supporters of an MRS, including committee Chairman J. Bennett Johnston, D-La., had argued that the perceived benefit of allowing reactor fuel to cool was a "driving force" behind the concept of interim storage and complained that the commission had failed to address the issue in its Nov. 1 report assessing the need for temporary storage (*IE/FL*, 6 Nov, 1).

The commission, which was created by Congress in late 1987 to study the need for an MRS, released a controversial report that rejected construction of an interim facility tied to the construction and operation of a permanent repository and recommended instead the construction of two smaller storage facilities without similar constraints.

Supporters of a single large MRS, including Johnston, criticized the panel's report and raised the cooling issue to partly justify arguments for interim storage.

The commission's addendum, sent to Johnston Dec. 20, acknowledged that aging of spent fuel prior to emplacement in a repository is "an important part of prudent spent fuel management. It allows time for decay of the shorter-lived fission products in the fuel and reduces the thermal output of the fuel. This could allow emplacement of more spent fuel per acre in a geologic repository, thus reducing the area to be excavated and the resulting repository costs. . . . "

The commission told Johnston, however, that if the start date for the repository were delayed to the year 2013 — only three years beyond the date DOE now expects to open the Yucca Mountain site — the average age of spent fuel would be 30 years with the youngest fuel emplaced being about 20 years old. "This aging of the fuel would occur regardless of whether there was an MRS in the system . . .," the commission said.

Further, the commission's report said extended cooling of spent fuel destined for the underground repository at Yucca Mountain ironically could complicate efforts to isolate the fuel from the surrounding environment.

In a geologic region such as Yucca Mountain, where the waste would be contained in an unsaturated rock formation, there is an advantage to maintaining high temperatures "to maintain a dehydration zone around the waste package. This decreases the possibility of package degradation and migration of the radionuclides in the spent fuel to the accessible environment. Therefore, extended cooling of the spent fuel may, in fact, be disadvantageous for the repository at Yucca Mountain," the commission told Congress.

Though the members advised Johnston that the issue should be re-examined by the year 2000, the commission currently "sees no compelling reason to alter its original position on this issue by recommending extended spent fuel cooling periods, especially since, with the announced delay in repository opening and assuming oldest-fuel-first emplacement, almost all of the spent fuel will automatically be aged at least 20 years." — *Jeff Barber*

PANEL TO PERFORM QUICK ANALYSIS OF PROPOSED CHANGES IN SSC DESIGN

DOE's High Energy Physics Advisory Panel has formed a subpanel to conduct a quick review of the changes to be proposed in the design of the Superconducting Super Collider. The subpanel is charged with completing its review in about one week, in time for consideration by the full HEPAP on Jan. 12.

Energy Secretary James Watkins ordered the HEPAP review after SSC Laboratory Director Roy Schwitters informed him last month the lab would propose doubling the size of SSC's injector facility from the original design level of 1 trillion electron volts (*IE/FL*, 18 Dec, 1). The change is likely to add several hundred million dollars to the current SSC cost estimate of $5.9 billion.

The HEPAP subpanel will examine the physics issues involved in the SSC design changes, but not the cost issues, which are being reviewed internally at DOE. That review is to be completed prior to submission to Congress of the Bush administration's FY-91 budget on Jan. 22.

Francis Low, HEPAP chairman, said the subpanel will be composed of about 15 physicists. As of press time, he had been able to reach only nine to confirm their participation. Those who have accepted include: Sidney Drell, of Stanford University, who will serve as chairman; Victor Weisskopf, MIT; Stephen Weinberg, University of Texas at Austin; Leon Lederman, University of Chicago; T.D. Lee, Columbia University; Chris Quigg, associate director of the SSC Laboratory; Robert Palmer, Brookhaven National Laboratory; Jack Sandweiss, Yale University; and Norman Ramsey, Harvard University.

The SSC Laboratory has proposed changes in SSC's 1986 conceptual design, maintaining that the injector energy level then proposed is insufficient to ensure that the collider's main ring will perform as envisioned. The lab's computer modeling has confirmed that the injector energy ought to be 10% of the main ring's energy level, or about 2 TEV, to ensure the original design's ultimate 20 TEV energy level in the main ring.

Sources said that in addition to the baseline 20 TEV design, the SSC Lab will propose a number of alternatives as a way of keeping the project within the $5.9 billion cost estimate developed in 1986. Those options would result in a reduction of SSC's energy below 20 TEV. — *David Kramer*

CONGRESS SHOULD HAND OUT ALTERNATIVE FUELS TAX CREDITS to all applicable facilities placed into service through Jan. 1, 2001, the National Conference of State Legislatures urged in a resolution adopted last month. The current tax credits are set to expire for facilities put into service after Dec. 31, 1990.

The resolution, adopted at NCSL's annual winter meeting in Washington, stated that the "federal government has granted an alternative fuels credit for coal seam gas that has been an important incentive for producing this premium fuel for almost a decade. This tax credit for coal seam gas and other alternative fuels, such as oil produced from shale and tar sands; gas produced from geopressurized brine; liquid gaseous or solid synthetic fuel (including alcohol) produced from coal; and qualifying processed wood fuels, is due to expire for facilities placed in service after December 31, 1990."

Congress, the resolution said, should address this issue at "the earliest possible opportunity so as to provide some stability and certainty in the efforts to develop alternative fuels."

THE SCHEDULE FOR DOE'S NEXT NATIONAL ENERGY STRATEGY HEARINGS was announced last week. The meetings will be held Jan. 11 in Honolulu, Jan. 22 in Washington and Feb. 2 in New Orleans.

The Honolulu hearing will focus on energy and international competitiveness. The Washington meeting, to be co-chaired by Federal Energy Regulatory Commission Chairman Martin Allday, will examine energy-related regulatory issues. In New Orleans, DOE will discuss energy production and tax policy. The meeting will be co-chaired by John Robson, deputy treasury secretary.

DOE is conducting the series of public hearings to help carry out President Bush's directive to the department to develop a national energy strategy. The first hearings were held in August and September and a second series was held in the first two weeks of December. Department officials plan to issue a draft of the strategy for public comment in April and to deliver the final product to Bush in the fall.

For more information contact Scott Neitzel at (202) 586-4767.

DONALD KANE HAS BEEN NAMED SENIOR PROGRAM MANAGER OF HANFORD activities for Environmental Management Operations, an organization that provides services for cleaning up hazardous waste on federal lands. Kane joins EMO after having served as chief of the Air Force's Environmental Division in Washington, D.C.

In his new post, Kane will direct EMO's waste-site cleanup activities, including risk assessment, environmental auditing, regulatory compliance, and occupational health and safety.

APR 25 [illegible]

UNITED STATES HOUSE OF REPRESENTATIVES

CONGRESSWOMAN CLAUDINE SCHNEIDER

30 ROLFE SQUARE, CRANSTON, RI 02910 401-528-5020 — 1512 LONGWORTH BUILDING, WASHINGTON, D.C. 20515 202-225-2735

SUMMARY OF
THE GLOBAL WARMING PREVENTION ACT HR 1078

The key point about this bill is that it establishes a comprehensive least-cost energy planning process throughout the federal government, including all foreign aid programs supported by the U.S. The bottom line result of this approach is to create a win-win strategy, as much as possible, for reducing global greenhouse gases while reducing energy costs at the same time. Indeed, we could as well have referred to this bill as the "global competitiveness and U.S. productivity enhancement act" because it should help Americans eventually save several hundred billion dollars per year on their energy bills, create high-efficiency energy-consuming devices for export, reduce foreign oil imports and the trade deficit, and reduce a range of other environmental pollutants in addition to greenhouse gases.

Repeated testimony before Congress indicates that energy efficiency has become one of America's largest sources of least-cost energy services. Over the past 15 years investments in improving the efficiency of America's stock of buildings, appliances, vehicles, industrial equipment, and other energy-consuming devices has cut energy consumption by one-third, reduced carbon-dioxide emissions 10% below what they otherwise would have been, and are saving U.S. consumers a phenomenal $160 billion per year. The energy savings have also dramatically reduced foreign oil imports, cutting the trade deficit by more than $40 billion per year.

Success breeds success, and this is undeniably true about remaining opportunities for saving more money and cutting carbon-dioxide, carbon-monoxide, nitrogen oxide, sulphur-dioxide, volatile organic compounds, and methane emissions through additional efficiency improvements.

Detailed studies show that the U.S. economy could maintain robust economic growth while achieving between $160 billion to $200 billion per year in energy savings through continued investment in efficiency technologies that are two to five times cheaper than conventional fossil or nuclear resource options.

However, a variety of market imperfections and institutional barriers currently inhibit the timely capture of these low-cost energy options. In particular, public policymaking has failed to keep pace with these technological innovations and new commercial opportunities, nor have any public policy efforts been made to deal with the threat of global warming. The proposed legislation sets

Efficiency is not a panacea to the global warming problem, but represents the most important first step this and other nations can take in reducing greenhouse gases in a cost-minimizing manner, while at the same time spurring economic productivity.

The energy savings -- cumulatively amounting to trillions of dollars per decade worldwide -- may offer one of the few sources of investment capital for undertaking additional steps to control greenhouse emissions.

Other vital steps that need to be taken, and that are addressed in this legislation, include: rapid development of ecologically sustainable renewable energy resources; prevention of deforestation and promotion of reforestation, afforestation, and agroforestry domestically and internationally; eliminating stratospheric ozone-depleting chlorofluorocarbons (CFCs) and reducing other greenhouse gases (e.g., methane, nitrous oxides); promoting population stabilization in developing countries through increased family planning services; and development of adaptative measures for agriculture and other affected parts of the economy that will be impacted by changing climate patterns and sea level rise as the global warming takes its course.

The bill gives high priority to reinvigorating the nation's renewable energy R&D program, which has been reduced 75% over the past decade. According to DOE's Energy Research Advisory Board (ERAB) the U.S. reserves of renewable energy resources exceeds 80,000 quads -- five to 10 times larger than U.S. coal reserves. ERAB estimates that 80 quads could be economically extracted from this resource base (or 80% of the energy projected to be needed by 2010), if the nation maintains stable-level RD&D funding. This bill takes that advice seriously.

Natural gas can also play an important role as a bridging fuel, since it produces about half as much CO2 as coal. The U.S. currently has the world lead in high-efficiency advanced gas turbines, developed over the past decade for the Air Force for aircraft. They can be modified to produce electricity and steam. The bill promotes the demonstration of this aero-derivative technology, known as Intercooled Steam-Injected Gas Turbines (ISTIGs) and Chemically Recuperated ISTIGs (CRISTIGs). They are 50% more efficient than conventional powerplants, and cost half as much as new coal or nuclear plants. Just using them to replace currently operating gas-fired power plants would save the nation half a million barrels of gas per day and $16 billion in net present value. Moreover, they represent an outstanding export product. An AID study found that they could be used to cost-effectively generate 50,000 megawatts (MW) of electricity in the 70 developing countries that grow sugar, using sugar cane wastes as the renewable fuel source. A more recent study that included paper and pulp and agriculture wastes finds a current global market potential exceeding 250,000 MW.

The U.S. annually mines upwards of one billion tons of coal, and coal produces over half of U.S. electricity. This legislation promotes research to reduce or offset CO2 emissions from coal. In particular, the bill promotes urban and rural tree-planting, which research shows to be one of the least-cost means of offsetting carbon emissions.

The bill builds upon the "Global Relief" program developed by the American Forestry Association, which has identified opportunities for planting over 150 million trees in urban communities. The trees are estimated to save consumers $4 billion per year by reducing the "summer heat island" effect and the need for as much air conditioning.

Key features of the bill include:

National Goals

- 20% reduction of 1988 CO2 emissions levels by 2000
- Intl Global Agreement on the Atmosphere by 1992 setting a global goal of 20% reduction of 1988 CO2 levels by 2000
- Periodic review of need for and the opportunity to achieve further reductions beyond 2000

TITLE I -- National Least-Cost Energy Plan

- Changes the National Energy Policy Plan (NEPP) into the National Least-Cost Energy Policy Plan (NLCEPP) and mandates DOE to prioritize policies in accordance with the least-cost options;

[NOTE: The least-cost language adopts the process Congress mandated in PL 96-501, the Pacific Northwest Electric Power Planning and Conservation Act of 1980]

- The Plan shall also rank cost-effective energy-saving options that reduce energy use per unit of GNP by 2, 3, 4, 5, and 6 percent per year, and estimates of CO2 reductions resulting from each option;
- A 2-year Action Plan to meet the goals of the Least-Cost Plan.

TITLE II -- Energy Efficiency

- 3-year R&D authorization of a minimum of $868 million -- $222 million in FY90, $296 million in FY91, and $350 million in FY92 (compared to $162 million in FY88, and still far below the FY79 level of $427.9);

[NOTE: Studies show that federal energy efficiency R&D has been an unparalleled success story--the investment returns on just seven of the most successful projects are sufficient to provide a 50 fold return on all taxpayer expenditures on efficiency R&D over the past 15 years]

- Establishment of 10 research centers to achieve multiple improvements in energy-intensive industries that reduce energy, capital and labor costs, and waste pollutants -- a minimum of $120 million for 3-year authorization;
- Reduce federal building primary energy use per square foot by 25% by 1995, and 40% by 2000 from 1987 levels -- a minimum of $1.1 billion for 3-year authorization to retrofit buildings;

[NOTE: Retrofit funds are estimated to pay back in 5 years, and will save taxpayers several billion dollars additional over the life of the improvements -- federal buildings currently waste over $3 billion per year by failing to procure energy-efficient equipment]

- Establish Voluntary Uniform Home Energy Rating System, provide technical support to state and local governments adopting the rating system, and direct primary and secondary federal lending institutions to loan for energy-saving improvements as standard operating procedure -- $20 million for 3-year authorization;

- Establish efficiency standards for incandescent and fluorescent lamps, and labels on efficiency of windows and window systems;

- R&D initiative to reduce energy and stratospheric ozone depleting chemicals -- a minimum of $30 million for 3-year authorization;

- Expand DOE's Least-Cost Electric Utility Planning Initiative -- a minimum of $30 million for 3-year authorization, and implement a Least-Cost Gas Utility Planning Initiative -- a minimum of $15 million for 3-year authorization;

[NOTE: Efficiency investments could cut in half the nation's $170 billion per year gas and electricity bill for buildings, but current utility regulations make it unlikely that most of thes savings will be captured -- these least-cost initiatives are designed to overcome these barriers with innovative changes in regulations]

- Requires Dept. of Transportation to review and report on Least-Cost Transportation options, including mass transport options, integration of transportation and land-use planning, and expansion of urban walkways and bikeways;

- Directs Federal Energy Regulatory Commission to pursue rigorous Least-cost utility planning in interstate power sales;

- Includes "Qualifying Efficiency" in PURPA cogeneration and small power production purchases by utilities, as well as in any "competitive bidding" arrangements;

TITLE III -- State Energy Conservation Program

- Provides 3-year authorization of $150 million for state energy conservation programs, and requires states to prepare comprehensive energy plans;

- New Weatherization Research program to increase the energy savings to investment ratio by 50% in the Low-Income Weatherization program;

- Provides 3-year authorization for Low-Income Weatherization Program of $1 billion -- $250 million in FY90, $350 million in FY91, and $400 million in FY92 (compared to $161.4 million in FY89);

TITLE IV -- Vehicle Energy Efficiency Improvements

- o Establishes new national vehicle energy efficiency performance standards based on percentage improvements for each manufacturer's vehicle fleet -- anticipated to increase new light car mileage to 45 mpg and new light trucks to 35 mpg by 1999;

- o Steadily raises federal vehicle fleet average fuel economy, requiring federal fleet to achieve 45 mpg for light cars and 35 mpg for light trucks by 1999;

- o Steadily raises gas-guzzler tax on inefficient light cars and trucks through 1999;

- o Provides tax rebates to consumers for purchase of fuel efficient vehicles -- ranging from $250 if at least 15% more efficient than average model for each size class, to $2000 if more than 75% efficient;

TITLE V -- Solar and Renewable Resources

- o 3-year authorization for R&D program of a minimum of $805 million -- $200 million in FY90, $265 million in FY91, and $340 million in FY92 (compared to $111.6 million in FY89, but still far less than the FY79 level of $856.9 million);

- o Requires DOE to prepare report detailing long-term RD&D program and policy options to achieve a doubling, tripling, and quadrupling of national renewable energy use by 2015;

[NOTE: DOE studies note that renewable resources constitute one of Amer ca's largest energy reserves -- over 80,000 quads per year, over five times America's coal reserves -- and that 80 quads (or 80% of projected energy needs in 2010) could be economically extracted within 25 years by maintaining an adequate and stable funded R&D effort. R&D has been cut 75% over the past 8 years, and this bill gets the needed R&D back on track]

- o 3-year authorization for district cooling demonstration ($3 million), and for research on integrating renewables with fuel cells ($15 million);

- o 3-year authorization to continue efforts of the Committee on Renewable Energy, Commerce, and Trade (CORECT) to promote export of renewable technologies ($6.2 million);

- o Demonstration of biomass-gasified steam-injected gas turbines (Bio-STIGs) -- ($50 million authorization);

[NOTE: advanced gas turbines fueled with biomass wastes and tree crops are an excellent way of generating electricity without adding to global warming]

TITLE VI -- Solar Hydrogen Fuels

- o 5-year authorization of $200 million for R&D on production and use of renewable energy-generated hydrogen fuels -- ($20 million in FY90, $30 million in FY91, $40 million in FY92, $50 million in FY93, and $60 million in FY94);

TITLE VII -- Natural Gas and Coal

- 4-year authorization of $200 million for cost-matching commercial demonstration of advanced gas turbines (ISTIGs, CRISTIGs, etc.), with units not exceeding 110 megawatts each -- ($50 million for each of FY90 to FY93);

[NOTE: the U.S. has the world lead on this technology development, and it could be one of the nation's most competitive exports to developing countries, where it can also be used with renewable resources]

- 3-year authorization of $90 million for demonstration of natural gas for mass transit -- ($30 million for each of FY90 to FY92);

- 3-year authorization for research on preventing, reducing, recycling, or offsetting CO2 emissions from coal combustion;

TITLE VIII -- U.S. Forest and Agriculture Policies

- Requires report assessing the extent to which the nation's lands are being reforested, an evaluation of increasing the rate of reforestation and afforestation, and the impact of such measures on mitigating the global "greenhouse effect";

- Requires National Academy of Sciences' report on linkages between agricultural production and global climate change, an assessment of potential changes that could occur, and recommendation of sustainable management practices to minimize detrimental impacts;

- 5-year authorization of $100 million for the Agriculture Productivity Research Program, designed to help farms fix nitrogen and carbon and reduce dependence on fossil fuel inputs -- ($20 million for each of FY90 to FY94, compared to $3.9 in FY89)

- 3-year authorization of $39 million for development of an Integrated Farming RD&D program designed to promote ecologically sustainable production of cost-effective renewable fuels and other multiple economic outputs ($13 million for each of FY90 to FY92);

- Mandates a comprehensive report on RD&D necessary to establish a National Farm Ethanol Program , and analysis of incentives necessary to stimulate production of ethanol feedstocks.

- Establishes an urban tree planting program designed to reduce the "summer heat island" effect in communities, leading to reduced energy costs and carbon-dioxide emissions -- ($100 million authorization);

TITLE IX -- Development Assistance

- Establishes a Bilateral Tropical Forestry and Agroforestry Program to slow deforestation, and promote reforestation, afforestation, and agroforestry;

[NOTE: Over two billion acres of the world's forests have been

cleared, and are in need of replanting. Each year an additional 35 million acres of forests are being razed -- an area the size of Pennsylvania each year. Reforestation rates are pitifully low -- only one tree replanted for every 20 cut down (39 in Africa)]

- Establishes Multilateral Tropical Forestry and Agroforestry Program to achieve similar goals;

[NOTE: Developing countries are losing 6 million hectares of cropland to desertification each year -- roughly the same level over the next ten years that could grow tree crops sufficient to provide the energy necessary to double agriculture output in these countries]

- Bans import of wood and wood products from countries failing to implement Tropical Forestry and Agroforestry Programs defined above;

- Establishes a Bilateral Least-Cost Energy Program to assist aid-recipient countries to implement national least-cost energy plans;

- Establishes Least-Cost Transportation Policies to guide aid and loans to recipient countries;

- Establishes Multilateral Least-Cost Energy Program that encourages all multi-development lending institutions to implement least-cost energy policies;

- Promotes debt reduction for developing countries implementing environmental conservation measures;

TITLE X -- International Initiatives

- To convene an international meeting in the U.S. to encourage adoption of a binding multilateral global climate protection convention to reducing global carbon dioxide emissions 20% below 1988 levels by 2000, and further reductions beyond 2000 as deemed necessary by periodic review;

- Adopt a binding multilateral agreement requiring reductions of not less than 30% in emissions of oxides of nitrogen over 1987 levels by 1998;

- Adoption of additional control measures requiring the virtual elimination of CFC production identified in the Montreal protocol within five to seven years of enactment of this Act;

- To convene an international meeting in the U.S. to encourage the exchange of information on energy efficiency and solar and renewable energy resources that are ecologically sustainable;

TITLE XI -- World Population Growth

- 5-year authorization for family planning services of $2.73 billion and at least $100 million available for the United Nations Population Fund -- ($500 million in FY90, $540 million in FY91, and $580 million for each of FY92 to FY94, compared to $242 million in FY89 for international family planning services);

- o Initiate an international conference on population to examine policies necessary to achieve sustainable world population levels, and advance the scientific understanding of the interrelationship between population, resources, environment, and economic development.

- o Establish a National Commission on Population, Environment, and Natural Resources, comprised of the Chairman of the President's Council on Environmental Quality, the Director of OTA, and 3 other Presidental appointees.

- o 3-year authorization of $45 million for Conference and Commission -- ($10 million in FY90, $15 million in FY91, and $20 million in FY92).

TITLE XII -- Recyclable Materials

- o Establishes Office of Recycling Research and Information within the Dept. of Commerce to promote recyclable materials programs, and to report on the nation's progress in using recyclable materials;

[NOTE: Studies show that if the U.S. increased its recycling rate 10% above the projected level by 1992 and 30% above the projected level by 2008 the nation could accumulate savings of $30 billion and 7 quads of energy;

- o Study of federal, state, and local government policies and practices in recycling government-generated wastes, and in procuring recyclable materials, and recommend changes in public policy to increase such efforts;

- o Pilot project on municipal waste and sewage sludge composting;

- o Study and scientific research regarding degradable materials and recycling, and identify potential incentives for facilitating development of new markets for recycled nondegradable materials;

- o Ban production or sale of certain designated nonrecyclable consumer goods;

Introduced: 1/10/90
Referred: State Affairs

BY REP. KOPONEN, Ellis, Goll, Greenberg, Brown, Ulmer

IN THE HOUSE

HOUSE CONCURRENT RESOLUTION NO. 41

IN THE LEGISLATURE OF THE STATE OF ALASKA

SIXTEENTH LEGISLATURE - SECOND SESSION

Relating to Earth Day.

BE IT RESOLVED BY THE LEGISLATURE OF THE STATE OF ALASKA:

WHEREAS April 22, 1990, is the 20th anniversary of Earth Day: and

WHEREAS Earth Day 1970 benefited all citizens of the state, the United States, and the world by celebrating the richness and complexity of life, and by calling attention to those systems of nature that sustain a fruitful and happy existence; and

WHEREAS our greater awareness of human need for an abundant and healthy environment has shown the way for long-term economic prosperity and cultural well-being; and

WHEREAS recognizing Earth Day in 1990 will confer similar benefits to the people of the state; and

WHEREAS Alaska is dependent upon and receives great benefit from our clean air and water, our rich ecosystems, abundant natural resources, and great natural beauty; and

WHEREAS this legislature wishes to recognize and encourage private citizen initiatives such as Earth Day;

BE IT RESOLVED by the Alaska State Legislature that April 22, 1990, is declared Earth Day 1990; and be it

FURTHER RESOLVED that private citizens, businesses, government agencies, schools, civic groups, and others are encouraged to observe Earth Day 1990.

COPIES of this resolution shall be sent to the Honorable George Bush, President of the United States; the Honorable Dan Quayle, Vice-President of the United States and President of the U.S. Senate; the Honorable Thomas S.

Foley, Speaker of the U.S. House of Representatives; and to the Honorable Ted Stevens and the Honorable Frank Murkowski, U.S. Senators, and the Honorable Don Young, U.S. Representative, members of the Alaska delegation in Congress.

Earth Day 1990

Earth Day 1990 is coming on Sunday, April 22, 1990!

Millions of Americans are searching for an effective and dramatic way to demonstrate their concern for the environment. Earth Day 1990 will be a time for us to commit "for the record" by taking a pledge to challenge ourselves, family, and communities to honor the environment when we vote, purchase, consume, and invest. Many activities are planned across the world at a grass-roots level. We encourage your consideration in planning activities for this day.

Schools are being asked to involve their students, using an exercise to involve the students and parents in appreciating home and community environmental issues.

Communities and local governments are being asked to examine their role in affecting the environment as are companies and corporations. They are also being asked to adopt the Valdez Principles (named after the EXXON Valdez oil spill incident), a set of ten guidelines for corporate conduct on the environment. A copy of the principles are attached for posting or distribution.

Rural Alaskans have an obvious reason to be concerned about the environment - *we depend upon it for their livelihood.* Yet there remain many opportunities for us to use our resources more wisely as we seek to develop our future.

A bill now before Congress seeks to declare the 1990's as the Decade of the Environment. With the many concerns over how humankind's activities are impacting the planet, this day is a wonderful opportunity to demonstrate our commitment to supporting the Earth and its ability to sustain life.

As Energy and Housing gets more relevant information for you on Earth Day, we will be forwarding it to you. In the meantime, we ask you to think about how each of us can make our environment better.

Further information on this and other Earth Day activities can be obtained from:

Tanana Chiefs Conference, Energy and Housing Services, 122 First Avenue, Fairbanks, 99701 or by phone, 1-800-478-6822 or 907-452-8251

The Valdez Principles

These principles were drawn up to help direct corporate conduct into the 1990's. Subscribers to the Valdez Principles affirm that corporations and shareholders have a direct responsibility for the environment, and must conduct their business as responsible stewards of the Earth and seek profits only in ways that leave the world healthy and safe.

The Valdez Principles are as follows:

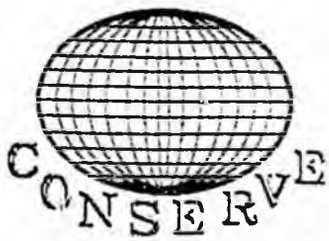
- **Protection of the Biosphere (Earth)** - minimize and eliminate emission of pollutants which cause envirnomental damage.
- **Sustainable Use of Natural Resources** - insure sustainable use of land, water, and frests; conserve non-renewable resources through efficient use; protect biodiversity.
- **Reduction and Disposal of Waste** - recycle whenever possible; employ safe disposal methods.
- **Wise Use of Energy** - employ safe and sustainable energy sources; conserve and maximize energy efficiency of products.
- **Risk Reduction** - minimize environmental, health and safety risks
- **Marketing of Safe Products and Services** - sell products that minize advserse environmental impacts; inform consumers of the impacts of products and services.
- **Damage Compensation** - restore the environment from harm caused; provide compensation to persons adversely affected.
- **Environmental Directors and Managers** - have at least one board member qualified to represent environmental interests; appoint a senior executive to be responsible for environmental affairs.
- **Assessment and Annual Audit** - conduct annual self-evaluation to determine progress in implementing principles; create independent environmental audit procedures.

Investors, consumers, and employees can influence corporate behavior by directing resources and energy to corporations that subscribe to the Valdez Principles. Environmental irresponsibility is bad for the planet. Many corporations know that it is also bad for business. A society that applies the principles can affirm that fact.

Further information on this and other Earth Day activities can be obtained from:

Tanana Chiefs Conference, Energy and Housing Services, 122 First Avenue, Fairbanks, 99701 or by phone, 1-800-478-6822 or 452-8251

Global Warming



This problem is that of the "greenhouse effect" or "global warming". This is a process whereby man is heating up the earth's atmosphere with carbon dioxide and other chemicals through the destruction of vegetation and by the burning of fossil fuels, such as oil, gas and coal. You may have read about it in the newspaper or magazines or seen reports on television about it.

While scientists are not yet in total agreement as to the nature of the problem, we would be quite foolish to fail to act with what we know now. The potential of this situation is that life on earth could be substantially and irrevocably altered in fifty years, if we don't start making major changes now. The Hopi Indians have a word for the present situation: *koyaanisqatsi*. One translation is "nature out of balance".

The scope of this problem is international and will require commitment, cooperation and involvement on a scale never before accomplished.

The solutions involve energy conservation, recycling of waste, more efficient use and better management of resources through the involvement of individuals to that of all countries.

Some of the costs of these solutions can be avoided by the use of more efficient technology, but the rest will eventually pass through to all of us. However, **we must realize that we have been using our resources without paying the full cost for those resources and our earth is paying the price for our lack of foresight.**

Some of the things individuals and local governments can do is to take personal responsibility for becoming more efficient with our use of energy, recycle that which can be recycled (such as aluminum cans), and to educate ourselves, those around us, especially our children. We can also make sure that our government officials are aware of the need for action, despite the complexities, the "politics" or the short term cost of the solutions.

One of the most effective ways of using energy more efficiently is to require less energy do the same task - energy conservation. This is one of the best ways of increasing the standard of living without increasing the cost of living. However, it does not have the appeal that big projects tend to, thus little government effort is expended in this regard.

Funding at most levels of government for energy conservation has steadily gone down in recent years, with the fall in the price of oil. **The citizens of the world need to make sure our leaders act now, despite the perceived political cost.** Energy policies must be developed that address the problem of global warming, without delay!

Two bills in Congress are currently attempting to address the issues of global warming: S. 324 by Sen. Tim Wirth and H.R. 1078 by Rep. Claudine Schneider. **Writing our congressmen and requesting that they become active co-sponsors of S. 324,** the National Energy Policy Act or **H.R. 1078,** the Global Warming Prevention Act **could help mobilize needed political support.**

One area closer to home we can do is to request that school curriculum include five minutes daily on global warming and other critical environmental problems, such as ozone depletion. In a sense, if we fail to solve this problem, our children have more to lose than we do, for they will lose their future.

While increased awareness and some modification of our lifestyles will be necessary, it will be a small sacrifice compared to the cost to future generations if we take no action now.

People in rural Alaska have lived in harmony with their world for hundreds of years. Let us work to bring together the technology of today with the traditional values and practices for the sake of our future on earth. Thank you for taking the time to read this.

This informational bulletin provided to you courtesy of Tanana Chiefs Conference, Energy and Housing Services.