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CHANGING BY DEGREES

STEPS TO REDUCE GREENHOUSE GASES

S U M M A R Y

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CONGRESS OF THE UNITED STATES
OFFICE OF TECHNOLOGY ASSESSMENT

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Contents

	<i>Page</i>
CLIMATE CHANGE AND GREENHOUSE GASES	3
U.S. SECTORAL ANALYSES AND PROJECTIONS OF CO ₂ EMISSIONS	7
Current Emissions	7
Future Emissions Scenarios	8
Costs	9
OPTIONS FOR REDUCING U.S. EMISSIONS	12
Technical Options	12
Policy Instruments	13
Sectoral Policy Options	17
U.S. INFLUENCE ON THE REST OF THE WORLD	31
Developing Countries	32
U.S.S.R. and Eastern Europe	33
U.S. Policy Options To Help Limit Greenhouse Gas Emissions Abroad	33
CONCLUDING REMARKS	41
REFERENCES	42

Boxes

<i>Box</i>	<i>Page</i>
1-A. The OTA Study in Context	4
1-B. The OTA CO ₂ Emissions Reduction Model	10
1-C. Agencies and Organizations That Can Influence Greenhouse Emissions Abroad ..	35

Figures

<i>Figure</i>	<i>Page</i>
1-1. Greenhouse Gas Emissions in 1985, by Region, and the Contribution of Each Greenhouse Gas to Global Warming in the 1980s	5
1-2. Summary of OTA's Analysis of Carbon Emissions With and Without "Moderate" and "Tough" Controls	6
1-3. U.S. Energy Consumption and Associated Carbon Emissions in 1989	7
1-4. 1987 U.S. CO ₂ Emissions by Sector	8
1-5. Carbon Emissions Under the Base Case, Moderate, and Tough Scenarios	9
1-6. Federal Government Funding for Energy Supply R&D, 1980 to 1990	16
1-7. Demand-Side Measures	17
1-8. Electric Utility Supply-Side Measures	25
1-9. Forestry Measures	28
1-10. Per Capita Energy Consumption	33
1-11. World Population Growth, 1750-2100	33

Tables

<i>Table</i>	<i>Page</i>
1-1. Measures To Lower U.S. Carbon Emissions	11
1-2. Policy Instruments To Reduce CO ₂	14

Foreword

The United States has a history as a Nation of working towards a common goal. It has demonstrated this in time of war, in landing a man on the moon, and in reducing energy use during the oil crises of the 1970s. However, in each case, the effort was sustained less than a decade; the desired goals were achieved or the crises passed.

The United States is the world's leading industrial society and largest single emitter of carbon dioxide. Climate change therefore presents a unique challenge to this Nation. It is a threat that will require major prudent political actions even before all the scientific certainties are resolved. The analysis, prevention, and remediation of global warming will require unprecedented international cooperation and action—an effort requiring actions sustained over decades, not just a few years.

Carbon dioxide and chlorofluorocarbon (CFC) emissions are responsible for 80 percent of the “global warming commitment” caused by human activities over the last decade. A landmark international agreement to totally phase out the use of CFCs by the year 2000 is already in effect. Many of the nations involved in that accord are now seeking ways to reduce the carbon dioxide emissions. This task is clearly more daunting since most industrialized nations currently depend so heavily on fossil fuels—the major source of carbon dioxide—for their economic well-being.

For this reason, this assessment focuses principally on ways to cut carbon dioxide emissions both in the United States and in other countries as well, although it does examine all greenhouse gases. The report responds to the concerns of six Committees of Congress who requested in 1988 that OTA undertake this study. The Senate requesting Committees are: Commerce, Science, and Transportation; Energy and Natural Resources; Environment and Public Works; and Governmental Affairs. The House requesters are: Committee on Science, Space, and Technology; and the Committee on Foreign Affairs.

This assessment shows that major reductions of carbon dioxide and other greenhouse gases will require significant new initiatives by the Federal Government, by the private sector, and by individual citizens. Many of these initiatives will pay for themselves; for others, the economic cost may be considerable. And many of these efforts must be sustained over decades.

Although many ancillary environmental benefits will accrue from the actions necessary to effect a major reduction of U.S. carbon dioxide emissions, such a decrease will not, in itself, significantly decrease the greenhouse effect. Other nations will have to take similar actions and, even then, those actions will only slow any warming trend. An Intergovernmental Panel on Climate Change and the U.S. Environmental Protection Agency estimated that at least a 50- to 80-percent worldwide reduction in carbon dioxide emissions is needed to keep the atmosphere at today's already altered level.

That level of reduction requires the world to wean itself from fossil fuels if it hopes to keep emissions from growing steeply under the combined pressure of economic and population growth. Steps taken now to use more efficient energy technologies would reduce emissions while buying time required for the transition to nonfossil fuels.

OTA appreciates the support this effort received from hundreds of contributors both from the United States and abroad. Workshop participants, reviewers, contractors, and informal advisers provided OTA invaluable support as it attempted to sift through the voluminous material on this subject. OTA, however, remains solely responsible for the contents of this report.


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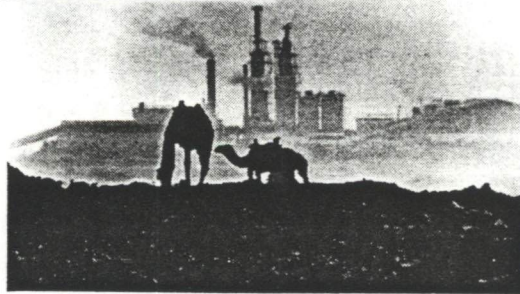
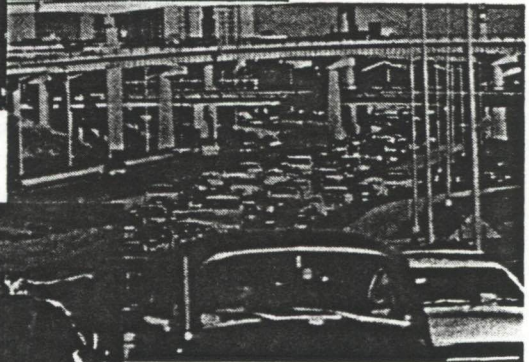
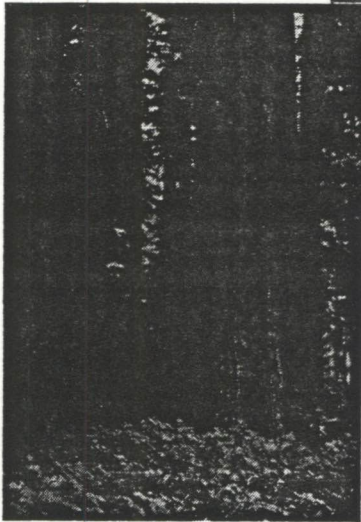
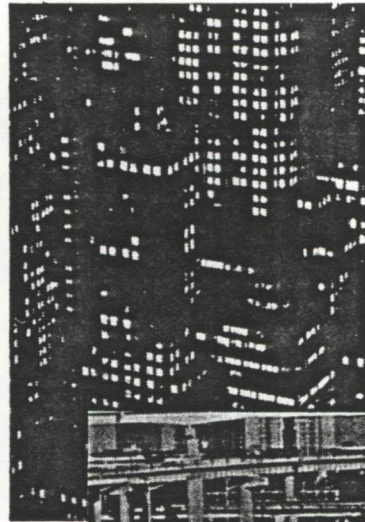
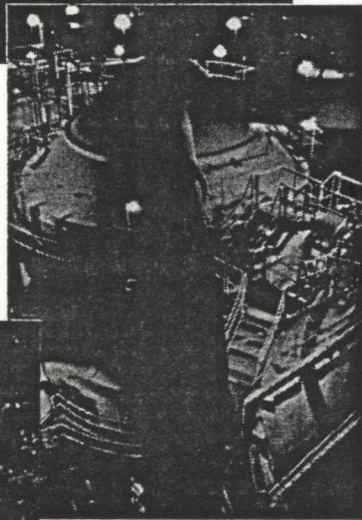
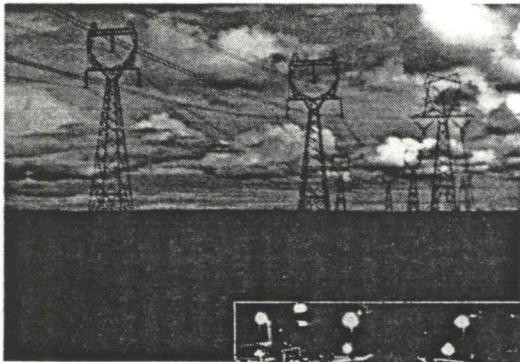
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CLIMATE CHANGE AND GREENHOUSE GASES

The first photographs from space brought home the fact that Earth is an integrated and isolated system. Concern that human impacts could be changing the equilibrium of this system grew in the 1970s as theories about ozone depletion and the "greenhouse effect" developed. The concept of the Earth changing over various time scales was not new: solar and astronomical cycles, the waxing and waning of ice ages, and seasonal changes have long been recognized. What was new was the realization that humans can have a lasting and far-reaching impact on Earth's natural fluctuations and cycles.

Potential human impacts on climate are linked to the globally increasing emission of "greenhouse gases"¹ through activities such as burning fossil fuels (coal, oil, natural gas); deforestation; fertilizing croplands; and heating, air-conditioning, and lighting buildings. Greenhouse gases, like other atmospheric gases, allow sunlight to reach and warm the Earth's surface; unlike other atmospheric gases, however, they trap much of the heat and keep it from escaping back into space. Such gases, therefore, aid in warming the surface of the Earth. Some of them—the chlorofluorocarbons (CFCs) and halons—also react with sunlight in the upper atmosphere to destroy the ozone layer around the Earth. In industrialized countries, greenhouse gas emissions are primarily related to energy use; with only 20 percent of the world's population, these countries account for 75 percent of annual energy use. In developing countries, current greenhouse gas emissions are tied primarily to changes in land use practices (e.g., deforestation).

We cannot yet predict the magnitude of climatic effects from greenhouse gas emissions with accuracy. But it is clear that the decision to limit

emissions cannot await the time when the full impacts are evident. The lag time between emission of the gases and their full impact is on the order of decades to centuries;² so too is the time needed to reverse any effects. Today's emissions thus commit the planet to changes well into the 21st century. And the lag times between identification of policy options, legislation of controls, and actual implementation can also be considerable. For example, the recent reauthorization of the Clean Air Act took 10 years; implementation of the Act will begin now and continue over the next 10 to 20 years.

Among individual countries, the United States is the leading contributor of greenhouse gases. With 5 percent of the world's population, the United States accounts for about 20 percent of the world's warming commitment (ref. 56; see figure 1-1a). U.S. CO₂ emissions (20 percent of the global total) originate almost exclusively from fossil fuel combustion. Anthropogenic sources of methane in the United States account for about 6 percent of global emissions from all sources; among the anthropogenic sources, landfills, coal mining, and domestic animals account for most of the U.S. total (2, 24). The United States also consumes between 20 and 30 percent of the world's CFC-11 and CFC-12, the two most damaging chlorofluorocarbons in terms of global warming. Roughly 60 to 70 percent of these CFCs are used in air-conditioning or in the production of thermal insulation; these gases are scheduled to be phased out by the year 2000 under the revised Montreal Protocol. U.S. nitrous oxide emissions (roughly 15 to 20 percent of the manmade global total; refs. 6, 24) originate primarily from fertilizer breakdown and high-temperature fossil-fuel combustion. Greenhouse gas emissions are closely entwined in the United States with energy use; currently, America uses about 15 times more energy per person than does the typical developing country.

¹The main greenhouse gases are carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O) and chlorofluorocarbons (CFCs). The increase in these gases over natural levels is largely due to actions of humankind; CO₂ levels are rising in the atmosphere at a rate 30 to 100 times faster than observed in the climatic record; CH₄ concentrations are increasing 400 times faster than historically. Most scientists anticipate the global average temperature will increase 2 to 8 °F over the next century if current emission trends continue. Changes in weather, wind and ocean circulation patterns, and sea level are expected, leading to unpredictable changes in agriculture, forests, and human settlements.

²The atmospheric lifetime of CO₂ is 50 to 200 years; N₂O, about 150 years; CFCs and halons, from 60 to 400 years; and CH₄, 10 years. CFC replacements allowed under the Montreal Protocol for the next several decades have lifetimes of less than 40 years.

Box 1-A—The OTA Study in Context

The six congressional committees requesting this assessment asked OTA to focus on a very specific question: "Can the United States reduce carbon dioxide emissions in the near term?"

Changing by Degrees does not examine in depth many equally difficult questions such as the science of climate change, the uncertainties and state of atmospheric modeling, or the projected ecological effects of global warming. Rather, most of OTA's resources have been devoted to analyzing technical options to decrease CO₂, although methane, nitrous oxide, and chlorofluorocarbon (CFC) emissions are addressed wherever possible. At the time of their request, the congressional committees were well aware of ongoing international efforts to phase out CFCs and halons; since OTA's study began, successful negotiations have been completed.

To answer the question Congress posed, OTA focuses specifically on potential emissions reductions in the next 25 years. The analysis is structured around six key sectors of the U.S. economy: Buildings, Transportation, Manufacturing, Energy Supply, Forestry, and Food. To the extent possible, the report quantifies the potential for emissions reduction within each sector—areas where gains in efficiency, product substitution, conservation, or other technical options can ameliorate increases in CO₂ and other greenhouse gases. A selection of policy options that appear to offer the most promise for achieving these reductions in the United States is presented. OTA was charged to look abroad as well, so the special needs of Eastern Europe, the U.S.S.R., and developing countries—with respect to both energy and natural resource issues—are also addressed.

In our detailed analysis of potential emissions reductions for the United States, we consider an extensive suite of technical options. For example, we estimate the potential increments of CO₂ reduction from electric utility fuel switching, possible improvements in automobile efficiency, changes in commercial building construction, more efficient manufacturing processes, etc. Most of the options relate to decreasing emissions, although some, such as reforestation, involve recapturing gases already emitted to the atmosphere.

The assessment lays out three paths: a Base case ("business as usual"), a Moderate (essentially "no-cost") case, and a Tough case. Only the last fulfills the congressional request and reduces future CO₂ emissions—to a level in 2015 that is 20 to 35 percent lower than today. Some will argue that our estimates of emissions reductions are both politically unattainable and costly. Others will decry a 20- to 35-percent reduction as not being nearly enough; the Intergovernmental Panel on Climate Change and the U.S. Environmental Protection Agency recently estimated that the world must reduce CO₂ emissions by at least 50 to 80 percent to stabilize the atmosphere. Congress' request that we work within a 25-year timeframe in the study proved to be a two-edged analytic sword. It forced OTA to take a close look at where U.S. CO₂ emissions were heading without policy intervention. But, 25 years also is too short a period to include a scenario in which fossil fuels are supplanted with such nonfossil fuel sources as renewable and improved nuclear energy sources.

Indeed, the United States described 25 years hence in this report does not sound fundamentally different from what we know today. However, an underlying theme in OTA's report is that a strong R&D effort is pivotal to bringing non-CO₂ (i.e., nonfossil fuel) sources to commercialization as quickly as possible, even as all sectors of the economy move to use more efficient equipment and decrease energy consumption. If long-term R&D is geared to that purpose, then new nonfossil supply technologies can start to replace existing powerplants and equipment early in the next century.

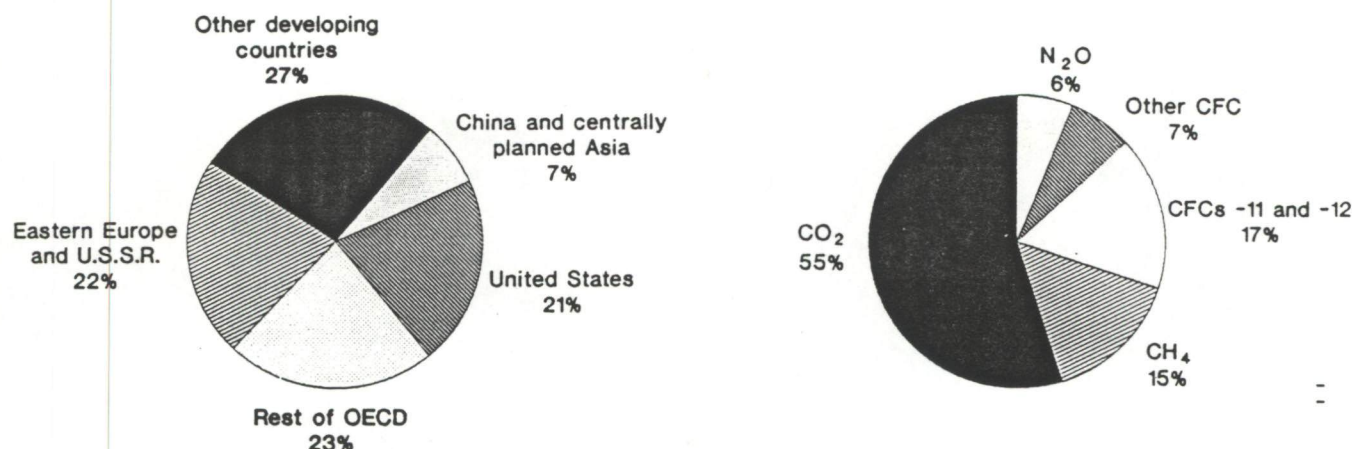
Many of the technical options evaluated here are worth pursuing for other reasons in addition to climate change, because they address other important U.S. goals such as energy security, local environmental quality, and economic competitiveness. They can reduce emissions in the short-term, reduce total energy demand, and serve to bridge the U.S. economy from a fossil-fuel age to a nonfossil future.

The warming commitment or "radiative forcing" caused by the different greenhouse gases is not equal. It depends on the absorbing characteristics, concentration in the atmosphere, and the lifetime of each gas. Although the other gases are more potent on a per molecule basis, currently CO₂ accounts for an estimated 55 percent of the commitment to global warming. This is largely due to the fact that so much CO₂ has been emitted worldwide (6 billion metric

tons of carbon in 1988) as to swamp the higher radiative forcings per unit of the other gases (24). Still, CFCs are responsible for 24 percent of the current commitment to global warming; CH₄ is responsible for 15 percent and N₂O for 6 percent (see figure 1-1b).

Recently, public interest and concern over global changes intensified with the discovery of the annual ozone hole over Antarctica, thinning ozone over the

Figure 1-1—Greenhouse Gas Emissions in 1985, by Region, and the Contribution of Each Greenhouse Gas to Global Warming in the 1980s



NOTE: Figure at left shows the share of greenhouse gas emissions by region, weighted by their contribution to radiative forcing between 1980 and 1990. It includes all greenhouse gases and CO₂ from deforestation and fossil fuel use. Estimates for CO₂ emissions from deforestation range from less than 10 to about 30 percent of total CO₂. If the upper range proves to be correct, developing countries' shares would be larger. Figure at right shows the contribution of each of the manmade greenhouse gases to the change in radiative forcing from 1980 to 1990. The contribution from urban ozone may also be significant, but cannot be quantified at present.

SOURCES: Figure at left: adapted from U.S. Environmental Protection Agency, 1990. Figure at right: Intergovernmental Panel on Climate Change, *Scientific Assessment of Climate Change*, Summary and Report, World Meteorological Organization/U.N. Environment Program (Cambridge, MA: Cambridge University Press, 1990).

Arctic, the severe drought of 1988, and recent abnormal weather patterns in Europe. International concern was demonstrated by the recent rapid renegotiation of the Montreal Protocol to completely phase out CFCs and assist developing countries in achieving that goal. Many industrialized countries, principally in Europe, have further called for a 20-percent reduction in CO₂ emissions from the developed world by 2000 or shortly thereafter; several have pledged to freeze or reduce emissions whether or not the rest of the world participates.

Meanwhile, there is debate here as to whether and when a freeze or a 20-percent reduction in U.S. greenhouse gas emissions could be achieved in the near-term. A 20-percent reduction in U.S. CO₂ emissions would represent a 3-percent decline in current worldwide emissions of CO₂ and less than a 2-percent decline in current worldwide emissions of all greenhouse gases. More importantly, however, even if a 20-percent cut by all developed Nations could be achieved, it would not be enough to stabilize the atmosphere at today's level, let alone to reduce greenhouse gases to pre-industrial levels. To stabilize the atmosphere, the Intergovernmental Panel on Climate Change (24) and the Environmental Protection Agency (EPA) (56) suggest, would require much more—up to an 80-percent global reduction in CO₂ emissions from current

levels as well as significant reductions in the other greenhouse gases. To achieve this under the combined pressures of economic and population growth, nonfossil fuel technologies such as solar or nuclear power would be needed to replace much of today's fossil fuel use.

Energy conservation is the logical first step for the United States if it wishes to reduce its own CO₂ emissions below present levels over the next 25 years. For comparison, if no actions are taken, emissions of CO₂ will likely rise 50 percent during the next quarter century. Under a set of modest policies designed to encourage people to choose technologies that are cost-effective, emissions of CO₂ probably will rise about 15 percent over the next 25 years. This policy package is labeled OTA's "Moderate" scenario.

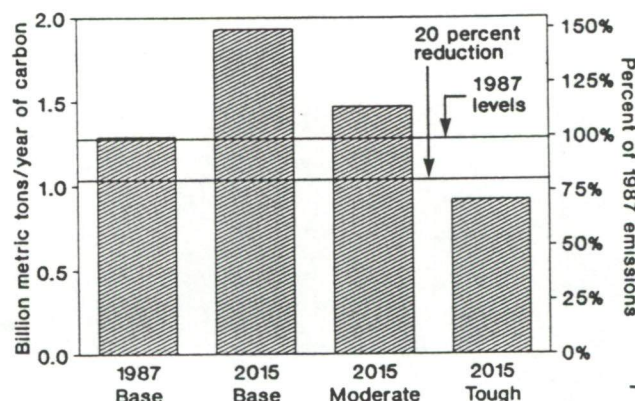
OTA also identified an energy conservation, energy-supply, and forest-management package that can achieve a 20- to 35-percent emissions reduction. This package is labeled OTA's "Tough" scenario. While difficult to achieve, major technological breakthroughs are not needed. Existing equipment would not have to be instantly scrapped and replaced with untested prototypes. The requisite energy-related technologies are either already available or are demonstrated and close to commercialization

today. Most of the forestry-related practices also are proven and already commercialized. OTA's Tough scenario thus does not represent "maximum technical potential." Although it could be argued, for example, that there is a "technical potential" for a massive return to nuclear power by 2015, we assume that this is not feasible for the United States, given lead times and current public concerns. Likewise, we assume that a massive penetration of solar-based electricity generation will not take place by then. Nor will most people be driving 80 mile per gallon (mpg) cars, although prototypes are available today. In each of these cases, though, increased research, development, and demonstration (RD&D) could bring substantial benefits within a half-century.

In the OTA analysis of energy-related activities, only those technical options that would result in CO₂ emissions reductions without loss of comfort or convenience were examined. If implemented, the energy conservation options discussed in our Moderate scenario would likely save consumers money over the lifetime of, for example, an energy-using appliance, given today's energy costs. Greater reductions are quite feasible, as our Tough scenario shows, with technologies that are either technically challenging or more expensive. Even greater reductions are possible if consumers can be persuaded to forego some amenity or comfort;³ however, because many such actions are reversible, they may not continue if energy prices drop and so are not considered here.

U.S. carbon dioxide emissions in 1987 expressed as carbon equivalents⁴ were about 1.3 billion metric tons per year (see figure 1-2). OTA projects that under "business-as-usual" conditions (i.e., our Base case) emissions in 2015 will rise to 1.9 billion metric tons per year. In order to reduce emission levels 20 percent below 1987 levels by 2015 (i.e., to about 1.0 billion metric tons), we must not only attain zero growth over the 1987 level, but must also trim that level by an additional 0.3 billion metric tons. As figure 1-2 shows, a 20-percent emissions reduction is much more than OTA's Moderate scenario but less than its Tough scenario.

Figure 1-2—Summary of OTA's Analysis of Carbon Emissions With and Without "Moderate" and "Tough" Controls



SOURCE: Office of Technology Assessment, 1991.

During the 1970s the extraordinary freeze in energy consumption—while the Gross National Product (GNP) grew 35 percent—was about two-thirds due to increases in energy efficiency and one-third due to structural change⁵ in the economy. Investments in more efficient technologies were facilitated by higher energy prices and the regulatory climate. We already have shown our ability as a Nation to change our energy consumption patterns.

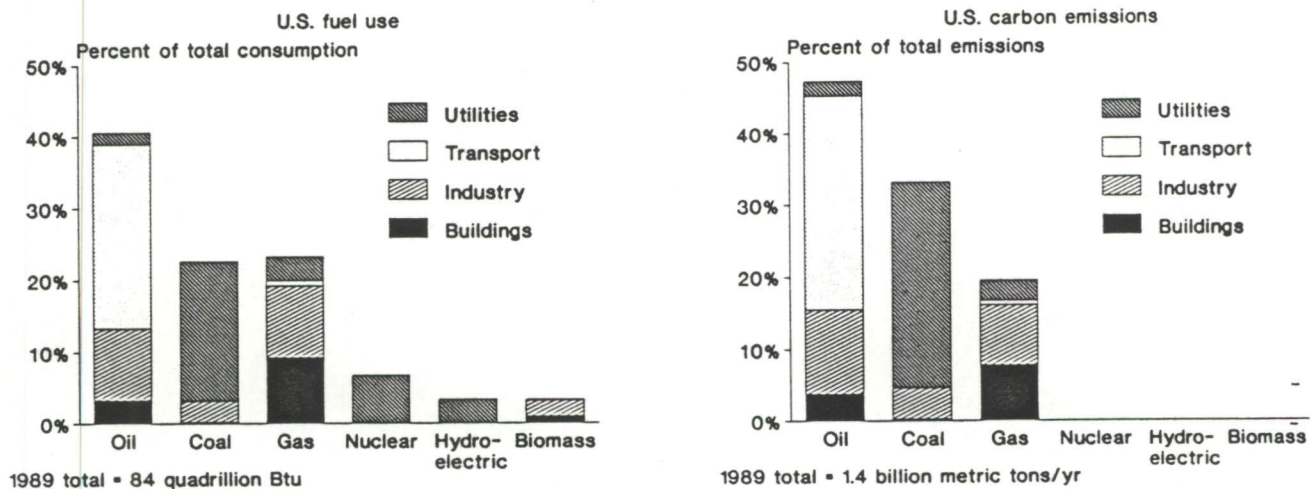
The Nation's track record gives us confidence that such improvements could continue to be achieved, especially if energy prices were to significantly rise again. To achieve lasting reductions in energy consumption, government signals (e.g., pricing and regulatory policies) need to be consistent and reinforcing. Otherwise we are likely to see reversals—as in the 1980s, when energy prices decreased and U.S. fossil fuel consumption started climbing again. For example, higher gasoline prices in the 1970s and early 1980s led to increased purchases of fuel-efficient automobiles. As gasoline prices fell and long-term energy problems were discounted by national leaders, car buyers shifted their attention away from efficiency toward higher luxury and power. Similarly, Federal R&D funding for renewable technology plummeted 90 percent (in constant dollars), from \$1.3 billion in 1980 to \$0.14 billion in

³The U.S. Department of Energy (DOE) found that of an 18-percent reduction in residential energy use between 1972 and 1984, one-third was due to behavioral changes (53).

⁴U.S. CO₂ emissions were 4.7 billion metric tons. For the purposes of this report, all emissions are shown as weight of carbon. To convert to CO₂ equivalent, multiply the weight of carbon by 3.67.

⁵I.e., declines in energy-intensive industry and increases in the service sector. For further details see ref. 47.

Figure 1-3—U.S. Energy Consumption and Associated Carbon Emissions in 1989



NOTE: Emission estimates in the right-hand figure calculated by multiplying fuel use (from left-hand figure) by fossil-fuel carbon emission factors. Coal, 55 to 60 lbs C/mmBtu; oil, 45 lbs C/mmBtu; gas, 32 lbs C/mmBtu. Wood emissions are similar to coal; however in the United States, wood is currently regrown, so we show no net emissions for biomass.

SOURCES: Office of Technology Assessment, 1991, using DOE, 1990.

1990 (see figure 1-6 below). The United States has recently become a net importer of solar thermal and wind systems after dominating the market in the mid-1980s.

A variety of policy interventions will be required to reduce CO₂ emissions 20 to 35 percent below current levels by the year 2015. These could include regulatory "push" and market "pull" mechanisms to provide maximum encouragement and flexibility. They could affect both energy supply and demand and forestry and agricultural practices. Without an increase in and refocusing of current Federal initiatives—including performance standards, incentive programs, energy taxes, and RD&D activities—the use of greenhouse gas reducing technologies is unlikely to increase greatly in the next few decades.

Many of the measures discussed in this study will have ancillary environmental benefits, including abating acid rain, urban smog, ozone depletion in the stratosphere, and groundwater contamination. Decreasing oil use—primarily affecting the transportation sector—will reduce our dependence on foreign oil. Developing and producing renewable energy technologies with worldwide applicability may strengthen U.S. trade markets and our competi-

tiveness abroad. Given that about a dozen industrialized countries⁶ have officially pledged to stabilize or reduce CO₂ emissions by 2005, and that energy demand in rapidly growing, developing countries must increase, burgeoning markets for efficient and lower CO₂-emitting technologies are likely. The United States, as the world's largest producer of greenhouse gases, has an opportunity both to set a good example and be in the forefront of developing new markets for the associated technologies and products.

U.S. SECTORAL ANALYSES AND PROJECTIONS OF CO₂ EMISSIONS

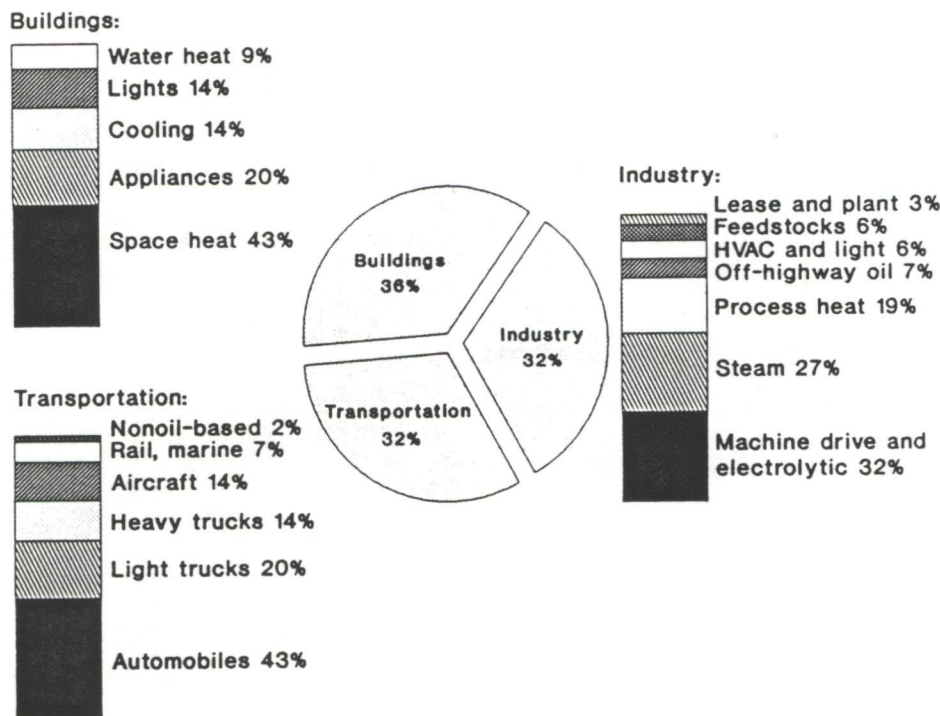
Current Emissions

Total U.S. energy use has risen since 1987, the year OTA's modeling effort begins. In 1989, energy use was about 84 quads (quadrillion British thermal units). As shown in figure 1-3a, in 1989 oil accounted for about 40 percent, coal and gas each provided about 23 percent, nuclear power provided 7 percent, and hydroelectric power and biomass each contributed about 3 to 4 percent of energy use.⁷

⁶As of January 1991, Austria, Australia, Canada, Denmark, France, Germany, Italy, Japan, The Netherlands, New Zealand, Norway, Sweden, United Kingdom. Some of these countries' policies are still subject to change.

⁷Data for 1989 energy consumption are from ref. 54.

Figure 1-4—1987 U.S. CO₂ Emissions by Sector



NOTE: Total carbon emissions from all three sectors equaled about 1.3 billion metric tons in 1987. Emissions have continued to increase since then.

SOURCE: Office of Technology Assessment, 1991.

About two-thirds of the total energy was used directly as fuel in "end uses," for example as gasoline to run our cars and natural gas to heat our homes. Another 35 percent was used to generate electricity; well over half of that electricity was generated from coal.

Carbon dioxide emissions (as carbon) from energy use in the United States in 1989 totaled about 1.4 billion metric tons (this is up from 1.3 billion metric tons in 1987), about 20 percent of the world total. As shown in figure 1-3b, oil accounted for about 48 percent of carbon emissions, coal about 34 percent, and natural gas about 18 percent. One-third of the energy was used to generate electricity. Oil dominates direct uses; coal dominates electricity generation. Coal and wood contain the highest concentrations of carbon per unit energy—commonly about 55 to 60 pounds of carbon per million Btu (lbs C/mmBtu). Natural gas has the lowest concentrations (32 lbs C/mmBtu) and petroleum is intermediate (45 lbs C/mmBtu).

When the emissions from the generation of electricity are allocated to the sector in which the electricity is used, total emissions from energy use are roughly equal in the buildings, transportation, and industrial sectors. Figure 1-4 displays emissions by sector, as well as the major components within each sector. We have detailed estimates of how energy was used in 1987, the reference year for our model. For that year, 36 percent of carbon emissions were from the buildings sector—about 20 percent from activities within our homes and apartments and 16 percent from energy use in commercial buildings.⁸ Another 32 percent of emissions are transportation related and 32 percent come from industry.

Future Emissions Scenarios

For the energy-related sectors, OTA projected future CO₂ emissions under a "business as usual" scenario—our baseline or "Base" case. Two scenarios were then modeled, based on "Moderate" and "Tough" technical measures respectively (see

⁸Of the 36 percent of total CO₂ emissions coming from the buildings sector, one-third is from fossil fuels (i.e., oil and gas) burned directly within residential and commercial buildings; two-thirds come indirectly as a result of the generation of electricity used in buildings.

box 1-B for a description of the model). Moderate measures typically require some initial capital investment but later save money through future fuel savings; in most cases savings more than compensate for initial costs. None of the measures are difficult to achieve technically, though inducing consumers to use them may not be easy.

The "Tough" measures would lower energy demand even further, but in many cases at a higher cost for the same level of convenience and comfort. All of the Tough measures analyzed are technically feasible, but most are not based on the best available prototypes or practices; OTA made judgments about what will be feasible for widespread use. Fully implementing the Tough measures would be challenging—politically, logistically, and perhaps economically.

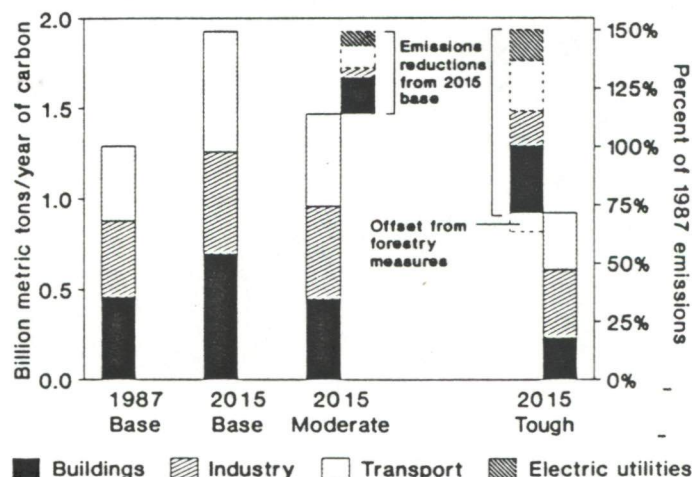
The model only included energy-related sectors. For the forestry sector, OTA independently evaluated Moderate and Tough measures; these were chosen by the same criteria as measures in the model (i.e., difficulty and cost) and estimates of CO₂ uptake over time were calculated. Data were not sufficient to calculate potential emissions reductions from the food sector.

Overall Modeling Results

Based on the OTA energy modeling analysis, under current trends and regulations carbon emissions by 2015 will be close to 50 percent greater than today's level—almost 1.9 billion metric tons per year (see figure 1-5). This Base case projection assumes that some efficiency improvements will occur even in the absence of new legislation. For example, by then we assume new homes will require 15 percent less heating, recently adopted appliance standards will have taken effect, and new cars will average close to 37 mpg.

By adopting all Moderate measures that lower energy demand, CO₂ emissions in 2015 could be held to about a 22-percent increase over 1987 levels. The emissions savings achieved by the Moderate measures are shown for each demand sector (buildings, transportation, industry) as well as for electricity supply in figure 1-5. Changes in the fuel mix used to generate electricity can lower emissions an additional 6 to 7 percent. The Moderate forestry

Figure 1-5—Carbon Emissions Under the Base Case, Moderate, and Tough Scenarios



NOTE: The boxes outlined with dashed lines represent the reductions in carbon emissions associated with control measures applied in each of the three demand-side sectors (i.e., buildings, industry, and transportation) and electricity supply (electric utilities); additional carbon offsets afforded by forestry measures are also shown. The boxes outlined with solid lines represent total emissions from each demand-side sector. For the solid boxes, emissions associated with electricity generation have been allocated to the three demand-side sectors.

SOURCE: Office of Technology Assessment, 1991.

measures provide about a 0.2-percent offset in carbon emissions by 2015. All Moderate measures together hold emissions to 15 percent above 1987 levels.

Finally, OTA's Tough scenario could lower net emissions by 2015 (excluding offsets from forestry measures) to 29 percent below 1987 levels—i.e., to about 0.9 billion metric tons per year. This is about half of our Base case forecast for 2015. Tough forestry measures could reduce emissions another 7 percent. The detailed emissions reductions estimated for the Tough scenario analysis are shown in table 1-1, by individual measures within sectors.

Costs

While we think the Moderate scenario is achievable at a net savings,⁹ nonetheless substantial shifts in the economy would have to occur. For example, energy expenditures would be 15 percent lower than they would be otherwise, but the cost of appliances, cars, and houses would be higher.

⁹We believe that overall savings are possible because, on balance, fuel savings (assuming projected 2015 prices) will exceed annual capital and operating costs.

Box 1-B—The OTA CO₂ Emissions Reduction Model

OTA developed a simple energy accounting model to estimate the effectiveness of various technical options for lowering CO₂ emissions. The model is based on a larger system of energy and economic models used by the Gas Research Institute (GRI) to forecast energy use through 2010 (23)¹. Of all the integrated energy/economic forecasting models available, the GRI approach includes the greatest detail on the demand side for specific technologies. (Other models may contain, for example, estimates of total residential electricity demand, but do not include breakdowns of heating, cooling, refrigerators, freezers, clothes dryers, etc.) With such information, changes in CO₂ emissions can be simulated in detail based on changes in technology.

GRI provided OTA with detailed output from its model simulations of energy use through 2010. We, in turn, built a very much simplified set of models by "modeling" GRI's detailed output. For example, to estimate the energy demand for heating homes, GRI's residential sector model starts with the number of existing furnaces, heat pumps, and electric heaters. It then forecasts the number that must be replaced through time (with more efficient technology) based on typical equipment lifetimes. The number of new homes (which, of course, must also be heated) is forecast based on economic conditions. Whether consumers buy gas, oil, or electric heaters is forecast in part based on economics and in part on historical buying habits.

OTA took the GRI forecasts of energy use by each technology category (e.g., gas furnaces) and built a series of simple models that simulate the number and energy efficiency of each technology type through time, based *only* on the GRI detailed output data, rather than the economic decisions that influence the forecast. Note that for two categories—highway vehicles and electric utilities—we felt that the GRI model did not have adequate detail for our needs. For highway vehicles, we used Oak Ridge National Laboratory's "Alternative Motor Fuel Use Model" (but used GRI's oil price assumptions for consistency). For electric utilities, we built our own model using detailed data from the U.S. Department of Energy's Energy Information Administration.

We total all the energy use and CO₂ emissions from each technology and sector. This forms the basis for our Base case forecast that emissions will be approximately 50 percent above today's level by 2015. In the Base case (business as usual), OTA implicitly assumes GRI's economic forecast of GNP growth averaging 2.3 percent per year and energy price increases averaging 1.7 percent per year for coal, 3.7 percent per year for oil, and 4.8 percent per year for natural gas over the next two decades. This represents a reasonable future picture barring major changes in energy supply, economic, or regulatory conditions.

Then we estimate the effect of changes in technology (e.g., more efficient gas furnaces than included in the GRI forecast) or policy (e.g., forcing coal-fired plants to retire after 40 years of operation) in two alternative scenarios: "Moderate" and "Tough." Our model, for the most part, assumes the same level of "services" as the GRI base case. In the alternative scenarios, CO₂ emissions are reduced, for example, by using more efficient furnaces, switching fuel, or insulating houses, but *not* by assuming people keep their homes at lower temperatures in the winter or warmer in the summer like they currently do. In a few cases, most notably the transportation options, all "services" are not identical. For example, one of the measures that we include is to reinstate a 55 mph speed limit. Under our most aggressive scenario, we assume that cars will be somewhat smaller than they are today (for either economic or regulatory reasons). Both of these include some loss of convenience to consumers.

¹The GRI modeling system has as its core the U.S. Energy Model, developed by Data Resources, Inc. (DRI). The model includes four submodels: the industrial sector, residential sector, commercial sector, and electric utilities. Economic projections, which drive the Energy Model, come from the DRI Macroeconomic Model of the U.S. economy. Additional inputs are generated from the Industrial Sector Technology Use Model, developed by Energy and Environmental Analysis, Inc.; the GRI Hydrocarbon Supply Model; and the RDI Coal Model, developed by Resource Data International.

Many of the Tough scenario measures entail costs in excess of projected fuel savings; others are cost effective over their lifetime but are difficult to implement. A rough estimate of the cost range for the Tough scenario is a savings of \$20 billion to a cost of about \$150 billion per year (in 1987 dollars)

by 2015, after subtracting fuel savings (assuming forecasted 2015 fuel prices).¹⁰ This range is equal to savings of a few tenths of a percent to a cost up to 1.8 percent of the Gross National Product (GNP) projected for 2015. For comparison, all environmental compliance costs today are about 1.5 percent of

¹⁰For example, we assume that oil prices by 2015 will be about \$50 per barrel.

Table 1-1—Measures To Lower U.S. Carbon Emissions
(expressed as percentage of 1987 total emissions)^a

	Reductions in 2015			Reductions in 2015	
	Moderate (in percent)	Tough (in percent)		Moderate (in percent)	Tough (in percent)
DEMAND-SIDE MEASURES					
Residential buildings					
New investments:			Industry		
Shell efficiency	1.3	2.0	New investments:		
Heating and cooling equipment ...	0.1	0.4 to 0.6	Efficient motors	1.2	3.7 to 4.0
Water heaters and appliances	1.2	1.5 to 2.3	Lighting	0.5	0.7 to 0.8
O&M, retrofits:			Process change, top 4 industries	3.0	8.2
Shell efficiency	0.8	0.9	Fuel switch to gas	0.0	2.4 to 2.7
Lights	0.6	0.8	Cogeneration	0.8	5.2 to 5.8
All residential measures together ...	4	5.6 to 6.6	O&M, retrofits:		
Commercial buildings					
New investments:			Housekeeping	1.9	2.0
Shell efficiency	2.3	4.0	Lighting	0.1	0.2
Heating and cooling equipment ...	1.0	1.2 to 1.9	All industrial measures together	8	17 to 18 ^b
Lights	2.1	3.0	ELECTRIC UTILITY SUPPLY-SIDE MEASURES		
Office equipment	1.6	2.1	Existing plant measures:		
Water heaters and appliances	0.1	0.1	Improved nuclear utilization	4.1	4.1
Cogeneration	0.2	1.5 to 2.3	Fossil efficiency improvements	1.7	1.7
O&M, retrofits:			Upgraded hydroelectric plants	0.5	0.5
Shell efficiency	0.8	0.8	Natural gas co-firing	—	3.7
Lights	0.5	0.5	New plant measures:		
All commercial measures together ...	8.5	13 to 15	No new coal; higher fraction of new nonfossil sources	—	0.0 to 4.7
Transportation					
New investments:			CO ₂ emission rate standards	0.4	0.0 to 0.1
New auto efficiency	0.8	3.5 to 3.8	All utility supply-side measures together	6.6	9.9 to 14
New light truck efficiency	0.5	2.5 to 2.7	FORESTRY MEASURES		
New heavy truck efficiency	0.4	2.4 to 2.4	Afforestation:		
Non-highway efficiency	0.5	1.2	Conservation Reserve Program ...	0.2	0.2
O&M, retrofits:			Urban trees	—	0.7
Improved public transit	0.2	3.5	Additional tree planting	—	2.3
Truck inspection & maintenance ..	0.3	0.4	Increased timber productivity	—	3.1
Traffic flow improvements/ 55 mph speed limit	1.2	1.4	Increased use of biomass fuels	—	1.2
Ridesharing/parking controls	0.4	1.0	All forestry measures together	0.2	7.5
All transportation measures together	4	14 to 15			

^a 1 percent of 1987 emissions = 13 million metric tons C = 0.7 percent of 2015 emissions.

SOURCE: Office of Technology Assessment, 1991.

GNP; direct fossil fuel and electricity consumption purchases account for about 9 percent of GNP.

Other groups have tried to estimate the costs of CO₂ reductions, but with different control scenarios, often a carbon tax. For example, using several short-term econometric models (i.e., analyses that extend only to the year 2000), the Congressional Budget Office (CBO) estimated that a \$100 per ton carbon tax phased in by the year 2000 would hold CO₂ emissions at just about current levels or reduce them to 25 percent below current levels by 2000 (45). By the end of the first decade, GNP would be lowered by about 0.5 to 2.0 percent (about \$40 to \$130 billion per year in 1987 dollars). However,

GNP effects over the first few years of a suddenly instituted policy could be 5 percent or more.

CBO also looked at two longer term econometric models that forecast energy use past 2000, one constructed by the Environmental Protection Agency (EPA) and the other by the Electric Power Research Institute (EPRI). These models' projections for Base case energy use in 2015 are reasonably close to each other and to OTA's Base case and thus offer useful comparisons of reductions and costs. The model used by EPA forecasts that holding emissions to 10 to 15 percent below current levels would lower GNP by about 1 to 1.3 percent by the year 2015. The EPRI model forecasts that holding emissions to 20 percent

below current levels would lower GNP about 3 percent by that year.

The costs associated with any scenario depend on many factors—including the price of fuel projected under Base case conditions. For example, we are assuming the price of crude oil will be \$42 per barrel (in 1987 dollars) by the year 2010 (23) and about \$50 per barrel by 2015.¹¹ Net costs for an emissions reduction scenario would be higher if 2015 fuel prices are lower than projected; for example, if oil prices are \$5 per barrel lower in 2015 than we forecast (and other energy prices remain the same as forecast), costs will be about \$15 billion higher. Similarly, net costs would be lower if energy prices rise more than projected. No quantitative estimates have been made of the ancillary air, water, soil, health, economic, and energy security benefits that result from reducing energy use and associated pollutants.

OPTIONS FOR REDUCING U.S. EMISSIONS

The major options available or likely to be available for reducing CO₂ emissions in the near-term fall into three categories:

1. increasing energy conversion and efficiency in end-use technologies,
2. changing use patterns to conserve energy, and
3. shifting energy supply away from high CO₂-emitting fuels.

Additional options to offset CO₂ emissions are primarily forestry-related or agricultural. If Congress chooses to pursue any of these options, it obviously will also seek to assure continuous economic progress.

When choosing policy options Congress must consider two interdependent components: the universe of possible technical (or in some cases, behavioral) changes and the policy instruments (e.g., taxes, regulations, financial incentives) available to require or encourage the technical change. One policy option, for example, would be to reduce CO₂ emissions through regulations (i.e., a policy instrument) to require more fuel-efficient autos (i.e., a technical option). An alternative or perhaps complementary policy option would be to use a high

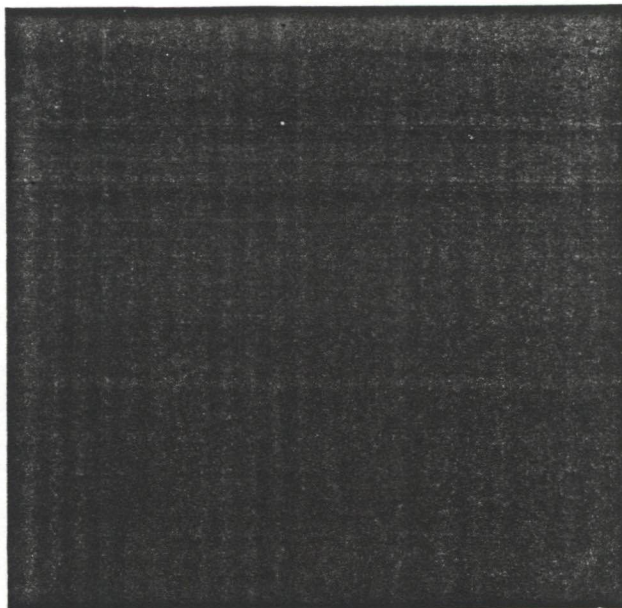


Photo credit: Chip Moore

Solar panels supply all of the hot water and up to 70 percent of the space heating needed for the 80,000-square-foot building in which OTA is housed.

“gas guzzler” tax (i.e., policy instrument) to stimulate purchase of fuel-efficient autos.

Technical Options

This report identifies a range of CO₂-reducing technical options available or likely to be available to the Nation over the next 25 years, and what their contribution might be. There are a large number of technical options to pick from and many targets of opportunity within each sector, as figure 1-4 shows. Significant progress in reducing U.S. CO₂ emissions will require that most of these options be pursued simultaneously.

Presently available energy “supply” options for achieving major CO₂ reductions over the 25-year timeframe of this assessment include: replacing high carbon-emitting fuels (e.g., coal) with lower carbon-emitting fuels (e.g., natural gas); using high-efficiency, electricity-generating technologies (e.g., high-efficiency gas turbines or cogeneration); and using nonfossil fuels.

While nonfossil energy offers the greatest long-term potential for achieving deep cuts in CO₂ emissions, we cannot count on large-scale use of

¹¹For comparison, DOE's Energy Information Administration estimated the price of oil to be \$28 to \$46 per barrel by 2010; the American Gas Association projected \$48 per barrel in 2015.

nonfossil energy sources to replace fossil fuels within 25 years. These sources do not yet offer the performance, costs, or social acceptance needed to fully displace fossil fuels in such a relatively short period of time (42). Only three nonfossil sources are presently being used on a significant scale in the United States: hydroelectric power, biomass, and nuclear light-water reactors (LWRs). Because of a combination of low baseload demand growth, cost, and environmental and social problems, no orders for new LWRs have been initiated in over a decade and there are no plans underway to build new reactors in the United States. Environmental factors set an upper limit on the number of potential new dam sites for hydroelectric facilities and on biomass production.

On the energy "end use" side, the technical options available today are primarily more efficient technologies or changes in energy use patterns. The first requires time and investment, whether for old equipment to be replaced or new equipment to be purchased. Changing energy use can include immediate (but reversible) changes such as fewer miles driven, lights dimmed, etc. In addition to the currently available technical options there is a large menu of additional options that could be developed over time. A diverse suite of energy R&D is ongoing, but what it will make available in the next quarter century depends greatly on Federal funding for demonstration.

Several technical options are available in the forestry sector to provide some offsets of CO₂ emissions. Increasing forest productivity and planting new trees can result in increased carbon storage that offsets fossil-fuel related emissions. Planting short-rotation tree crops for use as biomass fuels can partially replace the use of fossil fuels in some situations. These and other forestry options have attendant uncertainties and difficulties. For example, attempts to increase productivity focus on the timber component of forests (i.e., the commercially valuable portion). However, it is unclear whether increases in timber productivity actually indicate whether or not productivity in the entire forest has increased.

Policy Instruments

Policy instruments are the means government uses to require or encourage a desired technical or behavioral response. Many potential targets exist

within each sector to achieve CO₂ emissions reductions (see figure 1-4). Whatever the CO₂ reduction goal, Congress will have to use a variety of policy instruments to stimulate a diverse set of decisionmakers to use the appropriate fuels, technologies, and forestry and agricultural practices and to adopt energy use patterns that conserve energy.

Identifying the relevant decisionmakers will be critical to selection of appropriate policy instruments. Within the energy system, for example, appliance and lighting use patterns represent the collective decisions of nearly all Americans. In contrast, utility fuel choices are made within a relatively small community of decisionmakers (e.g., utility executives, State regulators, and segments of the financial community).

Certain generalizations nonetheless can provide guidance:

- Decisionmakers generally prefer lower cost options and many individuals prefer low first-cost options over low life-cycle cost options.
- Highly efficient "cutting edge" technologies often have relatively lower life-cycle costs but higher front-end costs.
- Historically, fragmented decisionmaking reinforces the preference for low first costs, especially in the buildings sector—decisions relevant to efficiency are made by developers and builders, not by the occupants who will be paying the energy bills.

A wide range of possible policy instruments could be used to influence decisionmakers. Table 1-2 groups them into six generic categories:

1. taxes;
2. financial incentives;
3. marketable permits;
4. regulations;
5. research, development, and demonstration (RD&D); and
6. information and public education.

Just as there is no single technical option that is a cure-all, many policy instruments will be needed. The synergisms possible among taxation, regulation, incentives, information, and RD&D programs are key to significantly reducing emissions. Taxes, if properly set, can be used to adjust prices to tilt purchase decisions. Regulation (codes and standards) can be used to remove the least efficient equipment, appliances, and buildings from the

Table 1-2—Policy Instruments To Reduce CO₂

	Taxes		Financial Incentives			Marketable permits		Regulations		RD & D		Information	
	Energy tax	Carbon tax	Purchase tax	Tax incentive	Low cost loans	Direct payments		Performance standards	Building codes	R&D	Demonstration	Labels/rating	Audits
Commercial buildings													
Thermal integrity	✓	✓	—	✓	✓	✓	—	—	✓	✓	✓	✓	✓
Appliance/lighting	✓	✓	✓	✓	—	—	—	✓	—	—	—	✓	✓
Usage patterns	✓	✓	—	—	—	—	—	—	—	—	—	—	—
Residential buildings													
Thermal integrity	✓	✓	—	✓	✓	✓	—	—	✓	✓	✓	✓	✓
Appliance/lighting	✓	✓	—	—	—	—	—	—	—	—	—	—	—
Usage patterns	✓	✓	—	—	—	—	—	—	—	—	—	—	—
Transportation													
Small car/truck efficiency ..	✓	✓	✓	✓	✓	✓	—	✓	—	✓	✓	✓	—
Alternate fuels	—	✓	—	✓	✓	✓	—	—	—	—	—	—	—
Off highway ^a	✓	✓	—	—	—	—	—	—	—	—	—	—	—
Vehicle miles traveled	✓	✓	—	—	—	—	—	—	—	—	—	—	—
Manufacturing													
Efficiency	✓	✓	—	✓	—	✓	—	—	—	✓	—	—	✓
Recycling	✓	✓	—	—	—	—	—	—	—	—	—	—	—
Energy supply													
High to low carbon fuels ..	—	✓	—	—	—	—	—	—	—	✓	—	—	—
Renewable	✓	✓	—	✓	—	—	—	—	—	—	—	—	—
Cogeneration	✓	✓	—	✓	—	—	—	—	—	—	—	—	—
Efficiency, existing plants ..	✓	✓	—	—	—	—	—	—	—	—	—	—	—
Forests													
Recycling	—	—	—	✓	—	✓	—	✓	—	—	—	✓	—
Increased productivity	—	✓	—	✓	—	✓	—	—	—	—	—	—	—
Afforestation	—	✓	—	✓	—	✓	—	—	—	—	—	—	—
Biomass	✓	✓	—	✓	—	—	—	—	—	—	—	—	—
Food													
Farm inputs	—	✓	—	—	—	✓	—	✓	—	—	✓	✓	—
Farm operation & efficiency	—	✓	—	✓	—	✓	—	✓	—	—	—	—	—
Food processing	—	✓	—	—	—	—	—	—	—	—	—	—	—

^aHeavy equipment, aircraft.

SOURCE: Office of Technology Assessment, 1991.

market. Incentive and information programs can be used to clarify cost information and help create a market for improved energy performance. Education programs also provide consumers with the knowledge and information needed to make wiser energy choices. Government-sponsored RD&D can help provide producers and consumers with new technical options that can be used to reach national goals, as well as reduce, by cost-sharing, the risk to industry of developing these new options.

Taxes

Taxes offer a way to make high CO₂-emitting technical options more expensive than lower CO₂-emitting options. If Congress so desires, new tax monies could help fund incentive programs, offset the budget deficit, or replace other existing taxes.

Three possibilities include: 1) a general energy tax, 2) a carbon tax, and 3) initial purchase taxes. A general energy tax is levied on the energy (i.e., Btu) content of fuels. A carbon tax is set to reflect the fact that some fuels emit more carbon per unit of energy than do others. Both of these are thus "fuel" taxes. An initial purchase tax is levied on energy-consuming technologies, rather than fuels; the tax would be based on estimates of lifetime energy use or carbon emissions.

The first—a general energy tax—would stimulate greater energy efficiency, regardless of whether energy is derived from fossil or nonfossil fuels. By making all energy more expensive, it would apply pressure to reduce total energy use. On the other hand, a carbon tax would not only stimulate energy efficiency, but also shift the energy system from high carbon-emitting fossil fuels to nonfossil fuels or lower carbon-emitting fuels (e.g., natural gas).

Initial purchase taxes could have effects broadly similar to either an energy or carbon tax, depending on whether they were based on lifetime energy use or carbon emissions. Because consumers are often more concerned with the initial cost of a technology than with "life-cycle" costs (i.e., including fuel costs), purchase taxes can be more effective than either type of fuel tax in many situations. An example of an initial purchase tax is the current "gas guzzler" tax on autos, which was increased in the 1990 Omnibus Budget Reconciliation Act (Public Law 101-508). In a similar fashion, a tax on less efficient appliances or houses could serve to reduce

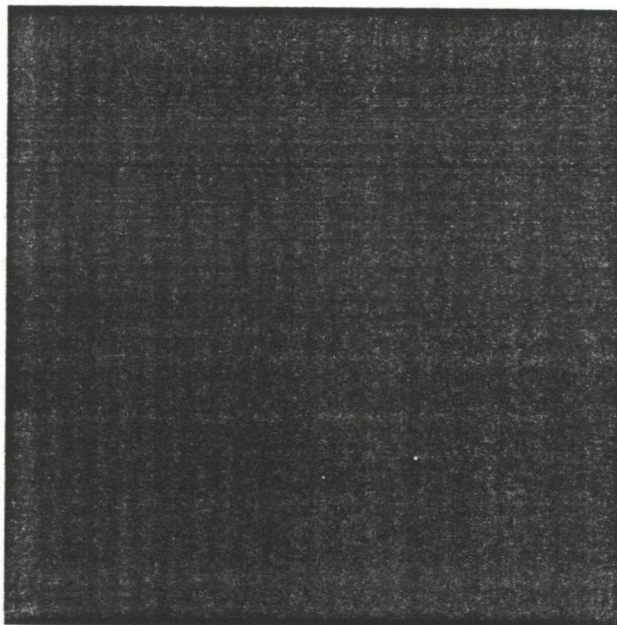


Photo credit: Chevron

The Trans-Alaska pipeline has been in operation since 1977. North Slope oil production is currently declining, and a little less than 2 million barrels of crude oil per day now flow through the 800-mile pipeline. The United States currently uses 17 million barrels of oil each day.

consumer preferences for lower initial costs rather than life-cycle costs.

Energy and carbon taxes have the advantage of affecting all emitters simultaneously, rather than focusing on a few selected technologies. A carbon tax is a particularly effective way of targeting the heaviest economic sanctions against the worst emitters of CO₂. A carbon tax would stimulate greater demand for natural gas relative to other fossil fuels. This, in turn, could drive natural gas prospecting and resource recovery technology development. Over the longer term, it could also motivate development of noncarbon energy sources whereas a straight energy tax would probably not.

Financial Incentives

Through financial incentives (e.g., tax incentives, low cost loans, and direct payment subsidies), the government pays part of the costs of utilizing desirable fuels, technologies, or practices. Tax incentives can be powerful instruments for stimulating desired actions by corporations and individual taxpayers looking for ways to reduce tax liabilities; however, tax incentives have little effect on those who pay low or no taxes.

Low-cost loans either defray some portion of loan interest or eliminate lender risk by insuring against loss. Low-cost loans can be effective policy instruments to stimulate utilization of CO₂-reducing technical options by both individuals and corporations. Direct payments for utilization of CO₂-reducing options (e.g., cash bonus for scrapping an old, fuel-inefficient car) are especially effective in stimulating the use of desired options by low-income or financially strapped decisionmakers.

Marketable Permits

Marketable permits and carbon taxes are closely related. Under a marketable permit system, policymakers fix the amount of carbon that can be emitted. The government then issues the allowed number of permits to emit a given amount of carbon. Permits can be bought and sold by energy users just like fuels. For example, for every 1 million Btu's of coal purchased, the user must also own (or purchase) permits to emit 57 pounds of carbon. To burn 1 million Btu's of natural gas, the user must own or purchase permits to emit 32 pounds of carbon. If demand for energy rises, the price of a carbon permit will rise to reflect the cost of lowering emissions. Some holders of permits will find ways to lower emissions (e.g., purchase more efficient equipment, switch from coal to natural gas) so that they can sell their permits (at a profit) to others. Theoretically, the effective price of fossil fuels will rise just high enough to meet the allowed carbon emission target. Just how high prices will rise, however, is difficult to forecast.

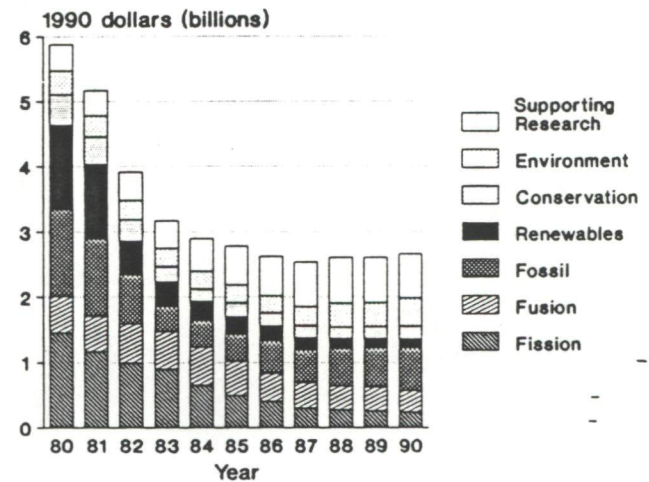
Marketable emission permits is the current U.S. method for enforcing the Montreal Protocol and controlling CFC emissions. A marketable permit system also is the regulatory mechanism for limiting emissions of sulfur dioxide to control acid rain under the new Clean Air Act Amendments (Public Law 101-549).

Marketable permits could be required for all fossil fuel users or only for large users such as electric utilities, factories, and even large commercial installations. Permits could be required for wholesalers who sell gasoline, rather than for individual drivers.

Regulations

Regulations are policy instruments that can eliminate inefficient and/or high CO₂-emitting activities from the market. They can take the form, for example, of performance standards and building

Figure 1-6—Federal Government Funding for Energy Supply R&D, 1980 to 1990



NOTE: The bars represent Federal budget authority for research, development, and technology demonstrations, in 1990 dollars. "Supporting" refers to research in basic energy sciences.

SOURCES: J.P. Holdren, "Energy in Transition," *Scientific American* 263(3):156-163, September 1990, original data compiled from the Office of Management and Budget, *Budget of the United States Government, Fiscal Years 1980 Through 1991* (Washington, DC: U.S. Government Printing Office, 1980 through 1990); Intersociety Working Group/American Association for the Advancement of Science, *Research and Development FY 1980-1991* (Washington, DC: 1980 through 1990); and *Environmental and Energy Study Conference, Weekly Bulletin(s) and Special Report(s)* (Washington, DC: several years).

codes. Performance standards can be established for many diverse types of technologies (e.g., lighting standards) and applied nationwide; they are currently used for automobile efficiency and appliance efficiency. Building codes traditionally have been the province of local governments and their effective use depends on enforcement at that level.

Research, Development, and Demonstration (RD&D)

Through RD&D, government can search for and fine-tune technological fixes to the greenhouse gas emissions problem. In fact, climate change can only be effectively addressed over the long-term with the development and worldwide use of better nonfossil energy sources. Government can speed the process of testing and commercializing many energy-supply and end-use technologies. However, only about 5 percent of the \$2.7 billion national budget for energy technology R&D in 1990 was devoted to renewables (including biomass energy) and only 7 percent to energy conservation. Fossil fuels had 25 percent of the research budget, nuclear fusion 12 percent, and nuclear fission 9 percent (see figure 1-6).

Information

Information as a policy instrument has the potential to change the awareness level and perceptions of decisionmakers. Information programs rest on the assumption that if decisionmakers are better informed they will make better decisions. The most common goal of information programs is to stimulate decisionmakers to opt for least cost (life-cycle) savings, as opposed to initial-purchase savings, in their energy decisions. For example, although the most efficient model of an appliance usually costs more initially, energy savings accrue over its useful life. Information can be supplied by Federal, State, or local governments, utility programs (see "Demand-Side Management" below), manufacturers, or non-governmental organizations (NGOs).

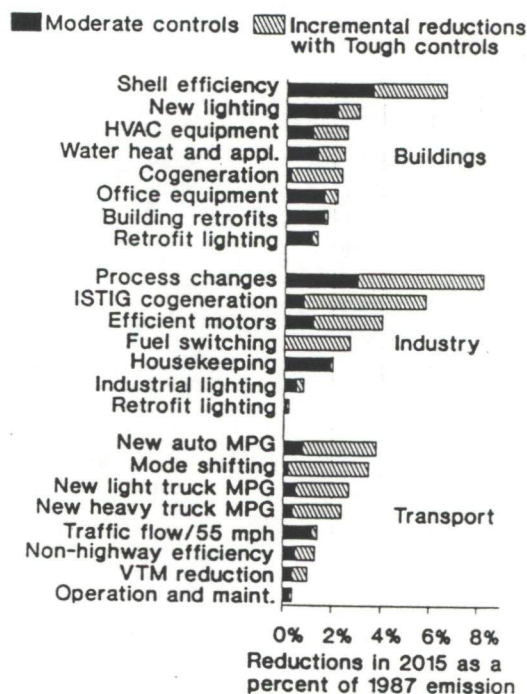
Information can be delivered to all decisionmakers in many ways, for example via label and rating systems and audits. Label and rating systems serve to provide purchasers with a basis for comparing front-end versus life-cycle costs at the time of purchase. Energy audits provide building owners and occupants with information they need when considering whether to purchase, rent, or retrofit alternatives. Energy audits can be effectively coupled with financial incentives to carry out retrofits that provide greater efficiency, and thus reduced CO₂ emissions.

Sectoral Policy Options

Buildings Sector

Figure 1-7 summarizes the emissions reductions possible for each "demand-side" option modeled by OTA under both the Moderate and Tough scenarios. For buildings, improving shell efficiency and lighting are the two technical options with the greatest potential for lowering CO₂ emissions. Under the Base case, OTA assumes that by 2015 new homes and apartments will be designed such that they need about 15 percent less heating and 8 percent less cooling than current new homes. By adopting Moderate shell efficiency measures, such as thicker insulation and better windows, new homes will require an estimated 50 percent less heat and 25 percent less air-conditioning than today's average new home (27). With Tough measures, homes can be built to require an estimated 85 percent less heat and 45 percent less air-conditioning (20).

Figure 1-7—Demand-Side Measures



NOTE: Reductions presented as a percentage of total U.S. carbon emissions in 1987.

SOURCE: Office of Technology Assessment, 1991.

As shown in table 1-1, Moderate shell improvements in new residential buildings can reduce U.S. carbon emissions by 1.3 percent of current levels by 2015. By implementing Tough improvements in the North and Moderate ones in the South, reductions of 2 percent in new residential buildings might be achieved. Tough measures for new commercial building shells can achieve reductions equal to 4 percent of 1987 levels by 2015.

Existing homes can also be made more efficient by installing more efficient heating and cooling equipment, insulation, windows, etc. The Base case assumes that existing homes will require 6 percent less heating by 2015 because of replacements and improvements that will happen anyway. Moderate measures boost this to 25 percent by 2015 and Tough measures boost it to 40 percent by 2015 (20). Tough measures in the North and Moderate ones in the South would reduce carbon emissions from existing buildings by 4 percent by 2000, but would have a declining effect thereafter as many of the older homes are replaced by new ones.

Improving the efficiency of lighting in new commercial buildings is another technical option that can yield substantial reductions. The Tough

scenario measures together—a combination of high-efficiency fluorescent bulbs and ballasts, improved reflectors, and better use of daylight—would lower lighting energy needs by 60 percent in these buildings (18). This achieves reductions equal to 3 percent of 1987 emissions by 2015.

Gains in commercial buildings can also be made by simply replacing existing bulbs with high-efficiency ones—without replacing fixtures—as shown under the “Operation and Maintenance” heading of table 1-1. Replacing the most heavily used incandescent bulbs in homes with compact fluorescents and using high-efficiency fluorescents in commercial buildings can lower emissions by 1.3 percent under our Tough scenario.

The instruments listed in table 1-2 and the policies described below appear to offer the most promise to achieve these reductions. While a carbon tax will certainly help, because there are so many different decisionmakers—some of whom may not be that responsive to price changes—a larger arsenal of policy instruments is needed. These include demand-side management (with the utilities as partners) as well as a series of targeted financial sanctions, incentives, and regulations.

Demand-Side Management (DSM)—DSM refers to electric utility programs designed to encourage customers to modify their patterns of energy use. Particularly promising—from a global warming perspective—are those situations where utilities allow energy conservation to compete with traditional supply technologies (e.g., powerplants) to balance energy supply and demand. DSM can be an effective approach to reduce energy consumption by improving building shells as well as the equipment inside buildings. In some cases, utilities pay for rebate programs, give out high-efficiency light bulbs, or otherwise stimulate end-use efficiency improvements, and save energy at a fraction of the cost of new power supplies.

Demand-side management can result in greater investments in energy efficiency than customers would otherwise make. Utility programs have long time horizons and can capture the potential in both the new and retrofit markets, for both equipment efficiency and building shell improvements. There is already considerable support for DSM by many

State energy offices, State legislatures, and public utility commissions.¹²

However, in order for DSM to stimulate significant investment in conservation, incentive structures must be changed so that utilities can profit from demand-side investments. Any Federal legislation concerning DSM would need to be general enough to allow States flexibility in implementation and specific enough to have a genuine impact on conservation. Congress could provide funding to evaluate various incentive structures currently being examined by States and utilities. Should Congress wish to pursue more direct action, it could require States to formally consider demand-side resources in their planning, with oversight by the Federal Energy Regulatory Commission (FERC).

The Federal and State Governments share the regulation of electric utilities, and there is a history of tension over this sharing of jurisdiction (48). Congress can play a powerful leadership role in the direction of utility planning through legislation that guides FERC (which has jurisdiction over wholesale electricity transactions). An example of such legislation is the Public Utility Regulatory Policies Act of 1978 (PURPA), which required utilities to purchase electricity from qualifying facilities at avoided cost. Recently Congress addressed some aspects of this; for example, the Omnibus Budget Reconciliation Act amended PURPA to eliminate the 80-megawatt capacity limitation for qualifying facilities fueled by wind, geothermal, solar, or waste energy.

Further, the Federal Government could mandate that environmental externalities be considered in evaluating supply-side options (as New York State has done—i.e., penalizing polluting options based on estimates of the costs of environmental damage that would accrue; ref. 33). Congress has already mandated, in the 1980 Pacific Northwest Electric Power Planning and Conservation Act (Public Law 96-501), that the Northwest Power Planning Council adopt rate structures that give conservation measures a cost break over other, more traditional supply-side measures.

Technology-Specific Regulations—Congress can directly mandate efficiency improvements through appliance standards and building energy codes.

¹²For a discussion of State initiatives in least-cost planning, see ref. 40.

Appliance Standards—Appliance standards, by fiat, remove inefficient appliances from the market. The National Appliance Energy Conservation Amendments (Public Law 100-12), passed in 1988, are expected to lower residential energy use by up to 10 percent by the year 2000 (17). However, even stricter standards are possible.¹³ The law requires review of appliance standards twice during the 1990s, which provides an opportunity to obtain additional energy reductions through more stringent standards. Congress could also consider extending standards to other equipment such as commercial heating, ventilation, and air-conditioning equipment; lightbulbs; and building components such as windows.

Standards could be even more effective if used in conjunction with other incentives. Policies such as utility programs, appliance labeling, and tax schemes provide incentives to do more than standards require.

Building Energy Codes—Building energy codes serve a function analogous to that of appliance standards by preventing the least efficient buildings from being constructed. Building codes have traditionally been under the jurisdiction of States and localities. Currently, there is little support from the States or the construction industry for a mandatory national building-code. In 1976, Congress enacted legislation that required the development of the Building Energy Performance Standards (BEPS), a mandatory national code based on performance standards. In 1983, the law was modified to be a mandatory code only for Federal buildings.

Greater energy savings could be achieved by:

1. mandating compliance with a uniform code or creating incentives for States to adopt the national code;
2. developing a more stringent national code; and
3. increasing funding for implementation and enforcement.

The National Affordable Housing Act of 1990 (Public Law 101-922) requires the Department of Housing and Urban Development (HUD) to develop energy efficiency standards for new public housing

and for housing subject to mortgages under the National Housing Act.¹⁴

Financial Measures—Congress can choose from among several sector-specific financial mechanisms, including building tax credits and subsidies and initial purchase taxes for appliances and other equipment.

Building Tax Credits and Subsidies—Tax credits and subsidies for using more efficient technologies can promote retrofitting of existing residential and commercial buildings. The Federal Government, for example, passed legislation that provided solar and conservation tax credits for the years 1978 through 1984. By 1983, 24 million households claimed a residential tax credit of up to \$700 each for investments in energy conservation; however, no evaluation or monitoring of energy saved by this program was ever conducted. The 1986 Tax Reform Act allowed the energy conservation tax credits for residential use to expire but extended residential solar tax credits and some commercial energy conservation credits.¹⁵

The Federal Government currently funds several subsidy programs. The Institutional Conservation Program, the Weatherization Assistance Program, and the Low Income Home Energy Assistance Program all pay for some energy conservation measures in low-income housing. The recently expired Solar Energy and Energy Conservation Bank helped finance energy conservation and cost-effective solar energy in low- and moderate-income housing and in commercial buildings owned by nonprofit organizations. Under these programs, the Federal Government provides funding to States, who in turn provide matching grants and loan subsidies. Such programs could be reinstated or expanded.

Initial Purchase Taxes and Rebates for Appliances and Other Equipment—An initial purchase tax scaled to penalize inefficient equipment could accelerate the market penetration of efficient equipment. Examples include a lump-sum tax on appliances and equipment at the time of purchase. Taxes collected on the most polluting items could be used

¹³The amendments define all energy-efficiency improvements with a payback of 3 years or less as economically justified. Any paybacks longer than 3 years must be shown to be economically justified.

¹⁴I.e., mortgages that include a loan, under the National Housing Act, for financing energy-conserving improvements or adding solar energy systems.

¹⁵The Omnibus Budget Reconciliation Act of 1990 extended the 10-percent business energy tax credit for solar and geothermal property through Dec. 31, 1991.

to provide a rebate on the least polluting items. However, although an initial purchase tax sends appropriate signals regarding consumer purchasing decisions, it would not—unlike an energy or carbon tax—change use of an appliance once it is purchased.

Consumer Information and Marketing Programs—Lack of information and uncertainty have been identified as key barriers to greater investment in energy conservation in the buildings sector. The large number of highly cost-effective investments in energy efficiency that are not chosen by consumers indicates that price alone does not stimulate optimal investment decisions. Therefore, information dissemination is a key element of several of the policy options discussed above, including the sector-specific financial measures and general energy and carbon taxes.

Home Energy Rating Systems—The Federal Government has been involved in home energy rating systems—which tell buyers how efficient their prospective homes or offices are—through its role in the mortgage market. In addition, the National Affordable Housing Act of 1990 requires HUD to develop a plan to make housing more affordable through mortgage financing incentives for energy efficiency. The Federal Government could play a further role by developing a uniform energy rating system for all residential and commercial buildings, making it easier and less expensive for lenders to include energy costs in their mortgage evaluations.

State Information Programs—The State Energy Conservation Program (SECP) provides financial assistance to the State energy offices to promote energy efficiency and conservation in commercial and residential buildings. The Energy Extension Service (EES) is a Federal/State effort to provide small-scale energy users with individually tailored technical assistance for energy conservation and increased use of renewables. The SECP and the EES were consolidated under the 1990 State Energy Conservation Programs Improvement Act (Public Law 101-440).

Energy Audits—The Federal Residential Conservation Service, created in 1978, mandated that gas and electric utilities provide their customers with onsite energy audits. The program was implemented in 1981 and recently expired. There has been little evaluation of the program, and little reliable information has been kept on its success in reducing

energy consumption. However, while it is unclear whether information from audits alone is enough to encourage conservation, it would certainly seem to be useful when combined with other measures.

Building Research, Development, and Demonstration—Major barriers to private investment in RD&D in the buildings sector include the fragmented structure of this sector and the short-term perspective of many of the decisionmakers (e.g., builders, renters). In addition, the U.S. Government currently spends a negligible amount on housing research. In contrast, in countries such as Sweden and Japan, RD&D spending has been part of a trend toward energy-efficient prefabricated housing. This spending has contributed to the energy efficiency of homes through standardization of energy-saving features and quality control in the design and manufacture of building components.

As a step, Congress has required HUD, in the National Affordable Housing Act of 1990, to develop a plan to encourage and improve energy efficiency in newly constructed, rehabilitated, and existing housing; and demonstrate various methods of improving the energy efficiency of existing housing. Such projects should encourage the development of “energy efficiency businesses” that can bridge the gap between owners, builders and occupants of buildings. Congress also required HUD to encourage the use of private energy service companies in public housing projects.

The Federal Energy Management Program (FEMP), administered by the Department of Energy, works with government agencies to implement cost-effective, energy-efficiency improvements. Congress could authorize FEMP to test and demonstrate performance, acceptance, and cost-effectiveness of new technologies in Federal buildings.

Transportation Sector

Urban passenger travel in cars and light trucks (i.e., light vehicles) in the United States requires the largest share of transport energy, consuming 15 percent of the world's oil production. The two main opportunities for reducing transportation's contribution to global warming are measures to increase the energy efficiency of light vehicles and measures to encourage urban passengers to drive less. Thus, under OTA's modeling exercise, the major reductions come from higher auto and truck efficiency,

better control of traffic, and, under the Tough scenario, more use of public transit (see figure 1-7).

With respect to auto efficiency, our Base case assumes that new cars will average about 32 mpg by 2000 and about 37 mpg by 2010. Under the Moderate scenario, new car efficiency averages 35 mpg by 2000 (9) and 39 mpg by 2010 (10). Under the Tough scenario, we assume a range of new car efficiencies. For example, efficiencies of 39 mpg by 2000 and 55 mpg by 2010 might be possible even if consumers maintain their current preferences for car size and performance (10). If consumers are willing to buy smaller cars, new car fleet average efficiencies of 42 mpg by 2000 and 58 mpg by 2010 might be achievable. Given this range of assumptions, reductions amount to about 3.5 to 3.8 percent of current emissions by 2015 (see table 1-1).

Reductions of about 2.5 to 2.7 percent from light trucks and another 2.4 percent from medium- and heavy-duty trucks are achievable under our Tough scenario, as well.

Traffic speed affects fuel consumption, too. By reinstating the 55 mile-per-hour speed limit and by reducing traffic congestion in urban areas in order to speed up travel, reductions of 1.4 percent by 2015 are possible under our Tough scenario.¹⁶

Measures to move people out of their cars and into mass transit under the Tough scenario would yield reductions of about 3.5 percent by 2015. To achieve this, however, urban auto traffic would have to be reduced by 10 percent through urban light rail, busways, and improved urban design. Additionally, 5 percent of car travel between cities would have to shift to high-speed intercity rail.

The following four policy instruments will promote new car efficiency: gasoline taxes, vehicle taxes and rebates, fuel economy standards, and incentives for vehicle manufacturers. In addition, improved operation and maintenance practices will reduce energy use in existing cars. Two other measures, transportation control measures (TCMs) and controlling settlement patterns, can help reduce CO₂ by reducing vehicle miles traveled.

Gasoline Taxes—A gasoline tax would create incentives for both increased efficiency and reduced travel. Taxes would induce consumers to use less fuel while leaving them free to choose how they adjust their behavior. In concert with increasing fuel economy standards (see below), a long-term impact on the efficiency of the vehicle fleet could be achieved.

Although the effectiveness of taxes is hard to predict from studies of past responses to price changes, one might expect a 10-percent hike in gasoline prices to yield a 1- to 6-percent drop in gas consumption.¹⁷ A 50-percent increase in price might reduce consumption 5 to 20 percent over the near term, even more over the longer term. A doubling or tripling in price (approaching the costs in Europe and Japan) might yield an immediate decrease of 13 to 20 percent and a longer term response of a 35- to 40-percent reduction in gasoline consumption. About half of this longer term adjustment to high price is expected from driving less, and the other half from more efficient vehicles. For example, consumers might choose to spend money on fuel-efficient technologies or to use mass transit, carpool, or simply travel less.

A gasoline tax, however, is regressive and thus affects the poor proportionately more than the rich.¹⁸ To ameliorate this, Congress could provide rebates to low-income households. It could also phase in the tax to give consumers time to adjust their purchasing decisions and operation and management practices.

Vehicle Taxes and Rebates—Taxes on inefficient vehicles can create incentives to choose better fuel economy and forego large size and extra power. Such a program would be most effective if accompanied by rebates for highly efficient cars. In a "revenue neutral" program, the money taken in from the taxes would be redistributed through the rebates. The Federal Gas Guzzler Tax¹⁹ already applies to cars with fuel economies below certain thresholds; the Omnibus Budget Reconciliation Act of 1990 recently doubled the tax for cars getting less than 22.5 mpg.

¹⁶Cars use gasoline most efficiently in the range of 35 to 45 mph; slower travel (due to congestion) and faster travel lead to losses in efficiency.

¹⁷Two recent studies (4, 8) review the "elasticity" of gasoline use relative to price (i.e., the ratio of the percentage change in use to the percentage change in price).

¹⁸For example, in 1985, households with earnings exceeding \$35,000 spent 4 percent of income on gasoline whereas households earning \$5,000 to \$10,000 spent 11 percent.

¹⁹The Energy Tax Act of 1978 (Public Law 95-618).

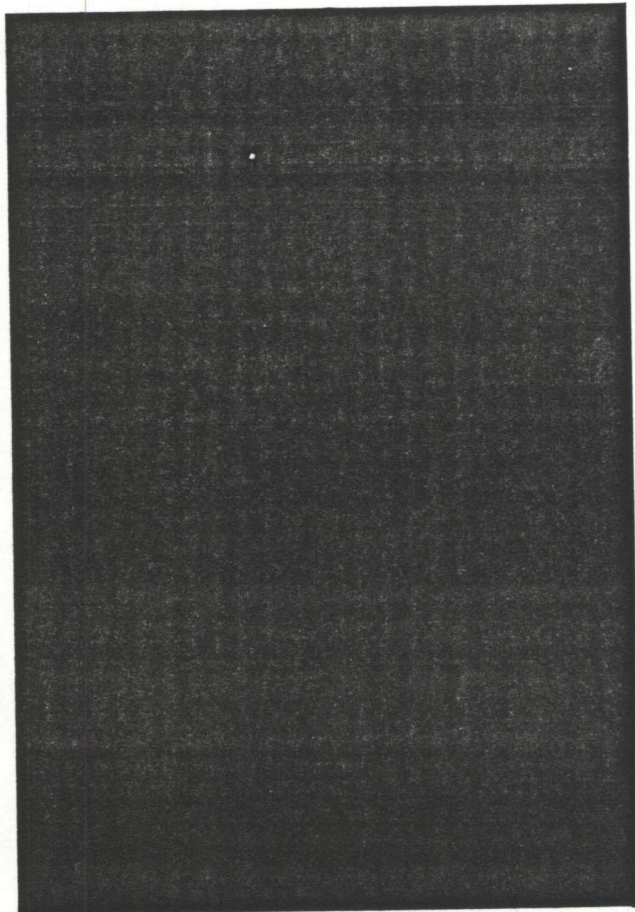


Photo credit: Bressler Editorial Cartoons, New York, Artist: Packer

A World War II poster encouraging car pooling. Urban commuters average 1.2 passengers per vehicle to and from work.

An expanded program of auto purchase taxes and rebates could complement fuel economy standards and taxes, but it could also pose serious trade difficulties as long as the high-efficiency end of the auto market is dominated by imports. If implemented suddenly, such measures would put domestic manufacturers at a disadvantage; on the other hand, measures designed to protect domestic manufacturers might conflict with General Agreement on Tariffs and Trade (GATT) rules.

Fuel Economy Standards—Standards influence the tradeoffs among cost, performance, size, and efficiency that underlie the development and introduction of new models. The current fuel economy standards for cars, in place since 1978, have helped to increase auto fuel economy (21). More stringent standards can both lower CO₂ emissions and reduce our dependence on imported oil. Redesigning stand-

ards that vary with vehicle volume can help minimize the burden on U.S. manufacturers that offer a full range of car sizes (31, 49).

Incentives for Vehicle Manufacturers—One incentive, aimed at producers instead of consumers, is the use of government-sponsored competitions to induce manufacturers to develop high-efficiency or alternate-fueled cars. A variant of the incentive scheme injects competitive elements into a high-efficiency rebate program. For example, the government could identify a few classes of vehicles most in need of fuel economy improvement and offer a competitive reward in the form of consumer rebates on a large (e.g., 200,000 units) production run of a new vehicle achieving the best fuel economy above a specified threshold.

Efficient Vehicle Operating Practices—Changes in vehicle operating practices offer small potential reductions individually but often have short startup times and do not require large, upfront capital investment. They include reimposing (and enforcing) the 55-mph speed limit; requiring efficiency inspections for trucks; and charging efficiency-promoting parking fees at Federal offices.

Transportation Control Measures (TCMs)—TCMs include a wide variety of measures to reduce the number of vehicle miles traveled (VMT) and lower congestion. They are attractive because they typically have short startup times and low capital costs, and can reduce energy use and greenhouse emissions even within existing settlement and employment patterns. In aggregate, TCMs appear to hold modest promise for reducing VMT. They include:

- ridesharing (promotion and matching services);
- employer-based transportation management (high parking charges, transit or vanpool subsidies, and expedited transactions—e.g., bus passes, van leasing, and insurance made available at work);
- High-Occupancy Vehicle (HOV) lanes (restricting lanes on freeways to cars with three or four occupants and to buses);
- parking management (parking taxes or development surcharges, restricting street parking, and mandating high parking charges at workplaces);
- Park and Ride (intercept drivers near their origins);

- mass transit improvements (bus service expansion, operational changes, and fare changes);
- travel substitution (telecommunications, work-at-home, 4-day work weeks);
- traffic flow improvements (sophisticated signals, ramp metering, intersection improvement); and
- bicycling promotion.

Under the Energy Tax Act of 1978, employer-provided vanpools between an employee's residence and place of work were excludable from the employee's income if the vehicle was capable of carrying nine people. Congress could consider reinstating this provision or a variation of it.

Under present law, employer-provided transit passes, tokens, fare cards, and employer reimbursements for travel over \$15 per month are considered taxable income. However, under current Federal tax law the value of parking provided to an employee is excludable from the gross income as a fringe benefit. Congress could consider making reimbursements for public transportation nontaxable or making parking taxable.

Controlling Settlement Patterns—Long-term reductions in emissions can be achieved by changing patterns of settlement to reduce the need for travel. This can be accomplished through higher densities, or through mixing uses so that residences, jobs, and services are roughly balanced at a local scale. When more destinations are close to home, more trips can be made by foot; when densities are higher, public transit can serve more people effectively.

In the United States, except possibly for some high-growth areas in the South and West, efforts to change the shape of settlement in major cities may meet local resistance. Nevertheless, some changes are feasible in suburban areas nationwide. Stringent suburban restrictions on development—sometimes only on commercial and industrial development, sometimes on new residential development as well—have been attempted in some regions of the United States (12).

Transportation RD&D—American automakers lag behind their Japanese, and to a lesser extent their European, counterparts in moving research results to the market (3). In the 1980s, a program to support more aggressive research and development in the American auto industry—the Cooperative Automotive Research Program—was briefly attempted by

the Department of Transportation. A revived, combined government/industry program could be successful if domestic automakers, their suppliers, and innovative research companies all are key players. The program could target important efficiency areas such as continuously variable transmissions, energy-storage systems, new engine designs for heavy trucks, improved safety for lighter vehicles, and innovations to permit increased intermodal freight.

An area of longer term research that deserves special attention is development of truly clean, economically acceptable, alternative fuels and a supporting infrastructure. Fuels with the greatest potential—electricity or hydrogen from noncarbon energy sources (e.g., solar and nuclear) and woody biomass fuels grown on a sustainable basis—are the furthest from large-scale technical viability. Research in these areas could be expanded, with parallel programs to assess and demonstrate the actual performance of a variety of fuels.

Manufacturing Sector

For manufacturing, as shown in figure 1-7, three types of technical improvements offer the greatest promise. The first area is "process changes." The top four manufacturing energy consumers (paper, chemicals, petroleum, and primary metals)—which account for more than 75 percent of energy use in this sector—improved their energy efficiency by between 2.3 and 4.3 percent per year between 1980 and 1985 (52). If this pace can be maintained, as we assume in our Tough scenario, reductions equal to about 8 percent of current emissions (by 2015) will result.

Cogenerating electricity and steam for industrial processes is a second promising option. When utilities generate electricity, about two-thirds of the energy from burning the fuel is released as heat. If electricity is generated at industrial sites where the heat can be used, the efficiency of fossil fuel use can be increased dramatically. Under our Tough scenario, we assume that 90 percent of new and replacement industrial steam boilers will cogenerate electricity. Such measures can lead to reductions equivalent to about 5.8 percent of current total U.S. emissions.

More efficient motors are a third technical improvement that can lead to substantial improvements. Moderate and Tough measures might improve motor efficiencies by 10 percent and 30

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percent (1), respectively, yielding reductions of about 1.2 percent by 2015 under the Moderate scenario and 4 percent under the Tough one.

The following policy instruments could encourage these technical measures: carbon taxes, DSM, efficiency standards, marketable permits, tax incentives, informational policies, and RD&D.

Carbon Tax—A carbon tax would levy economic penalties against the highest industrial emitters of CO₂. Under such an approach, the tax would be highest on coal, low for natural gas, and zero for noncarbon sources (e.g., wind, solar, geothermal, or nuclear). For industries where the cost of energy is particularly important, carbon taxes should encourage energy efficiency, fuel switching and cogeneration.

Using several econometric models, the Congressional Budget Office estimated that a carbon tax of \$100 per ton would lower CO₂ emissions from industry by between 10 and 35 percent by the year 2000. The higher reduction estimate reflects a 70-percent reduction in coal use.

Demand-Side Management—DSM programs—joint programs between electric utilities and their customers discussed previously—can help lower electricity use in the industrial sector. The major programs are:

1. rebates to customers who install approved equipment;
2. low-interest loans to customers for conservation installations; and
3. installation of conservation equipment at utility cost (37).

Many large industrial customers of electric utilities receive special lower rates because they supply the utility with a large, dependable portion of electricity demand. Utility programs could facilitate reductions in greenhouse gas emissions if these special rates were contingent on efficient use of electricity. This differs from demand-side management in that the financial burden of improving energy efficiency is placed on the manufacturer, not the utility.

Standards—A more traditional regulatory policy is to require efficiency standards for common energy-using equipment, similar to those existing for automobiles and some appliances. Motors would be the most likely candidate for this approach.

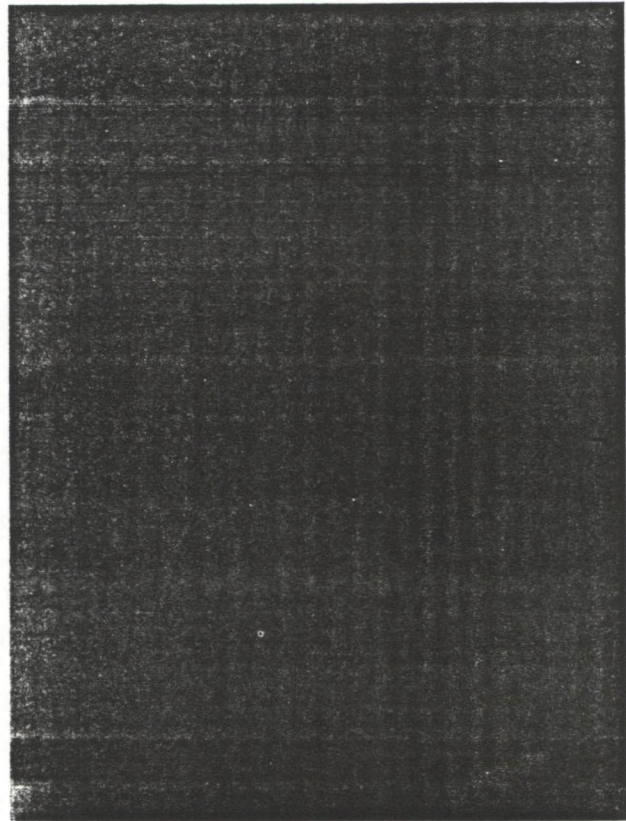


Photo credit: American Iron and Steel Institute

About 60 percent of the fossil fuels and electricity used by industry provides process heat, steam, and cogenerated heat and steam. Energy in manufacturing is also used for feedstocks, mechanical drive, electrolysis, lighting, and space heat.

Marketable Permits—CO₂ emissions can be regulated by requiring permits for emissions; manufacturers could be issued permits based, for example, on some percentage of their 1990 emissions. Reductions might be accomplished by installing energy-efficient technologies and fuel switching; offsets could result from approved reforestation/afforestation projects. It would be up to the manufacturer to choose the most cost-effective strategy. Marketable permits would allow firms to trade their unused carbon rights to a firm that is exceeding its budget.

Manufacturing Tax Incentives—Much industrial equipment is old and energy-inefficient compared to the best available technology. In many cases, replacing old equipment improves energy efficiency by 10 to 50 percent. Financial policies, such as tax credits or accelerated tax depreciation schedules, aimed at stimulating rapid replacement of older equipment have the potential to stimulate

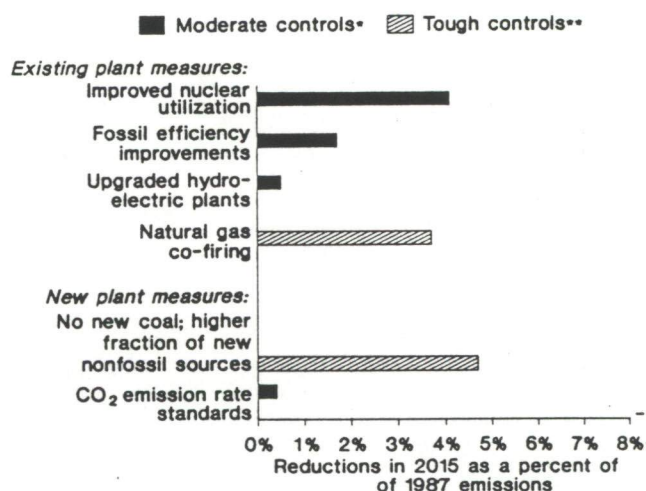
improvements in energy use. Such policies have a precedent: the Energy Tax Act of 1978 provided a 10-percent added "energy investment tax credit" for certain energy-conservation investments (as well as tax credits for some energy-supply investments). The tax credits were available until 1985 and applied to a specific list of technologies. However, rather than specify which technologies qualify, Congress could foster innovation by offering similar—or greater—tax breaks for company-chosen conservation technologies.

Informational Policies—A barrier to reducing emissions in the manufacturing sector is lack of information about how to improve energy use—especially for smaller, less energy-intensive industries. Informational policies can include performance goals, the collection of performance data, labeling of the energy performance of equipment, training, and performance audits.

Renewed support for cooperative government/industry information-sharing programs could help. For example, DOE's Energy Analysis and Diagnostic Center program funds faculty and students at several universities to perform free energy audits for small and medium-sized manufacturers in more than 30 States. Because costs saved by manufacturers translate to increased taxable income, the program can provide additional tax revenues to the Federal Government. The biggest cost savings have come from efficiency improvements associated with cogeneration, space heating, lighting, and process equipment maintenance and replacement (in descending order of savings; ref. 25). This program could be expanded or new programs could be modeled after it.

Manufacturing R&D—Research and development sponsored by DOE's Office of Industrial Programs in waste energy reduction and industrial process efficiency, if funded, are projected to save more than 3 to 4 percent of energy used by industry per year over the next decade. Research areas identified by Oak Ridge National Laboratory as particularly promising are: improved use of catalysts in chemical production; intelligent sensors and controls; and heat recovery and cogeneration (16). R&D in nonenergy areas, such as materials science, also holds promise for partial replacement of energy-intensive materials like steel and aluminum. Likewise, research and development to improve the quality of products made with recycled materials could help reduce energy use by increasing the

Figure 1-8—Electric Utility Supply-Side Measures



*assuming Moderate demand-side measures

**assuming Tough demand-side measures

NOTE: Reductions presented as a percentage of total U.S. carbon emissions in 1987.

SOURCE: Office of Technology Assessment, 1991.

demand for recycled materials such as paper, steel, and aluminum.

Electricity Generation

About one-third of U.S. carbon emissions come from generating electricity (see figure 1-3); by 2015 under our Base case this may be as high as 45 percent. Thus measures that lower the rate of carbon emissions per kilowatt-hour (kWh) of electricity generated would translate into substantial reductions.

Figure 1-8 shows OTA's estimate of the technical potential for emissions reductions in the electric utility sector depending on the demand for electricity and the stringency of policies. Moderate utility supply-side measures can lower emissions by about 6.6 percent (see table 1-1). The two with the greatest reduction potential are: 1) increasing the efficiency of fossil fuel-fired plants (by about 5 percent) through improved maintenance (14); and 2) operating existing nuclear powerplants 70 percent of the time (similar to Western Europe and Japan (16) and extending their useful life to 45 years.

Our Tough measures eliminate coal use wherever possible. A combination of renewable energy sources, nuclear plants with improved designs that may be available after 2005, and high-efficiency gas turbines are the only new utility plants built under the

Tough scenario. However, if all the Tough demand-side measures in the buildings and industrial sectors are implemented, growth in demand for electricity is so low that very few new plants are needed through 2015. Thus, the only way to lower emissions under this scenario is to either cofire existing coal plants (e.g., with 50 percent natural gas), or retire existing coal plants after 40 years of operation (rather than the typical 60 years) and replace them with renewable or nuclear fuels or natural gas. The former measure would reduce emissions by about 3.7 percent by 2015; the latter, by about 4.7 percent of current levels by 2015.

The following policy options could be used to encourage these technical measures: carbon taxes, marketable permits, subsidizing noncarbon sources, emissions limits and standards, and RD&D.

Carbon Taxes—A carbon tax, if set high enough, would encourage fuel switching and conservation. A carbon tax in the range of \$75 to \$150 per ton would make natural gas a more economic choice than coal at many facilities. A carbon tax would also provide added motivation to develop more noncarbon energy sources.

Marketable Permits—Utilities could be issued marketable permits for CO₂ emissions allowed from their coal-fired units, based on their generation in a historic year (e.g., 1990) multiplied by an allowed emission rate. Under this approach some utilities could curtail coal use more than necessary to meet their limits and sell permits to others exceeding their limits.

A variant on the above approach is to simply issue permits for a limited amount of coal use in existing facilities. Such an approach would be simpler to administer than emission permits, but it does not give credit to more efficient coal plants or to those plants that use lower CO₂-emitting coals.

To hold new coal plant construction between now and 2015 to a predetermined level, a limited number of coal permits (or carbon permits specific to coal plants) could be auctioned each year to the highest bidder. If such a policy were adopted in combination with marketable permits for existing coal plants, utilities could be allowed to freely trade among new and existing facilities.

Subsidize Noncarbon Sources—Any of the general financial instruments, such as a carbon tax or fossil fuel energy tax, will serve to encourage use of nonfossil sources for electricity generation. According to one estimate (40), a 2 cent-per-kWh subsidy or its equivalent²⁰ for only renewable sources of electricity might double the contribution of renewable sources of electricity by 2010—i.e., allow them to supply 40 percent of new demand under a Base case growth scenario. Under our Tough scenario, we assume nonfossil sources can provide between 30 and 45 percent of new demand (depending on the success of other demand-side measures).

CO₂ Emission Limits and Efficiency Standards—Congress could mandate reductions by setting CO₂ emission limits or efficiency standards. For example, an emission rate limit of 0.55 pounds carbon per kWh (lbs C/kWh) would require a typical Midwestern plant burning Illinois coal to burn between about 10 and 30 percent gas, depending on its efficiency. At 0.55 lbs C/kWh, the most efficient new coal burning technologies (e.g., integrated coal gasification combined cycle, or IGCC) would just qualify burning coal alone.

Two somewhat different strategies could be pursued to set CO₂ emission limits for new plants. If the intent is to force development of ultra-efficient coal technologies, then a standard in the range of 0.35 to 0.40 lbs C/kWh would be appropriate. Molten carbonate fuel cells, if successful, might be able to achieve such emission rates using bituminous coals. If the intent is to limit new fossil fuel-fired generation to the cleanest sources only—advanced combined cycle turbines burning gas—then a new source performance standard of about 0.25 lbs C/kWh would be more appropriate. To speed up replacement of old plants with new, lower emitting ones, Congress could mandate the retirement of existing fossil-fuel-fired plants earlier than their expected lifetime of 60 years.

In addition, powerplant efficiencies are not routinely monitored and industry attention to methods for improving efficiencies is only fairly recent (15). To demonstrate how better monitoring affects energy efficiency, Congress could require TVA and the Federal power agencies (e.g., Bonneville Power Authority) to undertake improvement at their own facilities. About 4 percent of the electricity gener-

²⁰A 2 cent-per-kWh subsidy is equivalent to a carbon tax of \$75 per ton of carbon for coal and about \$150 per ton of carbon for natural gas.

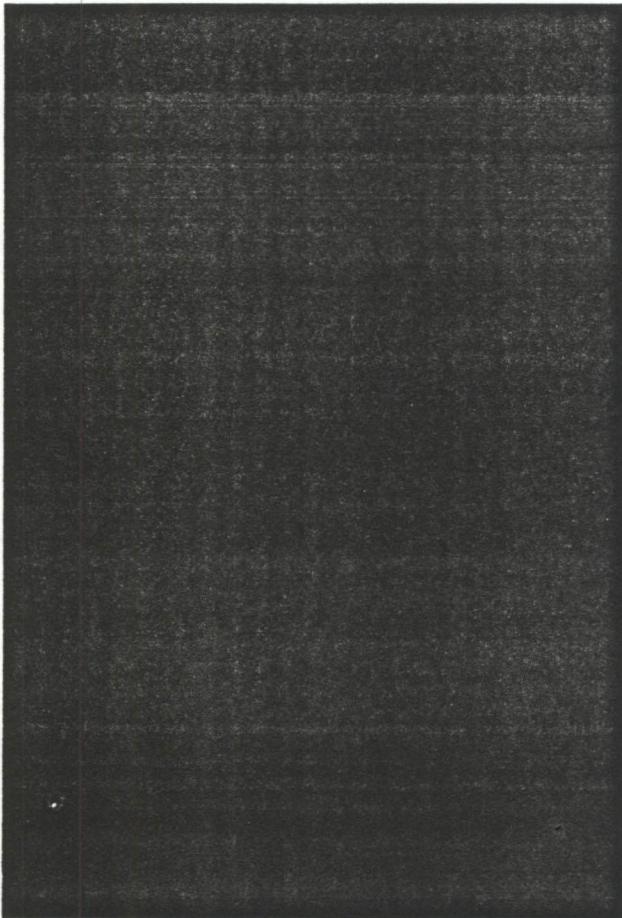


Photo credit: Southern California Edison Co.

A 500-MW wind turbine mounted on a vertical axis is insensitive to wind direction. All renewable sources of energy (wind, solar, geothermal, hydro, and biomass) currently contribute 5 to 10 percent of U.S. energy supply.

ated from fossil fuels comes from Federal power agency facilities (13).

The Federal Government, through the Federal Energy Regulatory Commission (FERC), also has indirect ability to influence private utility operations through its authority over the prices and conditions of interstate wholesale power sales. If Congress feels that the State Public Utility Commissions are not identifying and enforcing efficiency improvements, it could direct FERC to consider these issues when regulating interstate wholesale power sales.

Energy RD&D Funding—Over the last decade, Federal funding for renewable energy, conservation, and nuclear (fission) R&D fell rapidly (see figure 1-6). The 1990 combined energy technology R&D

budgets (in 1990 dollars) for these three categories were 82 percent lower than they were in 1980. To reinstate the funding levels of 10 years ago would require adding about \$2.6 billion. By doing so, the Federal Government could hasten the development and demonstration of supply technologies that would reduce greenhouse gas emissions. The most promising of these technologies include: commercial fuel cells; storage technologies for solar electricity; biomass-driven turbines; variable-speed wind turbines; and better designs for nuclear powerplants. Many experts estimate that these technologies could be commercially available within the next few decades.

The government could also play a role in reducing the perceived risk of new technologies and integrating renewable energy sources in existing energy systems by conducting demonstration projects or, perhaps, providing government-backed loans. To encourage new nuclear energy sources, a two-track process appears best: the Department of Energy could help fund full-scale demonstrations of both new “evolutionary” light water reactors and “revolutionary” design changes such as a modular high-temperature gas reactor.

For existing nuclear powerplants, the goal should be to increase the number of hours of operation, rather than to increase efficiency of fuel use. A Department of Energy demonstration program (coordinated with the Nuclear Regulatory Commission) might bring U.S. hours of nuclear plant operation from well below to above the average for Western Europe and Japan. Key elements of such a program would include improving preventive maintenance; installing automated controls to improve reactor operation; and speeding up time spent refueling.

Forests

Forestry-related measures with the greatest potential to offset carbon emissions include increasing the productivity of existing forests, planting trees in new areas, and growing tree crops for biomass energy; we consider these to be Tough measures, with the exception of ongoing tree planting in the Conservation Reserve Program. As shown in figure 1-9, OTA estimates that the increased carbon uptake from increasing productivity on about 60 million hectares of timberland might be equivalent to annual emissions reductions of about 3 percent of current levels by 2015. Planting new trees (i.e., afforestation) on farmland and other nonforested areas and in cities

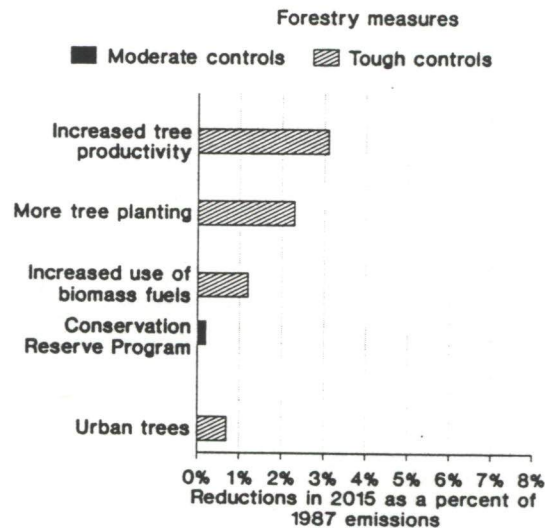
might result in carbon storage equivalent to emissions reductions of about 2 percent of current levels by 2015. Planting trees for biomass energy might result in an additional reduction of about 1 percent by 2015.

There are several caveats to this potential for offsetting emissions. Trees planted today can continue to store carbon beyond this report's 25-year timeframe. But this carbon eventually will be released to the atmosphere, either when trees die and decompose naturally, when they are harvested and burned, or when products made from wood eventually decompose. Unless the wood is used to displace fossil fuel use or is permanently stored under conditions that do not allow decomposition, carbon offsets in later years will dwindle. These estimates also assume that increasing the productivity of a forest's commercial timber component is equivalent to increasing the productivity of the entire forest ecosystem, but this assumption needs to be tested. Finally, forests—and the feasibility of using forestry practices to offset emissions—are likely to be affected by future climate changes. Therefore, forestry options in industrialized countries such as the United States cannot be considered a substitute for reducing total energy use, but rather as a way of “buying” time while developing alternative nonfossil fuel sources and improving the efficiency of energy use in general.

Congress could promote management practices that increase carbon storage or offset CO₂ emissions by augmenting existing forest management and tree planting programs of the U.S. Forest Service (USFS) and the Agricultural Stabilization and Conservation Service, and by enhancing the biomass energy research program of the Department of Energy. In addition to direct support for such programs, Congress also could consider using financial mechanisms (e.g., changing income tax policies to encourage more investments in forest management; imposing a tax on fossil fuels to make biomass fuels more competitive).

Incentives To Increase Carbon Storage on Forest Lands—Incentives to increase productivity—i.e., net carbon storage—will differ for publicly and privately owned forests. On public lands, which are located mostly in the West, management objectives

Figure 1-9—Forestry Measures



NOTE: Offsets presented as a percentage of total U.S. carbon emissions in 1987.

SOURCE: Office of Technology Assessment, 1991.

are determined by planning processes legislated by Congress.²¹ Government investments in these lands are likely to focus on reforestation and timber stand management. Congress could direct the USFS and Bureau of Land Management to, for example, increase reforestation activities and to conduct research on the ability of “new forestry” practices that proponents contend might help to both maintain higher levels of diversity and allow commodity production.

Privately owned forests are most extensive in the East and South. For nonindustry private forests, Congress could continue to increase assistance to States and private landowners under programs such as the Forestry Incentives Program and the Agricultural Conservation Program. These programs currently reach only about 2 percent of nonindustry private owners (32), even though these owners undertake over 40 percent of all reforestation. The Interior and Related Agencies Appropriations Act for fiscal year 1991 almost doubled funding for the USFS's State and private forestry programs, which include tree planting and management. The 1990 Food, Agriculture, Conservation, and Trade Act (Public Law 101-624), known as the 1990 Farm Bill,

²¹E.g., for National Forests in the Renewable Resources Planning Act (Public Law 93-378) and National Forest Management Act (Public Law 94-585), within the framework set forth in the Multiple-Use and Sustained-Yield Act of 1960 (Public Law 86-517).

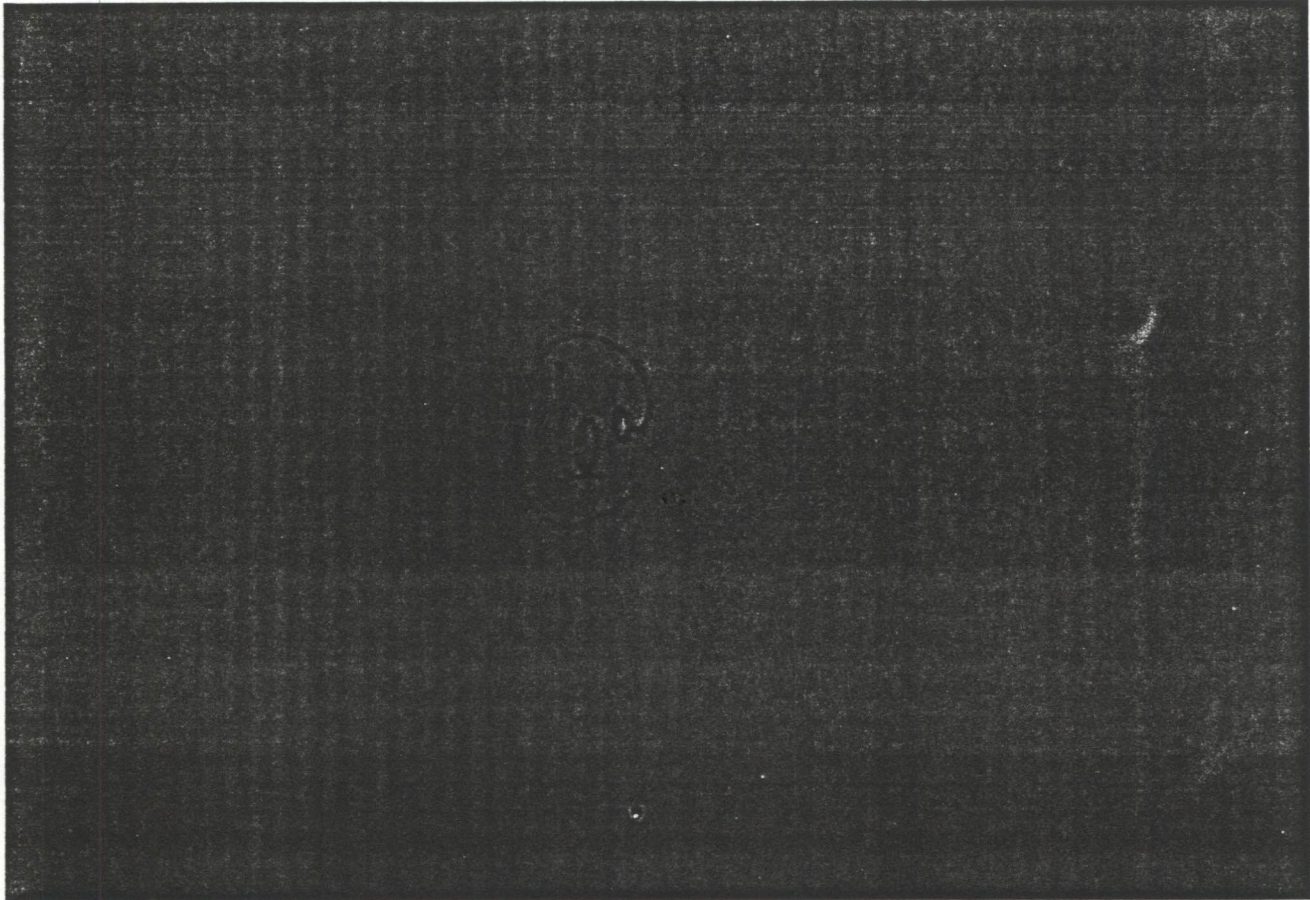


Photo credit: James P. Blair (c) 1990 National Geographic Society

The effects of clearcutting U.S. forests can be seen on the steep slopes of the Mount Baker-Snoqualmie National Forest below the Clearwater Wilderness.

also authorized a forestry stewardship program in which the USFS would work with State and local governments, land grant universities, and the private sector to improve resource management on privately owned forest land.

For industry-owned timberland, investments might be stimulated through changes in capital gains provisions (e.g., restoring preferential tax rates or providing a partial exclusion from taxable income for timber held longer than 20 years) or allowing full annual deductions for expenses, as well as by increasing funding for Federal assistance programs. One possibility for increasing support of such programs is to use funds that would accrue if below-cost timber sales in National Forests were eliminated.

Incentives for Growing New Trees on Unforested and Urban Lands—Mechanisms to promote afforestation include the Conservation Reserve Program (CRP), the President's proposed America the Beautiful program, and financial incentives such as tax credits for carbon storage. In general, any tree-planting program needs to consider the costs of maintaining trees in a healthy state once planted; this will be even more critical as climate changes occur.

Congress could expand the CRP by increasing its tree-planting goals and its incentives for enrolling land for tree planting (e.g., higher rentals, greater share of reforestation costs, longer contracts).²² The 1990 Farm Bill expanded CRP eligibility criteria to include, for example, marginal pasture lands previously converted to wetlands or wildlife habitat,

²²Under the CRP, farmers who take lands out of production for 10 years receive annual rental payments from the Federal Government and a one-time payment for one-half the cost of establishing protective vegetation.

marginal pasture lands to be converted to trees in or near riparian areas, and croplands that contribute to water quality degradation.²³ Another option would be to encourage new shelterbelts, perhaps through tax credits or by conservation compliance requirements tied to commodity support programs.

The 1990 Farm Bill authorized startup funds for the America the Beautiful tree-planting program, as well as funds for urban and community tree planting and maintenance. The Interior and Related Agencies Appropriations Act for fiscal year 1991 did not fund the program, although, as noted above, tree planting was included in funding for the USFS's State and private forestry programs. Infrastructure for increased planting also may need to be developed, since current planting is near the historical peak, and funding for long-term maintenance also will be needed.

Congress also could consider providing tax incentives (similar to those once more widely available for energy conservation) for properly planting and maintaining urban trees, especially near homes and buildings to save energy used for cooling.

Incentives for Biomass Energy To Offset CO₂ Emissions—Growing short-rotation woody crops on nonforested land for use as an energy source shows some promise. Congress could increase funding for Department of Energy research on uncertainties regarding long-term productivity, including effects on nutrient availability, and costs. Increasing fossil fuel taxes would make biomass fuels more competitive. Even then, farmers wishing to invest in biomass crops may be limited by loss of base acreage in commodity support programs and by lack of revenues for several years. Thus, changes in support programs or provision of some subsidy may be needed to stimulate investments in biomass crops on current cropland.

Food Sector

In the other U.S. sectors, CO₂ is the primary focus of OTA's analysis, although both CFCs (e.g., in buildings and transportation) and methane (e.g., from natural gas production and distribution) also

are assessed. The food sector, though, differs in two important aspects. First, the relative importance of methane (CH₄) and N₂O emissions is greater than in other sectors. Although estimates are uncertain, the food sector may account for one-third of global CH₄ emissions and anywhere from one-tenth to one-fifth of current global N₂O emissions. Its contribution to total U.S. CH₄ emissions is roughly 9 percent (its contribution to U.S. N₂O emissions is uncertain, though).

Second, fossil fuel-related CO₂ emissions (i.e., from farm machinery, irrigation equipment, fertilizer manufacturing, food transport, processing and packaging, and cooking) and CFC emissions (primarily from refrigeration) are subsumed in the transportation, industry, and buildings analyses summarized earlier. Further, CO₂ emissions from agricultural-related deforestation in the United States are very small (although they are very important in developing countries). To place the food sector in perspective, though, we estimate that it accounts for at least 8 percent of total U.S. CO₂ emissions and about 5 percent of U.S. CFC-11 and CFC-12 emissions (worldwide, it may account for one-fifth of global CO₂ emissions and up to 15 percent of global CFC-11 and CFC-12 emissions).²⁴

In the past, congressional concern about agriculture largely has focused on farm production, promotion, and income. With the passage of the 1985 Food Security Act, Congress began dealing with some of the environmental impacts of U.S. agriculture. Although the 1990 Farm Bill expanded these efforts, including extending the CRP until 1995, additional steps can still be taken, as discussed below for methane and nitrous oxide emissions.

Some of the opportunities discussed earlier for the buildings, industry, and transportation sectors also can affect food sector activities (e.g., more efficient cooking, processing and packaging, etc.). In addition, fossil fuel-related CO₂ emissions from the U.S. food system could be reduced by making fertilizer manufacture, farm machinery, and irrigation more energy efficient.

²³This will enhance the chances of achieving the CRP's goal of reducing soil erosion problems; some of these lands could be devoted to tree planting.

²⁴About 70 percent of the U.S. food sector's CO₂ emissions (i.e., about 5 percent of total U.S. CO₂ emissions) comes from fossil fuel combustion for food refrigeration, residential cooking, and food processing and packaging; the remainder comes from farm machinery, fertilizer manufacturing, and onfarm electricity use. These CO₂ emissions do not represent a complete accounting of emissions from the U.S. food sector; for example, CO₂ emissions associated with food transport are not included.

Reducing Methane Emissions—U.S. methane emissions from the food sector are primarily from ruminant animals (e.g., cattle, sheep). Congress could direct the U.S. Department of Agriculture (USDA) to determine the potential for techniques such as improved nutrient management, feed additives, and manure management to reduce methane emissions. To limit future growth in, or even reduce, livestock populations in the United States, Congress could consider reducing or removing price supports for feed grains, which might make beef and dairy products more expensive (although it is unclear if the costs would rise or fall over the long term). Such a policy could cause large near-term economic disruptions for some farmers and portions of the food industry, however.

Reducing N₂O Emissions—To reduce nitrous oxide emissions, Congress could modify commodity program policies, which now encourage monocropping and heavy fertilizer use, to give farmers more control over the types of crops they plant without losing program crop base acreage and support payments.²⁵ Congress could provide cropping flexibility only to those farmers who adopt environmentally sound cropping patterns. Congress also could make implementation of best management practices (BMPs) a prerequisite for receiving Federal price and income supports. BMPs, designed by the Soil Conservation Service (SCS) to reduce soil degradation and water contamination from agricultural activities, include more efficient fertilizer use, water impoundments, permanent vegetative cover, and manure storage.²⁶ At present, however, the SCS does not have statutory authority to promulgate enforceable regulations. Such a cross-compliance policy also would not apply to the one-third of U.S. croplands that are not enrolled in Federal farm support programs. In addition, enrolling more farm land in the CRP would help reduce N₂O emissions from fertilizer use (as well as CO₂ emissions from onfarm fossil fuel use and offsite fertilizer manufacturing).

Food RD&D—The development of an accurate emissions database for the food sector is perhaps the most critical research priority. Increased research is needed to quantify CO₂ emissions from agricultural

land-clearing activities, CH₄ emissions from ruminant animals (and from rice cultivation, particularly in the developing world), and N₂O emissions from nitrogenous fertilizers. The emissions reduction potential of different alternative practices must also be investigated; for example, support is needed for research on methane-reducing techniques, especially for livestock in confined and range-management systems. Congress also could increase funding for RD&D efforts to develop new alternative practices, especially those that simultaneously increase crop yields and reduce greenhouse gas emissions per unit of food output.

U.S. INFLUENCE ON THE REST OF THE WORLD

There are many reasons why the U.S. Congress should seek to promote the reduction of greenhouse gas emissions abroad. First, climate change is a global problem. Solutions must come from all emitters, as reductions made by one country will only make a small dent in total greenhouse gas emissions.

Second, emissions of greenhouse gases will rise in the developing countries. Because the developing countries have higher growth rates for energy use, population, and Gross National Product (GNP) than do industrialized countries, and because their current energy use per person is so low, their emissions of greenhouse gases will continue to rise significantly. Stabilizing or even reducing greenhouse gas emissions from developing countries will be next to impossible to achieve (at least until nonfossil energy sources are widely available), given their need to increase energy consumption for supplying basic services. However, the United States could influence emissions growth rates in developing countries and also assist these countries to achieve economic progress by helping them to increase energy production based on nonfossil fuels (e.g., solar or nuclear) and to make both their energy production and consumption more efficient.

Third, energy-related improvements may be cheaper and relatively greater—at least in the short term—in developing countries, Eastern

²⁵The 1990 Farm Bill now allows farmers to plant a limited amount of selected crops on land designated for other commodity program crops without losing program benefits.

²⁶This idea also could be extended to other energy-intensive inputs such as pesticides and irrigation water. For example, the SCS could establish guidelines on how, and in what quantities, various inputs should be applied to crops in specific regions of the country.

Europe, and the U.S.S.R. than in the United States. For example, because energy use in all the sectors of the U.S.S.R. and Eastern Europe is relatively inefficient, significant efficiency gains may be achieved at modest expense. In developing countries, much of the energy infrastructure is yet to be built; these countries can take advantage, for example, of new technologies that may be cost-effective for new construction but expensive for retrofits.

Fourth, tropical deforestation contributes between 7 and about 30 percent of worldwide CO₂ emissions; these forests are being lost at an estimated rate of over 17 million hectares per year—an area exceeding that of Virginia and West Virginia combined. In addition, much more than CO₂ emissions is at stake. Tropical forests harbor at least half of the world's species, are the source of many products used by people living in the forests and elsewhere in the world (e.g., medicines, nuts, fibers, fruits), and serve many critical functions such as watershed protection.

Developing Countries

The OECD countries (which include the United States), U.S.S.R., and Eastern Europe currently contribute about one-half to two-thirds of all greenhouse gas emissions, mostly from combustion of fossil fuels to power their economies (see figure 1-1; note the caveat on the figure regarding how the wide range of estimates of CO₂ emissions from deforestation affects estimates of the relative contribution from each region). In contrast, developing countries contribute about one-third to one-half of emissions, mostly from land use changes and practices (e.g., deforestation of tropical forests, cultivation of rice, and raising of livestock).

Most current forest-related greenhouse emissions come from tropical forests, which are located almost exclusively in developing countries and which are being felled, burned, and degraded on an unprecedented scale.²⁷ In contrast, loss of temperate-zone forests, located mostly in developed countries, currently contributes little to CO₂ emissions, although many of these forests were cleared in the past.

The major causes of tropical deforestation and degradation are the conversion of forests to temporary agriculture (e.g., "shifting" cultivation) and permanent agriculture (including cattle ranching), and poor timber harvesting practices. However, these are driven by underlying social, economic, and political factors—poverty and lack of land tenure for most people, national development policies, and foreign debts—that are exacerbated by rapid population growth (60). These factors encourage rapid exploitation of natural resources, for example to expand development and obtain foreign currency for servicing debts.

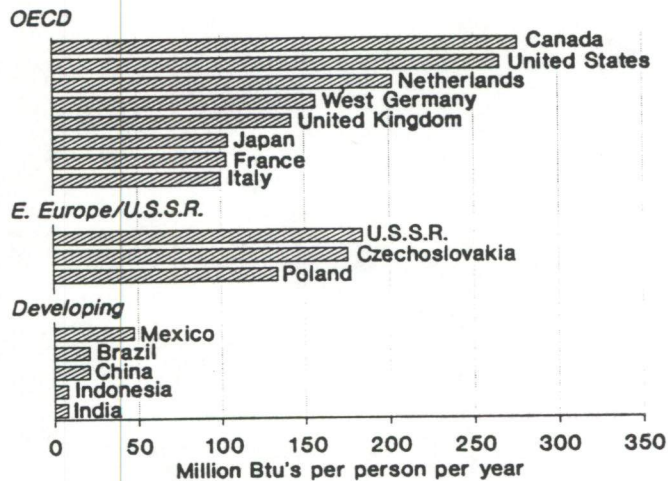
Emissions from fossil fuel use in developing countries are relatively less important now but will increase significantly in the future. Decisions that these countries make within the next 5 to 10 years about how to pursue economic growth and expand energy services and infrastructure (e.g., industrial bases, electric generation) will influence their share of emissions for decades to come. The ongoing OTA assessment, "Fueling Development: Energy and Technology in Developing Countries," will continue to examine this issue. A background report (51) discusses linkages between energy use, economic development, and environmental quality.

Figure 1-10 shows the great disparity in per-capita energy use in different parts of the world. Although a person in a developing country uses about one-fifteenth the amount of energy as does the average U.S. citizen,²⁸ even modest gains in per-capita and total economic growth in these countries translates into emissions that will exceed those from the developed world within a few decades. And such growth is likely to be more than moderate. Developing countries have been increasing their total energy use by approximately 6 percent per year, in contrast to 1 percent in OECD countries, and they increased their electrical power consumption by an average of 8 percent per year between 1971 and 1987; most of the added electrical capacity was provided by conventional powerplants (which are high CO₂ emitters) and was used for manufacturing and in buildings (43). Further increases will be needed since many countries are continuing to fully electrify cities and beginning or continuing rural electrifica-

²⁷"Deforestation" means converting forest land to other vegetation or uses (e.g., pasture, cropland, dams). "Degradation" involves practices that leave trees as the predominant vegetation but degrade overall forest quality (e.g., soil erosion; damages to trees and streams from selective logging).

²⁸The average American uses about 260 million Btu's. The average for the entire developing world (defined by the World Bank as "lower and middle income" countries) is about 20 million Btu's. The average for the selected developing countries shown in figure 1-10 is 25 million Btu's.

Figure 1-10—Per Capita Energy Consumption



SOURCES: U.S. Congress, Office of Technology Assessment, *Energy in Developing Countries*, OTA-E-486 (Washington, DC: U.S. Government Printing Office, January 1991).

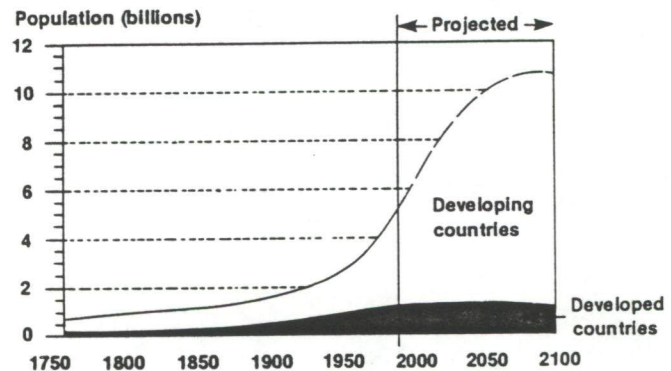
tion programs, and since refrigeration and air-conditioning are becoming more widely available. Moreover, rapid population growth, in combination with economic growth, will continue to fuel increased demands for energy and land resources long beyond the time frame of this study; the world population now grows by over 10,000 people per hour (figure 1-11), with virtually all of that growth occurring in developing countries.

U.S.S.R. and Eastern Europe

The economies of the U.S.S.R. and of Eastern European countries have been centrally planned for decades but now are changing, rapidly in some cases.²⁹ These countries account for about one-fifth of current global greenhouse gas emissions, mostly from the combustion of fossil fuels to provide energy. In 1988, the U.S.S.R. accounted for 18 percent of global primary energy consumption, Eastern Europe for 6 percent. The energy infrastructure in place in these countries is generally old and inefficient.

Efforts to promote energy conservation and efficiency in Eastern Europe and the U.S.S.R., and thereby reduce future growth in carbon emissions, face major obstacles. First, energy is highly subsidi-

Figure 1-11—World Population Growth, 1750-2100



SOURCE: Population Reference Bureau, 1990 *World Population Data Sheet* (Washington, DC: 1990).

dized, so consumers (particularly industries) bear only a small portion of its real costs.³⁰ Second, the central economic planning systems set rigid quotas for production (i.e., gross output) of goods and services. Enterprises must consume virtually all of the supplies allocated to them by central planners, even when not all are needed, in order to receive the same amount next year. Third, the production quotas require investments in heavy industries (e.g., steel, aluminum, chemicals) at the expense of services and consumer goods. Finally, implementation of plans for alternative energy sources is hindered by a fragmentation of responsibilities among multiple government agencies.

Thus, even when opportunities exist, there are strong disincentives to save energy and raw materials or to invest in energy efficiency. These obstacles have led to high industrial demand for energy, energy-inefficient production of goods and services, less availability of electricity for nonindustrial consumers, low standards of living, and severe environmental problems in many areas.

U.S. Policy Options To Help Limit Greenhouse Gas Emissions Abroad

Earlier sections in this summary set forth specific policy options that the United States could pursue to reduce or offset its own greenhouse gas emissions. By taking such actions to reduce its own emissions, the United States can provide leadership through

²⁹Eastern Europe as defined here includes Bulgaria, Czechoslovakia, East Germany (prior to unification with West Germany), Hungary, Poland, and Romania.

³⁰In Poland, for example, subsidies accounted for 49 percent of the delivered price of coal and 83 percent of the delivered price of natural gas in 1987 (ref. 41).

example. In the broader context, the United States also can work towards the adoption of international conventions and protocols regarding climate change, similar to those developed for phasing out CFCs and halons.

The United States also can attempt to help developing countries, Eastern Europe, and the U.S.S.R. to minimize their greenhouse gas emissions, without hindering the prospects for needed economic development. Indeed, strategies to lower greenhouse emissions can simultaneously help these nations become more economically efficient. Numerous existing programs and organizations in the United States and on the international scene directly influence development and indirectly can affect greenhouse gas emissions (see box 1-C). The United States, for example, provides direct bilateral assistance through the U.S. Agency for International Development (A.I.D.). Numerous other U.S. agencies—such as the State Department, the Commerce Department, the U.S. Trade Representative, the Treasury Department, the Agriculture Department, and the Environmental Protection Agency—support technology transfer and development assistance in certain areas. Through these U.S. and international organizations, the United States currently contributes about \$9 billion annually in foreign aid assistance (including bilateral aid, food aid, security-related economic support funds, and multilateral aid) to developing countries.³¹

The United States can continue to work through its own bilateral assistance programs and international organizations, as well as through NGOs, to increase the development and transfer of technologies and policies related to energy, family planning, and land use and management practices that provide sustainable alternatives to deforestation and dependence on fossil fuels. General congressional issues regarding developing countries, the U.S.S.R., and Eastern Europe fall into five categories:

- technology transfer and trade;
- building local institutional capacities;
- redirecting energy policies;
- redirecting natural resource policies; and
- redirecting family planning assistance policies.

Technology Transfer and Trade With Other Countries

The opportunity seems ripe for U.S. businesses to increase exports of energy-efficient and renewable energy technologies (as well as CFC-free technologies) to developing countries, since much of the energy infrastructure needed to fulfill development aspirations has yet to be built. For example, a market of \$370 to \$900 billion for electric power equipment is expected over the next 20 years (43). In addition, the U.S.S.R. and Eastern Europe have antiquated infrastructures in place; in these countries, the United States could provide modern equipment, as well as engineering and management services.

The U.S. Government promotes private sector technology transfer to non-OECD countries through government departmental programs (e.g., the Committee on Renewable Energy Commerce and Trade, or CORECT, led by the Department of Energy) and through independent government agencies and corporations (e.g., Eximbank, Overseas Private Investment Corp.). Some programs focus directly on energy technologies, while others are more general in nature.

Options—Congress could attempt to facilitate U.S. trade in renewable and efficient energy technologies in several ways. First, it could expand the financial resources of agencies that fund feasibility studies and project preparation (e.g., A.I.D., U.S. Trade and Development Program) or that provide financing for exports (e.g., Eximbank, Overseas Private Investment Corp.), as well as direct them to focus some resources on specific technology areas. For example, the fiscal year 1990 Foreign Operations Appropriations Act (Public Law 101-167) directs Eximbank to set aside 5 percent of its energy industry export funds for renewable energy projects. The Act also directed A.I.D. to focus on energy efficiency, renewable energy resources, and least-cost energy planning in the development of national energy plans, but additional funds were not appropriated. The Overseas Private Investment Corp. is planning a \$100 million Environmental Investment Fund.

³¹ Compared to other countries, U.S. foreign aid and assistance is a relatively smaller percentage of its GNP. The U.S. portion was 0.19 percent in 1987 and 0.21 percent in 1988. In 1987, the larger Western European countries provided an average of 0.42 percent and Japan provided 0.31 percent; Norway topped the list at 1.1 percent.

Box 1-C—Agencies and Organizations That Can Influence Greenhouse Emissions Abroad

This box briefly describes major U.S. and international “players” looking at climate change. While no organization seems to place a premium on discouraging climate-modifying emissions *for that reason* alone, most are exploring the ways in which their policies and programs may affect climate change. In addition to those listed below, there are also many regional organizations, industry-sponsored consortia, non-governmental organizations, and philanthropic foundations that influence energy and environment policy internationally.

U.S. Government Agencies

The *Agency for International Development* is the lead agency for administering foreign economic assistance, through training, education and research, policy advice, technical assistance, and technology transfer. It is the second largest bilateral aid donor in the world (following Japan), spending over \$2 billion in 1989 on nonmilitary Overseas Development Assistance. Of that sum, about 1 percent (between \$100 to \$200 million) is spent on energy projects. A.I.D. is presently undertaking an inventory of its activities and their related effect on climate change.

The *Department of Agriculture* promotes U.S. agricultural products and coordinates agricultural trade policy with other U.S. agencies. The Forest Service administers timber sales and other activities in national forests and is involved in international forestry issues. The Agricultural Stabilization and Conservation Service administers programs that provide cost-sharing for tree planting and forest management.

The *Department of Commerce* supports U.S. manufacturers and businesses in pursuing overseas export opportunities, collects and disseminates commercial information, and supports other U.S. overseas programs, including the Eximbank and the Overseas Private Investment Corp.

The *Department of Energy* is exploring, as a part of the forthcoming National Energy Strategy, how the U.S. energy program contributes to climate change problems and what technologies may be best suited to mitigate the problems. Among other programs, the department leads the multi-agency Committee on Renewable Energy Commerce and Trade, which promotes trade of U.S. renewable energy technologies.

The *Department of State* has responsibility for overall conduct of U.S. foreign policy. It is the lead agency in negotiating any international agreements and heads U.S. participation in the IPCC process.

The *Department of Treasury* has primary responsibility for U.S. financial policies affecting other countries and for international financial institutions. The department’s Office of Multilateral Development Banks directs the U.S. Executive Directors that sit on the boards of the multilateral development banks (e.g., the World Bank); through the directors, the United States has been active in scrutinizing the banks’ environmental policies. The department examines approximately 400 bank projects per year that might have adverse environmental effects.

The *Environmental Protection Agency* is examining climate change issues (including energy use, deforestation, sea-level rise, CFCs, and methane) in developed and developing countries; it provided technical support for U.S. involvement in the IPCC.

The *U.S. Trade Representative* is charged with formulating overall trade policy and with bilateral and multilateral trade negotiations.

Independent U.S. Agencies/Corporations

The *Export-Import Bank* (Eximbank) is an independent government agency that facilitates exports of U.S. goods and services, particularly in developing countries. Its main programs include direct loans to foreign borrowers, export credit guarantees and insurance, and discount loans. Since it is not a development assistance agency, it must have a reasonable assurance of repayment.

The *Overseas Private Investment Corp.* (OPIC) is a public/private corporation created by Congress that directly finances projects sponsored by U.S. private investors in developing countries and provides insurance against political risks for U.S. private investments in those countries. In 1987, OPIC accounted for over \$8 billion in insurance and \$230 million in directly financed projects.

The *U.S. Trade and Development Program*, housed in the U.S. International Development Cooperation Agency, funds feasibility and planning studies for projects involving export markets for U.S. goods and services; its focus is primarily on large public sector projects.

Continued on next page

Box 1-C—Agencies and Organizations That Can Influence Greenhouse Emissions Abroad— Continued

Multilateral Development Banks (MDBs)

The *World Bank*, the largest multilateral development bank, spent approximately \$15 billion in 1989, including \$3.3 billion in the energy sector. Bank funding for free-standing environmental projects from 1990 through 1992 is expected to be about \$1.3 billion. The Bank recently issued an operational directive outlining procedures for assessing the environmental consequences of proposed projects; it is too early to ascertain its effects. In 1990, the United States lost its position as the largest international aid donor to Japan. This change will reduce the U.S. voting share in the Bank.¹

The three regional MDBs—the *Asian Development Bank*, *African Development Bank*, and *Inter-American Development Bank*—are also major sources of assistance and have a larger role than the World Bank in many countries, for example in Central America. The latter two banks have provided about \$1 billion for energy sector projects since 1988. The *Inter-American Development Bank*, like the World Bank, has established procedures for evaluating environmental impacts.

United Nations Agencies

The *UN Development Program* (UNDP) provides funding and advisory services to developing countries dealing with trade in development technology. It spent approximately \$122 million in 1988 for natural resource, energy, and environment projects.

The *UN Food and Agriculture Organization* (FAO) is active in rural and agricultural research and development, fuelwood and charcoal projects, and forestry issues (including coordinating the *Tropical Forestry Action Plan*).

The *UN Population Fund* (UNFPA) provides technical and monetary assistance to developing countries on population issues. It provided about \$169 million in 1988 for programs in 141 developing countries.

The *UN Environment Program* (UNEP) coordinates environmental activities within the United Nations and led the development of the *Montreal Protocol to Protect the Ozone Layer*. Along with the *World Meteorological Organization*, UNEP coordinated the *Intergovernmental Panel on Climate Change* (IPCC), and is one of the managers of the *World Climate Program*.

The *UN Industrial Development Organization* (UNIDO) promotes industrialization in developing countries and provides assistance to improve industrial use of energy.

The *World Meteorological Organization* (WMO) monitors climate trends, provides a framework for research on global climate models, and facilitates the exchange of meteorological information between countries. Along with UNEP, it plays an important role in many activities involving climate change issues (see UNEP above).

International Science and Natural Resource Organizations

The *International Council of Scientific Unions* coordinates scientific research projects worldwide and works with non-governmental organizations and intergovernmental agencies. It runs the *International Geosphere-Biosphere Program* and is a joint manager of the *World Climate Program* with UNEP and WMO.

The *Intergovernmental Panel on Climate Change* (IPCC), set up in 1988 under the auspices of UNEP and WMO, has been the primary international forum for addressing climate change. Its three working groups were charged with: 1) assessing scientific evidence on climate change; 2) assessing likely impacts resulting from such change; and 3) considering possible response strategies for limiting or adapting to climate change. The groups were chaired by the United Kingdom, U.S.S.R., and United States, respectively. The IPCC's final report was presented to the UN General Assembly in the fall of 1990.

Other organizations focus on agriculture and forestry. The *International Fund for Agricultural Development*, funded by OPEC and OECD members, makes financial resources available on concessional terms for agricultural development in developing countries. The *Consultative Group on International Agricultural Research* is a network of organizations that conducts agricultural research in developing countries. The *International Tropical Timber Organization* provides a framework for coordination between tropical timber producing and consuming countries, and the *Tropical Forestry Action Plan* attempts to enhance donor cooperation and funding in sustainable forestry management.

¹In 1984, the United States had 19.5 percent of the voting power in the World Bank. This was larger than the combined voting power of the next three highest donors.

On December 26, 1990, the United States announced that it will double the number of joint trade-promotion programs in 1991; top priority will be given to helping the U.S.S.R. increase its oil and gas exploration and production capabilities—a means of obtaining needed hard currency. In December 1990, the President also approved credit guarantees for Soviet purchases of up to \$1 billion in American commodities, making the U.S.S.R. eligible for some Eximbank credits and guarantees. However, the continuing upheaval in the U.S.S.R. suggests that the Soviets may be unable to take full advantage of these programs for some time. In addition, the June 1990 trade agreement signed by President Bush will not be submitted to Congress for approval until Soviet emigration laws are revised, so “Most Favored Nation” status cannot yet be conferred on the U.S.S.R.

Second, Congress could continue the process of streamlining restrictions on technology exports to Eastern Europe and the U.S.S.R. This could be done as part of the reauthorization of the Export Administration Act and/or by providing new directions on U.S. participation in the Coordinating Committee on Multilateral Export Controls (COCOM), a nontreaty agreement among 17 Western countries established to harmonize export control policies.

Third, Congress could provide further direction regarding “tied-aid” financing (i.e., linking foreign aid to financing of foreign purchases of U.S. products); such financing runs counter to free market policies but is used by other OECD countries. Congress already appropriated some resources for tied-aid financing to Eximbank, which decided to join with A.I.D. in creating a \$500 million tied-aid pool to leverage financing for exports of U.S. products.

Congress also could consider supporting—with the cooperation of the host countries and perhaps in conjunction with other donor countries—technology research and/or assistance centers in Eastern Europe and developing countries. EPA already is coordinating the establishment of the Budapest Center in Hungary, and A.I.D. has proposed that a Global Energy Efficiency Initiative be developed to promote pricing reform, end-use energy efficiency, cogeneration, and private-sector activities.

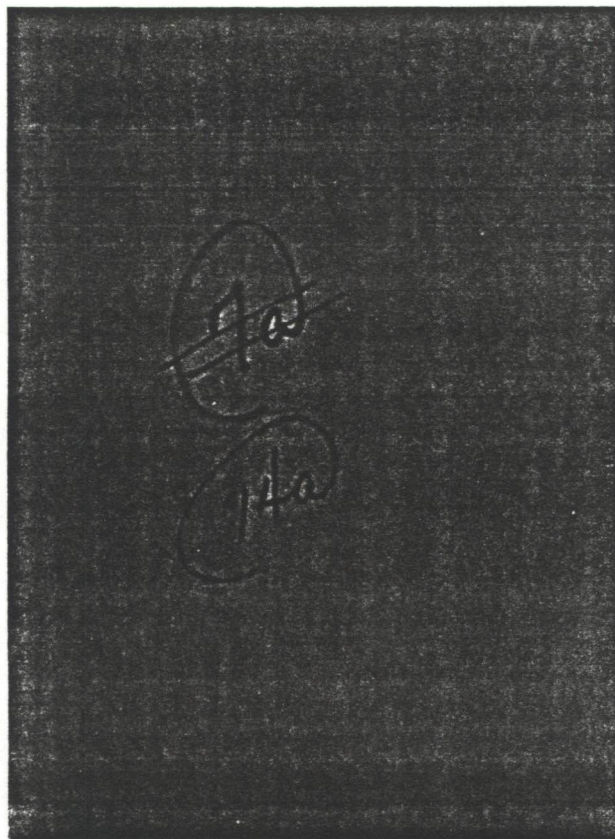


Photo credit: W. Westermeyer

St. Basil's Cathedral, located on the edge of Red Square in Moscow, U.S.S.R. The Soviet infrastructure is both massive and inefficient; investments are needed both in new, more efficient facilities and in retrofitting existing facilities for better energy use.

Building Local Institutional Capacities

Many developing country and Eastern European governmental agencies and NGOs lack the resources and experience needed to plan and implement projects, meet requirements of international donors, and assess the impact of policies and budgets on resources (29, 61). Building the institutional capacities of these governmental agencies and NGOs is critical to the success of energy and natural resource policies and programs. Bilateral agencies such as A.I.D. and multilateral assistance agencies such as the World Bank, United Nations Development Program (UNDP), and United Nations Environment Program (UNEP) already provide some assistance to help build these institutional capabilities.³²

³²The 1989 International Development and Finance Act (Public Law 101-240) requires the U.S. Executive Directors to the multilateral development banks to promote increased assistance and support for non-U.S. NGOs.

Options—Congress could direct A.I.D. to evaluate the effectiveness of its activities in this area. If found lacking, Congress could direct A.I.D. to increase its emphasis on this component. This would likely require increased funding for education and training; environmental information gathering and analysis; conservation planning and policy analysis; and coordination of regional authorities and community-based organizations.

Redirecting Natural Resources Policy

Most developing country economies are based on natural resources (29, 61), many of which have been exploited rapidly during the past few decades. However, short-term revenue gains have come at the expense of the underlying resource base and the long-term economic outlook for some countries. During the 1980s, for example, some countries that once were net exporters of tropical hardwood products found that their forests could no longer maintain a positive export flow. Resource depletion in one area also can have unintended consequences elsewhere—e.g., upland deforestation has increased silting of reservoirs and flooding in many downstream areas.

Many national and multilateral development policies foster resource exploitation, including subsidies for cattle ranching and short-term, low-rent licenses for timber harvesting. Fortunately, direct bilateral and multilateral assistance is beginning to be restructured to promote more environmentally sensitive economic development, although much more needs to be done. A.I.D., the World Bank, the Inter-American Development Bank, and UNDP, among others, are all developing or have recently adopted environmental assessment guidelines.

In addition, the food sector in developing countries is a major direct source of greenhouse gas emissions, particularly methane from cultivating rice and raising livestock. Most people in developing countries also rely on biomass fuels to meet their cooking and heating needs; in some cases, this has led to localized deforestation (from cutting fuelwood) or loss of soil nutrients (when dung and agricultural residues are used as fuels).

Options—Congress could influence what happens in tropical forests through several means:

1. encourage continued change in multilateral development bank (MDB) policies. For example, Congress should continue to review MDB

progress in implementing environmental impact assessment procedures, and in making loans contingent on host country development policies (e.g., eliminating subsidies that encourage inappropriate cattle ranching and poor logging);

2. increase funding for A.I.D. projects on agroforestry, sustainable agriculture, natural forest management, and nontimber forest products;
3. direct A.I.D. and the State Department to help make the Tropical Forestry Action Plan and the International Tropical Timber Organization, both of which have been severely criticized lately, more effective vehicles for promoting forest conservation and improved commercial forest management;
4. support development of a global forestry conservation protocol;
5. address family planning, land reform, and debt reduction issues; and
6. provide directions for U.S. participation as a donor in the new Global Environmental Facility, established in November 1990 (and coordinated by UNEP, UNDP, and the World Bank) to provide funding for projects on greenhouse gases (e.g., non-CO₂-emitting energy sources, energy efficiency, reforestation, CFC substitutes), biological diversity, and marine pollution.

The United States also can have some influence on emissions directly emanating from the food sectors of developing countries. Some of the policies described above for tropical forests, for example, would specifically involve agricultural projects. U.S. bilateral aid programs could attempt to introduce more efficient (in terms of greenhouse gas emissions) agricultural practices; this must, however, be carefully tailored to fit existing social traditions and economic conditions. At the same time, Congress could help fund, through U.S. bilateral aid programs and through multilateral lending organizations, various research organizations (e.g., the Consultative Group on International Agricultural Research centers) so that they could expand existing programs in developing countries to include methane reductions from livestock.

Redirecting Energy Policies

A.I.D., United Nations agencies, and the World Bank's Energy Sector Management Assistance Program provided over \$200 million in fiscal year 1988

for energy-related grants and assistance; in addition, over \$6 billion was provided for energy-related loans. Including technical assistance from other countries and technical support derived from portions of the loans, total technical assistance for energy may be on the order of \$500 million per year—less than 1 percent of total annual energy expenditures by developing countries (28).

Until recently, much of this assistance, particularly that from bank loans, focused on conventional energy supply projects such as large hydroelectric dams and coal plants. In 1989, for example, World Bank lending for solar, geothermal, and wood-based energy projects amounted to less than 1 percent of its energy sector funding. Similarly, energy efficiency has not been a significant focus (57).

Options—Congress could redirect U.S. (and attempt to redirect multilateral) energy policies away from large-scale energy projects, such as oil- and coal-fired powerplants, and toward energy efficiency, renewable technologies, and least-cost planning. Congress could ensure that A.I.D. and the Department of Treasury have sufficient resources allocated to comply with the provisions of the fiscal year 1990 Foreign Operations Appropriations Act (Public Law 101-167), which is a step in this direction.³³

Congress also could consider expanding A.I.D.'s Office of Energy program, which provides assistance to developing countries in formulating strategies for price reform. Similarly, it could encourage A.I.D. and the MDBs to work with the Eastern European and Soviet governments to initiate reforms in pricing policies.

To overcome agency reluctance to fund small projects, Congress could promote "bundling"—combining several small energy projects into one large project that supplies a substantial amount of energy and involves financial scales customarily handled by large development banks (e.g., \$5 million or more). Public Law 101-167 instructs the Secretary of Treasury to work with borrowing countries to develop loans for bundled projects on end-use energy efficiency and renewable energy.

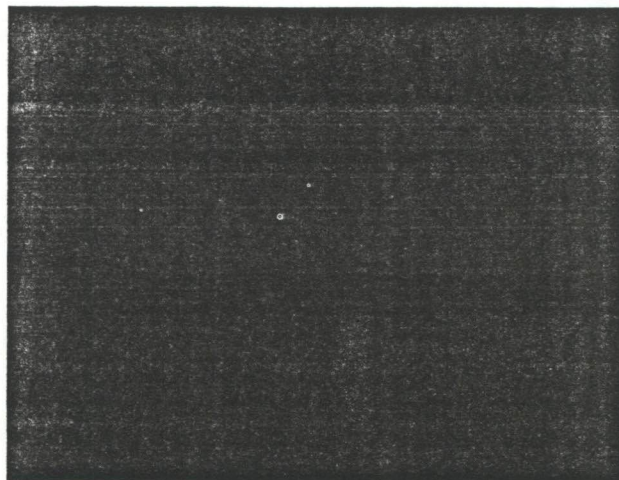


Photo credit: African Development Foundation

The juxtaposition of old and new technology: Guide leads oxen around solar cells at water pump, part of the Basaisa Project, Egypt.

Congress also could promote greater funding by smaller development organizations.³⁴ For example, the Inter-American Foundation (IAF) and the African Development Foundation (ADF) work closely with the larger Inter-American and African Development Banks to fund or implement community-scale, grassroots development programs. These smaller foundations generally have a greater ability to examine smaller scale, modular programs than do their parent organizations, but to date they have rarely been involved in energy projects.

Population Policy Issues

The U.S. Government supported the right of couples worldwide to control the number and spacing of their children beginning in the mid-1960s; under the Foreign Assistance Act as amended in 1965, family planning is considered an important contributor to economic development and improved health and nutrition (11, 46). Most nations now firmly support family planning assistance.

However, at the world population conference held in Mexico City in 1984, the United States reversed its historic position by declaring that population growth was a "neutral" factor and that economic

³³Public Law 101-167 directed A.I.D. to identify key middle- and low-income countries in which energy and forestry policies could significantly reduce greenhouse gas emissions. Four countries—China, Brazil, Indonesia, India—appear to emit as much greenhouse gases as the other developing countries combined. Other countries considered strong candidates for attention include Poland, Egypt, Mexico, Thailand, Colombia, the Philippines, Bangladesh, Nigeria, and Zaire. A.I.D. currently does not provide direct assistance to China, Poland, or Mexico.

³⁴Other mechanisms to facilitate private-sector trade in energy-efficient and renewable energy technologies were discussed above (see "Technology Transfer and Trade With Other Countries" above).

development could compensate for any population level. Associated with this change were new restrictions on A.I.D. Thus, two important international population assistance programs lost U.S. funds—the International Planned Parenthood Federation at the end of 1984, and the United Nations Population Fund (UNFPA) in early 1986. Moreover, U.S. funding earmarked specifically for A.I.D.'s main population account has declined in recent years, from \$290 million in fiscal year 1985 to an estimated \$218 million in fiscal year 1990 (44).³⁵

Some people argue that family planning assistance should be reduced or eliminated as a part of international aid (11). However, the UNFPA (38) concluded that more assistance is needed if the world's population is to stabilize—sometime early in the 22d century—at a level of 10 or 11 billion people (this is the UN's "mid-range" projection). In particular, more assistance is needed to eliminate the large "unmet need" for family planning services; the UNFPA estimates that the additional direct cost of providing contraceptive services would likely be less than \$1 billion per year, but that several billion dollars per year also are needed for a range of backup activities (e.g., education and communication, women's programs, research and evaluation).

Any global warming policies thus must include decisions on the U.S. role in international family planning. As indicated above, this issue has been and still is highly contentious. Nevertheless, Congress could reconsider the appropriate level of funding, how funds should be distributed, and under what restrictions or sanctions they should be distributed.

CONCLUDING REMARKS

Currently, the United States and other industrialized countries (including the U.S.S.R. and Eastern Europe) contribute up to two-thirds of all greenhouse gas emissions, mostly from fossil fuels used to power these highly energy-consumptive societies. There are opportunities for industrialized countries to stabilize or decrease their annual emissions of greenhouse gases. However, some sectors in Eastern Europe and the U.S.S.R. are also likely to increase CO₂ emissions still further. In the U.S.S.R., for example, there is only 1 car for every 25 people. In Poland and Hungary, living areas average 10 to 15

square meters per person as opposed to the U.S. average of 60.

Developing countries currently contribute at least one-third of greenhouse gases, mostly from land use changes and practices (e.g., tropical deforestation, rice cultivation, and livestock). But, CO₂ emissions will surely rise for developing nations still building an industrial base, just beginning to supply electricity to their people, and increasing the use of modern methods for cooking, heating, and transportation. Efficiency investments, while crucial to growth, can only decrease the need for new power; they can not eliminate it. Thus, if current trends continue, the greenhouse gas contribution from developing countries will grow quickly within a few decades to equal or exceed those from the developed world.

Social, cultural, and economic differences will be of paramount importance in any international negotiations that take place regarding climate change. For example, reductions in per-capita living standards (which reflect many of the above factors) are not a desirable policy goal, especially for countries that are well below the average. A goal for these countries is to decouple greenhouse gas emissions from desired economic growth. Conceptually, there are several ways to achieve this—switching to nonfossil fuels (e.g., solar, nuclear), increasing the efficiency of energy and materials use, reversing tropical deforestation, and implementing sustainable use of forest and agricultural resources. Moreover, no examination of the nature and dynamics of development, natural resource and energy use, and environmental protection can omit consideration of population growth nor, for that matter, issues such as foreign debt.

Options for the U.S. Congress are limited when dealing with the actions of other sovereign nations. However, Congress could directly encourage reductions in greenhouse gas emissions by adjusting aid policies and processes to take greenhouse gases into account. It could also encourage development and transfer of appropriate technology, encourage corporate ventures into nongreenhouse gas emitting technologies, and work towards adoption of international protocols.

³⁵These are actual or estimated expenditures and vary slightly from official authorizations. Total funding for population-related projects was slightly higher, because some family planning projects also are funded under other accounts.

The United States is the world's leading industrial society and largest single producer of CO₂. Major reductions of CO₂ and other greenhouse gases will require significant new initiatives by the Federal Government, the private sector, and individual citizens. The economic cost of these initiatives could be considerable. And many of these efforts must be sustained over decades.

OTA's analyses suggest that if the United States enacts a "Moderate" set of low-cost technical options, CO₂ emissions in 2015 will be about 15 percent higher than 1987 levels. If the United States enacts a "Tough" package, CO₂ emissions in 2015 could be as much as 35 percent below 1987 levels.

But, if the United States takes no action, emissions could increase by 50 percent in the next 25 years. This would continue the trend seen in the 1980s. Since the last two oil crises in the 1970s, concerted efforts to conserve energy have dwindled on all fronts—from government research and development to personal purchasing decisions. Many other goals diluted these efforts as energy prices dropped in the 1980s.

Now, as we begin the 1990s, several overarching issues loom on the horizon—energy insecurity, as demonstrated by the events in the Persian Gulf; domestic environmental problems as evidenced by numerous oil spills and persistent air pollution; global environmental degradation such as the Antarctic ozone hole, and tropical deforestation; and sustainable development as the Third World struggles to bring burgeoning populations into the industrial age and compete in world markets.

All of these concerns are difficult to control unilaterally, yet the changes they could induce in the average U.S. citizen's life over the next few decades may be profound. However, a common thread runs through these issues and can serve as an overall national goal—efficient energy use and conservation of natural resources. Ultimately, achieving this goal can help to sustain industrial output, competitiveness, and our overall quality of life. However, getting there will not be easy. Many of the options identified in this report can help move us in this direction while simultaneously reducing greenhouse gases.

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February 7, 1991

MEMORANDUM FOR D. ALLAN BROMLEY

FROM: NANCY G. MAYNARD *NH*

SUBJECT: Framework Convention Negotiations Update

Attached is a summary of the first three days of the Framework Convention negotiations.

global change file

Withdrawal/Redaction Sheet

(George Bush Library)

Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
01. Summary	Summary of Framework Convention Activities, 4-7 February 1991 (3 pp.)	2/7/91	(b)(1)	

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Office: Science and Technology Policy, Office of (OSTP)
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Subseries: Global Climate Change Files
WHORM Cat.:
File Location: Global Warming: NOORDWIJK [2 of 2] [1991]

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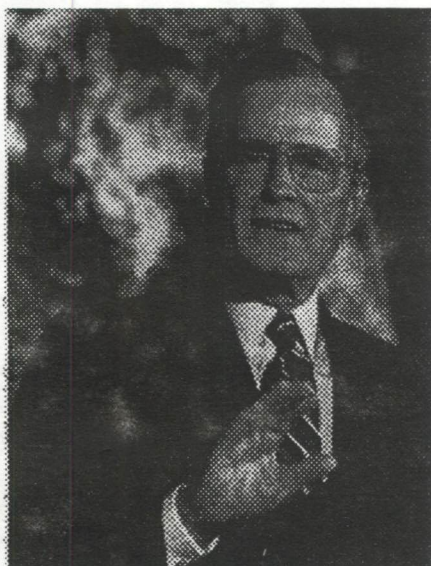
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(b)(9) Release would disclose geological or geophysical information

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Eco has been published by Non-Governmental Environmental Groups at major international conferences since the Stockholm Environment Conference in 1972. This issue is produced cooperatively by groups attending the Intergovernmental Negotiating Committee on a Framework Convention on Climate Change, Westfields Center, Chantilly, Virginia



George Bush in his brochure — lips moving faster than policy.

Climate Change Strategy US Says No With a Smile

by Eco Reporter

The pollution policies of the United States, which hosts world climate negotiations, yesterday attracted renewed criticism from environment groups and governments of countries vulnerable to sea level rise.

Michael Deland, Chairman of the US Council on Environmental Quality addressed the opening session of the Climate Convention Negotiations (Intergovernmental Negotiating Committee for a Framework Convention on Climate Change) at Chantilly near

Continued on back page, column 1

CLIMATE TALKS START IN RECORD WINTER HEAT WAVE

by Eco Staff

Temperatures in Washington DC broke a 108 year old record on the day that negotiations on global warming began. At Washington's National Airport, temperatures hit 70°F (21°C) breaking a record set in 1883, 68°F (20°C) according to the US National Weather Service. Temperatures at Dulles Airport reached 70°F (21°C) topping the previous high for February 4th of 53°F (12°C) by 17°F (10°C).

One day's record 'proves' nothing but the run of hot years has also now created a hot decade. In fact, 1990 set another global temperature record. Three different methods of measuring the surface temperature of the earth concluded that 1990 was the warmest

Continued on page 6, column 2

LAWYERS DRAFT CLIMATE CONVENTION

by Eco Staff

Debate began on a legal draft treaty on climate change yesterday, as delegates from over 200 countries gathered at Chantilly, Virginia to begin negotiations on climate protection. A draft was handed over to them by the IPCC Topic Group

Continued on page 6, column 1

Environmental NGOs —

- OECD nations should reduce energy CO₂ 20% by the year 2000.
- Industrialized countries should end deforestation and the destruction of all primary forests by 2000.
- Developing countries should phase out deforestation of primary forests as rapidly as possible, in most cases by 2000.

Full NGO Statement to Climate

Conference—pages 2-3.

CONTENTS

NGO Statement 2,3

Leader 4

Opinion and Analysis 4,5

View From Tuvalu 5

News 1,6,8

Quote of the Day 6

Who's Who 8

• This is an eight page Eco.

STATEMENT BY ENVIRONMENTAL NON-GOVERNMENTAL ORGANIZATIONS PRESENT AT THE INTERGOVERNMENTAL NEGOTIATIONS ON A CLIMATE CHANGE CONVENTION

The following statement reflects the broad consensus of the Climate Action Network, representing more than 25 environmental non-governmental organizations from over 40 countries.

In light of the conclusion of the Intergovernmental Panel on Climate Change (IPCC) that immediate global CO₂ emissions reductions of more than 60% would be required to stabilize atmospheric concentrations of this gas at current levels, this statement identifies the minimum elements that should be contained in a climate change convention.

Industrialized countries bear the main responsibility for the high concentration of greenhouse gases in the atmosphere. To reduce the chances of potentially catastrophic climate change and to enhance the ecological security of the planet, prompt and decisive action must be taken now. To be effective, a climate change convention should include the following specific commitments:

Goals

The Convention should set the objective of stabilizing atmospheric concentrations of greenhouse gases at levels low enough to limit future damage to human communities, agriculture, ecological systems, biological diversity, and coastal communities. Based on the best available scientific information, the peak atmospheric concentration of carbon dioxide, the most important anthropogenic greenhouse gas, should not be allowed to exceed approximately 400 parts per million. The peak level for all greenhouse gases, including carbon dioxide, on a carbon dioxide equivalent basis, should not be allowed to exceed approximately 475 parts per million.

These levels for peak atmospheric concentrations are based on the scientific and technical investigations of the Intergovernmental Panel on Climate Change and the Stockholm Environment Institute. These levels could limit the long term temperature increase to about

one to two degrees Celsius from pre-industrial levels and could hold the maximum rate of temperature increase to 0.1 degree Celsius per decade. In addition, potential sea-level rise could be limited to 20-50 centimeters above current levels, and maximum rate of rise of between two to five centimeters per decade. Even if temperature change and sea-level rise can be held to these levels, there may be serious ecological damage.

Substantive Elements

The following elements to be included within a convention are essential to establishing a process that will reach the goals described above.

1) Industrialized Countries Reduce CO₂ Emissions

Industrialized countries, with 25% of the world's population, are responsible for 75% of current global emissions of CO₂ from the energy sector. This fact and the dominant role of this source makes reductions in CO₂ emissions from the energy sector in industrialized countries the most important action needed to combat global warming. OECD nations should have a binding obligation to reduce energy-related CO₂ emissions by at least 20% below 1988 levels by the year 2000. Other industrialized nations should achieve this target by the year 2005. Deeper cuts in CO₂ emissions by industrialized countries will be required after these dates.

2) Developing countries slow emissions growth

Developing countries, with 75% of the world's population are responsible for 25% of global CO₂ emissions from the energy sector. These emissions are expected to grow to meet legitimate development needs. In order to remain within the global CO₂ target specified under the "Goals" section above, developing countries would have to limit their aggregate CO₂ emissions so that they

increase by no more than 50% over 1988 levels by 2005. The incremental costs of achieving this target should be borne by the industrialized countries.

The development path and norms of the industrialized world have been extended to developing countries through a package of international and national initiatives, policies and financial assistance. As a result, many of these countries have fallen into a cycle of debt and dependence from which they are unable to emerge. This plight, and the wide variations among developing countries, compel a new set of initiatives guided by new principles to enable the developing world to control its CO₂ emissions while realizing aspirations for a better quality of life for its people.

3) Biomass

Biomass cultivation and use can be both a major source and sink of CO₂. While establishing policies to address biomass, we must not destroy the natural carbon sinks in forests, oceans, and elsewhere.

Industrialized countries should end deforestation and the destruction of all primary forests by 2000. Countries with less than 15% of original primary forest should halt deforestation of primary forests by 1995. In addition, a net increase in forest cover through national reforestation and afforestation goals should be sought by 1995.

Developing countries should phase out deforestation of primary forests as rapidly as possible, in most cases by 2000. Countries forced to make a large shift from timber to non-timber based industries should be eligible for additional financial incentives. Conservation strategies designed to meet this goal must recognize the many forces contributing to deforestation such as agriculture, population pressure, trade barriers and government subsidies which encourage the clearing of forests. These strategies

should promote the transition to non-destructive models of forest use and establish reforestation and afforestation goals to regenerate degraded lands.

Any mechanisms linking forests to their carbon sink potential must include safeguards to protect biodiversity, cultural diversity and other ecosystem services.

4) Methane

Methane provisions should require countries to virtually eliminate emissions from natural gas transmission lines, coal seams, and landfills while "best practices" (e.g. conversion of agricultural and animal waste to biogas) should apply in the agricultural sector.

5) Funding Mechanisms

A climate change fund, comprised of new and additional resources, must be established by industrialized countries to enable states to meet the aforementioned commitments. Priority for these funds should be given to the most cost-effective options for reducing greenhouse gas emissions. In the longer term, technology-exchange mechanisms and market incentives, possibly including emissions trading, will need to be developed. Mechanisms for provision of technical assistance are also essential.

This funding mechanism must ensure public participation. Government agencies, NGOs, and citizens groups all

have an essential role to play in determining how these funds are used. Safeguards should be established to prevent the export of outmoded technologies.

6) Greenhouse Gas Plans

Each country should be required to prepare a report on projected greenhouse gas emissions and a plan identifying policy options for their control. Such plans should incorporate least cost planning, urban planning and the elimination of subsidies to greenhouse gas-emitting activities. Countries should begin to prepare such plans before a convention enters into force. Interim funding should be made available to countries which require such assistance for preparation of such plans.

7) Institutional Structure

An effective institutional structure, including the establishment of an adequate Secretariat to ensure data collection, enforcement, assessment, monitoring and reporting, together with an equitable decision-making process, is essential. In addition, as with funding mechanisms, the development objectives of all sectors of society must be incorporated into institutional structures by means of complete public participation.

A process must be established to set

long term goals and scenarios in order to define future greenhouse gas budgets consistent with the global atmospheric concentration limits discussed above, and to apply such budgets at the national level.

Organizational Issues

1) Working Groups

Four working groups should be established: energy, forests, technology transfer/financial assistance and institutional issues. Close coordination between working groups on forest and energy and on financial/technology assistance will be essential. The Energy Working Group should consider not only control measures for CO₂ and methane, but also promotion of renewable energy. A Technology Transfer/Financial Assistance Group should consider requirements for adaptation. The Institutional Working Group should identify both institutional requirements of a convention and desirable links to other relevant international institutions and agreements.

2) Rules of Procedure

The Rules of Procedure should provide for broad access to the negotiations by NGOs, including working groups, and the right of NGOs to speak and to present papers.

Chantilly

Chantilly was delighted to have been invited to a reception at the tasteful Westfields International Conference Center on Sunday. Chantilly met a number of quite charming civil servants [blue collar workers] from several continents, apparently at some sort of convention to do with the weather, which, Chantilly is pleased to report, has since been unseasonably warm. Yesterday groundhogs were gambolling, bluebirds were tripping from bough to bough, and chickadees were squeaking in the bushes.

The spring-like mood of nature didn't seem to have infected some of the visitors however. Chantilly met a very downcast white haired Swedish gentleman while taking a ride in the gilded revolving door,

and a doctor from Egypt who also seemed to be in two minds about the gathering. All in all though, the crowd at Westfields seems pleasant enough and the food is good, although it's difficult to work out what their convention is all about because it's only described as an Inter-governmental Negotiating Committee: obviously it's some big secret that the Government wants to keep under wraps.

Chantilly has also heard that Westfield's next venture will be something called a 'climate change theme park'. Popular features are expected to include solar bumper cars, a perpetual motion waterfall, and a cold fusion buffet. What a shame that there's no public transportation access.

Chantilly learnt from one of the red-coated Westfields footmen - individually recruited in Orlando - that the environmental 'NGOs' (whatever they

may be) attending the same convention, are worried that they may be excluded from full participation in the negotiations. Apparently there is something known as the 'UNCED' which takes place down in Brazil in 1992, and they fear that the civil servant types will try to keep them out. It's all a bit obscure but there must be money in it somewhere and Chantilly is convinced that these conventions are good for the local economy. Apparently the current event cost the US Government over \$2m to hold, and Chantilly was interested to meet several engaging representatives of the oil and coal industries, including one lady who seemed to be on something called 'the Australian delegation': perhaps they've discovered coal and oil reserves under Westfields?

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LEADERSHIP AND INACTION

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

greenhouse gas emissions.' These are the opening lines of the United States of America's *Climate Change Strategy*, subtitled *An Action Agenda*.

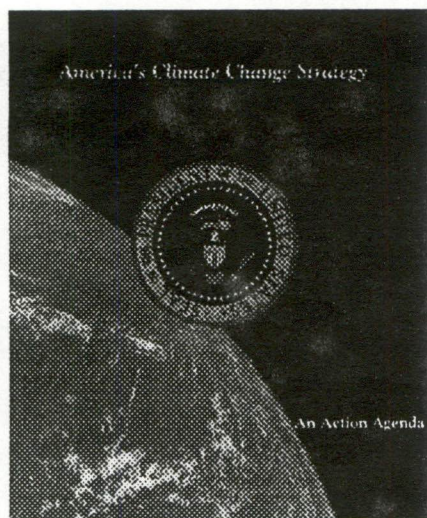
The document stresses that to be successful, a global climate change strategy must be comprehensive (taking in all gases, sources, sinks), long term, flexible and integrated. Few could much disagree with these thoughts, although they are scarcely original. But they do not constitute leadership or action.

Given that rhetoric and attractive design do not in themselves make a case for leadership, the US policy document can be judged only on its commitment to action. Top of the list comes eliminating CFCs: a transparent attempt to claim credit for actions which all major countries are undertaking under the Vienna Convention, although others do not try to have them double-counted. Next come Clean Air Act measures born not from leadership on the greenhouse

effect but from environmentalist pressure over acid rain. And so on.

'The United States' it declares under the picture of the President, 'is taking action'. And as host to these negotiations and the world's number one greenhouse polluter, the US should be leading the way into action. But it is not. The US has no firm national target to reduce carbon dioxide. Or methane. It is falling yet farther behind countries such as Germany, the Netherlands, Australia and Austria that have gone farther and faster and whose policies are tighter and clearer.

Although this document may be a welcome sign of a warm up, the US is not up and running on the climate issue. In truth it is not yet even walking. George Bush's 'strategy' is mainly an exercise in *laissez faire* in which windfall policies and serendipity are repackaged as concrete action. It is the sort of exercise the American body politic can take while lying down.



Looking Through 'America's Climate Change Strategy'

by Richard N. Mott, Treaties Officer,
WWF International

*America's Climate Change Strategy—
An Action Agenda*, released today at the
opening negotiations on a global warming

OPINION AND ANALYSIS

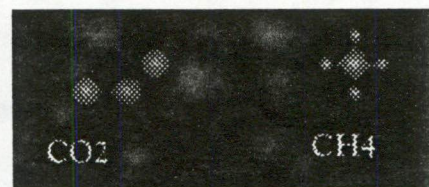
treaty, signals a significant and positive shift in tone in the Administration's stance on the climate issue. The document is the most elaborate statement of US climate policy to date, and, as incorporated into welcoming remarks of the first session of the Climate Convention negotiations, seems intended to recast the US as a supporter of action on global climate change.

The US strategy, however, sets no basic objective to limit global climate change. Instead it contains a series of diverse measures with climate benefits, but which were taken for reasons unrelated to climate change. Indeed, the 'strategy' relies almost entirely on US commitments to cut ozone-depleting chlorofluorocarbons (CFCs), already agreed to under the Montreal Protocol. Stripped of the CFCs reductions, the strategy actually allows a continued increase in US emissions of all other greenhouse gases taken together, up to the end of the century. This is largely due to a 15% increase in US emissions of CO₂, the single most important

greenhouse gas.

The US position's central philosophical premise is the so-called 'Comprehensive Approach'—which assigns a warming index to each of the several greenhouse gases. Nations can then be given an integrated greenhouse gas target, which they are free to meet by reducing emissions of those gases that are easiest or least costly to control.

Despite its theoretical appeal, the Comprehensive Approach has received a mixed review by the world environmental community which fears the approach will be used as a political device to 'double-count' CFCs reductions already committed, and to divert attention from the more urgent task of controlling CO₂ emissions. As released today, the US Strategy



unfortunately bears out both concerns.

A better interpretation of comprehensive action would be to mandate reductions in emissions of *all* greenhouse gases, reserving the flexibility inherent in the approach for implementing aggressive reductions obligations; not as a means of avoiding them at the outset. The long lead time needed to make infrastructural changes in the energy and transportation sectors makes CO₂ a priority candidate for early action.

America's Climate Change Strategy is replete with graphs and charts but they fail to mention the following salient facts:

- The US remains the world's greatest emitter of CO₂. Its CO₂ emissions are more than 19 metric tonnes per capita—a figure roughly twice per capita emissions in the United Kingdom, France, the Federal Republic of Germany, the Netherlands, or Japan. (Chart 22 at p. 15 obscures the great divergence in the various countries' emissions baselines.)

- High US emissions in the transportation sector are not a function of low population density. Chart 26 at p. 18 and accompanying text attribute high US transportation emission to low population density compared to Western Europe and Japan. In fact, US emissions in areas of comparably dense population still run 2-3 times higher than Europe—due in part to low fuel pricing here, urban settlement patterns, and lack of effective public transportation.

- Stabilizing global emissions is inadequate to prevent ever-increasing atmospheric concentrations. Real reductions in emissions are needed. Were the US simply to stabilize its overall greenhouse gas emissions, it would still lag far behind those industrialized countries that have pledged to control CO₂ as well as eliminate CFCs.

The US 'strategy' released today is the US's most complete acknowledgement that climate change is a threat significant enough to justify action now. To this extent it is a step forward. Unfortunately, the content of the strategy lacks a core commitment to address climate change, relying instead on actions taken in pursuit of other objectives. While the measures listed in the US program demonstrate the extent to which a climate policy can be harmonized with other environmental and social programs, they

are no substitute for a real commitment to protect the global climate. The true measure of US commitment to effective action on climate will be support for a treaty to be signed in 1992, and one that mandates significant and near-term reductions of CO₂ emissions by the industrialized countries.

** WWF-International is based in Switzerland.*



VIEW FROM TUVALU

Saving Ghana's Forests

By Elizabeth Acheampong, Friends of the Earth - Ghana

Climate change will affect all countries and the potential impact on Ghana could be disastrous. Ghana's socio-economic progress is heavily dependent on agricultural performance: the Sahel desert is already encroaching upon the northern part of the country, and towns in low-lying coastal areas are threatened. There has been a general small, but consistent increase in dryness of the environment.

Ghana's emission of greenhouse gases is low. The country is not industrialized, and hydro electric energy generates our power. Because Ghana depends on rainforest agriculture, preservation of the forest as a sink for carbon dioxide will be the primary way for Ghana to help address global warming.

We have come to this conference expecting to see a negotiated framework whereby the industrialized countries, who have been causing the problem of climate change, would commit themselves to substantial reductions in carbon dioxide emissions.

We can contribute towards reducing climate change by reducing activities which diminish our forest. In addition this could preserve biodiversity, prevent

drought, and improve water supplies.

The forestry sector is a key component of Ghana's economy because of its ability to directly or indirectly control most other sectors. It governs regional survival. The government established a Forestry Department in 1909 to create a resource base through the demarcation and mapping of forest reserves and the enactment of laws and regulations which give the timber resources legal protection. At that time, the population was about one million. Since then, the national population has grown to 4.6 million in 1957, 8 million in 1970, and 12.5 million in 1984. This represents a twelve fold increase in population since the demarcation of the forest reserves. People have rampantly encroached upon demarcated forest illegally, sometimes establishing whole new towns within forest reserves.

Our agricultural practices have transformed forest cover into semi-savannah and increased the incidence of bush fires. As the population increases, the slash and burn shifting cultivation practices have taken their toll on the land. Fallow periods on agricultural land continue to shorten.

Ghana has three main export commodities—cocoa, precious minerals, and timber. As the cocoa price continues to fall, there is added pressure to produce more timber to increase export earnings to cater for foreign debts and to meet our balance of payments.

We need the forest for survival. However, immediate pressing problems, such as dealing with external debt and our inability to meet balance of payment needs, make it imperative that we export timber and other forest products.

We cannot leave the forest alone. But with financial and technical assistance, we can reduce, if not halt, deforestation. We can also increase forest cover through forest management and afforestation programs.



VIEW FROM TUVALU

Continued from page 1, column 2

on legal measures. The legal draft framework for a Convention on Climate Change has been submitted to the delegations as a basis for discussion and the framework into which other substantive elements could be placed. The draft is simply a skeleton of an agreement in lawyers language and is still far from the sort of agreement which countries hope to reach in June 1992 at the United Nations Convention on Environment and Development in Brazil.

Environmental observers acknowledge that negotiation of legal language will be a long process and that any initial draft will be substantially changed. But they fear that the current draft starts off weak and may be further watered-down. "This draft clearly lacks sufficient ambition and needs substantial change to implement the conclusions of the IPCC", says Annie Roncerel of Climate Network Europe in Brussels.

The present draft is essentially an adaption of the 1985 Vienna Convention for the protection of the Ozone Layer. It mirrors its structure (both consist of 21 Articles) and echoes, almost to the word, the obligations of the Vienna Convention. Thus, thereby relies on general obligations (Article 2) to 'cooperate' in exchanging information, to develop 'appropriate mechanisms', and proposes that parties 'adopt measures and strategies' to limit climate change. Any concrete obligations for the reduction of greenhouse gas emissions (CO₂ is not mentioned) would, under this scheme, be left to subsequently concluded protocols, much as the Montreal Protocol followed the Vienna Convention.

Roncerel sees Article 17, 'entry into force,' as another example of the lawyers setting their sights too low. Paragraph 1 of this section provides that the Convention is to enter into force on the 90th day after it has received the 40th signatory. Paragraph 2 lays down the same condition for Protocols subsequently adopted. By contrast, the 1979 Convention on Long-Range Transboundary Air Pollution required the signature of only 24 parties to enter into force. Yet, three years after it was

ready for signature, only 12 parties acceded. Its entry into force was slow. The Vienna Convention - regarded by most governments as the most successful environmental treaty - moreover required 20 signatories.

Other time limits contained in the draft differ from those included in the Vienna Convention. Article 6(2), for example, permits an Extraordinary Conference to be convened, provided a request gains the necessary support from other parties, within a period of three months. The corresponding time frame within the Vienna convention is 6 months. Similarly, Article 9, dealing with amendments of the Convention and with Protocols, calls for a two-thirds majority vote, where the Vienna Convention demands three quarters.

Annie Roncerel concludes that in its present form "not only would such a Climate Convention not contain any substantial commitments, but its adoption will be excessively delayed and it will lack the necessary flexibility to respond to new issues".

Countries delegates have to work hard to improve it and start negotiating on a real draft Treaty. Compromise should not come at the beginning of the negotiations. That comes, if at all, at the end!

Quotes of the Day

"America's Climate Change Strategy includes actions that will result in U.S. greenhouse gas emissions in the year 2000 being equal to or below 1987 levels."

"As President Bush has written in a letter being delivered to each of you today: 'We are prepared to work openly, diligently, and respectfully toward achieving the goal of completing a climate change convention in time for its signature at the United Nations Conference on Environment and Development in June of 1992.'"

"We are united in the belief that despite large uncertainties, the potential threat of climate change justifies taking action now."

"In the final analysis, it is progress that counts."

Michael R. Deland Chairman, US Council on Environmental Quality

"A record-breaking day for Washington, D.C., in February"

Professor G.O.P. Obasi Secretary-General of the World Meteorological Organization

Record Temperatures — Continued from page 1, column 2

year on record. The results were released in January, 1991 by scientists from the British Meteorological Office, the NASA Goddard Institute for Space Studies (GISS) and the Air Resources Laboratory of the US National Oceanic and Atmospheric Administration (NOAA).

The British Meteorological Office data is based on measurements of land and marine temperatures. The GISS measurements are land surface only and the NOAA data set is based on balloon based radiosonde network measuring temperatures at all altitudes through the atmosphere. Both the British and GISS records extend for about a century or more and the NOAA data set is thirty years old.

In releasing the data all the scientists emphasized that it was more important to play attention to multi-year trends than to the results of a single year. The 1980s was the warmest decade in the available records.

The scientists noted that 1990 was warmer than any other year despite the absence of El Nino, a climatic event that occurs every few years in the Pacific Ocean that adds significantly to global temperatures. It is expected that if an El Nino were to occur global temperatures could easily exceed the record of 1990.

Also noted was the fact that a strong warming trend is evident in the record in recent years. The NOAA record, for example, indicates that the 1980s were about .3°C above the 1960s.

Scientific Background to the Negotiations

Dr. Daniel A. Lashof, Senior Scientist of the Natural Resources Defense Council reviews the role of science in bringing the world community to the start of climate negotiations.

The June 1988 Toronto Conference on the Changing Atmosphere, warned that 'humanity is conducting an unintended, uncontrolled, globally pervasive experiment whose ultimate consequences could be second only to a global nuclear war,' and called on the world to cut CO₂ emissions from fossil fuel combustion 20% by 2005. In the last two years the declaration of this ad hoc group of scientists, environmentalists, and policy makers has been strongly reinforced by the Intergovernmental Panel on Climate Change (IPCC), the Second World Climate Conference, and the Stockholm Environment Institute.

The IPCC, which was established in the fall of 1988, completed its *First Assessment Report* last summer. The first working group, chaired by Dr. John Houghton, Chief Executive of the British Meteorological Office, has provided the most authoritative scientific assessment of global warming ever conducted. Preparation of the report involved most of the active scientists working in the field: 170 scientists from 25 countries contributed sections and 200 others served as reviewers.

Under a "Business-as-Usual" emissions scenario the IPCC predicts that the Earth will be 3-6°C (5-10°F) warmer than preindustrial times within a century. Conditions would be warmer than any encountered during the last 150,000 years by the middle of the next century. The IPCC also examined a scenario in which warming would be limited to 1-3°C (2-5°F) by reducing CO₂ emissions 50% by the middle of the next century and controlling other greenhouse gases.

Detection

A great deal of public attention has focused on observed temperature changes over the last century. The IPCC concluded that the earth has warmed significantly, by 0.3-0.6°C (0.5-1.0°F), and that 'the size of this warming is broadly consistent with predictions of climate models, but it is also of the same magnitude as natural climate variability. Thus the observed increase could be largely due to this natural variability; alternatively this variability and other human factors could have offset a still larger human-induced greenhouse warming. The unequivocal detection of the enhanced greenhouse effect from observations is not likely for a decade or more.' This carefully worded statement underscores the danger of a wait-and-see policy. It makes no sense to wait for 'unequivocal detection' while we see ourselves being committed to ever greater warming. The scientific consensus that this warming will occur is clear, regardless of uncertainty over what has caused the warming to date.

Fortunately, the consensus of world leaders is that we should not wait. Ministers and other representatives from 137 countries (including the United States) at the Second World Climate Conference last November declared that 'the potentially serious consequences of climate change, including the risk for survival in low-lying and other small island States and in some low-lying coastal and arid and semi-arid areas of the world, give sufficient reasons to begin by adopting response strategies even in the face of significant uncertainties, and called for negotiating an international convention on climate change by June 1992. The Ministers agreed 'the ultimate global objective should be to stabilize greenhouse gas concentrations at a level that would prevent dangerous anthropogenic interference with climate.'

Limits Exceeded

The implications of this objective were spelled out by the Stockholm Environment Institute (SEI) in a recent report on *Targets and Indicators of Climatic Change*. This report concludes

that dangerous interference with climate can only be avoided if the rate of warming is kept to less than 0.1°C (0.2°F) per decade, and the absolute warming is kept to less than 1-2°C (2-4°F) compared with pre-industrial times. Warming greater than the lower limit of 1°C (2°F) 'may elicit rapid, unpredictable, and non-linear responses that could lead to extensive ecosystem damage,' 2°C (4°F) while beyond 'the risks of grave damage to ecosystems, and of non-linear responses, are expected to increase rapidly.' The world may already be committed to exceeding the lower limit. Even the upper limit is likely to be avoided only if immediate action is taken to cut emissions so that peak CO₂ concentrations are limited to about 400 parts per million.

The success of the upcoming negotiations must be judged on the progress made toward the critical objective of preventing dangerous climatic change.

ECO NEWSLETTER

This is the first issue of ECO newsletter, produced as a cooperative effort by the environmental NGOs attending the conference. ECO will accept contributions from delegates and others, and suggestions as to stories which should be covered or people who should be interviewed. ECO is produced at the National Wildlife Federation's Educational Facility in Virginia and can be contacted at (703) 790-4010/4012 or 4013, FAX (703) 790-4011.

THIS ECO HAS BEEN PRODUCED WITH THE SUPPORT OF MEDIA NATURA. DTP OPERATORS PETER COOK AND CAROL SHORT. EDITOR CHRIS ROSE. PRODUCTION ASSISTANTS KEN SNYDER, DEBBIE GOOD AND SHERRY TIGGETT. PHOTOCOPIED ON RECYCLED PAPER. HELP FROM LIZ COOK, NAVROZ DUBASH, SCOTTHAJOST, DAN LASHOF, RICHARD MOTT, RAFA POMERANCE, ANNIE RONCEREL.

Continued from page 1, column 1

Washington yesterday, by introducing *America's Climate Change Strategy: An Action Agenda*. Environment groups welcomed the recognition in the glossy colored brochure that action to combat global warming is now needed. "The document represents a significant change in tone for the White House," said Scott Hajost of the Environmental Defense Fund. Environmental analysts point out that the US still plans for a large increase in CO₂ emissions, while the European Community is already planning a freeze by 2000 and subsequent decreases. The report states the Strategy will result in US greenhouse gas emissions in the year 2000 being equal to or below the 1987 level.'

Environmental organizations attending the Climate Convention Negotiations as observers particularly objected to the US practice of 'double counting' reduction in the greenhouse gas CFCs, which already has to be controlled under the Montreal Protocol. They point out that all CFC producing countries have agreed to phase-out these compounds because of their threat to the stratospheric ozone layer, and none of them, except the US proposes to claim this as a credit on greenhouse emissions. US CO₂ increases are disguised by 'double counting' the CFCs, say groups. One observer noted that if Germany did its accounting the way the US proposes it would be able to claim about a 40% reduction in greenhouse gases by 2005. "The kind of emissions stabilization that the US now plans will lead to increases in greenhouse gas concentrations and a commitment to massive global warming at a rate of 2-5°C over the next 100 years," says Dan Lashof of the Natural Resources Defense Council.

Energy

Previously the US has said that the National Energy Strategy (NES), being prepared by the Department of Energy, would be the forum for addressing CO₂ emissions from fossil fuel use. But the CO₂ reductions identified in the Climate Strategy amount to less than 40 million tonnes of carbon (under 3% of current emissions). This is, says Lashof, too little to significantly offset expected growth in US CO₂ let alone stabilize or reduce current emissions. Environmentalists

conclude therefore that the NES will contain neither targets nor significant policy initiatives to cut CO₂. If this turns out to be true, when the NES is announced two weeks from now, the US will find it difficult to continue to criticize European countries for making commitments without specific implementation plans.

See also pages 4 and 5

ECO's Who's Who Guide to Environmental NGOs present at the negotiations

The Eco staff will keep this list up to date when new members join us.

Elizabeth Acheampong - FOE Ghana
Alexandra Allen - Greenpeace US
Paul Allen - NRDC
Gilbert Arum - Kenya Energy and Environment Organizations
Daniel Becker - Sierra Club
Ludmilla Georgievna Bogdan - SocioEcological Union (Russia, USSR)
Stewart Boyle - Greenpeace International
Guillermo Castilleja - NWF
Liz Cook - FOE USA
Peter Cooke - Audubon
Eric Corens - FOE USA
Zsolt Csikor - Independent Ecological Center (Hungary)
David Doniger - NRDC
Lori Lee Dooledy - WRI
Navroz Dubash - EDF
Bill Eichenbaum - WWF
Ted Freeman - Sierra Club
T. J. Glauthier - WWF
Peter Gleick - Pacific Institute
Don Goldberg - CIEL
Debbie Good - EDF
K. S. Gopal - Deccan Development Society (India)
Mary Ann Gourley - Alliance to Save Energy
Emmy Hafild - WALHI (Indonesia)
Scott Hajost - EDF
Ralph Hallo - Stichting Natuur en Milieu
Marty Hayden - Sierra Club
Paul Hohnen - Greenpeace International
Robert Hornung - FOE Canada
Leigh Ann Hurt - WWF
Jennifer Jerdon - NRDC
Li Junfeng - China
Daniel Lashof - NRDC

Pene LeFale - Greenpeace International
Roni Lieberman - Sierra Club
Magda Lomabrdo - Forum of Brazilian NGOs to UNCED '92
Alicia Luchowski - Union of Concerned Scientists
Adam Markham - WWF International
Yasuko Matsumoto - Greenpeace Japan
Giovanna Melandri - Lega Per L'Ambiente
Alden Meyer - UCS
Jim Middaugh - EDF
Alan Miller - Center for Global Change
Richard Mott - WWF International
William Nitze - Alliance to Save Energy
Michael Oppenheimer - EDF
Kim Perzel - NRDC
Jirka Plaminek - Czechoslovakia
Rafe Pomerance - WRI
Eileen Quinn - UCS
A. Atig Rahman - Bangladesh Centre for Advanced Studies
Kilaparti Ramakrishna - Woods Hole Research Center
Richard Ramsey - Sierra Club
Bill Roberts - EDF
Annie Roncerel - Climate Network Europe
Chris Rose - Media Natura
Karen Schmidt - EESI
Carol Short - Consultant to Media Natura
Daniel Silverman - Sierra Club
Ken Snyder - Audubon
Fran Spivey-Weber - Audubon
Paula Steihle - Alliance to Save Energy
Marie Stetson - Worldwatch
Peg Stevenson - Greenpeace US
Jim Tamburro - Communications Consortium
Sherry Tiggett - NRDC
Emily Tynes - Communication Consortium
Fiona Wier - FOE
Carol Werner - EESI
Pamela Wexler - Center for Global Change
Brooks Yeager - Audubon
Durwood Zaelke - CIEL
Marybeth Zimmerman - ATSE
Sharon Zweig - NRDC

WHERE TO FIND THE ENVIRONMENT NGOs

The nearly 80 NGOs (Non Governmental Organizations) who will be working at the Second World Climate Conference welcome the opportunity to speak with any and every Delegation, as well as print and broadcast media. Please call (703) 790-4010/4012 or 4013.

WELCOMING REMARKS OF
THE HONORABLE MICHAEL R. DELAND
CHAIRMAN, PRESIDENT'S COUNCIL ON ENVIRONMENTAL QUALITY

TO THE FIRST SESSION OF
THE U.N. INTERGOVERNMENTAL NEGOTIATING COMMITTEE
ON CLIMATE CHANGE

CHANTILLY, VIRGINIA, USA

FEBRUARY 4, 1991

Distinguished delegates, representatives of the nongovernmental community, ladies and gentlemen:

On behalf of President Bush, it is an honor for me to welcome such a distinguished assembly of public officials from so many nations. The President and all Americans are delighted to provide a forum for the United Nations General Assembly to begin negotiations on a landmark international convention on climate change.

President Bush sends his personal greetings to each and every one of you, and regrets that he cannot be here in person this morning. He believes deeply in the United Nations, and knows firsthand what remarkable things can be accomplished when diverse nations work together toward common objectives.

Lest there be any doubts about the United States' outlook as we enter these negotiations, let me state it clearly:

- o **First**, we recognize the growing scientific consensus that continued loading of the atmosphere with greenhouse gases will lead to global climate change. Uncertainties do remain as to the rate, magnitude, and geographical characteristics of such change. But we do not question the basic concern.

o **Second**, the United States believes that research and action must proceed in tandem. That is why we have accelerated our global climate research roughly fivefold since 1989, and will seek \$1.2 billion for the coming fiscal year. And that is why, had the President been able to join us this morning, he would have been pleased to announce ~~that~~ ^{which these} the U.S. Climate Change Strategy includes actions ~~that will result in U.S. greenhouse gas emissions in the year 2000 being equal to or below 1987 levels.~~ In addition, the U.S. has essentially stabilized its emissions of carbon dioxide (CO₂) over the last 15 years despite a growth in economic output of about 50 percent. A summary of this strategy will be distributed to you today. As our scientific and economic knowledge advances, the United States will continue to respond.

o **Third** and finally, our purpose in these negotiations is clear. As President Bush has written in a letter being delivered to each of you today: "We are prepared to work openly, diligently, and respectfully toward achieving the goal of completing a climate change convention in time for its signature at the United Nations Conference on Environment and Development in June of 1992."

No one believes that these responses will be simple or cost-free. The issues involved are complex and have many implications for our citizens and future generations. Yet we are here because

we recognize the need to promote global environmental stewardship for all the world's peoples, in a forum that is democratic and cooperative.

It is the height of irony that as we begin a constructive dialogue on our shared environmental future, Saddam Hussein's premeditated and wanton release of crude oil into the Persian Gulf inflicts enormous environmental damage.

Saddam's unconscionable act will not divert us from the task at hand. Indeed it only heightens our resolve. For no nation or bloc of nations has the upper hand when it comes to the environment. Either we all win or we all lose. Let us work cooperatively and be catalysts for an essential kind of peace-- a peace between humanity and our planet.

Turning to the agenda of these negotiations, the U.S. believes in several guiding principles.

First, our efforts must be comprehensive in scope. Twenty years ago, when we in the United States enacted our first environmental statutes, we focused on narrow aspects of a complex problem. The Clean Air Act of 1970... the Clean Water Act of 1972... the Toxic Substances Control Act... the Resource Conservation and Recovery Act... all addressed just a piece of an intricate puzzle. Too often, these statutes resulted in moving

pollution around from air to land to water. While they led to substantial success in cleaning up our environment, there is a better approach. The environment is holistic-- a dynamic system of interactions between living things, the waters, land, and skies. As we seek to protect our environment, we must do so from that broad, comprehensive perspective.

Second, our agreements should be long-term and adaptable. We are united in the belief that despite large uncertainties, the potential threat of climate change justifies taking action now. Yet each of us operates in unique circumstances: political, economic, social, ecological. Different policies will have different costs and benefits for different nations. We need an international climate convention that commits all nations to meaningful action, yet does not limit us to some fixed formula.

Let us remember that the actions to which we commit ourselves will not occur automatically or instantly. Our decisions will affect humanity for decades to come. Hence our actions must be continuously reviewed and refined as knowledge and conditions change. As President Bush stated, "Global stewardship is a continuous process of social decisionmaking that meets the needs of the present generation while expanding the opportunities of future generations."

A third element of success in our view will be an inclusive approach. Because the issues we address are global in nature, our actions must be global. We must make every effort to ensure the full participation of all nations in these negotiations. Further, a climate convention should consider the financial and technological realities of all nations. As President Bush stated last April, "Those who have ascended the economic hill must break down the barriers to progress and assist others now making the climb."

In the final analysis, it is progress that counts. Progress that will result from the partnerships we build in the months leading up to the UNCED conference in Rio de Janeiro, just eighteen months from now.

On behalf of President Bush, welcome to the United States. Just as we hope this gathering will prove to be a productive start in our cooperative efforts, so, too, do we hope you will have a most enjoyable stay. Good luck and Godspeed.

Thank you.

Gohnchange file

Document Originally
Attached to
Following Page

LDCs - 1

India. Suggests "Turn this into a decision document" *earlier summary*

13 February 1991 13:30 hours

* We need final outcome of this

Suggested Chairman's Summing Up of the Committee's Discussion on the Special Voluntary Fund to Assist the Participation of Developing Countries in the Work of the Intergovernmental Negotiating Committee

1. The Committee warmly welcomed the intention of several governments and a regional integration organization to contribute to the multilateral voluntary fund called for by General Assembly resolution 45/212 (para. 10). It noted that pledged contributions as of February 8 totalled approximately \$1,300,000.

2. The Committee noted that the cost of full developing country participation (travel and subsistence) by one delegate per developing country was estimated at \$500,000 per session. The Committee further noted that use of the fund must take account of needs arising from all sessions of the Intergovernmental Negotiating Committee in 1991 and 1992 and of the stipulation by some governments that their contributions were to cover sessions beyond 1991.

3. The Committee was informed that some countries were providing funds in bilateral contexts. Bilateral donors and recipients were invited to keep the secretariat informed of their funding arrangements so that the multilateral fund could be used most effectively.

4. The Committee urged governments which had not yet done so to contribute according to their possibilities to the fund at an early date and expressed the hope that those which had already done so would make further contributions.

5. The Committee urged other relevant bodies of the United Nations system to contribute generously to this fund, mentioning in particular UNDP, UNEP and WMO in this connection. It invited the Chairman to convey this appeal to the executive heads of these bodies as well as to other interested organizations.

6. With regard to the eligibility of countries for access to the multilateral fund, the Committee recalled that resolution 45/212, para. 10 specified funding for "developing countries, in particular the least developed among them as well as small island developing countries." The Committee considered that access to the resources available to the fund beyond these two latter categories should also take account of the vulnerability of the countries concerned to sea level rise, drought and desertification, and severe weather disturbances.

LDCS - 2

7. The Committee noted that reimbursement of participation in its sessions would be retroactive to its first (Washington) session and that such reimbursement could cover subsistence (per diem) as well as travel costs. It further noted that the related arrangements made in connection with participation in the Preparatory Committee for UNCED were differentiated, providing for payment of travel costs for one representative per developing country, on request, and of per diem to representatives of a limited category of developing countries, in that case the least developed countries.

8. The Committee underlined the importance within these arrangements of financing the attendance of experts including scientists as members of delegations from developing countries.

9. Regional organizations, particularly those of a technical nature, were recognized by the Committee to have an important role in providing suitable technical support toward the effective participation of developing countries in the negotiating process.

10. The Committee requested the Executive Secretary to further facilitate the full and effective participation of developing countries, and indeed of all its members, in its work by ensuring the timely and well directed distribution of notifications, documentation and other information well in advance of Committee sessions. It stressed the need for adequate provision to be made for this purpose in the capacities of the secretariat.

UNITED
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General Assembly

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14 February 1991

ORIGINAL: ENGLISH

INTERGOVERNMENTAL NEGOTIATING
COMMITTEE FOR A FRAMEWORK
CONVENTION ON CLIMATE CHANGE
First session
Washington, D.C., 4-14 February 1991
Agenda item 3

Atweles C. Lane Navideri
9-18 Sept. Geneva
9-20 Dec Geneva.

ORGANIZATIONAL MATTERS

Draft decision submitted by the ChairmanEstablishment of subsidiary organs and organization of workThe Intergovernmental Negotiating Committee for a Framework Convention on Climate Change

1. Decides to establish two Working Groups to assist the Committee in carrying out its work;
2. Adopts the guidelines for the negotiations, organization of Working Groups and procedural points contained in the annex to the present decision.

ANNEX

I. GUIDELINES FOR THE NEGOTIATIONS

1. All items in the negotiations should be dealt with in an integrated manner and on the basis of General Assembly resolution 45/212 of 21 December 1990, which inter alia, reaffirms the principles embodied in General Assembly resolutions 44/207 and 44/228, both of 22 December 1989.
2. The work of the groups must be interrelated and will be integrated by the plenary. To this end the two Working Groups will report regularly to the plenary.
3. Funding commitments, mechanisms and means for transfer of technology to developing countries, as well as matters concerning international scientific and technological co-operation, should be an integral element in the negotiations.

A/AC.237/L.5

English

Page 2

4. The final agreement on the convention should cover in an integrated manner all areas of common concern, including, inter alia: (a) emissions; (b) sinks; (c) transfer of technology; (d) financial resources and funding mechanisms for developing countries; (e) international scientific and technological co-operation; and (f) measures to counter the effects of climate change and its possible adverse impact, particularly on small island developing countries, low-lying coastal, arid and semi-arid areas, tropical regions liable to seasonal flooding and areas prone to drought and desertification.

II. ORGANIZATION OF WORKING GROUPS

5. The Working Groups will prepare draft texts for consideration by the plenary.

A. Working Group I: Commitments

6. Working Group I will prepare a text related to:

(a) Appropriate commitments, beyond those required by existing agreements, for limiting and reducing net emissions of carbon dioxide and other greenhouse gases, on the protection, enhancement and increase of sinks and reservoirs, and in support of measures to counter the adverse effects of climate change, taking into account that contributions should be equitably differentiated according to countries' responsibilities and their level of development;

(b) Appropriate commitments on adequate and additional financial resources to enable developing countries to meet incremental costs required to fulfil the commitments referred to above and to facilitate the transfer of technology expeditiously on a fair and most favourable basis;

(c) Commitments addressing the special situation of developing countries, taking into account their development needs, including, inter alia, the problems of small island developing countries, low-lying coastal areas and areas threatened by erosion, flooding, desertification and high urban atmospheric pollution; also taking into account the problems of economies in transition.

B. Working Group II: Mechanisms

7. Working Group II will prepare a text related to:

(a) Legal and institutional mechanisms, including, inter alia, entry into force, withdrawal, compliance and assessment and review;

A/AC.237/L.5
English
Page 3

(b) Legal and institutional mechanisms related to scientific co-operation, monitoring and information;

(c) Legal and institutional mechanisms related to adequate and additional financial resources and technological needs and co-operation, and technology transfer to developing countries corresponding to the commitments agreed to in Working Group I.

III. PROCEDURAL POINTS

8. There will be no more than two meetings held at any one time within the Intergovernmental Negotiating Committee.
 9. There will be no inter-sessional meetings of the Intergovernmental Negotiating Committee Working Groups or any subgroups.
 10. All drafting is to be done by each Working Group, within the framework of its mandate, subject to any subsequent need for harmonization.
 11. If and when it is deemed necessary, the Working Groups, subject to the approval of the Intergovernmental Negotiating Committee, may establish ad hoc subgroups to deal with specific issues, with due respect to the understanding that no more than two meetings may be held at any one time. These groups would be reviewed continually to allow reformulation and adjustment in order to reflect the progress of the negotiations.
-

Withdrawal/Redaction Sheet

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Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
02. Memorandum	To: Allan Bromley From: Nancy Maynard Re: Update on the EOS Review (2 pp.)	2/27/91	(b)(6)	

Collection:

Record Group: Bush Presidential Records
Office: Science and Technology Policy, Office of (OSTP)
Series: Bromley, D. Allan, Files
Subseries: Global Climate Change Files
WHORM Cat.:
File Location: Global Warming: NOORDWIJK [2 of 2] [1991]

Date Closed:	4/8/2010	OA/ID Number:	62055-005
FOIA/SYS Case #:	2005-0336-F	Appeal Case #:	
Re-review Case #:		Appeal Disposition:	
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(b)(8) Release would disclose information concerning the regulation of financial institutions [(b)(8) of the FOIA]
(b)(9) Release would disclose geological or geophysical information

Earth Observing System External Engineering Review

Terms of Reference

Background

The NASA Earth Observing System (EOS) program has undergone extensive scientific and engineering reviews by: (i) the Committee of Earth Studies of the Space Studies Board of the National Academy of Sciences (NAS); (ii) an NAS panel that reviewed the NASA EOS in terms of approach, content, and scientific relevance to the U.S. Global Change Research Program (USGCRP); and (iii) the Report of the Advisory Committee on the Future of the U.S. Space Program (Augustine Committee) that evaluated NASA's long-term goals, objectives, and programs. Each of these panels strongly endorsed the scientific goals and objectives of EOS, stating that EOS was an essential element of the USGCRP and Mission to Planet Earth (MTPE) program that have been endorsed by President Bush.

Purpose of the Review

As part of the President's FY 1992 budget process, it was determined that "...an external engineering review of the EOS platform configuration and launch sequence will be undertaken by a group of government, industry, and academic experts..."

The purpose of the review will be to assess alternatives for the implementation of EOS, including size of platforms, instrument configuration, and launch requirements and sequencing. The objective of the review are to ensure that the recommended program (1) meets established scientific objectives; (2) places highest priority on achieving data collection needs specifically focused on climate change and global warming issues; (3) minimizes annual funding requirement; (4) minimizes technical risk; and (5) has sufficient resiliency to be adaptable to changing requirements.

For the EOS-A series of platforms, which is an ongoing activity, the purpose of the review is to assess whether any alternatives are significantly superior to the current program, with respect to the objectives stated above. For the EOS-B series of platform, which is currently being reconfigured by NASA, the purpose of the review is to assist NASA in adopting a new design which best meets the stated objectives.

Review Panel Membership

The review will be undertaken by a group of government, industry, and academic experts prior to proceeding with future platform development. The members of this panel shall:

- o be of a sufficiently high level, and of sufficient independence of NASA and its contractors, so that its advice can be considered to be appropriate validation or criticism of NASA's current EOS implementation approach,
- o include an appropriate balance of scientists with strong knowledge of global change science and engineers with extensive technical expertise on the execution of spacecraft hardware and remote sensing instruments, and
- o include, as appropriate, members of both the National Research Council's Panel to Review NASA's Earth Observing System in the Context of the U.S. Global Change Research Program and the Advisory Committee on the Future of the U.S. Space Program (i.e., Augustine Committee) to ensure that the Panel's deliberations benefit from and are consistent with these recent reviews.

Panel Reporting Structure

The Panel will be established by NASA under the provisions of the Federal Advisory Committee Act. It will submit its findings to NASA and report, through NASA, to the NSPC, OMB, and OSTP.

Panel Charge

While ensuring no unacceptable degradation of the current U.S. Global Change Research Program (USGCRP) and EOS scientific objectives (i.e., the recent National Research Council conclusions on the USGCRP and EOS scientific objectives and data simultaneity requirements), this engineering review will include:

1. an analysis of cost, budget, technical, and scientific trade-offs of alternative approaches to the EOS instruments (i.e., relax the complexity of EOS instrument specifications without significant degradation of the science requirements).
2. an analysis of cost, budget, technical, and scientific trade-offs of launching and flying all the EOS instruments (as determined from 1.) with a series of large platforms or with a series of smaller platforms flying in formation. The analysis should also include an examination of alternative platform launch sequences with the objective of accelerating the instruments most directly related to global warming issues. In addition, an analysis should be made on the

possibilities and possible configuration of a near-term (prior to the late 1990s) data collection system focused on rapidly addressing issues specifically oriented around climate change and global warming. This portion of the analysis should include explicit discussion of climate change models and their data needs.

3. as recommended by the Augustine Committee, an analysis of NASA's plans to allow for evolution in EOS technology and science goals during the 15-year life of the EOS program. This NASA plan will be made available to the Panel at the earliest possible date, but not later than May 1, 1991.
4. an analysis of an interagency Committee on Earth and Environmental Sciences report on the cost, technical, budget, scientific utility of using high-altitude, unmanned aircraft missions as precursors or complements to the current ground- and space-based observations. This report will be made available to the Panel at the earliest possible date, but not later than May 1, 1991.

General Requirements

In comparing and analyzing alternatives, the Panel should clearly delineate the trade-offs among annual budget spending levels, total program costs and mission risks. In addition, the Panel should carefully assess the resiliency of the proposed alternatives to possible change in scientific requirements or technical capabilities that could occur over the lifetime of the program. Finally, the Panel's assessment should assess the resiliency of the proposed alternatives to possible future adjustment in budget projections.

The review shall cover both the EOS-A and EOS-B series of instruments and platforms. However, because the EOS-A platform and instruments are currently under development, any recommendations for changes to the EOS-A series must take into account this current status and provide significant risk, schedule, science return, and/or cost advantages over the current EOS-A plan.

Panel Reporting Schedule

The Panel should provide an interim report by June 1, 1991. The Panel should submit its final report by September 30, 1991.

Panel Recommendations

Due to the significant importance and impact of the Panel's recommendations, the Panel will make every effort to ensure that it's recommendations are conveyed in the most straightforward and unambiguous wording.

"CORRESPONDENCE TRACKING"

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DOCUMENT NUMBER: 9120621

FROM: BERNTHAL, Frederick M.: NATIONAL SCIENCE FOUNDATION

TO: DR. BROMLEY

DATE OF
CORRESPONDENCE: 02/28/91

SUBJECT: THE WORKING GROUP ON CLIMATE CHANGE

global change file

ASSIGNED TO:

ACTION REQUIRED:

SENDER'S DUE DATE:

OSTP DUE DATE:

DATE COMPLETED:

COPIES TO: D. Allan Bromley
Nancy Maynard
Thomas Ratchford

WHITE HOUSE TRACKING #:

CONTACT PERSON:

REMARKS:

DATE RECEIVED: 03/04/91

FILE: ENVIRONMENT-GLOBAL CHANGE

NATIONAL SCIENCE FOUNDATION
WASHINGTON, D.C. 20550



OFFICE OF THE
DIRECTOR

RECEIVED

31 MAR 4 P 3:00

February 28, 1991
OFFICE OF THE
DIRECTOR

Dr. D. Allan Bromley
Science Advisor to the President
and Director Office of Science
and Technology Policy
Room 358
Old Executive Office Building
Washington, D.C. 20506

Dear Allan:

Pursuant to our conversation and the approval last week of the Working Group on Climate Change, I want to formalize the transfer of responsibility to Bob Reinstein, Deputy Assistant Secretary of State for Environment, Health and Natural Resources, to chair on behalf of the United States the Working Group III of the Intergovernmental Panel on Climate Change.

As we discussed, I believe that this arrangement will serve USG objectives well, and is consistent with Bob's role as the negotiator for the proposed Framework Convention on Climate Change. I have notified IPCC Chairman, Professor Bert Bolin, of this change in U.S. representation.

I have very much appreciated your support in what was often a demanding task over the last two years in preparing the first report of Working Group III. I would, of course, be pleased to continue to assist on this issue in whatever way might prove useful.

Sincerely,

Frederick M. Bernthal
Acting Director

cc: Robert Reinstein, DOS

**EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506**

March 28, 1991

*General change
file*

Allan:

Attached is a list of the EPRG working group.

You will recall that we discussed the possible makeup of a steering group for UNCED composed of certain members of the EPRG. I have highlighted the names of those persons who would make the most sense for such a group. They include:

D. Allan Bromley, OSTP
Roger Porter, OPD
Bob Grady, OMB
~~Steve Danzansky, OCA~~
Dick Schmalensee, CEA
Mike Deland, CEQ
Richard Stewart, DOJ
Hank Habicht, EPA

Edie Hildrey OCA.

In addition, several others not listed here (lower level staffers attend the EPRG for them) include: C. Boyden Gray, Buff Bohlen, Bob Gates, and Andy Card.

Please tell me if you need anything else.

Ken

ENVIRONMENTAL POLICY REVIEW GROUP

Membership as of March 27, 1991

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Ede Holiday	OCA	456-2174
Michael Deland	CEQ	456-5080

(8-16-33)
(7-13-55)
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White House official says global warming policy changing
By GEORGE LOBSENZ

WASHINGTON (UPI) — President Bush's chief science adviser said Thursday the administration's policy on global warming is moving toward greater activism, but a leading Senate critic said the "change" is more rhetoric than reality.

Allen Bromley, director of the White House Office of Science and Technology Policy, said the administration's position is evolving due to growing scientific consensus that reductions in "greenhouse gases" are needed to prevent potentially harmful warming in the future.

He said the administration's view of the global warming threat — and possible responses — has changed over the last year due to new scientific and economic research such as a recent National Academy of Sciences report recommending immediate efforts to cut heat-trapping industrial emissions.

"The position we're taking is changing with time," Bromley said at a Senate Commerce Committee hearing on the policy implications of the academy report. "There's no question about it. I think the situation has changed."

But Sen. Al Gore, D-Tenn., said that while the White House is promising swifter action to reduce greenhouse gases, it remains "ideologically opposed" to the energy efficiency measures needed to achieve that goal.

Gore noted the academy report outlined more than a dozen "very low cost" recommendations to cut emissions, and that the study emphasized the need for aggressive energy efficiency measures to reduce carbon dioxide — the main greenhouse gas — from cars, factories and power plants.

Carbon dioxide is the main pollutant linked to the "greenhouse effect," the growing accumulation of industrial emissions in the atmosphere that scientists believe may be trapping heat radiating up from Earth that otherwise would escape into space. The same warming mechanism is achieved by glass walls in a greenhouse.

Gore said that, in contrast to the academy report, the administration has gone out of its way to eliminate strong efficiency proposals from its recently announced National Energy Strategy.

"The administration's energy policy is simply in opposition to many of the recommendations in the academy report," Gore charged.

Under questioning by Gore, Bromley repeatedly declined to defend the administration's failure to support tougher federal efficiency standards for automobiles, buildings and appliances. In each case, Bromley said he did not have enough information to respond to Gore's questions.

However, Gore scoffed at Bromley's protestations of ignorance and said it is an "open secret" that White House chief of staff John Sununu had quashed energy efficiency proposals that Energy Secretary James Watkins had recommended be included in the administration's energy strategy.

The reference to Sununu drew objections from Bromley, who said the allegation about Sununu's leading role was "not quite fair."

"John Sununu was in no way any more responsible for removal of items on (Watkins') list than other people who were involved in those discussions," Bromley said.

Gore suggested Bromley is more knowledgeable about the need for improved energy efficiency than he is willing to acknowledge publicly, possibly out of fear of incurring Sununu's wrath.

In friendly but pointed remarks, Gore told the science adviser: "I know you well enough to know that you are sometimes more prepared on some subjects than you would indicate under certain circumstances."

However, Gore warned that if Bromley continues to defer to Sununu on global warming policy, "history will judge the performance of the Bush administration (on global warming) very harshly."

Asked if he wished to respond, Bromley demurred, telling Gore with a smile: "Discretion suggests I should stop while I'm this far behind."

The science adviser maintained the administration has adopted an effective program to combat global warming, and that it was clearly detailed in the "action agenda" unveiled by the administration at an international climate change conference in Virginia this February.

The action agenda said the United States already had taken actions that would reduce growth in greenhouse gases so that emissions in 2000 would be equal or below 1987 levels.

However, Gore said that pledge was almost entirely based on the elimination of chlorofluorocarbons, or CFCs, which the nation already has agreed to ban by 2000 under an international treaty to protect Earth's ozone layer.

Gore said the action agenda contained virtually no measures to reduce carbon dioxide and that heat-trapping emissions would begin rising again after the CFC ban was in place.

global change file

APRIL 8, 1991

NOTE TO D. ALLAN BROMLEY

FROM: VICKIE V. SUTTON *VVS*

SUBJECT: EPA BRIEFING ON OZONE DEPLETION AND CANCER
FATALITIES

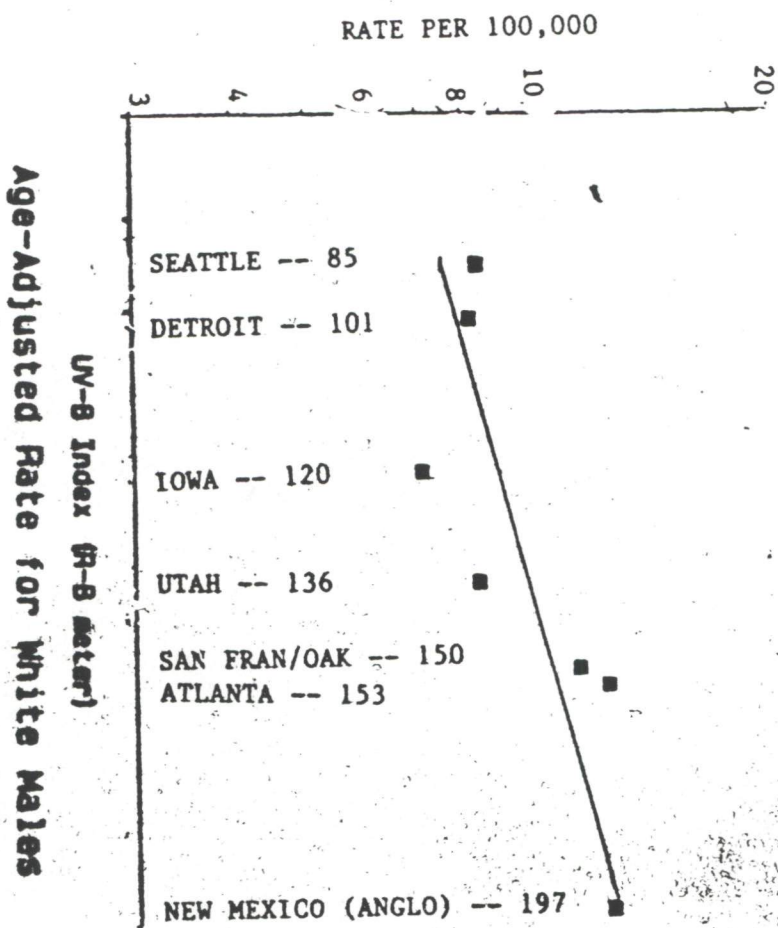
For your reference, I have attached two of the overheads presented today in the EPA briefing.

I can obtain the 1987 Ultraviolet Radiation and Melanoma EPA publication referenced in the briefing and a full set of the overheads, if you would like a follow-up.

cc: Nancy Maynard

Global Change file

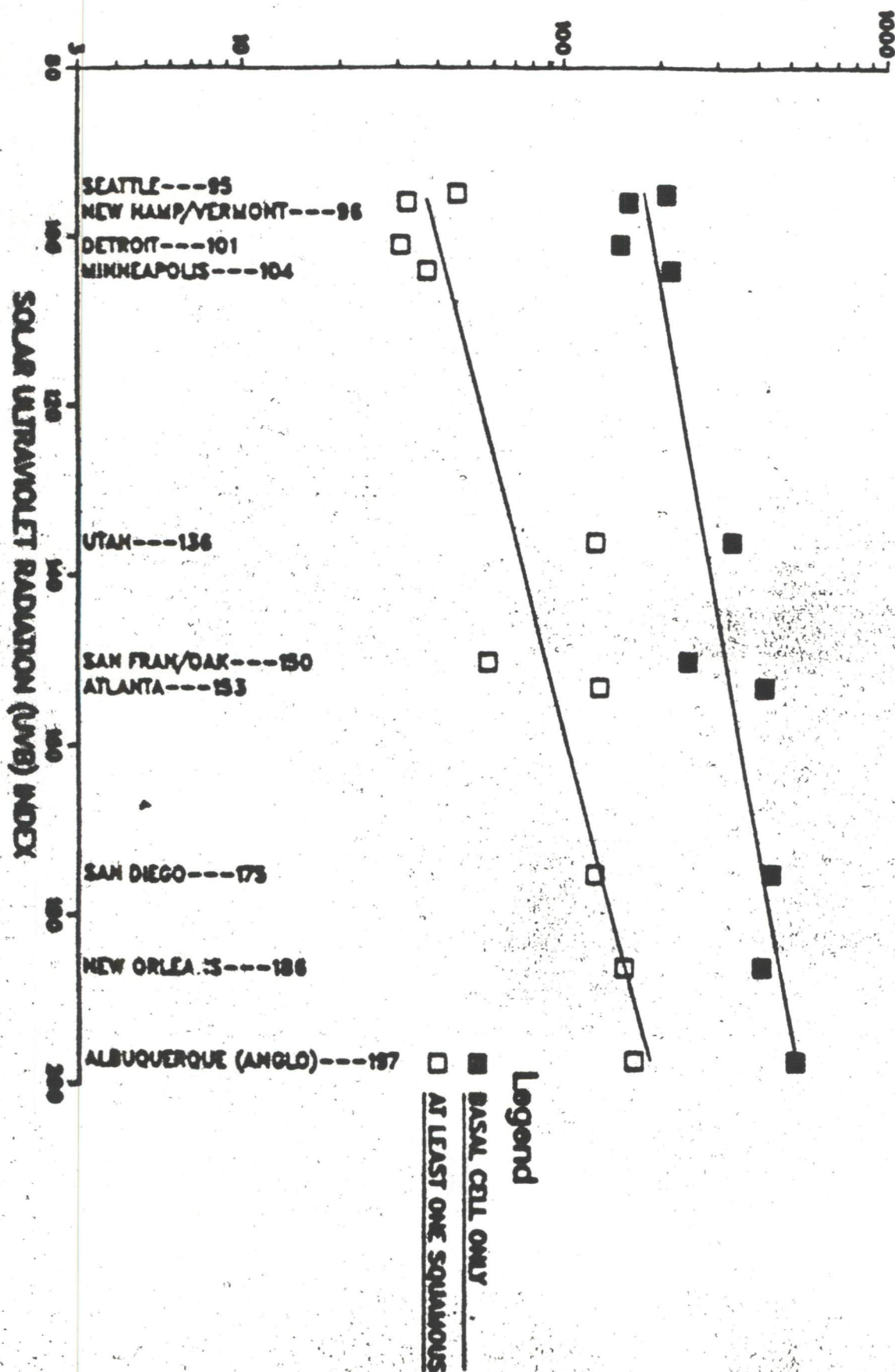
Melanoma skin cancer: dose-response



Source: Scott, National Cancer Institute, 1967

NON-MELANOMA SKIN CANCER INCIDENCE BY UVB INDEX WHITE MALES ACCORDING TO CELL TYPE

AVG. ANNUAL AGE-ADJUSTED (1970 US) RATE/100,000 POP



Source: Scotto, National Cancer Institute, 1986.

*Climate Change
file*

Document Originally
Attached to
Following Page

It was noted today that, while the US is pleased that delegates from more than 100 countries had been able to meet here in Washington to begin discussions on a climate change convention during such a difficult time in history, the US is now looking forward to beginning the process of work on developing text for the Framework Convention itself at the next session in June.

The President, who made the offer to host this first negotiating session a number of months ago, noted in his letter of welcome to the delegates, that "The U.S. takes the challenge of global stewardship very seriously and believes that these negotiations offer the opportunity to structure an important vehicle for cooperation toward that end."

In fact, President Bush chose the opening part of this first negotiating session to introduce America's Climate Change Strategy, An Action Agenda, a document (similar to those of several other countries) which lays out a summary of the US strategy for addressing the climate change issue.

This document, which outlines how the US is working to curb emissions, while continuing to promote economic growth, was presented to the delegates to help set the stage for serious negotiations with other concerned nations on the climate change issue.

The US Action Agenda is build on a series of actions which will have broad-ranging benefits - from curbing air pollution, to conserving energy, to restoring forest lands - and which will help curb net greenhouse gas emissions. These actions are based on a comprehensive approach which considers all greenhouse gases, sources, and sinks in order to achieve maximum benefit for costs expended.

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

In addition to the many specific actions being taken to curb greenhouse gas emissions, the US also announced plans to invest next year alone over \$2 billion in R & D efforts on global change science and economics research as well as on the development of economically sound, environmentally beneficial and energy efficient technologies.

The UN-sponsored meeting in Chantilly, VA concluded its deliberations last night after nearly two weeks by setting up working groups, adopting guidelines for negotiations, and establishing rules of procedure.

President Bush also noted in his letter to the delegates that "The US is prepared to work openly, diligently, and respectfully toward achieving the goal of completing a climate change convention in time for its signature at the UN Conference on ENvironment and Development in June of 1992."

The US and the other countries hope to begin writing a negotiating text of the Framework Convention on Climate Change at the next session of the negotiations in June, possibly in Nairobi.



United States Department of State

*Bureau of Oceans and International
Environmental and Scientific Affairs*

Washington, D.C. 20520

DATE 3-8-91 TIME _____

TELEFAX COVER SHEET

NUMBER OF PAGES TO FOLLOW: _____

TO: KARA KELLY TEL. # 395-3817
OFFICE: _____ FAX # 395-3⁷19

FROM: TERRI BAKER TEL. # 647-1554
OFFICE: OES - STATE FAX # 647-0217

MESSAGE: FOR DR. MAYNARD, as requested

RYAN JR, ROBERT J; DISTRICT OF COLUMBIA, 08/11/
39; GEORGE WASHINGTON U, JOHNS HOPKINS U AB 60,
MASS INST OF TECH MA 67; FR-08 11/60, FO-08 02/61,
FO-07 03/63, FO-06 05/65, FO-05 04/67, FO-04 03/69, NSC
STAFF MEMBER 03/69, FSI/LT TRAINING 01/71, PARIS
ECONOMIC/COMMERCIAL OFFICER 05/71, FO-03 05/72,
RABAT ECONOMIC/COMMERCIAL OFFICER 07/73, EB/
IFD/OMA OFFICE DIRECTOR 07/74, FO-02 03/75, FO-01
03/77, FSI/AOT TRAINING 09/77, OECD PARIS DEPUTY
CHIEF OF MISSION 08/78, FO-01 02/81, ARA/ECP OFFICE
DIRECTOR 08/81, FE-MC 09/81, SENIOR PERFORMANCE
PAY 83, HONOR - SUPERIOR 83, PRES - MERIT SVC 84,
AF REASSIGNMENT 03/84, BAMAKO CHIEF OF MISSION
08/84, AF REASSIGNMENT 09/87, PER/NGO 12/87, CA
REASSIGNMENT 11/88; PORTUGUESE, FRENCH; INTER-
NATIONAL RELATIONS OFF, M/MP 10/89; FE-MC/05 0020.

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

March 19, 1991

*Global Change
file -*

MEMORANDUM FOR D. ALLAN BROMLEY

FROM: NANCY G. MAYNARD *NM*

SUBJECT: Trip Report to IPCC Plenary

Summary of Trip to the 5th Plenary Session of the Intergovernmental Panel on Climate Change :

1. Date/Location/Participation

- . March 13-15, 1991, Geneva, Switzerland.
- . 78 Countries participated
- . 52 developing countries
- . 15 international organizations
- . 11 NGO's

2. Primary purpose: to discuss the future work plan of the IPCC following the completion of the IPCC First Assessment Report (August 1990) and in light of the beginning of negotiations on a Framework Convention on Climate Change in February 1990.

3. Delegation: Head = Robert Reinstein, Deputy Assistant Secretary of State for Environment, Health and Natural Resources

4. The IPCC agreed to pursue work in the following areas:

- a. The assessment of national net greenhouse gas emissions, further development of the Global Warming Potential (GWP) Index, and updating existing emission scenarios
- b. Predictions of the regional distributions of climate change and associated impact studies, including model validation
- c. Technical, economic and market assessment of energy-related technologies
- d. Forestry-related issues
- e. Country case studies of vulnerability to sea-level rise

5. The IPCC adopted a set of "Principles Governing IPCC Work"

Some of the developing countries complained that a lack of formal procedures (such as exist in the UN system) had made it difficult if not impossible for them to participate in the IPCC process to date. As a result, the IPCC established a set of "principles" to govern the IPCC work.

These principles impose a number of new administrative procedures regarding such things as advance notice of meetings and interpretation (the 6 UN languages). These principles also call for representation on the IPCC Bureau for all 5 UN geographic regions, and approval of all work plans by the Plenary.

IPCC has been able to compile an impressive amount of data and information which has resulted in the production of the 3 IPCC Working Group Reports in a rather short time due to a flexible mode of operation. There is some concern that these new procedures may significantly slow the future work of the IPCC.

6. Economic Tasks of the IPCC

The delegates to the Plenary discussed what economic tasks the IPCC might undertake. The US, with widespread support, intervened for including economic tasks that would not prejudice the climate negotiations nor intrude on the prerogatives of national governments. Brazil alone continued to oppose any consideration of economics through the IPCC as "too political". Time ran out, however, before the Plenary could discuss an economic workplan drafted by a small group under US leadership (Gruenspecht).

While no agreement was reached on an explicitly economic mandate for the IPCC, the US gained widespread support for its proposed economics workplan. Building on this support, we hope to gain formal adoption of an economics work plan in the next Plenary.

7. Structure of the IPCC

The issue of the structure of IPCC was deferred for future consideration. However, it was clear that certain nations such as Mexico and the Netherlands are concerned about the US chairing Working Group III. These nations will continue to seek to either eliminate Working Group III or to remove its most important tasks, such as economic assessment.

Chairman Burt Bolin stated late in the last day of the session that the current structure of the IPCC will have to be maintained. This avoided any effort to eliminate working Group III, at least until the next IPCC Plenary Session.

8. Future Meetings

Next Bureau Meeting: Early August 1991

Next Plenary Meeting: October or November 1991

GENERAL PRODUCTS IN MENT

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who operate waffle

ket-buddy

TOP TEN GOOD THINGS ABOUT THE GREENHOUSE EFFECT

10. Melting polar ice caps make for better surfing
9. Long lines at Disney World reduced by sunstroke
8. Within five years, Jerry Lewis's hair will be bone-dry
7. Can use "stuck in road tar" as acceptable excuse for missing work
6. ABC will take a 200-million-dollar bath on Winter Olympics
5. Intense heat should open pores in General Noriega's forehead
4. My dog-shaving business will take off
3. "I'm dehydrated" will replace "I'm not gonna pay a lot for this muffler" as America's favorite phrase
2. Can cook lobster by lowering it into toilet
1. Hot babes, less clothes. 'Nuff said

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

Initial Change file

February 26, 1991

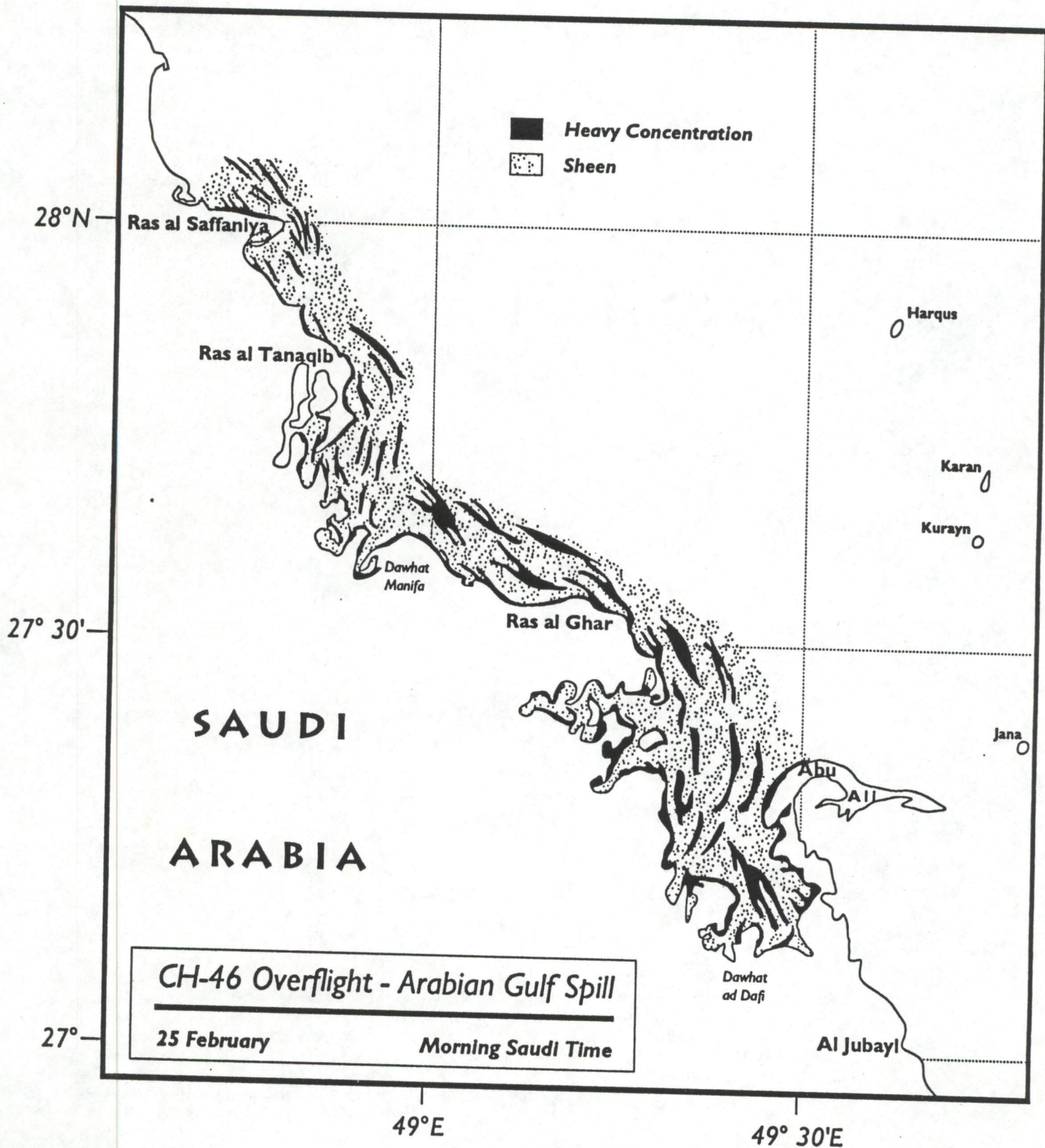
MEMORANDUM FOR D. ALLAN BROMLEY

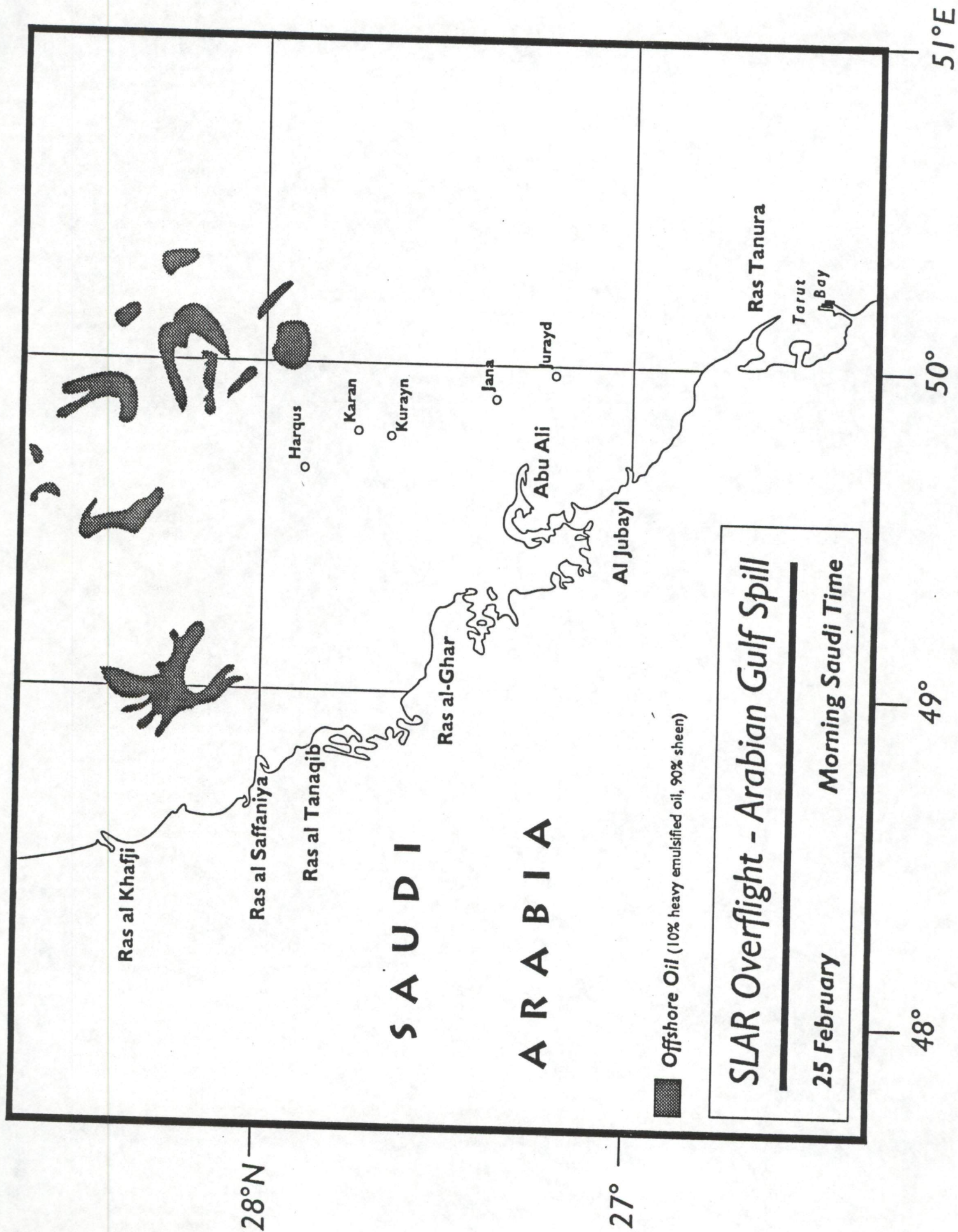
FROM: NANCY G. MAYNARD *NM*

SUBJECT: Update on Gulf Oil Spill

A short summary of a briefing I attended Tuesday on the Gulf oil spill follows:

1. Most of the spilled oil is located just offshore along the coast of Saudi Arabia between Ras al Saffanlya and the island of Abu Ali. (see figure 1)
 - a. It is estimated that there is approximately 2 million barrels total here.
 - b. The oil has been blocked from further movement to the south by the island. The oil has moved back and forth behind the island for the past week (by winds and currents).
 - c. The winds continue to be mostly out of the NW.
 - d. Because of this, a major desalinization plant near Al Jubayl has not been heavily impacted.
2. There are also some large patches offshore (see figure 2).
 - a. It is estimated that there are approximately 15-20 thousand barrels total in these patches.
 - b. These are not new but were probably not as easy to find earlier because of war activity.
 - c. These are the patches CNN was referring to Tuesday (in error as "new")
3. Essentially, most of the oil is in relatively shallow water, has moved more slowly than predicted, and is presently contained in a restricted area.
4. The long term fate of the oil is tied to the influence of sand in the environment.
 - . tar mat formation (subtidal)
 - . becomes moussee, gets denser, and eventually sinks
 - . tar mats from previous spills can been seen throughout Gulf
 - . unique in the area are "sandfalls" from the air
 - . 20 - 120 tons/acre/mo have been measured
 - . hi winds carry sand up and drop it, especially in March
 - this will increase density of oil and sink it eventually





*Climate Change
files*



EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET

NATURAL RESOURCES DIVISION

DATE: 9-18 PAGES FOLLOWING 15

TO:

Wmcy maynard
3719

FROM: NORMAN HARTNESS

(202) 395 - 6840

FAX (202) 395 - 1067

COMMENTS:

395/93-
Final

TESTIMONY OF
WILLIAM K. REILLY
ADMINISTRATOR
U.S. ENVIRONMENTAL PROTECTION AGENCY
BEFORE THE
FOREIGN RELATIONS COMMITTEE ON
UNITED STATES SENATE

September 18, 1992

Good morning Mr. Chairman, members of the Committee. I am pleased to be here today to present the United Nations Framework Convention on Climate Change which the President signed in Rio de Janeiro on June 12, 1992. Negotiated over a period of nearly two years, this Convention is the most complex and far-reaching international environmental agreement achieved to date. Signed in Rio by 154 countries and the European Community, it represents an unprecedented worldwide commitment to act together to respond to the environmental challenge posed by potential global climate change. The breadth of this support, and the form and content of the Convention are due in no small measure to the efforts of the United States.

The United States is endowed with unique and abundant natural resources. Years ago our pristine waters, vast forests, and rich soil drew thousands of settlers to our country. In more recent decades, we have reacted to threats to our environmental quality by passing such laws as the Clean Water Act and the Clean Air Act.

But environmental problems know no boundaries and today we face new issues that require a response on a global scale. Indeed, climate change may pose a far reaching challenge to our

- 2 -

country. It may have consequences for our food supply, the forests that give us shelter, the water we drink, the coastal regions we use for recreation and the air we breathe. It presents issues of unprecedented scientific complexity and scope.

With this Convention before you, we will put the nations of this planet on a common path to respond to this challenge. I urge your speedy consideration and consent to ratification of this path-breaking agreement. I would now like to review some of the specific provisions of the Convention.

OBJECTIVE

The ultimate objective of the Convention is to stabilize greenhouse gas concentrations in the atmosphere (not emissions) at a level that would prevent significant damage to the global climate. It sets a sweeping yet flexible objective that recognizes the scientific uncertainties concerning the rate, timing and magnitude of global climate change and it allows for the continued evolution of the science of climate change. This objective is to be sought through national measures and programs (which may be implemented jointly). I believe the United States can contribute to this objective in a sound economic fashion, fulfilling both our commitment to global environmental protection and our aspirations for continued economic growth.

The Convention reflects realistically the current state of scientific understanding and current economic conditions. The Convention sets in motion an international process that can be

- 3 -

modified and strengthened as circumstances warrant. I underscore that the Convention commits all Parties to formulate and implement national measures and programs. I believe the process of developing these national plans will help expand our understanding of climate change mechanisms and reveal innovative and cost-effective means to reduce net greenhouse gas emissions.

I urge you to keep in mind the context and origin of the Agreement being submitted. It was only in 1988 that the World Meteorological Organization and the United Nations Environment Program (UNEP) commissioned an assessment report from the Intergovernmental Panel on Climate Change (IPCC). The first report of the IPCC was produced in August of 1990. In remarkably clear language it laid out what was certain, what was probable, and what was uncertain about the science on climate change. The IPCC made the following statements and predictions:

- "Based on current model results, we predict an average rate of increase of global mean temperature during the next century of about 0.3 C per decade (with an uncertainty range of 0.2 - 0.5 C per decade)..."
- "The oceans act as a heat sink, and thus delay the full effect of a greenhouse warming. Therefore we would be committed to a further temperature rise which would progressively become apparent in the ensuing decades and centuries."
- "...[A]n average rate of global mean sea-level rise of about 6 cm per decade over the next century (with an uncertainty range of 3 - 10 cm per decade) mainly due to thermal expansion of the oceans and the melting of some land ice. The predicted rise is about 20 cm in global mean sea-level by 2030, and 65 cm by the end of the next century. There will be significant regional variations."

The IPCC described the following key uncertainties:

- 4 -

- "There are many uncertainties in our predictions particularly with regard to the timing, magnitude and regional patterns of climate change, especially changes in precipitation."
- "These uncertainties are due to our incomplete understanding of sources and sinks of greenhouse gases, and the response of clouds, oceans and polar ice-sheets to a change of the radiative forcing caused by increasing greenhouse gas concentrations."

Regarding policy responses, the IPCC stated:

- "The consideration of climate change response strategies presents formidable difficulties for policy makers. The information available to make sound policy analyses is inadequate because of: (a) uncertainty with respect to how effective specific response options or groups of options would be in actually averting potential climate change; (b) uncertainty with respect to the costs, effects on economic growth, and other economic and social implications of specific options or groups of options."
- "The potentially serious consequences of climate change give sufficient reasons to begin adopting response strategies that can be justified immediately even in the face of significant uncertainties."
- "Governments should undertake now:
 - "accelerated and coordinated research programs to reduce scientific and socio-economic uncertainties with a view toward improving the basis for response strategies and measures;
 - "review of planning in the fields of energy, industry, transportation, urban areas, coastal zones and resource use and management;
 - encouragement of beneficial behavioral and structural (e.g. transportation and housing infrastructure) changes;
 - expansion of the global ocean observing and monitoring system.

"It should be noted that no detailed assessments have yet been made of the economic costs and benefits, technological feasibility or market potential of the underlying policy assumptions."

- 5 -

Now let me highlight some of the Convention's other important features.

INSTITUTIONS ESTABLISHED BY THE CONVENTION

The guiding body of the Convention is the "Conference of the Parties" which will review regularly the implementation of the Convention and any related legal instruments which may be adopted. The Convention also establishes a "Secretariat" to facilitate the operation of and provide services to the Conference of the Parties, and to prepare reports on its activities. The Convention further establishes two "subsidiary bodies" to assist in performing the substantive functions of the Convention. The Subsidiary Body for Scientific and Technological Advice will provide the Conference of the Parties with timely advice on scientific and technological matters relating to the Convention. The Subsidiary Body for Implementation will assist in the assessment and review of the implementation of the Convention.

The Convention also establishes a financial mechanism to support implementation of the Convention by developing countries. The convention designates the Global Environment Facility (GEF) of the World Bank, UNEP and United Nations Development Program (UNDP) as the interim financial mechanism, operating under the guidance of and accountable to the Conference of the Parties.

- 6 -

NATIONAL INVENTORIES

Turning to the specific requirements of the Convention, each Party is required to develop, update and make available detailed information on its sources, sinks and reservoirs of greenhouse gas emissions. To ensure a thorough effort to improve our understanding of climate change, and recognizing the often limited capacities of developing countries in these areas, the Convention stipulates that developed country Parties will provide financial and technical assistance to developing countries in collecting and reporting this information. The United States has already offered to provide \$25 million over fiscal years 1993 and 1994 to assist selected developing countries in developing their capabilities and to carry out "country studies" relating to these inventories and national plans.

The United States and other developed country Parties pledged to submit greenhouse gas inventory data within six months after entry into force of the Convention. Developing country Parties have three years to submit their inventories after entry into force of the Convention (or within three years of receiving financial assistance for this purpose) and least developed country Parties may make their initial reports at their discretion.

MITIGATING AND ADAPTING TO CLIMATE CHANGE

Essentially three options were proposed during the negotiations. One was to make the Convention a purely

- 7 -

"framework" document, akin to the Vienna Convention for the Protection of the Ozone Layer, with no provisions to control emissions. Another was to apply quantitative requirements to emissions of greenhouse gases (or in some formulations, to apply them only to emissions of CO₂ from industrialized countries.) A third option was to require countries to fashion and report "national strategies" or "action plans" that would have the result of limiting emissions, though without specifying legally binding limitations.

The United States supported the third approach, which was eventually adopted by the Parties to the Convention. It has the significant advantage of creating a continuous process by which the measures and policies of all industrialized countries can be assessed. This process will provide an opportunity for countries to learn emissions reduction strategies from each other. More important, it will require all countries to undergo scrutiny by the international community through publication of the action plans. Through this process the global community will be able to measure the progress of industrial countries in meeting the Convention's objectives far in advance of the year 2000.

Under the Convention, all Parties must formulate and implement national measures and/or programs (including, where appropriate, regional programs) to mitigate and adapt to climate change, taking into account each Party's specific national and regional development, priorities, objectives and circumstances. In the Convention, the U.S. and other developed country Parties

- 3 -

are committed to taking the lead in meeting the long-term objective of the Convention by adopting national policies and corresponding measures to limit greenhouse gas emissions and protect and enhance greenhouse gas sinks and reservoirs. The Convention provides that such policies and measures may be implemented jointly with other Parties, thereby promoting a global response that will be more cost-effective than if all actions were taken unilaterally.

Developed country Parties are required to provide detailed information on their national policies and measures within the first six months after the treaty enters into force, and periodically thereafter. Developed country Parties also committed in the Convention to report on the projected effect on net emissions of their policies, "with the aim of returning individually or jointly to their 1990 levels of these anthropogenic emissions of carbon dioxide and other greenhouse gas emissions not controlled by the Montreal Protocol."

There has been considerable attention paid to the adequacy of this particular provision. So let me turn for a moment to the "specific commitments" issue. The language I just quoted sends a clear and unmistakable signal about where the world is going in response to possible climate change. The Parties explicitly committed to measures aiming at a return to 1990 levels of anthropogenic emissions as a reference point designed to permit parties to move quickly to modify their response to greenhouse gas emissions as the science dictates.

- 9 -

This model has worked well in the context of the Montreal Protocol where we tightened our phase out schedule for CFCs in June of 1990 in London, and are poised to do so again this fall in Copenhagen. I believe we are on the right course again. If the science demonstrates the problem of climate change is more urgent, we will be poised to respond quickly with inventories, and plans in place.

TECHNOLOGICAL AND FINANCIAL ASSISTANCE

The Convention recognizes that developing country Parties will need financial and technical assistance to implement policies to limit greenhouse gas emissions or to adapt to impacts of climate change. The Convention commits developed country Parties to take all practicable steps to promote, facilitate, and finance, where appropriate, the transfer of environmentally sound technologies.

In many cases, the technologies needed are available within developing countries. In other cases, the technology might not be available within the developing country but commercially accessible from a foreign firm. There is thus a significant incentive for the developed countries to assist in cooperative technology development, either through financial mechanisms, or through technology cooperation and training programs.

It is now clear that there is a growing market for more efficient systems -- everything from light bulbs to total system design. Promoting the application of under utilized but

- 10 -

available technologies can go a long way toward reducing greenhouse gas emissions, improving the general well-being of society and promoting the export of U.S. environmental goods and services. Let us not lose sight of the fact that reducing greenhouse gas emissions could serve as a stimulus to innovation and as an opportunity for U.S. export promotion and the creation of new job opportunities. As one example, U.S. agencies and private companies are already cooperating on efforts to identify and help reduce methane leaks from energy systems in Russia and other Eastern European countries.

SCIENTIFIC COOPERATION

While the Convention cannot solve the complex problems confronting the scientific community, it fosters a regime of international scientific cooperation which can contribute significantly to the effective planning and implementation of scientific programs to address these issues. Of particular note is the Convention's emphasis on promoting access to, and exchange of, data and analyses, including that obtained from areas beyond national jurisdictions -- consistent with U.S. policy on access to remote sensing data.

- 11 -

SPECIAL CONSIDERATIONS

The obligations of the Convention take into account the specific circumstances of individual parties in a number of ways.

For example, the Convention affords flexibility to countries with economies in transition (e.g. the republics of the former Soviet Union and eastern European countries) in the implementation of their national plans to mitigate and adapt to climate change. In addition, Parties are to give full consideration to developing countries that are particularly vulnerable to the adverse effects of climate change (such as countries with low-lying coastal areas) in meeting the costs of adaptation. Parties are also to take full account of the specific needs and special situations of the least developed countries. Finally, when evaluating the implementation of commitments under the Convention, Parties are to take into consideration the situation of countries with economies that are vulnerable to the effects of response measures, such as countries whose economies are highly dependent on income generated from the production, processing and export, and/or consumption of fossil fuels.

PRINCIPLES

Article 3, entitled "Principles," deserves special note. It describes an approach which differentiates between developed country parties, and developing country Parties who may bear disproportionate burdens due to their vulnerability to adverse

- 12 -

effects of climate change, or due to the burden of the Convention itself. Accordingly, in the name of equity, developed country Parties should take the lead in combating climate change and its adverse effects. While these are not legally binding commitments in and of themselves, these principles will guide the Parties in their implementation of other provisions of the Convention.

CURRENT U.S. POLICIES AND MEASURES MEET CONVENTION OBLIGATIONS

The United States already has policies and measures in place which meet the Convention's commitments. The sum of these policies and measures constitutes the U.S. action strategy. These include the U.S. Global Change research programs, actions under the Clean Air Act Amendments of 1990, the National Energy Strategy, and the Intermodal Surface Transportation Act of 1991, as well as other legislative and non-legislative administrative programs and initiatives such as the "America the Beautiful," "Green Lights" and "Energy Star" Computer Programs, and programs to reduce methane and nitrous oxide emissions.

The U.S. has produced two iterations of its national action strategy: the first in February of 1991 and the second in April of 1992. Few other countries have taken this concrete step. The extent to which our net emissions are actually limited by these and other measures will depend on a number of factors including: GNP and population growth, the energy intensiveness of the economy, the resource mix in the energy sector and market penetration rates of energy efficiency technologies.

- 13 -

Actions contained in the U.S. action plan are estimated to reduce projected net emissions of methane, carbon dioxide and nitrous oxide by the equivalent of approximately 125-200 million metric tons of carbon in the year 2000 -- implying a projected net emission in 2000 of 1.4 to 6 percent above 1990 levels. Furthermore, we plan to continue to update and refine our action strategy as new information on science, economics, technology and policy becomes available. We anticipate producing a new draft of our national action plan by January 1993, a goal the President set in Rio.

To meet its obligations for technical and financial assistance, the U.S. has already agreed to provide \$25 million over two years for country studies and \$50 million to the core fund of the Global Environment Facility in addition to the \$150 million in bilateral aid already committed to the GEF pilot phase. Earlier this week the United States hosted a workshop in Berkeley, California, on methodologies for "country studies." Representatives of developed and developing countries and international organizations attended.

Country studies serve two important purposes: first, they provide data to make good decisions. Second, for most countries, country studies are a critical first step to enable a national government to evaluate its options in confronting the possibilities of climate change. The United States is committed to the country studies process and we are working and will continue to work directly with a number of countries, including

- 14 -

Poland, Brazil and Mexico. The United States also has numerous activities in place to meet its scientific research and information exchange obligations. The U.S. Global Change Research Program fosters research in the physical, biological and economic sciences, and has strongly promoted the creation and management of global change information and data bases. With requested fiscal year 1993 funding of nearly \$1.4 billion, this program accounts for more than the combined total of the rest of the world's research programs.

PROMPT START AND U.S. RATIFICATION

When the President signed the Framework Convention on Climate Change at the United Nations Conference for Environment and Development, he invited his colleagues from the industrialized world to join in a prompt start on the Convention's implementation. In addition, he proposed that these countries meet by January 1, 1993, to lay out their national plans for meeting the specific commitments in the Convention, and he committed the United States to six concrete actions:

- 1) signing the Convention in Rio;
- 2) seeking prompt consent to ratification by the U.S. Senate;
- 3) establishing a carbon dioxide monitoring program as provided by the Clean Air Act;
- 4) expanding U.S. scientific research on greenhouse gas emissions;

- 15 -

- 5) promoting developing country efforts to produce "national plans" through U.S. - supported country studies; and
- 6) preparing the U.S. national plans by January 1993.

I urge the Senate to do what it can to get this Convention off to a prompt start by moving quickly to ratify. I would like to note that ratification will not require new implementing legislation, although periodic appropriations will be necessary to meet our financial obligations under the Convention. This Convention represents a milestone in global efforts to protect our environment and deserves your support.