

September 1996

# GLOBAL WARMING

## Difficulties Assessing Countries' Progress Stabilizing Emissions of Greenhouse Gases





**Resources, Community, and  
Economic Development Division**

B-272113

September 4, 1996

The Honorable John D. Dingell  
Ranking Minority Member  
Committee on Commerce  
House of Representatives

Dear Mr. Dingell:

Industry, transportation, agriculture, and other human activities are emitting increasing amounts of carbon dioxide and other heat-trapping “greenhouse gases” into the earth’s atmosphere. According to the International Panel on Climate Change (IPCC), a group established to assess the scientific and technical information on climate change, climate models project an increase in the earth’s average surface temperature of between about 2 and 6 degrees Fahrenheit by 2100; the projection is based on estimated increases in greenhouse gas emissions and aerosols.<sup>1</sup> As we stated in our report and subsequent testimony on climate change models, some uncertainty exists about the timing, magnitude, and distribution of global warming.<sup>2</sup> Nevertheless, climate changes could have such important consequences as changes in weather patterns, including shifts in precipitation patterns that could lead to flooding; changes in crop yields; and changes in ecosystems.

To address the potential consequences of climate change, the United States, other developed countries, the former Soviet Union, and other Eastern European states—collectively known as the countries of Annex I to the 1992 United Nations Framework Convention on Climate Change (Convention)—agreed to aim to return their emissions of greenhouse gases to 1990 levels by 2000. Negotiations are under way to identify appropriate actions under the agreement after 2000, including possible specific emissions targets for these Annex I countries. The negotiations are scheduled to conclude in 1997. Because of your concerns about the possible implications of such negotiations, you asked that we evaluate (1) the progress of the United States and other Annex I countries toward meeting the goal of reducing greenhouse gas emissions to 1990 levels by 2000 and (2) the major factors that affect the countries’ ability to reach that goal. As agreed with your office, in addition to the United States, we

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<sup>1</sup>Aerosols are airborne particles that tend to cool the atmosphere, thereby offsetting some of the projected temperature increase.

<sup>2</sup>Global Warming: Limitations of General Circulation Models and Costs of Modeling Efforts (GAO/RCED-95-164, July 13, 1995) and Global Warming: Limitations of General Circulation Models (GAO/T-RCED-96-43, Nov. 16, 1995).

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included in our review Canada, Germany, Italy, Japan, and the United Kingdom—the six developed countries that are the largest emitters of carbon dioxide, the greenhouse gas considered to be the largest single contributor to human-induced climate change.

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## Results in Brief

The Annex I countries' progress in meeting the Convention's goal to reduce greenhouse gas emissions cannot be fully assessed because the emissions data are incomplete, unreliable, and inconsistent. For example, many of the national plans of Annex I countries do not include the 1990 inventory levels or projections to 2000 for all greenhouse gases. Although the emissions data for carbon dioxide are considered to have a high level of certainty, the data for other greenhouse gases are much less reliable. For example, the range of uncertainty<sup>3</sup> for Canada's reported emissions data on methane was plus or minus 30 percent at a 90-percent confidence level<sup>4</sup> and for nitrous oxide emissions, plus or minus 40 percent at an 85-percent confidence level. Such problems limit the completeness and comparability of the inventories and projections and therefore the ability to assess progress against the Convention's goal. The problems generally result from a lack of specific reporting requirements by the Convention and from limitations in the ability to quantify certain greenhouse gas emissions.

While these problems limit the efforts to fully assess the countries' progress, recent estimates of the countries' emissions of carbon dioxide by the Energy Information Administration and the International Energy Agency indicate that Germany and the United Kingdom are the only major developed countries likely to meet the Convention's goal. Canada, Italy, Japan, and the United States are unlikely to meet the goal. In our discussions with environmental officials from these countries and with climate change experts, we found that factors such as economic growth, population growth, fuel prices, and energy efficiency affect trends in energy use, thereby influencing trends in greenhouse gas emissions. For example, higher-than-expected economic and population growth and lower fuel prices resulting in higher energy use will probably prevent the United States and Canada from reaching the goal.

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<sup>3</sup>Uncertainty represents the degree to which the actual emissions data could differ from those that are reported.

<sup>4</sup>Confidence levels are expressed as percentages of the likelihood that actual emissions will fall within a given range of the reported levels.

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## Background

According to a 1995 assessment by the IPCC, climate models project that increasing atmospheric concentrations of the primary greenhouse gases—carbon dioxide, methane, and nitrous oxide—and aerosols will raise the average global surface temperature between 1.8 and 6.3 degrees Fahrenheit by 2100. The IPCC estimates that such a temperature increase could lead to many potential impacts, including flooding, droughts, changes in crop yields, and changes in ecosystems.

In an effort to address concerns about the possibility of global climate change, the United States and other countries signed the United Nations Framework Convention on Climate Change at the Rio Earth Summit in May 1992. As of June 1996, 159 countries had ratified the Convention. The Convention's ultimate objective is to stabilize the concentrations of human-induced greenhouse gases in the atmosphere at a level that would prevent dangerous interference with the climate system.<sup>5</sup>

To accomplish this objective, the Convention directs the Annex I parties to adopt policies and measures to limit greenhouse gases and to protect and enhance the greenhouse gas sinks and reservoirs that absorb and store carbon dioxide from the atmosphere.<sup>6</sup> The Convention also directs the Annex I parties to submit plans to the Conference of the Parties with detailed information on the policies and measures that will help return net greenhouse gas emissions to 1990 levels by 2000. (See app. I for more details on the Convention and a list of Annex I countries.) As of May 1996, 33 of the 36 countries listed under Annex I had ratified the Convention.<sup>7</sup>

At the first session of the Conference of the Parties to the Convention held in April 1995, the countries acknowledged that the existing commitments under the Convention are not adequate to meet the overall objective of stabilizing greenhouse gas concentrations. This determination was formally designated by the Conference of the Parties as the Berlin Mandate. To address the inadequacies, the parties agreed to begin a process to define actions in the post-2000 period, including strengthening the commitments of the parties included in Annex I by elaborating policies and measures, as well as by setting quantified objectives for limiting and reducing emissions. The Department of State's Under Secretary for Global

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<sup>5</sup>The Convention excludes greenhouse gases controlled by the 1987 Montreal Protocol on Substances That Deplete the Ozone Layer and its subsequent amendments.

<sup>6</sup>A sink is any process, activity, or mechanism that removes greenhouse gases from the atmosphere. A reservoir is a component of the climate system where greenhouse gases are stored.

<sup>7</sup>The European Economic Community was also included as an Annex I party and has ratified the Convention.

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Affairs recently announced to the Conference of the Parties that the United States supports the adoption of binding emissions targets beyond 2000. The process of determining actions beyond 2000, designed to include in its early stages an analysis and assessment phase, is scheduled for completion before the third Conference of the Parties, currently set for late 1997.

Carbon dioxide is considered the major contributor to global warming. Developed countries—as identified by their membership in the Organization for Economic Cooperation and Development (OECD)—accounted for about half of the world’s energy-related carbon dioxide emissions in 1990. The United States was responsible for about 22 percent of the total carbon dioxide emissions. Developing countries are projected to account for an increasing share of worldwide carbon dioxide emissions in the future as a result of their increasing growth in energy demand. For example, the Energy Information Administration estimates that China’s share of carbon dioxide emissions will almost double from about 10 percent in 1990 to about 19 percent in 2015. Therefore, even if the developed countries are able to stabilize carbon dioxide emissions, worldwide emissions are likely to increase because of the expected large growth in developing countries.

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## Countries’ Progress Toward Meeting the Convention’s Goal Cannot Be Fully Assessed

The incomplete, unreliable, and inconsistent data on emissions prevent a complete assessment of Annex I countries’ efforts to limit greenhouse gas emissions to 1990 levels by 2000. These problems occurred for several reasons, including a lack of specific reporting requirements by the Convention.

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## Data on Greenhouse Gases in National Plans Are Incomplete, Unreliable, and Inconsistent

As of February 1996, the Convention had compiled data from the national plans of 29 Annex I countries. These countries accounted for 60 percent of the estimated global carbon dioxide emissions from fossil fuel combustion in 1990. All 29 countries reported 1990 data on carbon dioxide, and 28 of the 29 reported similar data on methane and nitrous oxide. However, eight countries did not provide projections to 2000 for at least one of those gases. For example, Spain did not include projections of either methane or nitrous oxide in its plan. Additionally, only eight countries provided projections of the other greenhouse gases also covered under the Convention, such as hydrofluorocarbons. While emissions for such gases are now small, they are projected to increase in the future.

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Also, some reported data lack precision. Specifically, although countries provided emissions data for methane and nitrous oxide, the level of certainty in such data is low. For example, the uncertainty range for reported methane emissions in Canada's national plan is plus or minus 30 percent at a 90-percent confidence level; the range is plus or minus 40 percent for nitrous oxide at an 85-percent confidence level. In contrast, the uncertainty level for Canada's carbon dioxide emissions was only plus or minus 4 percent at a 95-percent confidence level. Reliability in measuring the emissions data for methane and nitrous oxide is not as high as for carbon dioxide. Because these gases come from many sources and are nontoxic, little effort has been given to measuring their emissions.

Additionally, the countries' emissions data were not always consistent. For example, some Annex I countries adjusted their 1990 inventory levels in order to develop what they believed to be a more reasonable starting point for projections to 2000. As a result, a different picture emerges of a country's ability to meet the goal, depending on whether the projections are compared to actual or adjusted 1990 levels. To illustrate, Denmark adjusted its 1990 inventory level upward to show what emissions would have been if imported hydroelectric power had been generated domestically with fossil fuels. Consequently, Denmark's carbon dioxide projections exceed the actual 1990 levels; but when the adjusted level for 1990 is used, the projections for 2000 are below the 1990 level.

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## Problems With Greenhouse Gas Data Have Two Major Causes

Two major factors contributed to problems in the Annex I countries' reporting of emissions data. First, the parties to the Convention did not formally adopt reporting guidelines until April 1995—after most countries had submitted their national plans—and the guidelines adopted in 1995 were not specific in all cases. For example, the guidelines did not specify whether emissions' projections were to be reported on the basis of gross emissions or net emissions, which account for the carbon dioxide removed from the atmosphere by forests and other greenhouse gas sinks. Only 13 of 29 Annex I countries separately reported projections of carbon dioxide sinks.

The parties to the Convention have recognized shortcomings in the guidance. In its comments on a draft of this report, the Department of State noted that the parties had adopted revised reporting guidelines at their Second Conference in July 1996. These revised guidelines will be used for the second round of national plans due to be submitted in April 1997. The Department of State has stated that these national plans

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will be significantly improved because of the revised guidelines. Furthermore, it expects that the Conference of the Parties will continue to revise and improve the guidelines.

The other major factor contributing to problems with the data on greenhouse gas emissions is that, as previously noted, the countries have not yet been able to quantify with certainty the emissions of methane and nitrous oxide because of the limited reporting data.

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## Economic Factors Make Most Annex I Countries Unlikely to Meet the Convention's Goal

Although the currently available emissions data prevent a complete assessment of countries' progress in meeting the Convention's goal, projections by energy forecasting agencies of carbon dioxide emissions from fossil fuel use—which is the largest single category of greenhouse gas emissions—indicate that few Annex I countries will likely be able to return emissions to 1990 levels by 2000. Of the major developed countries, only Germany and the United Kingdom appear likely to reduce carbon emissions to 1990 levels by the year 2000. Other major developed countries—including Canada, Italy, Japan, and the United States—will probably not reach the goal. A few other Annex I countries in eastern Europe, such as the Czech Republic, may be able to meet the Convention's goal.

The projections by the Annex I countries themselves indicate that only 7 of the 24 countries that provided point estimates of carbon dioxide emissions in 2000 project that they can hold emissions near or below 1990 levels. (See table 1.) For the remaining countries, the increases over the 1990 inventory levels ranged from 1.7 percent to 28.8 percent.



**Table 1: Reported Emissions Data for Carbon Dioxide**

Emissions in gigagrams			
Country	1990 levels	Year 2000 projections	Percent change
Australia	288,965	332,799	15.1
Austria	59,200	65,800	11.1
Canada	457,441	510,000	11.5
Czech Republic	165,792	135,536	-18.2
Denmark	52,100	53,753	3.2
Finland	53,900	70,200	30.5
France	366,536	399,000	8.8
Germany	1,014,155	917,000	-9.6
Greece	82,100	94,500	15.1
Hungary	71,653	68,741	-4.1
Ireland	30,719	36,988	20.4
Italy	428,941	482,440	12.5
Japan	1,173,360	1,200,000	2.3
Latvia	22,976	16,956	-26.2
Netherlands	167,600	167,600	0.0
New Zealand	25,530	29,550	15.7
Norway	35,533	39,500	11.2
Portugal	42,148	54,274	28.8
Slovak Republic	58,278	48,639	-16.5
Spain	248,005	276,523	11.4
Sweden	61,256	63,800	4.2
Switzerland	43,600	43,800	0.5
United Kingdom	577,012	586,720	1.7
United States	4,957,022	5,163,136	4.2

Note: Belgium, Poland, and the Russian Federation also provided estimates of ranges of projections for carbon dioxide.

Sources: National Communications from Parties Included in Annex I to the Convention, Tables of inventories of anthropogenic emissions and removals in 1990 and projected anthropogenic emissions in 2000, February 1996; and Projections for Greenhouse Gases, Supplementary Report of April 1996 to the First Report of the Government of the Federal Republic of Germany pursuant to the United Nations Framework Convention on Climate Change.

The projections from other organizations also indicate that few countries will be able to stabilize carbon dioxide emissions.<sup>8</sup> For example, the Energy Information Administration's May 1996 International Energy

<sup>8</sup>Estimates by these other organizations do not take into account factors that could offset carbon dioxide emissions, such as the enhancement of carbon sinks.

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Outlook forecasts that carbon dioxide emissions from energy consumption will increase for most of the Annex I countries from 1990 to 2000. Specifically, the agency projects that carbon dioxide emissions will increase 11 percent in the United States, 21 percent in Japan, 18 percent in Canada, and 6 percent in OECD Europe. The International Energy Agency (IEA) also projects increases in carbon dioxide emissions between 1990 and 2000 for Annex I countries. In its 1994 Review of Energy Policies of IEA Countries, published in July 1995, this agency forecasts increases in energy-related carbon dioxide of 10 percent for the United States, 13 percent for Canada, and 8 percent for Europe.

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**Factors Affecting Energy Use Also Affect Progress Toward the Goal**

On the basis of our review of six developed countries—Canada, Germany, Italy, Japan, the United Kingdom, and the United States—we found that energy use is the major factor affecting the ability of those countries to meet the goal of returning greenhouse gas emissions to 1990 levels by 2000. Therefore, the major factors that affect trends in energy use—such as growth in gross domestic product (GDP), population growth, energy prices, and energy efficiency—also affect trends in greenhouse gas emissions. The ability to shift from coal, the burning of which produces a high level of greenhouse gases, to other fuels is also a major factor. Table 2 provides information on these factors for the six countries we reviewed. (App. II provides additional information on the goals of the six countries in connection with climate change and the status of the additional actions that those countries are considering to help reach the Convention’s goal.)

**Table 2: Factors Affecting Efforts to Reach the Convention's Goal**

Country	Likely to achieve goal?	OECD's estimate of annual GDP growth, 1990-2000 (percent)	OECD's estimate of annual population growth, 1990-2000 (percent)	Key factors affecting achievement of goal
Canada	No	2.3	1.7	High rate of energy use, low energy prices, and a fast growing population
Germany	Yes	Not available	-0.1	Negative economic growth and phaseout of coal in former East Germany
Italy	No	1.6	0.1	High rate of energy efficiency makes additional gains difficult
Japan	No	2.1	0.3	Difficult to obtain additional energy efficiencies and difficulties in siting nuclear power plants designed to replace coal-powered facilities
United Kingdom	Yes	2.7	0.3	Shift from coal and oil to natural gas due to privatization of utilities
United States	No	2.5	0.9	Higher-than-expected economic growth, low energy prices, and funding reductions

Sources: GAO's analysis and OECD's GDP and population growth from *Measuring Up to the Year 2000 Aim of the Framework Convention on Climate Change*, The EOP Group, Inc., November 1995.

## United States Is Not Likely to Meet Goal, Largely Because of Economic Factors

In response to the Convention's goal on greenhouse gases, the United States issued its Climate Change Action Plan (CCAP) in October 1993. The plan includes 44 largely voluntary initiatives designed to return net emissions of the major greenhouse gases—carbon dioxide, methane, nitrous oxides, and hydrofluorocarbons—to 1990 levels by 2000. The CCAP aimed to cut the net projected growth of 7 percent in the major greenhouse gas emissions between 1990 and 2000 and to achieve stabilization at the 1990 level of 1,462 million metric tons of carbon equivalent (MMTCE). Without the plan's initiatives, emissions were projected to grow to 1,568 MMTCE. The CCAP laid the foundation for the U.S. national plan submitted to the Convention in September 1994.

The United States estimates that it will fall short of its target. Efforts to reduce greenhouse gas emissions in the United States have been hampered

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by changes in forecasts of key economic variables, such as higher-than-projected economic growth and lower-than-expected energy prices, that differ from the assumptions made in the CCAP. The changes in these economic indicators tend to increase energy use and therefore also increase greenhouse gas emissions. For example, the world oil price per barrel in 2000 was estimated to be \$24.04 (1994 dollars) in the CCAP, but the Energy Information Administration's 1996 Annual Energy Outlook—which contains the executive branch's latest forecasts—now estimates that the price will be \$19.27 per barrel (1994 dollars). Also, annual population growth is now projected to be higher than expected when the CCAP was formulated—about 1.0 percent per year as compared with the 0.7 percent projected in 1993. Population growth tends to increase energy use and consequently greenhouse gas emissions. (App. III compares in more detail the changes in key economic factors and fuel prices affecting the U.S. efforts.)

Officials at the Department of Energy and the Environmental Protection Agency—which are responsible for implementing the bulk of the CCAP actions—noted that the reductions in the funding for the plan also have a substantial negative effect on the United States' ability to reduce greenhouse gas emissions by 2000 by limiting the agencies' ability to implement voluntary initiatives in the plan. For example, in fiscal year 1996, only about one-half of the requested funds were appropriated. Table 3 provides annual budget requests and appropriations for fiscal years 1995 through 1997. Lower estimated prices will, in general, also make the implementation of voluntary initiatives less likely. According to an official with the Council on Environmental Quality, legislation has also precluded the implementation of the few nonvoluntary actions in the plan, such as requiring that tires be labeled for fuel economy.

The Council on Environmental Quality, the Department of Energy, the Department of State, and the Environmental Protection Agency are currently revising the CCAP. A new plan is scheduled to be issued in the fall of 1996.

**Table 3: Budget Requests and Appropriations for CCAP**

Dollars in millions

Agency	Fiscal year 1995 budget request	Fiscal year 1995 appropriation	Fiscal year 1996 budget request	Fiscal year 1996 appropriation	Fiscal year 1997 budget request
Department of Energy	\$208	\$101	\$185	\$85	\$144
Environmental Protection Agency	123	102	138	83	142
Others	13	9	13	6	19
<b>Total</b>	<b>\$344</b>	<b>\$212</b>	<b>\$336</b>	<b>\$174</b>	<b>\$305</b>

Source: Office of Management and Budget.

### Canada, Japan, and Italy Also Likely to Miss Goal Due to Economic Factors

Canada's national plan relies primarily on a set of voluntary measures aimed at increasing energy efficiency and conservation and encouraging a switch to less carbon dioxide-intensive energy sources. Because of Canada's high energy-intensity, most of its human-induced greenhouse gas emissions are generated by the demand for energy to heat and light homes, operate industries, and other uses. Factors such as low population density, large distances between urban areas, and a cold climate create unique circumstances that make Canada a highly energy-intensive country. A recent estimate indicates that Canada will likely miss the Convention goal by a significant amount—carbon dioxide emissions are estimated to increase by 18 percent by the Energy Information Administration. The country's high rate of energy intensity, low energy prices, and fast-growing population, among other factors, have contributed to the gap.

Japan is also likely to miss the Convention's goal. Japan's Action Report on Climate Change, issued in 1994, estimated that total carbon dioxide emissions in 2000 would exceed their 1990 levels. Current projections by the Energy Information Administration indicate that carbon dioxide emissions in Japan may increase by 21 percent. Over the last 20 years, Japan has consistently consumed one of the lowest percentages of energy per dollar of economic output for developed countries because of energy efficiency programs and initiatives. Therefore, achieving additional greenhouse gas reductions is difficult. As a result, even low levels of growth in the economy and population increase energy use and greenhouse gas emissions. Additionally, Japan had planned to build several additional nuclear power plants that would emit fewer greenhouse gases than the coal-powered facilities they would replace. However, the country has encountered difficulties in siting and building those plants.

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Italy also is low in energy-intensity as compared to other major developed countries. According to a State Department official, Italy is more energy efficient than other developed countries because of high energy prices and regulations limiting energy use. Therefore, additional energy savings and greenhouse gas reductions may be difficult to achieve, although Italy is forecast to experience a relatively low rate of economic growth. Italy's national plan discusses additional measures to further reduce carbon dioxide emissions, but their impact may be minimal. In its national plan, Italy projects that its carbon dioxide emissions in 2000 will exceed 1990 emissions by about 12.5 percent without additional measures.

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### Germany and United Kingdom Are Likely to Meet Goal Largely as a Result of Unique Factors

Germany and the United Kingdom, the only two major developed countries positioned to meet the Convention's goal, are also subject to economic factors that can cause energy use to increase. However, as the result of unique circumstances set in motion before the Convention's goal was established, both Germany and the United Kingdom are likely to meet the goal.

According to an official in Germany's Ministry of the Environment, the principal reason that Germany is expected to exceed the Convention's goal is the reunification of the former East Germany with West Germany in 1990. The depressed economic conditions in East Germany, including low productivity levels and high unemployment, and the shift from inefficient coal technology to natural gas are helping to reduce greenhouse gas emissions significantly. For instance, carbon dioxide emissions in the former East Germany have already decreased by about 43 percent from 1990 to 1994. In contrast, during the same period, carbon dioxide emissions increased about 3 percent in what was formerly West Germany. In its national plan, Germany has also sought to achieve the Convention's goal by implementing a broad range of voluntary and regulatory measures aimed at reducing greenhouse gas emissions.

Progress in the United Kingdom is largely attributable to the privatization of its energy utilities over the last decade, which is bringing about a significant switch from coal to natural gas, the fossil fuel that produces the lowest level of carbon dioxide emissions per unit of energy consumed. To illustrate, the Energy Information Administration has estimated that natural gas as a percentage of total energy consumption will increase in the United Kingdom from 23 percent in 1990 to 35 percent in 2000. The United Kingdom has also increased its taxes on energy use, which it believes will also help to reduce greenhouse gas emissions. United

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Kingdom officials now estimate that carbon dioxide emissions in 2000 will be about 4 percent to 8 percent below 1990 emissions.

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## Conclusions

The ability to assess countries' individual and relative efforts in reducing greenhouse gas emissions depends greatly on the countries' reporting of complete, reliable, and consistent emissions data. However, some of the national plans submitted by Annex I countries have not provided such data. Consequently, a complete assessment cannot be made of whether these countries will meet the Convention's goal of reducing all greenhouse gas emissions to 1990 levels by 2000. The recent adoption of revised reporting standards should improve the ability to assess progress against the current Convention goal. Negotiations are already under way aimed at reaching agreement on new, binding emissions targets past 2000 for these same countries. Reporting guidelines designed to help ensure that complete, reliable, and complete emissions data are provided by countries will also be an essential element of any new agreement.

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## Recommendation

We recommend to the Secretary of State that, as part of ongoing international negotiations, the United States urge that reporting standards be formulated and adopted for any new targets beyond 2000 in order to enhance the completeness, reliability, and consistency of emissions data.

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## Agency Comments

We provided a draft of our report to the Department of State, the Council on Environmental Quality, the Department of Energy, and the Environmental Protection Agency for their review and comment.

The Department of State commented that our report provides an accurate assessment of the progress of countries in reducing greenhouse gas emissions. The Department also agreed with our recommendation and noted that revisions had recently been made to the reporting guidelines that will lead to improved national plans. We updated our report to reflect that recent development. The Department also provided several additional comments, and we have revised the report as appropriate. (See app. IV for the Department of State's comments and our response.)

The Council on Environmental Quality noted that our report provides a useful overview of the activities to date by the United States and other developed countries and agreed with our recommendation. The Council

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provided additional information to add context to our report. (See app. V for the Council's comments and our response.)

The Department of Energy provided editorial comments on our report, which we incorporated as appropriate. The Environmental Protection Agency had no comments on our report.

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We conducted our audit work from September 1995 through July 1996 in accordance with generally accepted government auditing standards. A detailed discussion of our objectives, scope, and methodology is contained in appendix VI.

As agreed with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 15 days from the date of this letter. At that time, we will send copies to the Secretary of State; the Secretary of Energy; the Administrator, Environmental Protection Agency; the Director, Council on Environmental Quality; the Director, Office of Management and Budget; and other interested parties. We will also make copies available upon request.

Please call me at (202) 512-6111 if you or your staff have any questions. Major contributors to this report are listed in appendix VII.

Sincerely yours,

A handwritten signature in black ink, appearing to read "P. F. Guerrero", with a long horizontal flourish extending to the right.

Peter F. Guerrero  
Director, Environmental  
Protection Issues



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### Abbreviations

AEO	Annual Energy Outlook
CCAP	Climate Change Action Plan
GAO	General Accounting Office
GDP	gross domestic product
IEA	International Energy Agency
IPCC	International Panel on Climate Change
MMTCE	million metric tons of carbon equivalent
OECD	Organization for Economic Cooperation and Development

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# Commitments Established by the United Nations Framework Convention on Climate Change

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The United Nations Framework Convention on Climate Change entered into force on March 21, 1994. As of June 1996, 159 countries had ratified the Convention. The Convention's ultimate objective is the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous interference with the climate system from human activities."<sup>9</sup> To achieve this goal, the Convention established different types of goals and commitments for developed and developing countries. Under the Convention, all parties are to do the following:

- Prepare and communicate to the Conference of the Parties inventories of greenhouse gas emissions caused by human activity using comparable methodologies.
- Develop and communicate to the Conference of the Parties programs to mitigate the effects of greenhouse gases and measures the countries might take to adapt to climate change.
- Cooperate in the transfer of technology addressing greenhouse gas emissions in all relevant sectors of the economy.
- Promote sustainable management of greenhouse gas sinks and reservoirs.
- Cooperate in preparing for adaptation to the impacts of climate change.
- Integrate considerations of climate change with other policies.
- Conduct research to reduce the uncertainties about scientific knowledge of climate change, the effects of the phenomenon, and the effectiveness of responses to it.
- Exchange information on matters such as technology and the economic consequences of actions covered by the Convention.

In addition to the above commitments, the Convention required developed countries and other parties included in Annex I of the Convention to do the following:

- Adopt national policies and take corresponding measures to mitigate climate change with the aim of returning human-induced emissions of greenhouse gases to 1990 levels by the year 2000 and by protecting and enhancing greenhouse gas sinks and reservoirs.
- Communicate, within 6 months of the Convention's entry into force and periodically thereafter, detailed information on policies and measures to limit greenhouse gas emissions, as well as on the resulting projections of greenhouse gas emissions and removals by sinks.
- Coordinate as appropriate with other parties the relevant economic and administrative instruments developed to achieve the objective of the Convention.

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<sup>9</sup>The Convention seeks to control those greenhouse gases not covered under the Montreal Protocol.

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**Appendix I**  
**Commitments Established by the United**  
**Nations Framework Convention on Climate**  
**Change**

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- Identify and periodically review policies and practices that encourage activities that lead to greater levels of human-induced emissions of greenhouse gases than would otherwise occur.

The 36 Annex I countries are listed below.<sup>10</sup> Of the Annex I countries, Belarus, Ukraine, and Turkey have not ratified the Convention. The European Economic Community—now known as the European Union—was also included as an Annex I party to the Convention. The countries listed in bold are those undergoing a transition to a market economy.

Australia  
Austria  
**Belarus**  
Belgium  
**Bulgaria**  
Canada  
**Czech Republic**  
Denmark  
**Estonia**  
Finland  
France  
Germany  
Greece  
**Hungary**  
Iceland  
Ireland  
Italy  
Japan  
**Latvia**  
**Lithuania**  
Luxembourg  
Netherlands  
New Zealand  
Norway  
**Poland**  
Portugal  
**Romania**  
**Russian Federation**  
**Slovak Republic**

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<sup>10</sup>On January 1, 1993, the Federal Republic of Czechoslovakia was dissolved and the Czech Republic and the Slovak Republic became independent States, each of which took on Annex I commitments.

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**Appendix I**  
**Commitments Established by the United**  
**Nations Framework Convention on Climate**  
**Change**

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Spain  
Sweden  
Switzerland  
Turkey  
**Ukraine**  
United Kingdom of Great Britain and Northern Ireland  
United States of America

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# Description of Countries' National Goals

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The six countries we reviewed—Canada, Germany, Italy, Japan, the United Kingdom, and the United States—established various goals and employed varying approaches to attempt to meet their commitments under the Convention. This appendix describes the goals and plans to meet the goals for each of the six countries we reviewed.

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## Canada

In 1990, Canada adopted a national goal to stabilize net emissions of all greenhouse gases by 2000 relative to 1990 emissions. Canada released its National Report on Climate Change to meet the goal. Canada's approach relies primarily on a set of voluntary measures aimed at increasing energy efficiency and conservation and encouraging a switch to less carbon dioxide-intensive energy sources. Because of Canada's high energy-intensity, most of its greenhouse gas emissions are generated by the demand for energy to heat and light homes and operate industries, as well as for other uses. Carbon dioxide emissions, generated chiefly from energy production and consumption, accounted for the majority of the 1990 actual emissions. Canada has acknowledged that it will miss its national goal if additional actions are not taken. It is not yet known how any additional initiatives will affect Canada's progress toward the climate change goal.

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## Germany

Germany established an ambitious goal of reducing its emissions of carbon dioxide by 25 percent to 30 percent and its emissions of other greenhouse gases by 50 percent in 2005 relative to 1987 emissions levels. Germany has sought to achieve the goals by implementing a broad range of over 100 measures primarily aimed at reducing carbon dioxide emissions. Thus far, carbon dioxide emissions in Germany have decreased by about 16 percent from 1987 to 1994, primarily because of depressed economic conditions in the former East Germany. In addition to those reductions, several German industry associations have agreed to voluntarily decrease carbon dioxide emissions by up to 20 percent relative to 1990 levels in order to help Germany meet its own ambitious goal. However, recent reports suggest that Germany will not be able to meet its own ambitious goal, although it will most likely meet the Convention's goal by reducing greenhouse gas emissions below 1990 levels by 2000.

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## Italy

The Italian government has noted that its national plan was the outgrowth of policies adopted for the Convention, but also designed to comply with prior decisions by the European Union to stabilize greenhouse gas

emissions. The plan cites several initiatives already under way in the energy and transportation sectors but notes that an annual increase of between 0.4 percent and 0.9 percent in carbon dioxide emissions from energy consumption would still result.

The plan also discusses possible additional initiatives that would help stabilize greenhouse gas emissions. These initiatives are primarily aimed at electricity generation, industrial production, the residential sector, and transport. Budgetary constraints and other factors, however, may impede the implementation of such measures. A recent estimate by the Italian Environment Ministry is that carbon dioxide emissions will increase by about 3 percent between 1990 and 2000. An official in that ministry stated that the government is still confident that it can meet the Convention's goal by enacting additional measures.

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## Japan

Japan has established a goal of stabilizing its per capita emissions and total emissions of carbon dioxide at 1990 levels by 2000. To achieve the carbon dioxide target, in October 1990 Japan established an Action Program to Arrest Global Warming. In addition, Japan has pledged to undertake efforts to stabilize methane, nitrous oxide, and other greenhouse gas emissions, but has not specified a reference year. Japan estimates that it will not reach its goal of reducing total carbon dioxide emissions, if additional measures are not taken. Japan sought to reduce its emissions by building several nuclear power plants to help phase out the use of coal, but it has encountered difficulties in siting and building the plants.

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## United Kingdom

The United Kingdom has adopted the Convention's goal of stabilizing emissions of all greenhouse gases at 1990 levels in the year 2000. The United Kingdom establishes its strategy for meeting the goal in a January 1994 report, *Climate Change, The UK Programme*. The program relies essentially on a set of measures to reduce carbon dioxide emissions by improving energy efficiency. The United Kingdom also has adopted an 8-percent value added tax on residential fuel. The United Kingdom's program aims to return carbon dioxide emissions to 1990 levels by reducing emissions by 6 percent. The program also aims to reduce emissions of methane around 10 percent below 1990 levels, nitrous oxide by 75 percent, and emissions of other greenhouse gases from 25 percent to 90 percent. A United Kingdom official said that the country estimates it will meet its national target.



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**United States**

In response to its commitment to the Climate Convention, the United States issued the Climate Change Action Plan (CCAP) in October 1993. The plan includes 44 initiatives designed to return net emissions of the major greenhouse gases—carbon dioxide, methane, nitrous oxides, and hydrofluorocarbons—to 1990 levels by 2000. The plan relies primarily on voluntary programs to reduce greenhouse gas emissions and enhance the capacity of greenhouse gas sinks to store carbon dioxide removed from the atmosphere. The U.S. plan aims to cut the net projected growth of 7 percent in the major greenhouse gas emissions between 1990 and 2000 in order to return emissions to 1990 levels by 2000.

The United States estimates that it will likely fall short of its target without additional measures. Currently, the Council on Environmental Quality, the Department of Energy, the Department of State, and the Environmental Protection Agency are updating the plan by developing additional ways to achieve the Convention's goal. The new CCAP is scheduled to be issued in the fall of 1996.

# Changes in Key Economic Factors for the United States

Changes in key economic factors and energy prices have made it more difficult for the United States to meet the goal of reducing greenhouse gas emissions to 1990 levels by 2000. Table III.1 shows changes in key growth factors between the 1993 Climate Change Action Plan (CCAP) and the Energy Information Administration's Annual Energy Outlook (AEO) 1996. Table III.2 compares projected fuel prices in 2000 in these two documents.

**Table III.1: Projections of Annual Growth Rates in Key Economic Factors, 1990-2000**

Economic factor	CCAP (percent)	AEO 1996 (percent)	Effect on greenhouse gas emissions
Real GDP growth	2.3	2.4	Increase
Annual population growth	0.7	1.0	Increase
Residential housing stock	0.9	1.0	Increase
Commercial floorspace	1.3	1.6	Increase
Industrial production index	2.5	2.0	Decrease
Industrial energy intensity	-1.4	-0.8	Increase

Sources: Technical Supplement to CCAP and AEO 1996.

**Table III.2: Projections of Major Fuel Prices for 2000**

Fuel type	CCAP (in 1991 dollars)	CCAP (converted to 1994 dollars)	AEO 1996 (in 1994 dollars)
World oil price (dollars per barrel)	\$22.28	\$24.04	\$19.27
Wellhead natural gas (dollars per thousand cubic feet)	\$2.53	\$2.73	\$1.89
Minemouth coal (dollars per ton)	\$25.97	\$28.03	\$17.44

Sources: Technical Supplement to CCAP and AEO 1996.

# Comments From the Department of State

Note: GAO comments supplementing those in the report text appear at the end of this appendix.



United States Department of State

Washington, D.C. 20520

July 31, 1996

Dear Mr. Fultz:

We appreciate the opportunity to review your draft report, "GLOBAL WARMING: Difficulties Assessing Countries' Progress Stabilizing Emissions of Greenhouse Gases," GAO/RCED-96-188, GAO Job Code 160316.

Department officials in the Office of Global Change reviewed the report and provide the enclosed comments and update as a result of the recent Second Conference of the Parties (COP-2) of the U.N. Framework Convention on Climate Change (UNFCCC) in Geneva.

If you have any questions, please contact Dr. Jonathan Pershing, OES/EGC, at (202) 647-4069.

Sincerely,

  
Richard L. Greene  
Chief Financial Officer

Enclosures:  
As stated.

cc:  
GAO - Mr. Wurster  
STATE/OES/EGC - Dr. Pershing

Mr. Keith O. Fultz  
Assistant Comptroller General,  
Resources, Community, and Economic  
Development Division,  
U.S. General Accounting Office.

Appendix IV  
Comments From the Department of State

U S. Department of State Comments: GAO/RCED-96-188  
GAO Draft Report on "Global Warming: Difficulties In  
Assessing the Progress of Countries' Efforts to Stabilize  
Emissions of Greenhouse Gases," GAO Job Code 160316

Overall, the Department finds the GAO draft report to provide an accurate assessment of the state of our understanding of the success Parties to the United Nations Framework Convention on Climate Change (UNFCCC) have had in reducing their emissions of greenhouse gases. Furthermore, we concur with the recommendations made in the report: that additional rigor must be provided in national reports to allow a better assessment of progress made toward implementing national greenhouse gas reduction programs. In this context, we note that, largely as a consequence of U.S. urging, the Parties to the UNFCCC have adopted, at their second session, revisions to the guidelines for reporting. We believe these guidelines will significantly improve the transparency of information on both inventories of emissions, and on the effects of measures to reduce those emissions. Attached is a copy of the revised guidelines as adopted by the Parties.

We offer a few additional comments as well:

1. In several places, the report suggests that data are "incomplete, unreliable and inconsistent." If measured against an absolute scale, this may be true; however, the implication is that the severity of these strictures prevents a valid assessment of the state of our information with regard to inventorying current, or projecting future national emissions of greenhouse gases. We believe that notwithstanding the lack of a perfect record, significant information is available, and provides a clear guide regarding the extent and level of success of national efforts in reducing emissions of greenhouse gases. In fact, the GAO report seems to agree that such an assessment is possible. Based on its assessment, the GAO suggests few Parties will indeed return their emissions to 1990 levels by the year 2000 -- a conclusion which in our view is extremely robust.

2. The report does not provide any history of the development and agreement of reporting guidelines, or the timing of the submission of communications with respect to the adoption of such guidelines. In fact, most national communications were submitted prior to the adoption by the COP\* of the guidelines -- and therefore, the lack of compliance with the guidelines does not reflect on countries' intent to circumvent or ignore the agreed format for reporting. The second communications (which are due in April 1997, and will follow revised guidelines, agreed at the most recent session of the COP, held in July 1996) can be expected to better reflect compliance than do the first communications. In this context, it should also be noted that a number of countries have submitted documentation on aspects of their reports that were inadequate in the initial versions (either following their initial communications, or as a consequence of the FCCC Secretariat-led in-depth reviews of their communications).

\*Conference of the Parties

See comment 1.

See comment 2.

See comment 3.

Appendix IV  
Comments From the Department of State

See comment 4.

3. The Report concludes that assessing national efforts to reduce greenhouse gas emissions will be predicated solely on the reports submitted by Parties. However, it does not also note that independent efforts to assess national emissions trends (either directly, or through energy projection proxies) may also be used to verify national greenhouse gas emission reduction efforts. For example, the International Energy Agency, the World Bank and others provide estimates which may be used to independently verify national estimates. Ultimately, it must be the responsibility of both the FCCC Secretariat, and of individual Parties, to assess efforts to reduce emissions -- and to ensure that reports submitted are essentially in conformity with other international assessments.

See comment 3.

4. Finally, the GAO recommendation is one that the State Department wholeheartedly endorses -- and on which significant action has already been taken. At the most recent session of the Conference of the Parties, held from July 8-19, 1996 in Geneva, the Parties agreed to a substantial series of revisions to the guidelines for the preparation of national communications. However, we view the preparation of guidelines for national communications -- and the reports themselves -- as an evolving effort. We believe that the first communications represented a sincere and extremely forthcoming effort by Parties. We expect the next iteration of the communication to be a significant improvement -- and that we will continue to revise and improve both the guidelines, and the reports which are produced based on the guidelines.

See comment 5.

Ultimately, however, because of inherent uncertainty in projecting the future, projections of emissions over time are unlikely to ever be completely accurate. In our view, one of the most critical components of the reports will continue to be inventories of current emissions -- and in this area, there is broad agreement on both methodologies, and the appropriate application of these methodologies in Parties' national communications. In fact, while even a conservative estimate suggests that few countries will return emissions to their 1990 levels by the year 2000, we cannot yet say for certain whether, or by how much, country emissions will exceed this target.

In the U.S. view, targets for next steps must be designed to accommodate the inability of countries to predict with absolute certainty their future emissions -- and must thus provide flexibility to allow for inaccurate projections.

5. The Department of State's Office of Global Change has the lead for the climate change issue including with respect to national communications. Any additional comments or inquiries may be directed to OES/EGC Dr. Jonathan C. Pershing.

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The following are GAO's comments on the Department of State's letter dated July 31, 1996.

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## GAO's Comments

1. We have revised our report to reflect the recent adoption of revised reporting guidelines for national plans to be submitted in conjunction with the Convention's current goal and the potential improvement they provide.
2. We continue to believe that a significant portion of the emissions data from national plans submitted thus far are incomplete, unreliable, or inconsistent. Therefore, as noted in the report, these data limit an assessment of countries' progress against the Convention's goal. We agree that estimates provided by other groups, such as the International Energy Agency, also provide some basis for determining progress, especially given that many Annex I countries will probably not come close to reaching the Convention's current goal. However, these other estimates are limited to carbon dioxide. Additionally, it is unclear how emissions data from these other groups will be considered by the Conference of the Parties in assessing progress against the current goal or any future binding targets.
3. We revised our report to note the formulation and adoption of improved guidelines from the Conference of the Parties in July 1996. We also noted that the original guidelines were adopted in April 1995, after the submission of many of the national plans.
4. We do not state in our report that progress will be assessed solely on the basis of the national plans but rather that the ability to assess countries' progress depends greatly on complete, reliable, and consistent data. We believe national plans will be a key component of that assessment and therefore improving the data in the plans is important. Additionally, as noted in comment 2, estimates from other groups apply only to carbon dioxide, and it is unclear how such estimates would be factored into assessing progress by the Conference of the Parties.
5. We revised our recommendation to note that reporting guidance could help enhance the completeness, reliability, and consistency of the reported emissions data rather than solve all the data problems. Also, despite broad agreement on methodologies for calculation of historical emissions, high levels of uncertainty still exist on reported emissions data other than carbon dioxide.

# Comments From the Council on Environmental Quality

Note: GAO comments supplementing those in the report text appear at the end of this appendix.



EXECUTIVE OFFICE OF THE PRESIDENT  
COUNCIL ON ENVIRONMENTAL QUALITY  
WASHINGTON, D.C. 20503

August 1, 1996

Mr. Peter F. Guerrero  
Director  
Environmental Protection Issues  
U.S. General Accounting Office  
Washington, D.C. 20548

Dear Mr. Guerrero:

I appreciate the opportunity to review and provide comments on the draft report entitled, Global Warming: Difficulties Assessing Countries' Progress Stabilizing Emissions of Greenhouse Gases. In general, the report provides a useful overview of activities to date by the United States and other developed countries in meeting the goal established under the Framework Convention on Climate Change to return greenhouse gas emissions to 1990 levels by the year 2000.

The key finding of the report is fully consistent with our own assessment of activities to date. It appears that only two developed countries are likely to achieve the goal of returning emissions to 1990 levels by the year 2000, both due to unique circumstances not related to climate change. Despite considerable progress under the Climate Change Action Plan (CCAP), the United States finds itself among the vast majority of developed nations likely to fall short of stabilization in 2000.

Our own detailed review of the national CCAP is underway and points to a number of factors behind the anticipated shortfall including: deep cuts by Congress of about 50 percent for funding of the CCAP as part of the fiscal year 1996 budget; policy riders attached to fiscal year 1996 appropriations prohibiting certain CCAP activities (e.g., tire labelling and appliance efficiency standards); higher than projected economic growth; and lower than expected energy prices. This detailed review of CCAP should be completed in fall of this year.

Finally, we also agree with the one specific recommendation in the report, that reporting guidelines for submissions of national communications be improved. However, we believe it is important to put this recommendation in its proper context. The initial reporting by Parties under the Convention has provided extremely useful information. It is not surprising that some differences in details among countries exist, particularly for those gases that constitute only a small fraction of the total greenhouse gas emissions. We fully expect that reporting will improve over time with experience and in response to comments from the on-going process for reviewing national communications.

See comment 1.

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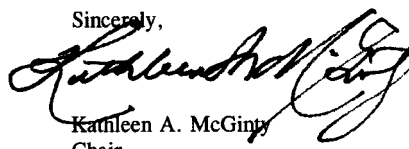
**Appendix V  
Comments From the Council on  
Environmental Quality**

Mr. Peter F. Guerrero  
Page 2

In fact, at the recent Conference of the Parties, with the strong support of the United States, revised guidelines were adopted aimed at improving consistency in reporting of data in national communications. More details about the reporting revisions will be provided in the response to the draft report being prepared by the Department of State.

I hope these comments are useful in finalizing this report.

Sincerely,



Kathleen A. McGinley  
Chair

KAM/pgu

See comment 2.



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The following are GAO's comments on the Council on Environmental Quality's letter dated July 31, 1996.

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## **GAO's Comments**

1. The Council on Environmental Quality notes that it is not surprising that differences exist in details reported by the countries, particularly for gases that constitute only a small fraction of greenhouse gases. However, we found that some of the problems with reported greenhouse gas emissions data, such as adjustments to 1990 emissions, also applied to carbon dioxide, the greenhouse gas reported to be the largest contributor to global warming. Additionally, emissions of greenhouse gases other than carbon dioxide—for which reported emissions data were incomplete in some cases and for which the reliability of the data was uncertain—constitute a significant enough portion of estimated total greenhouse gases to influence whether or not countries can meet the Convention's current goal or future binding targets. For example, these gases have been estimated to account for about 15 percent of the total U.S. greenhouse gas emissions in 1990 and that percentage is higher in many Annex I countries.
2. We have revised the report to note this recent development.

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# Objectives, Scope, and Methodology

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The Ranking Minority Member of the House Committee on Commerce asked us to review the efforts of the United States and other Annex I countries toward returning greenhouse gas emissions to 1990 levels by 2000 as agreed under the 1992 United Nations Framework Convention on Climate Change. In addition, the requester asked that we determine the major factors that may impede the countries' progress in achieving the goal. We conducted our work from September 1995 through July 1996 in accordance with generally accepted government auditing standards.

To determine the progress that the United States and other Annex I countries have made in reducing greenhouse gas emissions to 1990 levels, we obtained data on each country's greenhouse gas emissions for 1990 and projections for 2000—from the United Nations Secretariat on the Climate Change Convention and from other groups such as the Energy Information Administration and the International Energy Agency. We also reviewed other reports prepared by the Convention Secretariat that assessed the adequacy of the Convention's reporting guidelines and the national plans. We also discussed reporting issues with State Department and Convention officials.

To determine the major factors that affect the countries' progress toward achieving the emissions target, we concentrated our efforts on Canada, Germany, Italy, Japan, the United Kingdom and the United States. We chose those six countries because they have been the largest emitters of carbon dioxide for developed countries. We obtained and reviewed the national plans of the six countries and spoke with representatives of each country to determine the major factors affecting their ability to reach the Convention's goal. We also discussed these factors with climate change experts and reviewed relevant reports from the Organization for Economic Cooperation and Development, the International Energy Agency, the Energy Information Administration, the Global Climate Coalition, and the United States Climate Action Network.

# Major Contributors to This Report

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Resources,  
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