

**The Global
2000 Report
to the President**

The Technical
Report

Volume Two

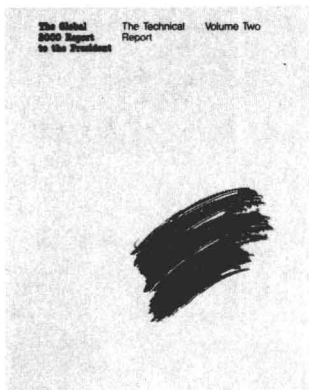


The Global 2000 Report to the President

Entering the Twenty-First Century

A Report Prepared by
the Council on Environ-
mental Quality and the
Department of State

Gerald O. Barney
Study Director



About the Cover

The Global 2000 Report to the President presents a picture that can be painted only in broad strokes and with a brush still in need of additional bristles. It is, however, the most complete and consistent such picture ever painted by the U.S. Government. Many rapid and undesirable developments are foreseen if public policy concerning population stabilization, resource conservation and environmental protection remain unchanged over the coming decades. Dramatic changes in public policy are needed around the world. These changes need to be made soon while the picture is yet fluid and nations are still preparing to enter the twenty-first century.

Preface and Acknowledgments

ON MAY 23, 1977, President Carter stated in his Environmental Message to the Congress:

Environmental problems do not stop at national boundaries. In the past decade, we and other nations have come to recognize the urgency of international efforts to protect our common environment.

As part of this process, I am directing the Council on Environmental Quality and the Department of State, working in cooperation with the Environmental Protection Agency, the National Science Foundation, the National Oceanic and Atmospheric Administration, and other appropriate agencies, to make a one-year study of the probable changes in the world's population, natural resources, and environment through the end of the century. This study will serve as the foundation of our longer-term planning.

Entering the Twenty-first Century is the interagency report prepared by the Global 2000 Study in response to President Carter's directive. The report comprises three volumes: (1) an interpretive report that summarizes the findings in nontechnical terms, (2) this technical report, which presents the projections and related analyses in greater detail, and (3) a volume of basic documentation on the models used in this Study.

The Study was supervised by an executive group cochaired originally by Charles Warren, Chairman of the Council on Environmental Quality, and Patsy Mink, Assistant Secretary of State for Oceans and International Environmental and Scientific Affairs. During the course of the study Mr. Warren was succeeded by Mr. Gus Speth, and Mrs. Mink by Mr. Thomas Pickering. The other executive group members and participating agencies are as follows:

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Each executive group member designated a member of his or her staff to be a point of coordination for the Study. The coordinators are as follows:

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Study Plan and Focus

President Carter's purpose in requesting this Study was to understand the long-term implications of present policies and programs and to establish a foundation for longer-range planning. Such a foundation cannot be established by merely publishing official projections. An assessment and a strengthening of the Government's current analytic capabilities is also needed.

Accordingly, it was decided early that the Global 2000 Study should exercise and employ the "present foundation" to the fullest extent possible. As a result the Study has been conducted almost exclusively with Government personnel and Government projection tools. Research and data from outside the Government were used only when needed capabilities and information within the Government were not available.

It was also decided that methodologies underlying the Study's projections should be carefully described. Therefore, Chapters 14 through 23 of this technical report contain an analysis—in relatively nontechnical terms—of every model and analytical tool used to project trends for this Study.

Entering the Twenty-First Century builds upon the work of a number of important Government-sponsored organizations that preceded it, including:

- National Commission on Supplies and Shortages (1975)
- Advisory Committee on National Growth Policy Processes (1975)
- National Growth Reports Staff (1972)
- Commission on Population Growth and the American Future (1972)
- National Commission on Materials Policy (1970)
- National Goals Research Staff (1969)
- Public Land Law Review Commission (1965)
- President's Commission on National Goals (1960)
- Outdoor Recreation Resources Review Commission (1958)
- President's Materials Policy ("Paley") Commission (1951)
- National Resources Planning Board (1939)

The work of these organizations has contributed significantly to the Government's present foundation of tools for longer-range planning relating to population, resources, and environment, and one of the Study's first priorities was to review and assess the impact of this earlier work. The results of this historical review are summarized in Appendix A.

Perhaps the most striking feature of this review is the very existence of a 70-year record of Government concern with issues relating to population, resources, and environment—issues that are often thought of as new. There are, however, several genuinely new features emerging in the most recent studies, interdependence being perhaps the most important. The early studies view population, resources, and environment primarily as unrelated short-term, national (regional, or even local) topics. Only in the most recent studies does the interrelatedness of these three topics come increasingly into focus.

The present Study is the first Government study to address all three topics from a relatively long-term, global perspective. It also attempts to emphasize interconnections and feedback, but in this much remains to be done.

The basic plan for the Global 2000 Study was to identify the long-term global models* currently used by Government agencies and to establish a set of uniform assumptions so that these models and tools could be used by the agencies' projection experts as a single, internally consistent system. Since the models and tools used in this Study are the ones now employed by the agencies in their long-term global analyses, they reflect the present foundation for long-term planning. Collectively, therefore, these models and tools can be thought of as the Government's present "global model."

The elements of the Government's global model were not, of course, designed to be used together as an integrated whole. The constituent models were developed separately and at different times to serve the various projection needs of individual agencies. As a result, there are certain inconsistencies in the Government's overall global model. These inconsistencies and the individual constituent models are described and analyzed in Chapters 14 to 23. While some of the inconsistencies were eliminated during the Study, difficulties were encountered in linking the agencies' models together and in synthesizing the projections into a coherent whole.

A group of outside experts (listed in the acknowledgments) met with the agency experts and the Study staff to assist in synthesizing the projections. This group had many criticisms. Some of the problems noted were corrected; others could not be. Excerpts from the criticisms are included in Appendix B.

In spite of remaining weaknesses, the projections reported in Chapters 1 through 13 present an important and useful picture of the future. Assuming continued technological progress (but no departures from present public policy), the picture that emerges is one of only modest—if any—global increase in human welfare. In fact, there is real risk that population growth and environmental degradation may lead to a significant decrease in welfare in parts of the world by 2000. (See appendix C for examples of this phenomenon already being observed.) Furthermore unless present efforts to meet human expectations and basic human needs are modified between now and 2000, they may undermine biological capabilities to meet basic needs early in the 21st century. Finally, Chapter 31 suggests that the projections behind this picture would be still more sobering if it had been possible to correct the remaining inconsistencies in the analysis and to supply the missing linkages.

The projections were developed assuming no change in public policy.† Clearly policy changes will be made, and these changes will have important

* The agencies guided the selection of these models and tools. Emphasis was placed on models that are (1) long-term, (2) global, and (3) used.

† Exceptions to this rule were made in the population projections and the projections of energy impacts on the environment. The population projections assumed that countries that do not already do so will make family planning services available to an appreciable portion of their populations during the 1975–2000 period, and that countries with family planning programs now in operation will extend coverage, particularly in rural areas. The projections of energy impacts on the environment assume that all countries will have implemented U.S. new-source emission-standards by 1985 at all energy-conversion facilities.

SECTOR	PROJECTION CHAPTER	ANALYSIS CHAPTER
Population	2	15
Gross National Product	3	16
Climate	4	17
Technology	5	23
Food	6	18
Fisheries	7	19
Forestry	8	19
Water	9	19
Energy	10	20
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effects on long-term trends. Equally clearly, improved tools are needed to analyze and evaluate alternative policies if optimal choices are to be made.

Since only one policy option—no policy change—was analyzed, the Study is not an adequate basis for detailed policy recommendations. Consequently, no detailed policy recommendations are made, but the chapters presenting the projections and those presenting the analysis of the projection tools (see the following table) unavoidably imply ways in which both the projections and the future might be improved.

The Study plan also called for the examination of alternative methodologies for projecting longer-term global trends on an integrated basis. Since the early 1970s, when the Club of Rome sponsored the first global model to examine longer-term trends involving population, resources and the environment, there have been several private-sector attempts to develop internally consistent global models from a variety of differing perspectives. At least five global models now exist. Chapters 24 to 31 examine these models and compare their results and structures with the Government's global model. Most of the non-Government global models contain many more feedback linkages than it has been possible to achieve in this Study with the agencies' models. Chapter 31 describes the results of experiments in which feedback linkages in two global models were cut to make these two models more closely resemble the linkages achieved by this Study among the agencies' models. Projections from these two global models are distinctly more optimistic when the feedback linkages are missing (as they are in the Government's global model) than when the linkages are present.

Finally, it should be stated that this is the first time the Government has attempted such a broad study, and difficulties in interagency coordination of analyses and assumptions were encountered on an enormous scale. Resolving of the inconsistencies received the first priority of attention, and, in spite of time extensions, other important (but less urgent) objectives thus proved to be unattainable. For example, there is an unevenness in style in the chapters of this volume. There is no indication of the uncertainty associated with most of the numbers reported, and in several places results are reported as, for example, "3.745816352," when what is really meant is "4, plus or minus 50 percent." It was intended originally to use metric units throughout followed by values in other units in parentheses; instead,

the report contains a mixture of metric and other units. (To help the reader with the units problem, Appendix D provides an extensive set of conversion tables.) A consistent grouping of countries by region, with individual detail provided for a small set of representative countries, was desired, but current methodological differences underlying the agencies' projections made this impossible. In the time available, problems of this sort were simply unavoidable.

Acknowledgments

Literally hundreds of people contributed in one way or another to this Study, and at different points each contribution was vitally important. Initially, the members of the executive group (listed earlier) made the project possible by establishing guidelines and providing the necessary budget.

The agency coordinators (also listed earlier) played a vital role throughout in helping to identify persons in their agencies who could provide data and analysis. Five persons—George M. Bennsky, Lindsey Grant, Dolores Gregory, Donald King, and Lee M. Talbot—played particularly important roles in the development of the papers setting forth the initial concept of the Study.

The hardest work—the detailed preparation of the projections—was done by a group of experts, most of whom were already more than fully occupied with other work before this study came along, but somehow they managed to find time to complete their contributions to the study. These experts and their contributions are:

PROJECTIONS

Chapter 1	Introduction	Gerald O. Barney
Chapter 2	Population	Samuel Baum, Nancy B. Frank, Larry Heligman, Donald Bogue, Amy Tsui, Melanie Werkin McClintock, Patricia Baldi
Chapter 3	Gross National Product	Gerald O. Barney, Nicholas G. Carter, Lachman Khemani
Chapter 4	Climate	Russell Ambroziak
Chapter 5	Technology	Pieter VanderWerf
Chapter 6	Food	Patrick O'Brien
Chapter 7	Fisheries	Richard Hennemuth, Charles Rockwood
Chapter 8	Forestry	Bruce Ross-Sheriff
Chapter 9	Water	John J. Boland, John Kammerer, Walter Langbein, James Jones, Peter Freeman, Alan C. More
Chapter 10	Energy	John Pearson, Mark Rodekohr; Richard Ball, Gregory D'Alessio, Stephen Gage, Leonard Hamilton, Sam Morris, Gerald Rausa, Steve Resnek, Walter Sevia

Chapter 11	Fuel Minerals	Walter Dupree
Chapter 12	Nonfuel Minerals	Gerald O. Barney, Pieter VanderWerf, Allan Matthews, Alvin Knoerr
Chapter 13	Environment	Jennifer Robinson and Gerald O. Barney, with major assistance from Jeffrey M. Maclure and Peter Freeman. Other contributors include Wayne Bloch, Dan Botkin, John Costlow, Joel Davis, Erik P. Eckholm, Lawrence Fahey, Stephen Gage, Leonard Hamilton, Barbara Ledeen, Paul E. Lehr, Thomas E. Lovejoy, Allan Matthews, Samuel Morris, Albert Printz, Gerald Rausa, Steve Resnek, John Ross, Bruce Ross-Sheriff, Walter Sevia, Fred Smith, George Woodwell, and Pieter VanderWerf. Wayne Bloch with Albert Printz assembled an initial inventory of the environmental analyses done by the contributing agencies.

ANALYSES OF GOVERNMENT MODELS

Chapter 14	The Government's Global Model	Ned W. Dearborn, Gerald O. Barney
Chapter 15	Population	Ned W. Dearborn
Chapter 16	Gross National Product	Ned W. Dearborn
Chapter 17	Climate	Judith Johnson
Chapter 18	Food	Ned W. Dearborn
Chapter 19	Fisheries, Forestry, Water, and Environment	Jennifer Robinson
Chapter 20	Energy	Pieter VanderWerf
Chapter 21	Fuel Minerals	Pieter VanderWerf
Chapter 22	Nonfuel Minerals	Ned W. Dearborn
Chapter 23	Technology	Pieter VanderWerf, Gerald O. Barney, Ned W. Dearborn

ANALYSES OF OTHER GLOBAL MODELS

Chapter 24	Introduction	Jennifer Robinson
Chapter 25	Worlds 2 and 3	Jennifer Robinson
Chapter 26	Mesarovic-Pestel World Model	Jennifer Robinson
Chapter 27	MOIRA	Jennifer Robinson
Chapter 28	Latin American World Model	Jennifer Robinson
Chapter 29	U.N. World Model	Jennifer Robinson

COMPARISON OF RESULTS

Chapter 30	Introduction	Jennifer Robinson
Chapter 31	Comparisons	Jennifer Robinson, Mihajlo Mesarovic, Berry Hughes, Samir Salama, Jeffrey Amlin

Appendix A	Historic Analysis	Robert Cahn and Patricia L. Cahn
Appendix B	Advisory Views	Ned W. Dearborn (editor)

The thoughtful and insightful writing done by Ned W. Dearborn, Jennifer Robinson, and Pieter VanderWerf of the Global 2000 Study staff, deserves special note and acknowledgment.

The Study benefited enormously from the active participation of two groups of expert advisers. One group consists of seven persons who have previously attempted integrated studies of population, resources, and the environment. They are:

ANNE CARTER Brandeis University, Waltham, Mass.	MIHAJLO MESAROVIC Case Western Reserve University, Cleveland, Ohio
NICHOLAS G. CARTER World Bank, Washington, D.C.	DOUGLAS N. ROSS Joint Economic Committee, U.S. Congress, Washington D.C.
ANNE EHRLICH Stanford University, Stanford, Calif.	KENNETH E. F. WATT University of California, Davis, Calif.
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On two occasions these seven met for a total of three days with the agency experts to discuss ways of integrating and improving the projections. Their criticisms were often pointed but always constructive. Some of the problems and inconsistencies they noted could be resolved; others could not be. Excerpts from written criticisms submitted by this group are included in Appendix B.

The other group consists of more than one hundred individuals from academic institutions, public interest groups, business, labor, and foundations, who read and criticized the manuscripts. Their constructive—sometimes rather candid—comments were very helpful in identifying errors, weaknesses, and inconsistencies. Some of their comments are also included in Appendix B. The members of this group are listed at the end of the Acknowledgments.

Information regarding forestry and agricultural practices and trends in a score of countries in Africa, Asia, and Latin America was provided on very short notice by U.S. Embassy personnel in response to the Study's last-minute request for information not otherwise available. Their cabled responses, which were particularly helpful in making the environment projections presented in Chapter 13, are reproduced in Appendix C.

Assistance and consulting on particular topics was provided by George Bennsky, Edmond R. du Pont, Frank Pinto, Patrick Caddell, Daniel Tunstall, Nicolai Timenes, Bill Long, Donald King, James L. Holt, John H. DeYoung, Jr., Michael Field, David Overton, and Raphael Kasper.

Several persons made special contributions to the study. Story Shem, detailed from the Department of State, served as Special Assistant to the Study Director and provided the primary liaison between the Council on Environmental Quality and the Department of State. In addition, she contributed to the research and writing and found imaginative solutions to a seemingly endless array of institutional, financial and procedural difficulties. Jeffrey M. Maclure, a member of the Study's small central staff,

contributed to the research and writing, and coordinated much of the final rewriting and editing. Frank Rossomondo often went out of his way to facilitate progress of the Study generally and to locate missing data and needed documents. George Bensusky, Delores Gregory, and Leonardo Neher were always available for valuable counsel and guidance. And Lee Talbot and Lindsey Grant were especially helpful throughout in guiding and shaping the Study. During the final phase of the Study Wm. Alston Hayne, Katherine B. Gillman, Lindsey Grant (then a consultant to the Department of State), and John M. Richardson Jr. contributed significantly to the reviewing and editing.

A great deal of credit goes to the persons who brought the pieces of the Study together in an attractive final form. Fred Howard edited the entire manuscript in an incredibly short time. The cartographic and graphic support effort was handled by Holly Byrne and Roy Abel of the CIA's Cartographic Division with consulting assistance from Lawrence Fahey. Charles D. Collison guided the manuscripts through the Government Printing Office under difficult circumstances. Louise Neely, Project Secretary, managed to remain calm and collected through seemingly endless pressures and illegible manuscript. But the job could not have been done without others, too, including Thomas J. Delaney, Lilia Barr, Linda Arnold, Bernice Carney, Alvin Edwards, Susan Reigeluth, Gavin Sanner, Marie Pfaff, Charles McKeown, Betty Ann Welch, Lachman Khemani, Nancy Boone, Judith Johnson, and Oriole Harris.

Finally, indirect—but very important—contributions by the Rockefeller Brothers Fund and the George Gund Foundation are acknowledged gratefully.

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