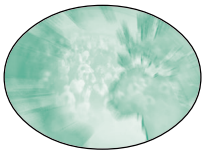


Appendixes

APPENDIX A

Biographical Information on Board Members and Staff

CHAIR

Edward A. Frieman is director emeritus of the Scripps Institution of Oceanography. He also has served as vice chancellor for Marine Sciences at the University of California, San Diego, deputy director of the Princeton Plasma Physics Laboratory, and director of energy research for the US Department of Energy. A fellow of the American Physical Society and a member of the National Academy of Sciences, Dr. Frieman was awarded a National Science Foundation Senior Postdoctoral Fellowship in 1964, the John Simon Guggenheim Fellowship in 1970, the Department of Energy Distinguished Service Medal in 1984, and the Richtmyer Award from the American Physical Society in 1984. He has served on numerous science advisory panels and committees, including the Vice President's Space Advisory Board, the President's Committee on the National Medal of Science, the White House Science Council, and the Secretary of Energy Advisory Board. Dr. Frieman has a BS, engineering, Columbia University; MS and PhD, physics, Polytechnic Institute of Brooklyn.

MEMBERS

Lourdes Arizpe is a researcher at the Regional Center for Multidisciplinary Research and former director of the Institute of Anthropological Research of the National University of Mexico. She is vice president of the International Social Science Council and has served as president of the

International Union of Anthropological and Ethnological Sciences (1988-93). She was a Fulbright scholar at Rutgers University in 1978 and received a Guggenheim grant in 1981. She has been on the Steering Committee of Development Alternatives for Women in a New Era (1985-89) and assistant director-general for Culture at UNESCO (1994-98). She holds an MA, National School of Anthropology in Mexico, and PhD, London School of Economics and Political Science.

John Bongaarts is vice president of the Population Council, Research Division, where he has been employed since 1973. His research has focused on a variety of population issues, including the determinants of fertility, population-environment relationships, the demographic impact of the AIDS epidemic, and population policy options in the developing world. He is a member of the Royal Dutch Academy of Sciences and a fellow of the American Association for the Advancement of Science. He has been recognized with the Mindel Sheps Award from the Population Association of America (1986) and the Research Career Development Award from the National Institutes of Health (1980-1985). Dr. Bongaarts holds an MS, systems analysis, Eindhoven Institute of Technology, The Netherlands; and PhD, physiology and biomedical engineering, University of Illinois.

Ralph J. Cicerone is the chancellor of the University of California, Irvine, where he also is Daniel G. Aldrich, Jr. Professor in the Earth System Science Department. He is an atmospheric chemist with research interests in how chemicals in the atmosphere may cause climate change. He is also involved in research on the stratospheric ozone layer, and the sources and sinks of atmospheric methane, nitrous oxide, and methyl bromide. From 1980 until 1989, he was director of the Atmospheric Chemistry Division of the National Center for Atmospheric Research. From 1992 to 1994, he served as the president of the American Geophysical Union (AGU), the world's largest scientific society for earth scientists. He is a past chair of the National Research Council's Board on Global Change. He is a fellow of the American Association for the Advancement of Science, the AGU, and the American Meteorological Society. He is a member of the National Academy of Sciences and the American Academy of Arts and Sciences. He has a SB, Massachusetts Institute of Technology; and an MS and a PhD, engineering and physics, University of Illinois.

William C. Clark is the Harvey Brooks Professor of International Science, Public Policy and Human Development at Harvard University's John F. Kennedy School of Government. He served as director of the school's Center for Science and International Affairs (1993-1994) and also as vice

chairman of the University Committee on Environment. Dr. Clark's current research focuses on how societies learn to cope with the policy issues arising through the interactions of environment, development, and security concerns in international affairs. In particular, he has studies under way on the development of fair assessment frameworks for use in the management of climate change and on the comparative histories of social learning in national efforts to deal with global environmental change. Dr. Clark is a member of the Sigma Xi Scientific Research Society and was awarded a MacArthur Prize Fellowship in 1983 for his achievements in environmental policy. He holds a BS, biology, Yale University; and a PhD, ecology, University of British Columbia in Canada. Dr. Clark serves as co-chair of the Sustainability Transition Study.

Robert A. Frosch is a senior research fellow at the Belfer Center for Science and International Affairs of the John F. Kennedy School of Government at Harvard University. After doing research in underwater sound and ocean acoustics, he served for a dozen years in a number of governmental and intergovernmental positions, including deputy director of Advanced Research Projects Agency of the Department of Defense, assistant secretary of the Navy for research and development, assistant executive director of the United Nations Environmental Program, and administrator of the National Aeronautics and Space Administration. In 1989, Frosch revived, redefined, and popularized the term "industrial ecology," and his research has focused on this field in recent years, especially in metals-handling industries. In 1993, he retired as vice president of General Motors Corporation, where he was in charge of the North American Operations Research and Development Center. Dr. Frosch is a member of the National Academy of Engineering. He holds an AB, Columbia College; and an MS and a PhD, theoretical physics, Columbia University.

Malcolm Gillis is the president of Rice University and a professor of economics. Prior to this appointment, Dr. Gillis served as dean of the Faculty of Arts and Sciences and dean of the Graduate School and vice provost for Academic Affairs at Duke University. His research and teaching activities have focused on two broad classes of issues in their national and international dimensions: fiscal reform and environmental policy. He has published more than 70 articles in journals. He is author, coauthor, or editor of eight books, including a widely acclaimed 1988 publication, *Public Policies and the Misuse of Forest Resources,* and *Tax Reform in Developing Countries,* published in 1989, as well as the leading textbook in its field, *Economics of Development (4th edition),* now available in five languages. Dr. Gillis holds a BA and MA, University of Florida; and a PhD, University of Illinois.

Richard H. Harwood is C.S. Mott Foundation chair of sustainable agriculture in the Department of Crop and Soil Sciences at Michigan State University. Dr. Harwood worked in Asian farming systems development for 15 years while employed by the Rockefeller Foundation in Thailand and the International Rice Research Institute. He directed the Asian programs of the Winrock International Institute for Agricultural Development from 1985 to 1990. He served as director of the Rodale Research Center in Pennsylvania from 1977 to 1985. Dr. Harwood returned to Michigan State University in 1990 to assume teaching and research responsibilities and continue extension activities in sustainable development. He holds a BS, vegetable crops, Cornell University; and an MA and a PhD, horticulture and plant breeding, Michigan State University.

Robert W. Kates is a geographer, independent scholar, and emeritus director of the Feinstein World Hunger Program at Brown University. His research focuses on the persistence of hunger, climate impact assessment, long-term population dynamics, and the sustainability of the biosphere. A member of the National Academy of Sciences and the American Academy of Arts and Sciences, Dr. Kates serves as an executive editor of *Environment* magazine. He is a recipient of the 1991 National Medal of Science, the MacArthur Prize Fellowship (1981-85), and the honors award of the Association of American Geographers. Dr. Kates has a MA and PhD, geography, University of Chicago, as well as an honorary DSc, Clark University. Dr. Kates serves as the vice chairman of the board and co-chair of the Sustainability Transition Study.

Philip J. Landrigan is the Ethel H. Wise professor and chair of Community Medicine and director of the Environmental and Occupational Medicine at the Mount Sinai School of Medicine. He is responsible for directing research programs, training residents, and teaching medical students. From 1970 to 1985, Dr. Landrigan was a commissioned officer in the United States Public Health Service, where he served as an epidemic intelligence service officer and then as a medical epidemiologist with the Centers for Disease Control. He also established and directed the Environmental Hazards Branch of the Bureau of Epidemiology. From 1979 to 1985, he was director of the Division of Surveillance, Hazard Evaluations and Field Studies of the National Institute for Occupational Safety and Health. Dr. Landrigan holds an AB, Boston College; an MS, occupational medicine, University of London; and an MD, Harvard University Medical School.

Kai N. Lee is the John J. Gibson professor of environmental studies at Williams College, where he teaches environmental studies and public policy. Previously, he taught at the University of Washington (1973-91). His research interests center on institutional arrangements for a sustainability transition, particularly in biodiversity conservation. He is the author of *Compass and Gyroscope* (1993) and a member of the NRC panel that wrote *Upstream: Salmon and Society in the Pacific Northwest* (1996). Dr. Lee has interrupted his academic career twice, as a White House Fellow (1976-77) and as a member of the Northwest Power Planning Council (1983-87). He also serves as a member of the National Research Council's Commission on Geosciences, Environment, and Resources; senior fellow at the World Wildlife Fund US; chair of the environment committee of the Advisory Council of the Calvert Social Investment Fund; and a member of the editorial boards of the journals Ecological Economics and Ecosystems. Dr. Lee holds an AB, physics, Columbia University; and a PhD, physics, Princeton University.

Jerry Mahlman is director of the Geophysical Fluid Dynamics Laboratory of the National Oceanic and Atmospheric Administration and is a lecturer with rank of professor in the Atmospheric and Oceanic Sciences Program at Princeton University. Much of Dr. Mahlman's research career has been directed toward understanding the behavior of the stratosphere and troposphere. This has involved extensive mathematical modeling of the interactive chemical, radiative, dynamical, and transport aspects of the atmosphere, as well as their implications for climate and chemical change. Among his recent commitments, Dr. Mahlman has served on the Joint Scientific Committee of the World Climate Research Program, been a Councilor of the American Meteorological Society, chaired the advisory committee for National Aeronautics and Space Administration's Mission to Planet Earth, and is a member of the Advisory Committee for the Department of Energy's Climate Change Prediction Program. He is a fellow of the American Geophysical Union, was awarded the Presidential Distinguished Rank Award, and received the American Meteorological Society's highest honor, the Carl-Gustaf Rossby Research Medal. Dr. Mahlman holds a PhD, atmospheric sciences, Colorado State University.

Richard Mahoney is the distinguished executive in residence at the Center for the Study of American Business at Washington University in St. Louis. While at the Center, he has written a number of research reports and op-eds for major publications, including *The New York Times*, *Washington Post*, *The Wall Street Journal*, and others. He created "The CEO Series," to which he has contributed many essays, including *The Anatomy of a Public Policy Crisis*, *Business Must Act for All Its Stakeholders—Before*

"The Feds" Do, Trade Winds or Head Winds?, U.S. Government Export Policy, and *Insights from Business Strategy and Management "Big Ideas" of the Past Three Decades: Are They Fads or Enablers?* Mr. Mahoney joined Monsanto Company in 1962 as a product development specialist. He subsequently held various marketing, technical service, and new product development positions in Plastic Products, Agriculture, and International Operations. He was named executive vice president in 1977, president in 1980, and chief executive officer in 1983. He retired in 1995 as chairman of the board and chief executive officer. Mr. Mahoney holds a BS, chemistry, University of Massachusetts.

Pamela Matson is a professor in the Department of Geological and Environmental Sciences and the Institute of International Studies, Stanford University. Previously, she was a professor of ecosystem ecology at the University of California, Berkeley, and worked for 10 years as a research scientist at NASA/Ames Research Center. Her research has focused on the effects of natural and anthropogenic disturbances on biogeochemical cycling and trace gas exchange in tropical and temperate ecosystems. Other interests include the analysis of consequences of anthropogenic nitrogen on downwind and downstream ecosystems at regional scales. She serves on numerous committees, including the Scientific Committee for the International Geosphere-Biosphere Program, and the National Research Council's U.S. National Committee for the Scientific Committee on Problems of the Environment. She was named NASA-Ames Associate Fellow in 1991 in recognition of research excellence, and is a member of the American Academy of Arts and Sciences and the National Academy of Sciences. In 1995, Dr. Matson was selected as a MacArthur Fellow, and in 1997 was elected a Fellow of the American Association for the Advancement of Science. She holds a BS, biology, University of Wisconsin-Eau Claire; an MS, environmental science, Indiana University; and a PhD, forest ecology, Oregon State University.

William Merrell is the President of the H. John Heinz III Center for Science, Economics, and the Environment. Previously, Dr. Merrill was appointed vice chancellor for Strategic Programs of Texas A&M University where he also assumed the role of professor of oceanography and marine sciences. Immediately preceding this assignment he served as vice president for Research Policy of Texas A&M and was president of Texas A&M at Galveston from 1987 to 1992. He received the Distinguished Member Award for Research Achievement from the Texas A&M University Chapter of Sigma XI, the Distinguished Achievement Award from the Geosciences and Earth Resources Council, and the Distinguished Service Award of the National Science Foundation for "his lasting impact on the

course of American science." Dr. Merrell holds a BS and an MA, physics, Sam Houston State University; and a PhD, oceanography, Texas A&M University.

G. William Miller is Chairman of G. Miller & Co., Inc., a merchant banking firm located in Washington D.C. Mr. Miller served as secretary of the US Department of Treasury, from August 1979 to January 1981. Previously he was chairman of the board of governors of the Federal Reserve System; chairman and chief officer of Textron Inc., a diversified manufacturing company; director of the Federal Reserve Board of Boston; and chairman and chief executive officer of Federated Stores, Inc., which operated a chain of department stores and supermarkets. He is currently the non-executive chairman of Home Place of America, Inc., a specialty retail company. Throughout his business career, Mr. Miller has taken an active part in public service, contributing as chairman of the Conference Board, the National Alliance of Business, the President's Committee on HIRE, and the US Industrial Payroll Savings Bond Committee, as well as co-chair of the US-USSR Trade Economics Council and the Polish-US Economic Council. He served as a Coast Guard Officer in the Far East and on the US west coast. He is a member of the Business Council, a trustee of the John H. Heinz III Center for Science, Economics and the Environment, a trustee of the Marine Biological Laboratory, and a member of the Presidents' Circle of the National Academies. Mr. Miller holds a BS, marine engineering, US Coast Guard Academy; and a JD, University of California, Berkeley.

Berrien Moore III is director of the Institute for the Study of Earth, Oceans, and Space at the University of New Hampshire. He has served as chair of the National Aeronautics and Space Administration's (NASA) Space Science and Applications Advisory Committee, for which he received the Distinguished Public Service Medal. He also serves as chair of the Scientific Committee for the International Geosphere-Biosphere Program and its Task Force on Global Analysis, Interpretation, and Modeling. Other boards on which he has been a member include the NASA Advisory Council's Committee on Earth System Science, the National Research Council's Board on Global Change, the Space Science Board's Committee on Earth Science, and the Science Executive Committee for the Earth Observing System. Dr. Moore's computer modeling of the global carbon cycle has received worldwide attention through his publications on the contribution of terrestrial biota to the concentration of atmospheric carbon dioxide and the role of the ocean as a sink for carbon dioxide. He holds a PhD, mathematics, University of Virginia. Dr. Moore served as chair of the Board on Sustainable Development Committee on Global Change Research until December 1998.

M. Granger Morgan is professor and head in the Department of Engineering and Public Policy at Carnegie Mellon University, where he also holds academic appointments in the Department of Electrical and Computer Engineering and the H. John Heinz III School of Public Policy and Management. Dr. Morgan's research involves the treatment of uncertainty in quantitative policy analysis, integrated assessment of global change, and a variety of issues in the assessment and management of risks to health, safety, and the environment. He is also working on the development of methods to perform risk ranking to support decision making in risk management organizations, such as federal agencies. He holds a BS, physics, Harvard College; an MS, astronomy and space science, Cornell University; and a PhD, applied physics and information sciences, University of California, San Diego.

Paul D. Raskin is president of Tellus Institute and director of the Stockholm Environment Institute—Boston, where he directs a comprehensive research program on environmental, resources and developmental policy. He previously was associate professor, Empire State College, State University of New York; assistant professor, State University of New York at Albany; and instructor of physics, City College of New York. Dr. Raskin's current research focuses on the requirements for a transition to sustainability at global, regional, national, and local scales. He conceived and implemented widely used planning tools for these purposes including the Long Range Energy Alternative Policy system, the Water Evaluation and Planning system, and the PoleStar System for integrated sustainable development analysis. He has provided policy assessments for numerous governments and private organizations throughout the world. Dr. Raskin holds a BS, physics, University of California, Berkeley; and a PhD, theoretical physics, Columbia University.

John B. Robinson is director of the Sustainable Development Research Institute and professor in the Department of Geography at the University of British Columbia. Previously, he worked in the Department of Environment and Resource Studies at the University of Waterloo, and as a consultant for federal and provincial departments and several coalitions of environmental groups. His research interests include energy and energy policy, socio-economic modeling and forecasting, scenarios of a sustainable society, sustainable development and resource use, and the history and philosophy of environmental thought. He was a principal lead author of Working Group III of the Intergovernmental Panel on Climate Change, and is a member of the Canadian Committee for the Institute for Applied Systems Analysis, the Canadian National Committee for the Scientific Committee on Problems of the Environment, and the board of

directors of the Canadian Global Change Program. Dr. Robinson holds a BA, University of Toronto; an MES, York; and a PhD, University of Toronto.

Vernon W. Ruttan is a regents professor in the Department of Applied Economics at the University of Minnesota. He has authored and co-authored nine books and numerous technical publications, many of which focus on the economies of technical change and agricultural development. He has served on the President's Council of Academic Advisors and assumed the role of Agricultural Economist for the Rockefeller Foundation at the International Rice Research Institute in the Philippines. His non-academic service also includes president of the Agricultural Development Council and positions on advisory committees and boards, including the Research Advisory Committee of the U.S. Agency for International Development. Dr. Ruttan holds a BA, Yale University; and an MS and a PhD, University of Chicago.

Thomas C. Schelling is professor of economics and public affairs at the University of Maryland. Before his current position, he worked in the Executive Office of the President, the Department of Economics, at both Yale and Harvard Universities, and the RAND Corporation. He also has served as a consultant, member, and lecturer to many science- and defense-related organizations such as the Central Intelligence Agency and the Scientific Advisory Board of the U.S. Air Force. Dr. Schelling is a member of the National Academy of Sciences and the Institute of Medicine and has published several books and articles on energy and environmental policy, arms control, military strategy, crime, international economics, and public policy. He holds an AB, economics, University of California, Berkeley; and a PhD, economics, Harvard University.

Marvalee H. Wake is professor and chair of the Department of Integrative Biology at the University of California at Berkeley. Formerly, Dr. Wake was a visiting professor at the Université de Paris VII and the Universitat Bremen, Bremen, Germany. Her research interests include studies of evolutionary morphology, reproductive biology of lower vertebrates, patterns of evolution, and issues in biodiversity science. Her honors include fellow of both the California Academy of Sciences and American Association for the Advancement of Science, and a John Simon Guggenheim Foundation Fellowship. She is the secretary general of the International Union of Biological Sciences and a member of the executive committee of DIVERSITAS, an international biodiversity science program. Dr. Wake holds a BA, an MS and a PhD, University of Southern California.

Warren Washington is a senior scientist in the Climate and Global Dynamics Division at the National Center for Atmospheric Research, Boulder, Colorado. He has been at NCAR since 1963. Dr. Washington's areas of expertise are atmospheric science and climate research, and he specializes in computer modeling of the earth's climate. He has published more than 100 papers in professional journals and his book *An Introduction to Three Dimensional Climate Modeling*, co-authored with Claire Parkinson, is a standard reference on climate modeling. He serves on the National Science Board of the National Science Foundation. He previously served as president of the American Meteorological Society, on the President's National Advisory Committee on Oceans and Atmosphere, on the Secretary of Energy's Advisory Board, and on several National Research Council boards and panels. He is President of the Black Environmental Sciences Trust. He holds a BS, physics, an MS, meteorology, Oregon State University; and a PhD, meteorology, Pennsylvania State University.

M. Gordon Wolman is a professor in the Department of Geography and Environmental Engineering at the Johns Hopkins University, where he has taught since 1968. Previously, Dr. Wolman was a hydrologist for the U.S. Geological Survey. He served as chairman of the National Research Council's Commission on Geosciences, Environment, and Resources for the National Research Council, and president of the Geological Society of America, and president of the American Geophysical Union Section on Hydrology, and the Council of the American Geographical Society. He is a member of the National Academy of Sciences and the Philosophical Society, and a fellow of the American Academy of Arts and Sciences and the American Association for the Advancement of Science. Dr. Wolman holds a BS, Johns Hopkins University; an MS and a PhD, geology, Harvard University.

STAFF

Sherburne B. Abbott joined the Policy Division in January 1997 as the executive director of the Board on Sustainable Development. She has worked with the National Research Council for 13 years, serving previously as the director of the Committee on International Organizations and Programs of the Office of International Affairs and the director of the Polar Research Board of the Commission on Geosciences, Environment, and Resources. Prior to her work with the NRC, she was assistant scientific program director of the U.S. Marine Mammal Commission, a science teacher in a private high school, and a research assistant in cancer research at Tufts University. She has published papers on environmental monitoring in Antarctica, salmonid biology, and polar research. She holds an AB,

biological sciences, Goucher College, and an MFS, ecology and natural resource policy, Yale University.

Laura J. Sigman joined the National Research Council as a research associate with the Board on Sustainable Development and the Committee on Global Change Research in February 1997. She holds an A.B. in environmental studies from Dartmouth College.

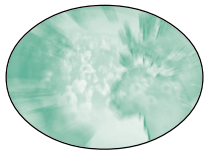
APPENDIX B

Acronyms

ARPA	Advanced Research Projects Agency
ASCEND 21	International Conference on an Agenda of Science for Environment and Development into the 21st Century
CFCs	Chlorofluorocarbons
CGIAR	Consultative Group on International Agricultural Research
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CSD	Commission on Sustainable Development (UN)
EMEP	Geneva Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe
ENSO	El Niño-Southern Oscillation
EPA	U.S. Environmental Protection Agency
FAO	UN Food and Agricultural Organization
GDP	Gross Domestic Product
GHCN	Global Historical Climatology Network
GSG	Global Scenarios Group

HCFCs	Hydrochlorofluorocarbons
HFCs	Hydrofluorocarbons
HDI	Human Development Index
IAP	InterAcademy Panel on International Issues
ICSU	International Council for Science
IGBP	International Geosphere-Biosphere Program
IHDP	International Human Dimensions Program
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
IUCN	The World Conservation Union
LTER	NSF Long-Term Ecological Research Program
NGO	Nongovernmental organization
NO_x	Nitrogen oxides
NAE	National Academy of Engineering
NAS	National Academy of Sciences
NASA	National Aeronautics and Space Administration
NPPC	Northwest Power Planning Council
NRC	National Research Council
NSF	National Science Foundation
OECD	Organization for Economic Cooperation and Development
PSR	Pressure-State-Response model
RAINS	Regional Air Pollution Information and Simulation Model
SCOPE	Scientific Committee on Problems of the Environment
START	SysTem for Analysis, Research, and Training
UN	United Nations
UNCED	United Nations Conference on Environment and Development (Rio de Janiero, 1992, also known as "the Earth Summit")
UNCLOS	UN Convention on the Law of the Sea
UNCSD	UN Commission on Sustainable Development
UNDP	UN Development Program
UNEP	UN Environment Program

UNESCO	UN Educational, Scientific, and Cultural Organization
UNICEF	UN Children's Fund
VOC	Volatile organic compounds
WGBU	German Advisory Council on Global Change
WCED	World Commission on Environment and Development
WCRP	World Climate Research Program
WHO	World Health Organization
WRI	World Resources Institute
WSC	World Summit for Children



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