

Anthropogenic Greenhouse Gases and US Climate: Evidence and Impacts

Committee

Shirley M. Tilghman

Chair

Shirley Tilghman is a Professor of Molecular Biology and Public Affairs Emerita at Princeton University, where she served as the 19th president from 2001 to 2013. Following her retirement from the presidency she returned to the faculty, where she had been teaching and conducting research since 1986 as an Investigator of the Howard Hughes Medical Institute. She is best known for her pioneering work on genomic imprinting. Tilghman is a recipient of the L'Oréal-UNESCO Award for Women in Science, the Lifetime Achievement Award from the Society for Developmental Biology, the Genetics Society of America Medal for outstanding contributions to her field, and the society's George W. Beadle Award for contribution to the genetics community. Tilghman is a member of the National Academy of Sciences, the National Academy of Medicine, the American Philosophical Society, the Royal Society of London, and is an Officer of the Order of Canada. She serves as a trustee of the Broad Institute of the Massachusetts Institute of Technology and Harvard University, the Institute for Advanced Study, the Simons Foundation and the Hypothesis Fund. Tilghman received an Honors B.Sc. in chemistry from Queen's University at Kingston, Canada, and a Ph.D. in biochemistry from Temple University. She previously served on the National Academies Committee on Mapping and Sequencing the Human Genome, the Board on Life Sciences, and the Roundtable on Aligning Incentives for Open Science.

David T. Allen

Member

David Allen is the Norbert Dittrich-Welch Chair in Chemical Engineering and the co-Director of the Center for Energy and Environmental Systems Analyses at the University of Texas at Austin. His expertise is in urban air quality and the engineering of sustainable systems. He has been a lead investigator for multiple air quality measurement and modeling studies, including studies that reported some of the first measurements of methane emissions from oil and gas supply chains. He is a member of the National Academy of Engineering and a recipient of the ENI Energy Transition Award. He previously served on the U.S. Environmental Protection Agency Science Advisory Board (EPA SAB) and the U.S. Department of Energy National Petroleum Council. Allen received a B.S. degree in chemical engineering, with distinction, from Cornell University, and an M.S. and Ph.D. in chemical engineering from the California Institute of Technology. He previously served on the National Academies Committee on Anthropogenic Methane Emissions in the United States, the Board on Energy and Environmental Systems, and chaired the Committee on the Chemistry of Urban Wildfires.

Allen has previously provided consulting services to oil and gas companies and consortia involving oil and gas companies. The Center for Energy and Environmental Systems Analyses is supported by research gifts through an Industrial Affiliates Program. During his service on the EPA SAB he co-authored public reports and made public statements related to methane emission regulations under consideration by the EPA.

Susan Anenberg

Member

Susan Anenberg is a Professor and Chair of the Environmental and Occupational Health Department at the George Washington (GW) University Milken Institute School of Public Health. She is also the Director of the GW Climate and Health Institute. Previously, she was a Co-Founder and Partner at Environmental Health Analytics, LLC, the Deputy Managing Director for Recommendations at the U.S. Chemical Safety Board, an environmental scientist at the U.S. Environmental Protection Agency (EPA), and a senior advisor for clean cookstove initiatives at the U.S. State Department. Her research focuses on the health implications of air pollution and climate change, from local to global scales. She currently serves on the World Health Organization's Global Air Pollution and Health Technical Advisory Group and previously served on the EPA Science Advisory Board and as President of the GeoHealth section of the American Geophysical Union. Anenberg received a B.A. in biology and environmental science from Northwestern University and a Ph.D. in environmental science and engineering and environmental policy from the University of North Carolina. She previously served on the National Academies Committee on Utilizing Advanced Environmental Health and Geospatial Data and Technologies to Inform Community Investment and the Committee to Advise the U.S. Global Change Research Program.

Anenberg has previously submitted public comments on proposed EPA rules related to greenhouse gas emissions and air pollution. She receives research support for work on climate and health from the Natural Resources Defense Council. Anenberg signed a brief of amici curiae submitted to the Supreme Court in *State of West Virginia, et al., v. U.S. Environmental Protection Agency, et al.*, that argued anthropogenic climate change, fueled by emissions of greenhouse gases such as carbon dioxide, harms public health in the United States.

Michele Barry

Member

Michele Barry is the Drs. Ben & A. Jess Shenson Professor of Medicine and Tropical Diseases at Stanford University. She is also the Director of the Center for Innovation in Global Health and Senior Associate Dean for Global Health. Prior to her current role, she was a Professor of Medicine at Yale from which she was recruited to be the inaugural dean for global health at Stanford. She has published in the areas of climate's impact on health, tropical diseases, and human and planetary health. She is a member of the National Academy of Medicine (NAM), the Council on Foreign Relations, and the American Academy of Arts and Sciences. Barry is Chair Emerita of the Board of Directors for the Consortium of Universities for Global Health and a past President of the American Society of Tropical Medicine and Hygiene (ASTMH). She is a recipient of the Ben Kean Medal from the ASTMH and the Elizabeth Blackburn Award from the American Medical Woman's Association. Barry received an A.B. from Bryn Mawr College and an M.D. from the Albert Einstein College of Medicine. She previously served on the National Academies Board on Global Health and has co-led the NAM climate interest group.

Charles T. Driscoll, Jr.

Member

Charles Driscoll is Distinguished and University Professor of Environmental Systems Engineering in the Department of Civil and Environmental Engineering at Syracuse University where he also serves as the director of the Center for Environmental Systems Engineering. His teaching and research interests are in environmental chemistry, biogeochemistry, and environmental quality modeling. A principal research focus has been the response of forest, aquatic, and coastal ecosystems to disturbance, including air pollution, climate and land use change, and elevated inputs of nutrients and mercury. Driscoll is a member of the National Academy of Engineering, a fellow of the American Association for the Advancement of Science and the 2023 Clarke Laurate in Water Science and Technology. Driscoll received his B.S. in civil engineering from the University of Maine and his M.S. and Ph.D. in environmental engineering from Cornell University. He previously served on the National Academies Committee on Assessing Causality from a Multidisciplinary Evidence Base for National Ambient Air Quality Standards and Board on Environmental Studies and Toxicology.

Driscoll currently serves in a compensated role on the advisory committee for The Penobscot Estuary Mercury Remediation Trusts for the Natural Resources Defense Council. Driscoll signed briefs of amici curiae submitted to the U.S. Court of Appeals District of Columbia Circuit in *American Lung Association, et al., v. U.S. Environmental Protection Agency, et al.*, that argued that the Affordable Clean Energy Rule would cause an increase in carbon dioxide emissions and did not adequately consider impacts to historic resources and communities.

Susan Hanson

Member

Susan Hanson is an urban geographer, now retired for nearly 20 years from Clark University, where she taught for 25 years and was the Landry Professor of Geography and Director of the School of Geography. Prior to Clark, she was an Assistant and Associate Professor at SUNY Buffalo. Her research has focused on the relationship between people and the urban built environment. This has included understanding people's everyday travel-activity patterns, examining the way that different groups make use of the city and showing how urban spatial structure configures household travel. She also seeks to understand the emergence of sustainable versus unsustainable practices in urban areas. Hanson's Awards include the Lifetime Achievement Award and the Award for Creativity, both from the American Association of Geographers, as well as the Carey Award for Leadership & Service from the Transportation Research Board of the National Academies. She is a member of the American Academy of Arts and Sciences and the National Academy of Sciences. Hanson received an A.B. in geography from Middlebury College and an M.S. and Ph.D. in geography from Northwestern University. Prior to graduate school, she was a Peace Corps Volunteer in Western Kenya, teaching at a boys' secondary school.

Chris T. Hendrickson

Member

Chris Hendrickson is the Hamerschlag University Professor of Engineering Emeritus and director of the Traffic 21 Institute at Carnegie Mellon University. His expertise is in engineering planning and management, including transportation systems, design for the environment, system performance, construction project management, finance, and computer applications. Central themes in his work are a systems-wide perspective and a balance of engineering and management considerations. He is the editor-in-chief of the American Society of Civil Engineers (ASCE) Journal of Transportation Engineering Part A (Systems). Hendrickson is a recipient of the Council of University Transportation Centers Lifetime Achievement Award, the American Road & Transportation Builders Association Steinburg Award, the Faculty Award of the Carnegie Mellon Alumni Association, the Turner Lecture Award of the ASCE, and the Fenves Systems Research Award from the Institute of Complex Engineering Systems. He is a member of the National Academy of Engineering, the National Academy of Construction, a fellow of the American Association for the Advancement of Science, and a distinguished member of the ASCE. Hendrickson received a B.S. in general engineering (resources strategy) and an M.S. in civil engineering from Stanford University, an M.Phil. in economics from Oxford University, and a Ph.D. in civil engineering from the Massachusetts Institute of Technology. He previously served on the National Academies Committee on Accelerating Decarbonization in the United States: Technology, Policy, and Societal Dimensions and chaired the Transportation Research Board Division Committee.

Marika Holland

Member

Marika Holland is a Senior Scientist at the National Science Foundation National Center for Atmospheric Research (NSF NCAR). Her research is focused on polar climate variability and change. She has extensive experience in using climate models to study coupled climate interactions and has been active in the development of improved sea ice models for climate simulations. Holland has served as co-chair for the Polar Climate Working Group of the Community Earth System Model and Chief Scientist for the Community Earth System Model project. She contributed to the Third, Fourth, Fifth, and Sixth Assessment Reports of the Intergovernmental Panel on Climate Change. Holland is a fellow of the American Geophysical Union and the American Meteorological Society and a recipient of the International Arctic Science Committee Medal and the Community Earth System Model Distinguished Achievement Award. Holland received a Ph.D. in atmosphere and ocean sciences from the University of Colorado and was a Postdoctoral Fellow at the University of Victoria in British Columbia. She previously served on the National Academies Committee on Understanding and Monitoring Abrupt Climate Change.

George M. Hornberger

Member

George Hornberger is University Professor Emeritus at Vanderbilt University. He was previously the Director of the Vanderbilt Institute for Energy and the Environment. His work has focused on coupled natural-human systems and aimed to understand how climate, groundwater, surface water, energy production, food production, and human abstraction of water interact in complex ways. Hornberger is a fellow of the American Geophysical Union (AGU), a fellow of the Geological Society of America, and a fellow of the Association for Women in Science. He is a recipient of the AGU Robert E. Horton Award, the U.S. Geological Survey John Wesley Powell Award, the AGU Excellence in Geophysical Education Award. He is a member of the National Academy of Engineering and the American Academy of Arts and Sciences. Hornberger received a B.S. in civil engineering and an M.S. in hydrology from Drexel University and a Ph.D. in hydrology from Stanford University. He previously served on the National Academies Committee on Advancing a Systems Approach to Studying the Earth and the Water Science and Technology Board.

Arthur Lee

Member

Arthur Lee retired from Chevron in 2024, where he was a Chevron Fellow. During his Chevron career he held roles of increasing responsibilities, including the corporation-wide formulation of strategic positioning and policy development on issues ranging from Chevron's internal energy policy to U.S. air pollution issues and actions addressing climate change concerns. He continues to mentor employees as Chevron Fellow Emeritus in retirement. Lee represented Chevron in numerous roles: Chair of the International Petroleum Industry Environmental Conservation Association's Climate Change Working Group, member of the board of directors of the International Emissions Trading Association, and member of the Executive Committee of the International Energy Agency Greenhouse Gas R&D Programme. Prior to Chevron, Lee held positions as an engineer with the U.S. Environmental Protection Agency, Fluor Daniel Inc., and Directed Technologies. He served on the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment as Review Editor in the Special Report on Carbon Dioxide Capture and Storage, contributing author on geothermal energy in the Special Report on Renewable Energy, and again as Review Editor in the Sixth Assessment, and he was awarded a certificate recognizing his contribution to the IPCC's Nobel Peace Prize. Additionally, Lee served on the National Climate Assessment Development and Advisory Committee and was a coordinating lead author of the climate change adaptation chapter. Lee received a B.S. in chemical engineering from the Massachusetts Institute of Technology and an M.S. in chemical engineering from the California Institute of Technology. He previously served on the National Academies Board on Atmospheric Sciences and Climate.

Kari C. Nadeau

Member

Kari Nadeau is the Chair of the Department of Environmental Health and the John Rock Professor of Climate Science and Population Studies at the Harvard T.H. Chan School of Public Health. She is also a Professor of Medicine at Harvard Medical School and works at the Beth Israel Deaconess Medical Center. Her expertise is in immunology, allergies and asthma, and climate change solutions, with a focus on understanding how environmental and epigenetic factors affect the risk of developing immune dysfunction. Her wet lab laboratory has been studying exposomics and solutions-facing research with policy-oriented outcomes. Nadeau has started four biotechnology companies, co-started a sustainability seed grant program, and works with the World Health Organization and United Nations on several projects in environmental and global health. She is a member of the National Academy of Medicine, the American Association of Physicians, the American Society of Clinical Investigation, and a Fellow of the American Academy of Allergy, Asthma, and Immunology. Nadeau received a degree in biology from Haverford College and an M.D. and Ph.D. in biological chemistry and molecular pharmacology from Harvard Medical School. She complete a residency in pediatrics and a fellowship in allergy, asthma, and immunology.

Nadeau has previously submitted a public comment on proposed EPA rules related to greenhouse gas emissions and air pollution. She signed a brief of amici curiae submitted to the U.S. Court of Appeals Central District of California in *G.B., et al., v. U.S. Environmental Protection Agency, et al.*, that argued that children are uniquely vulnerable to the consequences of rising temperatures and to increased air pollution from climate change.

Charles W. Rice

Member

Charles Rice is a University Distinguished Professor in soil microbiology and holds the Vanier University Professorship in the Department of Agronomy at Kansas State University. His research focuses on soil carbon and nitrogen, soil health, microbial ecology, and the impacts of climate change on agricultural and grassland ecosystems. Rice contributed to the Third and Fourth Assessment Reports of the Intergovernmental Panel on Climate Change (IPCC) and he was awarded a certificate recognizing his contribution to the IPCC's Nobel Peace Prize. He is a Fellow of the Soil Science Society of America, the American Society of Agronomy, Sigma Xi, and the American Association for the Advancement of Science and a National Associate of the National Academies. Rice received a B.S. in natural environmental systems from Northern Illinois University and an M.S. in soil science and Ph.D. in soil microbiology from the University of Kentucky. He previously served on the National Academies Board on Agriculture and Natural Resources.

Drew T. Shindell

Member

Drew Shindell is Nicholas Professor of Earth Science at Duke University. He was previously a senior scientist at the National Aeronautics and Space Administration's Goddard Institute for Space Studies. His expertise is in modeling the impact of emissions changes, and his work has investigated how the atmospheric chemical system has important effects on humans through pollutants such as smog or particulates, through acid rain, and through stratospheric ozone change, and how climate can be altered by greenhouse gases, solar variability, volcanic eruptions, aerosols, and ozone, and what impacts changes in climate and air quality may have on society. Shindell contributed to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change and the Fifth National Climate Assessment. He is a member of the National Academy of Sciences and is a Fellow of the American Geophysical Union and the American Association for the Advancement of Science. Shindell received a B.A. in physics from the University of California, Berkeley and a Ph.D. in physics from the State University of New York Stony Brook. He previously served on the National Academies Committee on the Provisions in the Internal Revenue Code on Greenhouse Gas Emissions and on the Committee on Assessment of Himalayan Glaciers: Climate Change, Water Resources, and Water Security.

Shindell has previously submitted a public comment on proposed EPA rules related to greenhouse gas emissions and air pollution. He has also provided Congressional testimony on the relationship between climate and health as well as greenhouse gas emissions. Shindell signed briefs of amici curiae submitted to the U.S. Court of Appeals District of Columbia Circuit in *Competitive Enterprise Institute, et al., v. National Highway Traffic and Safety Administration, et al.*, that argued that the Safer Affordable Fuel Efficient Vehicles Rule would not adequately address fossil fuel emissions from vehicles as well as a brief of amici curiae submitted to the U.S. Court of Appeals District of Columbia Circuit in *American Lung Association, et al., v. U.S. Environmental Protection Agency, et al.*, that argued that the Affordable Clean Energy Rule did not adequately consider impacts to historic resources and communities.

Graeme L. Stephens

Member

Graeme Stephens is the director of the Center for Climate Sciences at the Jet Propulsion Laboratory (JPL). He was previously Distinguished University Professor at Colorado State University. Stephens is the principal investigator of NASA's CloudSat mission, and previously chaired the World Climate Research Program Global Energy and Water and EXchanges (GEWEX) project, which examines the topic of global water cycles and the global energy balance and the connections between. His research activities focus on atmospheric radiation including the application of remote sensing in climate research to understand the role of hydrological processes in climate change. Stephens is a member of the National Academy of Engineering and a Fellow of the Royal Society, American Meteorological Society, American Geophysical Union (AGU), and American Association for the Advancement of Science. He is a recipient of the American Meteorological Society's Houghton and Jule Charney Awards and the AGU Jule Charney Lecturer. Stephens received a B.S. in physics and meteorology and a Ph.D. in meteorology from the University of Melbourne, Australia. He previously served on the National Academies Committee on Earth Science and Applications from Space.

David W. Titley

Member

David Titley is President and Founder of RV Weather, providing weather and routing services to the Recreational Vehicle community. Previously, he was Professor of Practice in Meteorology and Professor of International Affairs at The Pennsylvania State University. Titley served as a Naval Officer for 32 years and rose to the rank of Rear Admiral. Titley's career included duties as Commander of the Naval Meteorology and Oceanography Command, as well as Oceanographer and Navigator of the Navy. While serving at the Pentagon, Titley initiated and led the U.S. Navy's Task Force on Climate Change. After retiring from the Navy, Titley served as the Deputy Undersecretary of Commerce for Operations, the Chief Operating Officer position at the National Oceanic and Atmospheric Administration. Titley is an expert on climate, the arctic, and national security. He received an honorary doctorate degree from the University of Alaska Fairbanks and is a Fellow of the American Meteorological Society. Titley received a B.S. in meteorology from Pennsylvania State University, an M.S. in meteorology and physical oceanography and Ph.D. in meteorology from the Naval Postgraduate School. He previously served on the National Academies Board on Atmospheric Sciences and Climate.

John C. Wall

Member

John Wall retired from Cummins, Inc. in 2015, where he was Chief Technology Officer. He has over 45 years of industry experience in the development of low-emission internal combustion engines and fuels and working with regulatory agencies in the United States and worldwide to align engine and fuel technologies with future emissions policy with the objective of delivering products meeting both commercial and environmental expectations. During his time with Cummins, Wall was directly involved in the most critical technology programs for low emissions, powertrain efficiency and alternative fuels and he also led the growth of the Cummins technical organization from 1,000 engineers, mostly centered in the United States to more than 6,000 engineers globally. Prior to joining Cummins, he led Diesel Fuels Research for Chevron, where his team was first to discover the important contribution of fuel sulfur to diesel particulate emissions, leading to the first low-sulfur fuel standards by the U.S. Environmental Protection Agency (EPA) in 1994. Wall is a member of the National Academy of Engineering and a Society of Automotive Engineers (SAE) Fellow. He received the SAE Horning and Colwell Awards for research in the area of diesel fuel effects on emissions, SAE Pischinger Powertrain Innovation Award, and ASME Honda Medal for significant contributions in the field of personal transportation, the California Air Resources Board Haagen-Smit Award and EPA Zosel Award for career accomplishments in diesel emission control, and has been recognized by the Health Effects Institute for technologic innovation and commitment to clean air. Wall received an S.B., S.M., and Sc.D. in mechanical engineering from the Massachusetts Institute of Technology. He currently serves on the National Academies Board on Science, Technology, and Economic Policy and previously served on the Board on Energy and Environmental Systems.