NATIONAL ACADEMIES Sciences Engineering Medicine

Why Indoor Chemistry Matters Workshop 2: Prioritizing Indoor Chemistry Research

THURSDAY, FEBRUARY 8TH, 2024 (ALL TIMES LISTED EST)
NATIONAL ACADEMY OF SCIENCES BUILDING, LECTURE ROOM
2101 CONSTITUTION AVENUE NW, WASHINGTON, DC 20418 **ZOOM LINK**

8:30 AM **Optional: Early Morning Coffee and Breakfast**
Provided by the Academies for In-person Attendees

9:00 AM **Open Remarks and Introductions**
Linda Nhon, Program Officer, Board on Chemical Sciences and Technology (BCST), National Academies of Sciences, Engineering, and Medicine (NASEM)

Committee and Workshop Organization Team
- Glenn Morrison, PhD, University of North Carolina at Chapel Hill
- Dustin Poppendieck, PhD, National Institute of Standards and Technology (NIST)
- Charles Weschler, PhD, Rutgers University

9:10 AM **Why Indoor Chemistry Matters: Select Recommendations**
Vicki H. Grassian, PhD, Distinguished Professor, Department of Chemistry and Biochemistry, University of California, San Diego

9:50 AM **Q&A with Dr. Grassian**
Moderated by Glenn Morrison

10:00 AM **Session One - Sources and Mixtures**

Emerging and Impactful Research Needs: Insights from the Standpoint of Sources
Barbara Turpin, PhD, Professor, University of North Carolina, Chapel Hill

10:30 AM **Q&A with Dr. Turpin**
Moderated by Glenn Morrison

10:35 AM **Break**

10:50 AM **Panel Discussion 1 - Assessing Chemical Complexity in Indoor Environments**
Moderated by Glenn Morrison

- Robin E. Dodson, ScD, Associate Director of Research Operations and Research Scientist, Silent Spring Institute
- Vito Ilacqua, PhD, Acting Director of the Center for Scientific Analysis, Office of Radiation and Indoor Air (ORIA)-Office of Air and Radiation (OAR), U.S. Environmental Protection Agency
- Xiaoyu Liu, PhD, Senior Physical Scientist, U.S. Environmental Protection Agency
- Barbara Turpin, PhD, Professor, University of North Carolina, Chapel Hill

11:30 AM **Break**

11:40 AM **Session Two - Transformations**

Chemical Transformations and their Impact on Indoor Air
Delphine Farmer, PhD, Professor, Colorado State University

12:10 PM **Q&A Dr. Farmer**
Moderated by Dustin Poppendieck

12:20 PM **Panel Discussion 2 - Germicidal UV Radiation, Unintended Chemistry**
Moderated by Dustin Poppendieck

Delphine Farmer, PhD, Professor, Colorado State University
Michael F. Link, PhD, Physical Scientist, Engineering Laboratory, National Institute of Standards and Technology (NIST)
Paula Olsiewski, PhD, Contributing Scholar, Johns Hopkins Center for Health Security
Richard Williamson, Program Director, Far-UVC, Blueprint Biosecurity

1:00 PM **Lunch**
Provided by the Academies for In-person Attendees

2:00 PM **Session Three - Indoor Chemistry and Exposure**

We are Living in a Material World: Indoor Air and Exposure
Krystal Pollitt, PhD, PEng, Associate Professor of Epidemiology, Yale School of Public Health (YSPH)

2:30 PM **Q&A with Dr. Pollitt**
Moderated by Charlie Weschler

2:35 PM **Panel Discussion 3 - How Do we Strengthen the Handshake between IAQ and Exposure Science/Cognition, Health and Wellbeing**
Moderated by Charlie Weschler

Antonia Calafat, PhD, Chief, Organic Analytical Toxicology Branch, Centers for Disease Control and Prevention (CDC)
Elaine Cohen-Hubal, PhD, Senior Science Advisor, U.S. Environmental Protection Agency
LCDR Jason Ham, PhD, Research Scientist, Health Effects Laboratory Division (HELD), Chemical and Biological Monitoring Branch (CBMB), National Institute for Occupational Safety and Health (NIOSH)
Krystal Pollitt, PhD, PEng, Associate Professor of Epidemiology, Yale School of Public Health (YSPH)
Treye Thomas, PhD, Lead Toxicologist and Program Manager, Chemicals, Nanotechnology and Emerging Materials (CNEM) Program, Office of Hazard Identification and Reduction, Consumer Product Safety Commision (CPSC)

3:15 PM **Break**

3:30 PM **Session Four - Building Science and Instrumentation**

Buildings Are Dynamic: Implications for indoor chemistry
Jeffrey Siegel, PhD, Professor, University of Toronto

4:00 PM **Q&A with Dr. Siegel**
Moderated by Dustin Poppendieck

4:10 PM **Panel Discussion 4 - Buildings Impact on Chemistry**
Moderated by Dustin Poppendieck

Brian Gilligan, PEng, SCPM , Deputy Director, Office of Federal High Performance Green Buildings, General Services Administration
Odessa Gomez, PhD, Indoor Air Quality/Ventilation Assessment Program Manager, Colorado Dept of Public Health and Enviornment
David Rowson, Director, Indoor Environments Division, Environmental Protection Agency
Jeffrey Siegel, PhD, Professor, University of Toronto
Brett Singer, PhD, Senior Scientist and Principal Investigator (PI), Energy Technologies Area, Lawrence Berkeley National Laboratory

4:50 PM **Reflect on Next Steps**
Discussion led by Glenn Morrison, Dustin Poppendieck, Charles Weschler

5:00 PM **Adjourn**

Link to attend Virtually
https://nasem.zoom.us/j/95398623711?pwd=MmRiTVd2TkwxL2xyTWJOd0ozQ2JWUT09

Biographies

Jonathan Abbatt is a chemistry professor at the University of Toronto, having received his PhD from Harvard University in atmospheric chemistry. Dr. Abbatt's research activities lie broadly in the areas of atmospheric aerosol and multiphase chemistry, using both laboratory and field measurement techniques. His current research interests include the chemistry of polluted atmospheres, the Arctic, wildfires, and indoor chemistry. He is a fellow of the American Geophysical Union and the Royal Society of Canada, and was a member of the National Academies committee which wrote "Why Indoor Chemistry Matters".

Dr. **Antonia Calafat** is the Chief of the Organic Analytical Toxicology Branch at the National Center for Environmental Health of the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia. She leads CDC's biomonitoring programs for assessing human exposure to chemicals added to consumer and personal-care products such as phthalates and phenols, flame retardant chemicals; pesticides; polycyclic aromatic hydrocarbons; and persistent organic pollutants including polybrominated diphenyl ethers; polychlorinated dibenzo-p-dioxins, furans, and biphenyls; and per- and polyfluoroalkyl substances (PFAS). She has developed and maintained extensive collaborative research with leading scientists in the fields of exposure science, epidemiology, toxicology and health assessment, and has coauthored over 650 peer-reviewed articles. Her research has made important contributions to biomonitoring science, including CDC's National Reports on Human Exposure to Environmental Chemicals. In 2019, she received the Excellence in Exposure Science Award given by the International Society of Exposure Science. Since 2017, she is the co-Editor-in-Chief of the International Journal of Hygiene and

Environmental Health. Dr. Calafat earned her PhD in Chemistry in 1989 from the University of the Balearic Islands, Spain. She was a Fulbright scholar at Emory University (Atlanta, GA) where she completed her postdoctoral training. She joined CDC in 1996.

Dr. **Robin E. Dodson** is an exposure scientist at Silent Spring Institute and an adjunct assistant professor at Boston University School of Public Health. Her research focuses on three main areas: development of novel exposure measurements for epidemiological and community-based studies, analysis of environmental exposure data with particular emphasis on semivolatile organic compounds (SVOCs), and interventions aimed at reducing chemical exposures. Dr. Dodson investigates environmental exposures of chemicals linked to a range of health outcomes, including asthma, altered neurological and reproductive development, and breast cancer. Her current research focuses on exposure to consumer product chemicals such as phthalates and flame retardant chemicals and has been used to identify exposure sources and implement effective exposure reduction strategies in homes. Dr. Dodson completed her doctorate in environmental health and masters in environmental science and risk management at Harvard T.H. Chan School of Public Health.

Delphine Farmer is a Professor of Chemistry at Colorado State University, where she runs a research group studying atmospheric and indoor chemistry, with particular focus on using mass spectrometry to study processes that control sources and sinks of organic gases and particles in the atmosphere. She received her BSc in Chemistry from McGill University, her MS in Environmental Science, Policy, and Management from the University of California at Berkeley, and then her PhD in Chemistry from UC Berkeley. She held a NOAA Climate and Global Change Postdoctoral Fellowship at the University of Colorado Boulder before moving to her current position at CSU in Fort Collins. She is a recipient of the 2013 Arnold and Mabel Beckman Young Investigator Award and the 2022 AGU Ascent Award.

Brian Gilligan is a Professional Engineer and the Deputy Director of the Office of Federal High Performance Green Buildings in the General Services Administration (GSA). He has 20 years experience in facilities, construction, and energy management and a passion for sustainability in the built environment. He is currently focused on GSA's Health in Buildings and Workplace 2030 efforts. This work seeks to envision the future of the federal workplace, develop tools and methods to enhance health in buildings, and make every project at GSA a learning experience. Brian holds degrees in Mechanical Engineering and Civil and Environmental Engineering from RPI and Stanford University.

Odessa Gomez is a Research Affiliate at the University of Colorado Boulder and the Program Manager for the Indoor Air Quality/Ventilation Assessment Program in the Division of Disease Control and Public Health Response at the Colorado Department of Public Health and Environment (CDPHE). Dr. Gomez has served as a Senior Research Associate at CU Boulder, conducting research on indoor air quality in public schools during the COVID-19 pandemic, as well as approaches in bioaerosol disinfection and control technologies. After completing her MS in Chemical Engineering and PhD in Civil Engineering from CU Boulder, she was awarded an Alfred P. Sloan Foundation Postdoctoral Research Fellowship in Microbiology of the Built Environment. Dr. Gomez also has experience in the private sector, including as the former Chief Scientist for a startup focused on instrumentation for indoor air quality characterization. She has leveraged her multidisciplinary experience in teaching, research and professional practice to advance IAQ initiatives at the state level. Her current interests focus on translating building science research to accessible and actionable guidance for program administrators, building managers, and the public.

Vicki H. Grassian is currently a Distinguished Professor in the Department of Chemistry and Biochemistry and the Associate Dean for Research in the School of Physical Sciences at the University of

California San Diego. Professor Grassian's research focuses on the chemistry and impacts of environmental interfaces as it relates to atmospheric aerosols, engineered and geochemical nanomaterials, and indoor surfaces She has received several awards for her research including the American Chemical Society (ACS) National Awards in both Surface Chemistry and Creative Advances in Environmental Science and Technology Award. She also received the William H. Nichols Medal Award, the John Jeyes award from the Royal Society of Chemistry, the Chemical Pioneer Award from the American Institute of Chemists, the Sustainable Nanotechnology Organization Award and the Geochemistry Medal from the ACS Geochemistry Section. She has been recognized by the ACS Committee on Environmental Improvement for incorporating sustainability into chemistry education. She is an elected member of the American Academy of Arts and Sciences and a Fellow of several societies including the American Association for the Advancement of Science. Professor Grassian also provides extensive service to the scientific community in many roles including as an appointed Member of the National Science Foundation's Advisory Committee for Environmental Research and Education, a Member of the National Academies of Sciences, Engineering and Medicine Committee on Emerging Science on Indoor Chemistry and co-author of "Why Indoor Chemistry Matters: A National Academies Consensus Report" and, she led the Surface Consortium for the Chemistry of the Indoor Environment Program funded by the Sloan Foundation. She received her Ph.D. from the University of California Berkeley.

LCDR **Jason E. Ham**, Ph.D., has been working for 19 years at the National Institute for Occupational Safety and Health (NIOSH) as a Research Chemist. He has been in the United States Public Health Service (USPHS) as a Commission Corps Scientist Officer for 10 years. He has served in multiple capacities as a principal investigator, co-investigator, and team lead also while serving on multiple internal and international committees (e.g., Morgantown Safety, ASTM, ISIAQ). He is a subject matter expert in the collection and analysis of volatile and semi-volatile compounds in the gas-phase, on particles, and from surfaces. He also specializes in the characterization of highly oxidized species generated through a variety of indoor reactions that occur during cleaning events and manufacturing processes. Currently, LCDR Ham is the Team Leader of the Gas and Vapor Team of the Chemical and Biological Monitoring Branch (CBMB) in Morgantown, WV.

Elaine Cohen Hubal is an expert in the field of environmental health with broad scientific background in environmental engineering, human exposure, and chemical safety evaluation. Her primary research interest is in understanding complex systems at the nexus of the built environment, natural environment, and human health with an emphasis on impacts to vulnerable populations and life stages. Dr. Cohen Hubal currently works as a Senior Science Advisor in USEPA's Center for Public Health and Environmental Assessment. In this capacity, she leads the EPA Office of Research and Development research efforts to advance understanding of human exposure to Per- and polyfluoroalkyl substances (PFAS). She also serves as Editor-in-Chief for the Journal of Exposure Science and Environmental Epidemiology. Previously, Dr. Cohen Hubal served as Deputy National Program Director for EPA's Chemical Safety for Sustainability research program. She also served as Interim Director of the Computational Exposure Division and as Acting Director of the Integrated Systems Toxicology Division.

Vito Ilacqua is an environmental scientist with broad interests in environmental health issues, with research experience in government and academic institutions; teaching experience at undergraduate and graduate level. Currently, Dr. Ilacqua is a chemist at the US EPA, Office of Air and Radiation, where he works in the Center for Scientific Analysis on a variety of issues important to indoor air quality. His current research interests are in indoor air chemistry modeling and epidemiology. Previously, he was a project officer for research grants in the Agency, one of the founding faculty members of the Department of Environmental and Global Health at the University of Florida, and a researcher at the Finnish National Public Health Institute. He received a doctorate in Environmental Sciences from Rutgers University, after selection as a Fulbright scholar, and holds a BS/MS degree from the Universita' degli Studi di Milano, Italy.

Dr. **Michael Link** is a Research Chemist in the Indoor Air Quality and Ventilation Group in the Engineering Laboratory (EL) at the National Institute of Standards and Technology (NIST). He graduated from Colorado State University in 2020, under the mentorship of Dr. Delphine Farmer, with a PhD in Chemistry specializing in mass spectrometry, chemical kinetics, outdoor air quality, and instrument development. After his Ph.D., he did a two-year postdoc with Dr. A.R. Ravishankara at Colorado State University, studying UV degradation of gas-phase ketones, before coming to NIST working in collaboration with Dr. Dustin Poppendieck. His research focuses on understanding the chemical reactions that occur indoors that control indoor air quality. Recently, he has worked with Dr. Poppendieck developing an ASTM standard test method for the chemical assessment of air cleaning technologies.

Dr. **Xiaoyu Liu** is a senior physical scientist at U.S. EPA Center for Environmental Measurement & Modeling. Dr. Liu's research interests include development of new testing and analytical methods to better characterize indoor sources, fate and transport of pollutants from building materials and consumer products, applications of indoor air quality models for exposure assessment, and investigation of fate and transport mechanisms and exposure pathways of emerging contaminants between sources, air, house dust, contaminated water or commercial aqueous solutions, and interior surfaces in the indoor environment. She has been working on EPA's high-priority chemicals for assessing and managing chemicals under EPA's Toxic Substances Control Act. Dr. Liu has been the subcommittee chair of ASTM D22-05 on Indoor Air since 2016 and an Editorial Board member of journal Indoor and Build Environment since 2014. She received her PhD in Environmental Science from University of North Carolina at Chapel Hill.

Glenn Morrison is a professor of environmental sciences and engineering at the University of North Carolina, Chapel Hill. His research is related to the chemistry and physics of indoor air pollution and its influence on human exposure to contaminants. He has a particular interest in interfacial chemistry, ozone-surface chemistry, acid-base chemistry, methamphetamine contamination in buildings, and the interactions of chemicals with occupant surfaces, including skin. His research group has studied how chemicals can be transported by fine particles indoors and has measured reactive oxygen species in homes. In recent years, he has focused on how clothing influences indoor chemistry and occupant exposure to chemicals. He is a fellow of the International Society of Indoor Air Quality and Climate and has served on the board and as the president from 2014-2016. He received his PhD from the University of California, Berkeley.

Dr. **Paula J. Olsiewski**, Ph.D., is a Contributing Scholar at the Johns Hopkins Center for Health Security. She is a pioneering leader in policy and scientific research programs in the microbiology and chemistry of indoor environments. Dr. Olsiewski leads the Center's work on indoor air quality policy to mitigate airborne disease and global catastrophic biological risks. During her 2 decades at the Alfred P. Sloan Foundation, she led innovative and multidisciplinary programs that inspired, accelerated, and produced lasting impact. Her expertise in partnering with academic, governmental, and for-profit stakeholders fostered innovation and built research capacity through the creation of diverse stakeholder networks. Her accomplishments include the creation and direction of the microbiology of the built environment, chemistry of indoor environments, and biosecurity programs. She is a member of the Academy of Fellows of the International Society for Indoor Air Quality and Climate, a Fellow of the American Association for the Advancement of Science in chemistry, and a member of the Council on Foreign Relations. Dr. Olsiewski received a PhD in biological chemistry at the Massachusetts Institute of Technology (MIT) and BS in chemistry, cum laude, from Yale.

Dr. **Krystal Pollitt** is an Associate Professor in the Department of Environmental Health Sciences at the Yale School of Public Health and hold a cross-appointment in the Department of Chemical and Environmental Engineering at the Yale School of Engineering and Applied Science. She trained in chemical engineering for her bachelor's and master's degrees at the University of Toronto before obtaining a PhD at King's College London in environmental toxicology. She was subsequently awarded a Canadian Thoracic Society Postdoctoral Research Fellowship. Dr. Pollitt's research combines her interests in exposure science and analytical chemistry and applies exposomic approaches to investigate the influence of environmental factors on chronic disease. Her work has focused on addressing the technical hurdles of performing systematic and comprehensive measurements of environmental chemicals using high resolution mass spectrometry. She has pioneered technologies for exposomics, including a wearable passive sampler (Fresh Air wristband) to assess personal exposure to thousands of environment contaminants. Dr. Pollitt's work has resulted in over 100 published peer-reviewed papers and 2 book chapters. She was awarded the Joan M. Daisey Outstanding Young Scientist Award from the International Society of Exposure Science and an Early Career Research Award from the Yale School of Public Health.

Dustin Poppendieck is an environmental engineer at the National Institute of Standards and Technology. He is interested in how building materials, building envelopes, low energy building designs, air filtration, infiltration, ventilation, and HVAC system operation can interact and affect indoor chemistry. His research involves characterizing primary emission sources, reactions at material surfaces and ozone influenced air chemistry. He has investigated emissions from kerosene can lamps, spray polyurethane foam, and non-smoldering cigarette butts. He has examined the impacts of air cleaners and high concentrations of gaseous disinfectants on indoor chemistry. He received his PhD in civil and environmental engineering from the University of Texas at Austin.

David Rowson, M.S., is the Director of Indoor Environments Division at the U.S. Environmental Protection Agency (EPA). During his approximately 30-year career at EPA, Mr. Rowson has led several important public health initiatives, including initiatives on radon, healthy schools, and asthma and international programs on indoor air. Mr. Rowson is an alumnus of the University of Virginia where he earned his undergraduate and graduate degrees in environmental sciences and meteorology. He also worked in state-level water pollution control programs prior to joining EPA.

Jeffrey Siegel, Ph.D., is Professor of Civil and Mineral Engineering and a member of the Hub for Advancing Buildings at the University of Toronto. He is a Bahen/Tanenbaum Chair in Civil Engineering. He holds joint appointments at the Dalla Lana School of Public Health and the Department of Physical & Environmental Sciences. He has an M.S. and Ph.D. in Mechanical Engineering from the University of California, Berkeley as well as a B.Sc. from Swarthmore College. He is internationally recognized for his work on indoor air quality generally and air cleaning specifically and is a fellow of ASHRAE and a member of the Academy of Fellows of the International Society for Indoor Air and Climate (ISIAQ). His research interests include healthy and sustainable buildings, filtration and air cleaning, ventilation and indoor air quality in residential and commercial buildings, control of indoor particulate matter, cognitive impacts of indoor air quality, and the impact of building systems on indoor microbiology and chemistry. He has published over 100 peer-reviewed journal articles on indoor air quality and related subjects and has been active in disseminating information about filtration and ventilation solutions for COVID-19.

Brett C. Singer is a Senior Scientist and Head of the Sustainable Energy and Environmental Systems Department in the Energy Technologies Area of Lawrence Berkeley National Laboratory. He is also Senior Advisor to the Indoor Environment Group, which he led from 2015 through early 2023, and a matrixed PI in the Whole Building Systems Department. Dr. Singer conceives and conducts research on the emission sources, physical-chemical processes, human factors and engineering controls that affect air pollutant exposures in real indoor environments. His guiding motivation is to provide the scientific basis to inform

equitable energy and environmental policy. Key foci of his work over the past 15 years have been environmental quality and exposure mitigation technologies, policies, and practices in high performance homes. Dr. Singer's early research examined the impact of sorption-desorption processes on exposures to organic gases from secondhand smoke, helping to launch interest in the study of thirdhand smoke. Dr. Singer earned his Ph.D. in Civil and Environmental Engineering from the University of California, Berkeley in 1998 and he was named to the Academy of Fellows of the International Society of Indoor Air Quality and Climate in 2016.

Treye Thomas, Ph.D., is a Program Manager for the Chemicals, Nanotechnology and Emerging Materials (CNEM) program area in the U.S. Consumer Product Safety Commission's (CPSC) Office of Hazard Identification and Reduction. His duties include establishing priorities and projects to identify and mitigate potential health risks to consumers resulting from chemical exposures during product use. Dr. Thomas has conducted comprehensive exposure assessment studies of chemicals in consumer products and quantified the potential health risks to consumers exposed to various chemicals including flame retardants, nanomaterials, wood preservatives, PFAS compounds and heavy metals. Dr. Thomas played a lead role in developing the CPSC nanotechnology research program and continues to engage in addressing the health and safety implications of emerging technologies including additive manufacturing/3D printing and wearable technology including virtual reality (VR) devices. Dr. Thomas serves as a CPSC representative in a number of activities including as a federal liaison for the NAS Emerging Science for Environmental Health Decisions standing committee, the UL 3D Technical Advisory Board, and is the co-chair for the NNI Nanotechnology Environmental and Health Implications (NEHI) working group. Dr. Thomas received an MS from UCLA and PhD from the University of Texas, Health Science Center.

Barbara Turpin is Professor and Past-Chair of the Department of Environmental Sciences and Engineering in the Gillings School of Global Public Health at the University of North Carolina (UNC) at Chapel Hill. Professor Turpin received a BS from the California Institute of Technology, PhD from OGI at the Oregon Health Sciences University, and conducted a postdoc at the University of Minnesota Particle Technology Laboratory. She was a Distinguished Professor at Rutgers University before joining UNC eight years ago. Professor Turpin conducts research on many aspects of indoor and outdoor air chemistry, including chemistry impacting aerosols, the behavior of water-soluble gases, PFAS, and human exposures. She is a Fellow of the American Association for the Advancement of Science, Fellow of the American Geophysical Union, and Fellow of the American Association for Aerosol Research (AAAR). She is a recipient of AAAR's Sinclair Award (2010) and the American Chemical Society's award for Creative Advances in Environmental Sciences and Technology (2018).

After completing his Ph.D. in chemistry at the University of Chicago, Dr. **Charles J. Weschler** did postdoctoral studies with Prof. Fred Basolo at Northwestern University. In 1975 he joined Bell Laboratories as a research scientist in the Physical Chemistry Division. He conducted research at Bell Labs and its successor institutions until 2001 being named a Distinguished Member of Technical Staff (1986). In 2001 he retired from Bellcore/Telcordia and accepted positions at the Environmental & Occupational Health Science Institute and the International Centre for Indoor Environment and Energy, Technical University of Denmark. He has continued in those positions through the present. In 2010 he joined the faculty of the Building Science department at Tsinghua University (Beijing) as an ongoing Visiting Professor. He is also an Adjunct Professor in the Rutgers School of Public Health. He was a Member of the Committee on Air Quality in Passenger Cabins in Commercial Aircraft, National Academy of Sciences, 2000-2001; Advisor on Strategies to Protect the Health of Deployed US Forces, National Academy of Sciences, 1998-2000; Member of the Committee to Review the Structure and Performance of the Health Effects Institute, National Academy of Sciences, 1991-1993; and Member of the Committee on Advances in Assessing Human Exposure to Airborne Pollutants, National Academy of Sciences, 1987-1990. From 1999-2005 he served on the US EPA's Science Advisory Board. He was elected to the

International Academy of Indoor Air Sciences in 1999 and received the Pettenkofer Award, its highest honor, in 2014. He has been conferred the 2017 Haagen-Smit Prize from Atmospheric Environment; "Distinguished Visiting Professor" at Tsinghua University (2018); "Doctor Technices Honoris Causa" from the Technical University of Denmark (2018); and was recently (2020) elected a Fellow of the American Association for the Advancement of Science (AAAS). He has an h-index of 73 with over 17,000 citations (Web of Science) and 83 with over 26,000 citations (Google Scholar).

Richard Williamson is Program Director at Blueprint Biosecurity, where he leads the Blueprint project on the use of Far-UVC germicidal light to suppress transmission of respiratory pathogens. Richard has over ten years of management and leadership experience in the private sector across strategy consulting, finance, strategic sourcing, and operational supply chain. Most recently he was Head of Technical Operations at Alvea, a vaccine biotech startup, where he was also a member of the R&D leadership team.