Federal Interagency Committee on Indoor Air Quality (CIAQ) Meeting Minutes

October 20, 2021

Moderator: Laureen Burton, U.S. Environmental Protection Agency

Meeting Overview

- Welcome, Introductions and Announcements
- Federal CIAQ Member Agency Updates (Pages 2–28)

- Federal Member Agency Project Spotlight

IAQ Tools for Schools Program

Mary Jo Errico, Ph.D., Indoor Environments Division, EPA

- Indoor Air Quality (IAQ) Area of Interest Presentations

Buildings Can Help Stop the Spread of SARS-CoV-2: Evidence and Research Priorities

P. Jacob Bueno de Mesquita, Ph.D., Indoor Environment Group, Lawrence Berkeley National Laboratory

Measured Influence of Overhead HVAC on Exposure to Airborne Contaminants From Simulated Speaking in a Meeting and a Classroom

Haoran Zhao, Ph.D., Indoor Environment Group, Lawrence Berkeley National Laboratory

- Post-Meeting Updates and Announcements
  - The next CIAQ meeting is scheduled for February 2022.

U.S. Environmental Protection Agency (EPA), Indoor Environments Division (IED)

COVID-19 Update

Important updates to EPA's COVID-19 indoor air content are now posted on the EPA website: https://www.epa.gov/coronavirus/indoor-air-and-coronavirus-covid-19. These updates reflect IED analysis of the evolving science related to transmission of COVID-19, further highlighting airborne transmission indoors as a primary route of exposure and noting that transmission of COVID-19 from inhalation of virus in the air can occur at distances greater than six feet, particles from an infected person can move throughout an entire room or indoor space, and particles also can linger in the air after a person has left the room and can remain airborne and infectious for hours in some cases.

FAQs specific to indoor air quality (IAQ) issues are available at https://www.epa.gov/coronavirus/frequent-questions-about-indoor-air-and-coronavirus-covid-19.

EPA's indoor air COVID-19 guidance and FAQs include links to additional resources, including relevant CDC guidance, for managing IAQ to help provide protection against airborne transmission of COVID-19 in homes, schools, offices and other commercial buildings.

For multilingual web content on COVID-19 and indoor air quality (as well as other indoor air environmental health issues), visit www.epa.gov/lep. EPA is continuing to add multilingual content and updating this FAQ list, so please consider checking it routinely.

For the latest information on EPA's overall COVID-19 guidance and response, visit https://www.epa.gov/coronavirus.

Science

IED-Sponsored Consensus Study, Health Risks of Indoor Exposures to Fine Particulate Matter and Practical Mitigation Solutions, Launched by NASEM

The National Academies of Sciences, Engineering, and Medicine (NASEM) has been tasked by EPA to convene an expert committee to consider the state of the science on the health risks of exposure to fine particulate matter ($PM_{2.5}$) indoors and engineering solutions and interventions to reduce risks of exposure to it indoors, including practical mitigation solutions to reduce exposure in residential settings. The NASEM recently announced the committee members, which include—

- Richard L. Corsi (Chair), Portland State University
- Lilia A. Abron, PEER Consultants, P.C.
- Seema Bhangar, WeWork
- Wanyu R. Chan, Lawrence Berkeley National Laboratory

- Elizabeth C. Matsui, The University of Texas at Austin
- Linda A. McCauley, Emory University
- Meredith McCormack, Johns Hopkins University
- Kimberly A. Prather, University of California, San Diego
- Jeffrey A. Siegel, University of Toronto
- Brent Stephens, Illinois Institute of Technology
- Marina E. Vance, University of Colorado Boulder

During the course of the study, the committee will produce a consensus report with findings and recommendations regarding the key implications of the scientific research for public health, as well as where additional research will be most critical to understanding indoor exposure to $PM_{2.5}$ and the effectiveness of interventions. IED will provide updates on future public information–gathering sessions held by the study committee as they are announced. The consensus study report is expected to be completed by the end of 2022.

More information, including full bios of the committee members, can be found on the consensus study website or by contacting the NASEM by email at indoor-pm@nas.edu.

Webinar on the Formation of Secondary Byproducts from an Oxidant-Generating Electronic Air Cleaner

On September 15, 2021, IED hosted a webinar in the IAQ Science Webinar Series titled *Formation of Oxidized Gases and Secondary Organic Aerosol from a Commercial Oxidant-Generating Electronic Air Cleaner.* The webinar featured a presentation by Dr. Nga Lee "Sally" Ng, Georgia Institute of Technology. Dr. Ng discussed the results of a study investigating the production of oxygenated volatile organic compounds and secondary organic aerosol formation by an oxidant-generating electronic air cleaner in an indoor environment. This research has implications for stakeholders selecting indoor air cleaners for use as part of layered risk reduction strategy to reduce the transmission of SARS-CoV-2. The webinar was recorded and will be available soon at EPA – Indoor Air Quality Science and Technology |Webinars.

Cleaner Indoor Air During Wildfires Challenge Competition Winners to be Announced October 26

EPA's Office of Research and Development will announce the winners of the Cleaner Indoor Air During Wildfires Challenge during a webinar on September 26, 2021. EPA and other federal, state, local and tribal partners held this Challenge Competition to encourage the development of low-cost air cleaning technologies that reduce particulate air pollutants in homes during wildfires or other high-pollution episodes. Challenge winners whose ideas are chosen will receive prizes of up to $10,000. Register for the webinar here, or visit the challenge website to learn more.

Release of New IED Webpage on the Indoor Microbiome

The IED has published a new webpage on the indoor microbiome (https://www.epa.gov/indoor-air-quality-iaq/indoor-microbiome). All the living microorganisms inside an indoor environment, and their byproducts, are known collectively as an indoor microbiome. On this page, you will find answers to questions like "What is a normal indoor microbiome?" and "Where do microorganisms in the indoor environment come from?" As we continue to learn more about the indoor microbiome and how it can impact occupant health, this new resource gives an overview of our current understanding. The webpage provides links to EPA-sponsored microbiome reports from NASEM and includes information on actions that can be taken to maintain a generally healthy indoor environment.

IAQ Emergency Preparedness, Response and Recovery

Weather-related and man-made emergencies and disasters can damage homes and buildings and make the air indoors unhealthy to breathe. With climate change, weather-related emergencies are becoming more frequent and more severe. EPA's updated Emergencies and IAQ webpage provides tips on how to prepare for, respond to and recover from weather-related and man-made emergencies and disasters that affect indoor environments, including wildfires, power outages, hurricanes and flooding, and more.

IED recently posted a video on Wildfire Smoke and Indoor Air Quality: How to Set Up a Clean Room at Home. A clean room is a room that is set up to keep levels of smoke and other harmful particles as low as possible during wildfire smoke events.

Household Energy (Cooking, Heating and Lighting in Low- to Middle-Income Countries)

President Recommits Work with Clean Cooking Alliance During the Climate Leaders' Summit

In April, President Biden committed to rejoin the Paris Agreement and took executive action to tackle the climate crisis in the United States and other countries. In coordination with the President's action, Administrator Michael Regan also announced that EPA will resume and strengthen our commitment to the United Nations Foundation's Clean Cooking Alliance and will work with the Alliance, other country governments and partners at every level to reduce emissions from home cooking and heating that contribute to climate change and affects the health and livelihoods of almost 40 percent of the world's population. At the 26th meeting of the Council of Parties (COP26), which will be held in Glasgow, Scotland, in November 2021, the Administration will announce a whole-of-U.S.-government approach to address this challenge. This announcement is expected to include commitments by numerous agencies (Agency for International Development, CDC, DOE, EPA and National Institutes of Health) on what actions they will be taking in the coming years.

Promotion of ISO Standards

The household energy community has completed and issued important standards in the past two years through the International Organization for Standardization (ISO) process. In 2018, ISO published the international standard for laboratory testing of cookstoves, which includes protocols to test and report

the emissions, efficiency, safety and durability of cookstoves in a lab setting. The new standards serve as the basis for national policies and programs on cookstoves, while also incentivizing manufacturers and developers to improve stove quality and performance. In 2019, a second ISO household energy standard was finalized, "Guidance on Field Testing Methods for Cookstoves," which provides a framework for organizations, countries and regions to adapt and implement cookstove protocols, metrics and targets based on their priorities over the coming months and years. EPA is now working with the Clean Cooking Alliance, ISO, the World Health Organization, and the Dutch and German development agencies to organize and facilitate regional workshops to promote the adoption or the adaptation by countries of the recently finalized ISO harmonized laboratory standards for clean cookstoves and clean cooking practices.

Last month, EPA, in partnership with the Clean Cooking Alliance, ISO, World Health Organization, Pan American Health Organization and the Berkeley Air Monitoring Group, launched the first in a series of virtual sessions to support the adoption or adaptation, and implementation, of national standards for cookstoves in Latin American countries. More than 125 stakeholders from the Ministries of Energy, Environment, and Health; national standards bodies; as well as other implementation partners from 12 countries (Bolivia, Brazil, Chile, Columbia, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay and Peru) are participating. This workshop series is the fourth in a series of regional standards dissemination workshops, following an Asian regional workshop held in Nepal (December 2018), an East African/Anglophone regional workshop held in Uganda (July 2019), and a virtual workshop for Francophone African countries and Haiti (October 2020 to March 2021).

Advancing Sustainable Household Energy Solutions (ASHES) Initiative at Colorado State University

An EPA cooperative agreement recipient, Colorado State University, in collaboration with Berkeley Air Monitoring Group, began a new household energy solutions and air quality initiative. Through the Advancing Sustainable Household Energy Solutions (ASHES) initiative, Colorado State is building a consortium of household energy community members that includes researchers, academics, practitioners, private industry and community partners working together to define the way forward and advance sustainable household energy solutions for public health and environmental sustainability. This work includes a webinar series that focuses on disseminating the latest on household energy. In past months, ASHES has worked with EPA to highlight the research findings from numerous principal investigators and their organizations. For more information on ASHES, or to watch previous ASHES webinars, please go to www.ashes-csu.org.

Radon

National Radon Action Plan (NRAP)

IED continues to support the growing national network of federal agencies, private-sector nongovernmental organizations and states to prevent lung cancer deaths through the National Radon Action Plan (NRAP). Along with its founding members, the American Lung Association has brought in supporting organizations (those who have signed a declaration of support) and emerging potential partners (organizations identified to help drive progress) to increase the mitigation of existing homes

and the construction of new homes with radon-reducing features. The NRAP expands the efforts under the Federal Radon Action Plan to focus on actions that go beyond federal governmental actions alone.

The NRAP presents a long-range strategy for eliminating avoidable radon-induced lung cancer in the United States. The Plan's near-term goals are to reduce radon risk in 5 million homes and to save 3,200 lives. While these goals offer bold and important milestones, the NRAP's ultimate goal is to eliminate avoidable radon-induced lung cancer in the United States by incorporating radon testing, radon mitigation and radon-resistant construction into the systems that govern purchasing, financing, constructing and renovating homes and other buildings. Progress for NRAP strategies can be tracked at www.radonleaders.org/resources/nationalradonactionplan.

NRAP Leadership is currently reviewing and finalizing a new Action Plan that will cover the period from 2021–2025. We at EPA deeply appreciate the involvement of the American Association of Radon Scientists and Technologists (AARST), Conference of Radiation Control Program Directors (CRCPD), our colleagues at HUD and CDC, as well as NGOs as we come together to identify the most important work over the next few years to save lives from radon-induced lung cancer.

Several themes have emerged in discussions for the next version of the NRAP, including—

- A commitment to changing building codes, as well as a focus on tenant resources and action.
- Leveraging available sources of funding and recognizing opportunities to seek additional funding.
- And finally, a commitment to address disparities in radon risk reduction.

State Indoor Radon Grants (SIRG)

This Administration requested an increase of $1 million (M) in the fiscal year (FY) 2022 budget for state and tribal radon grants (the FY 2021 SIRG funding was appropriated at $7.795 M). EPA will need to wait for Congressional appropriations to confirm the requested increase is enacted, but the Agency is hopeful that it will be, and IED has begun engaging our regional offices to consider options for how to implement the increase in SIRG funding.

Tribal Performance Partnership Grants

Performance Partnership Grants (PPGs) will become more accessible to tribes. PPGs allow grantees to combine funds from multiple environmental program grants into a single grant with a single budget and allows grantees to direct resources to where they are needed most to address their environmental and public health priorities.

By including radon in a PPG, a tribe could eliminate the high match requirement for radon grants and overcome the significant hurdle that the high grant match requirement has created for tribes.

IED is hopeful this action will create a pathway for additional tribes to successfully apply for and receive radon grant funds and provide some relief for existing tribal radon grant recipients. EPA Regions are the

lead for communicating with their states and tribal communities about the availability of funds, how to apply, conditions, limitations, as well as how to properly use SIRG funds.

Building Codes

EPA continues to collaborate with industry and states to actively engage in efforts to promote adoption of radon-resistant new construction (RRNC) practices through international, national, state and local building codes. These efforts are mandated by the Indoor Radon Abatement Act and also are a key component of the NRAP.

EPA is working with key radon stakeholders to draft code changes or introduce new code requirements in several different areas within the broad spectrum of the International Code Council (ICC) portfolio, which includes—

- International Building Code
    - Educational Occupancies Requirement (schools and daycares)
    - Multifamily Buildings Requirement (R-2: apartment houses, congregate living facilities, etc.)
    - A non-mandatory provision for radon control in the body of the code
    - A new appendix—available for adoption by local and state jurisdictions
- Property Maintenance Code
    - A testing and mitigation requirement

The proposals for the various changes/additions to the ICC codes were submitted in January 2021 and then presented/defended at the Committee Action Hearings (CAH). While all proposals were voted down (disapproved), support was shown by some members of the voting board. EPA collaborated with radon stakeholders and provided comments during the public comment period on the Committee's ruling taking into account feedback from the CAH and simplifying language to make it more enforceable.

Radon Credentialing

EPA's work on radon credentialing is part of the Agency's responsibility to promote and support the availability of quality radon services to the public. Professionals who provide radon testing and mitigation services play a key role in public health protection efforts. Because of the substantial risk resulting from exposure to radon, it is critical for radon service providers to possess the necessary skills to provide quality services and ensure consumer protection. Over the last several years, EPA has been working, through consultation with states, the public and industry—and in response to Congressional direction—to develop a contemporary framework to guide the credentialing of radon service providers going forward. EPA remains committed to facilitating access to a qualified workforce through a national, nonregulatory framework that will help establish a quality standard for state-run and independent programs that credential radon service providers. The Agency plans to post an updated proposal online

that reflects stakeholder feedback and hold an information session soon. For more information about EPA's proposal, visit the EPA radon website, where we will post the most up-to-date information.

Asthma

Community of Practice (CoP)

The Asthma CoP is comprised of leading asthma community practitioners who are working to identify and help design asthma management programs that can be sustainably financed with health care and other funding to address the home environment as locations for effective asthma interventions for disease treatment and prevention, particularly where asthma disparities are pronounced. On September 30, 2021, EPA hosted a quarterly CoP meeting that featured Nightingale Partners, LLC, to share insights and approaches to financing health equity investments that include community-based care, in-home visits and environmental interventions, as well as the broader perspective on building sustainable systems that address the environmental and social determinants of disease disparities to drive better health and health care outcomes.

Upcoming Launch of 2022 National Environmental Leaderships Award in Asthma Management

Each year, EPA honors two exceptional community-based asthma programs with the National Environmental Leadership Award in Asthma Management. EPA recognizes programs for their leadership in promoting environmental asthma management as part of comprehensive asthma care in the communities they serve. The application period for the 2022 award will open in December. Information and application will be posted on EPA's Asthma website.

AsthmaCommunityNetwork.org

An important component of EPA's asthma program is equipping stakeholders with ongoing technical knowledge, as well as capacity building. This is accomplished through AsthmaCommunityNetwork.org, an online resource that facilitates peer-to-peer engagement and action learning events. Currently, almost 4,700 members are registered. EPA hosts technical webinars throughout the year, which are archived on this website. In addition, AsthmaCommunityNetwork.org features over 600 asthma educational materials in its Resource Bank and offers mentoring opportunities for registered members. You also can find more information on our asthma award winners and sustainable financing. If you are a current member, please consider updating your program profile on the Network. Also, we encourage any program that is not a member to join today!

Comprehensive IAQ Interventions in Homes

Indoor airPLUS: New Homes

IED's Indoor airPLUS Program continues to see growth through the second quarter of 2021, with the most labeled homes reported in a single quarter to date (1,953 labeled new homes). With recent commitments from production builders across the country, the total Indoor airPLUS–labeled homes for the second quarter represents a more than 60 percent increase over the first quarter of 2021 and is

more than double the total for the second quarter of 2020. More than 40,000 new homes have received the IAP label to date.

Indoor airPLUS: Leader Awards

On September 16, 2021, IED's Indoor airPLUS Program announced the 2021 Indoor airPLUS Leaders of the Year award winners. EPA has selected one Indoor airPLUS Leader of the Year in both the builder and rater categories for outstanding commitment and program performance. This year's Indoor airPLUS Leader of the Year winners are Mandalay Homes (builder) and JKP Energy Inspections (rater). Indoor airPLUS is a voluntary partnership and labeling program that helps new home builders address customer health concerns through construction practices and product specifications that minimize exposure to airborne pollutants and contaminants. The 2021 award winners build and verify Indoor airPLUS–qualified homes and have exhibited outstanding leadership in the promotion of the Indoor airPLUS program by educating homebuyers, trade professionals and allied stakeholders about the importance of enhanced indoor air quality.

Indoor airPLUS: Web Content

The Indoor airPLUS Program continues to add web content to further illustrate the role of Indoor airPLUS as a comprehensive, whole building system approach to a healthier home. Webpages include messaging on how Indoor airPLUS–labeled homes can help reduce exposure to airborne pollutants and contaminants, such as viruses, bacteria and other pathogens, as well as wildfire smoke. This content is available at https://www.epa.gov/indoorairplus/indoor-airplus-and-viruses-bacteria-and-mold and https://www.epa.gov/indoorairplus/indoor-airplus-and-wildfires.

Comprehensive IAQ Interventions in Schools

Indoor Air Quality, Healthy Green Cleaning, and Preventive Maintenance in Schools

As a result of the COVID-19 pandemic, EPA's Schools Program has pivoted to focus work on increased interest in healthy indoor environments in schools, increased urgency to respond to IAQ issues in schools, and leveraging key partnerships to expand our network of stakeholders.

EPA developed a new infographic, *Proven Strategies to Improve Indoor Air Quality in Schools*, in response to requests from stakeholders for more information about proven strategies to reduce pollutants in the air and limit the spread of viruses and bacteria in schools. The infographic outlines key actions for providing healthy air to students and staff, such as (1) increasing ventilation rate, (2) increasing HVAC filter efficiency, and (3) supplementing with portable air cleaners. Schools should maximize ventilation rates to the extent possible by bringing in as much outdoor air as weather and outdoor air quality permit. When sufficient HVAC adjustments are not possible, consider other means of bringing in outdoor air and using portable air cleaners as a supplemental filtration strategy.

EPA released updated web content on schools and COVID-19. The newly updated schools and COVID-19 webpage, now housed on the main EPA Coronavirus website, serves as an informational hub for schools and school stakeholders who are looking to prepare for the back-to-school season. The webpage points

to a variety of links, resources and guidance to help create, maintain and improve healthy learning environments during and beyond the pandemic. Specifically, the webpage features—

- Guidance from EPA and Other Federal Agencies on Schools and COVID-19
- Strategies for Maintaining Healthy Indoor Environments in Schools, including how to—
    - Establish an IAQ Management Program
    - Perform Routine HVAC Systems Maintenance
    - Develop a Communications Plan
    - Train and Educate Staff Members

You can view this webpage at www.epa.gov/coronavirus/healthy-indoor-environments-schools-during-covid-19-pandemic-and-beyond.

Collaboration with Federal Partners to Promote School Environmental Health

EPA collaborated on the U.S. Department of Education's (ED) new guidance on using American Rescue Plan (ARP) funds to improve ventilation systems in schools to prevent the spread of COVID-19, as well as improve indoor air quality in schools. The promotional message also included other EPA and IED resources, including the newly updated "Healthy Indoor Environments in Schools During the COVID-19 Pandemic and Beyond" webpage and *IAQ Tools for Schools* ventilation resources, checklists and webinars.

EPA also collaborated with DOE's Efficient and Healthy Schools campaign. DOE's campaign aims to help K–12 schools—especially those serving low-income student populations—identify practical HVAC solutions and upgrades to improve energy efficiency while promoting healthier spaces for teaching and learning. This campaign will promote peer-to-peer learning among school participants and will recognize schools for their best practices and exemplary solutions. The campaign also will engage supporters, such as designers, engineers, consultants and program implementers, to better support schools that are investing in efficient and healthy school buildings.

EPA co-moderated a virtual sustainability chat with the ED 2021 Green Ribbons Schools Honorees regarding Indoor Environments and Efficiency with representatives from DOE, ED and EPA.

EPA participates in the Federal Partners in School Health (FPSH) Virtual Meetings. The FPSH, coordinated by ED, is an alliance of federal agencies that assists and supports the physical and mental health of all students. The FPSH has developed a website, inventorying resources promoting healthy school environments for K–12 schools, school districts, and state and local education agencies: https://studenthealth.ed.gov.

Upcoming Engagements

EPA will host a webinar on October 21, 2021, *Ventilation and COVID-19 in Schools: Using a Framework to Assess, Prioritize, and Plan for HVAC Upgrades and IAQ Improvements.* The Ventilation, COVID-19 and IAQ in Schools webinar will feature experts from the Detroit Public Schools Community District and the Michigan Board of Education who will discuss how Detroit Public Schools Community District took action to assess IAQ, ventilation and HVAC systems (including working with consultants and contractors to perform assessments, commissioning and retro-commissioning) to help reduce the spread of COVID-19 transmission and create safe breathing environments for all students and staff. Register at https://register.gotowebinar.com/register/3212042218848461071.

Expanding the Reach for School IAQ Training

EPA continues to support healthy indoor environments in schools during the COVID-19 pandemic.

View IED-hosted webinars in the series at Healthy Indoor Environments in Schools: Plans, Practices and Principles for Maintaining Healthy Learning Environments.

EPA continues promoting the *IAQ Tools for Schools: Preventive Maintenance Guidance* documents to help school personnel take a holistic, proactive approach to IAQ issues. The guidance leads school personnel through the steps to develop and implement an IAQ preventive maintenance plan and offers a framework to make the case using a value proposition for an IAQ preventive maintenance plan and to gain buy-in from the school community.

EPA promotes IAQ guidance, tools and training to gain wider adoption of effective IAQ policies and practices in school districts across the country. EPA continues to actively deliver technical assistance to the schools' community through two professional training webinar series: IAQ Master Class Professional Training Webinar Series and IAQ Knowledge-to-Action Professional Training Webinar Series. Since 2015, both series have had more than 22,000 views from live webinars and on-demand recordings online. EPA is eager to drive even more action in school districts through spreading the IAQ Master Class Professional Training Webinar Series across more networks and platforms. Please contact us at iaqschools@epa.gov if your organization would like to use your existing training platforms and vehicles to host or link to the webinar series.

Consider Subscribing to Email Alerts on IAQ Topics

EPA offers a free subscription service for information on over 20 indoor air topics—opt in at public.govdelivery.com/accounts/usepaiaq/subscriber/new to receive email updates on IAQ. More than 145,000 subscribers regularly receive announcements of upcoming trainings, webinars and events, as well as practical tips and information resources to improve IAQ. Subscribers can choose among 20 topics, such as mold, air cleaners, radon, environmental asthma, air quality in schools, and IAQ emergency preparedness and response. Many topics are also presented in Spanish. Subscriptions can be cancelled easily at any time.

U.S. Department of Energy (DOE)

Agency Point of Contact: Chris Early, 202-586-0514, chris.early@ee.doe.gov

DOE created the Research Status Dashboard so that people can find publications and resources related to COVID-19 and buildings.

The Research Status Dashboard is an Excel spreadsheet that also provides key summary information and overview statistics of these publications. There are over 300 publications from various organizations from all over the world at this website: https://www.energy.gov/eere/buildings/articles/research-status-dashboard-covid-19-and-buildings.

Scope of Database

Topics related to COVID-19 or coronavirus and buildings, housing, home, HVAC, ventilation, air conditioning, heating, indoor air quality, outside air, filter, filtration, humidity, ultraviolet, energy and electricity.

Includes publications on—

- Pathogen or COVID-19 transmission within buildings.
- Pathogen or COVID-19 and HVAC systems.
- COVID-19 and building operations.
- COVID-19 and building energy consumption.
- Pathogen transmission mitigation technologies (filtration, UVGI, ventilation, etc.).

Excludes publications—

- Without specific reference to buildings and building operations.
- Focused on occupant behavioral change (mask wearing, hand washing, social distancing) without reference to building operation or energy consumption.

New infographic helps homeowners and contractors understand energy efficiency and health.

DOE's new Health + Home Performance Infographic reveals the link between efficiency and health—something everyone cares about. Efficiency programs and contractors can use the question-and-answer format to discover a homeowner's needs. The one-page infographic is ideal for the "kitchen table" conversations where people decide what to do and who they want to do it. It also has links for homeowners to find a qualified contractor if they do not already have one.

You can download the infographic from DOE's Better Buildings Residential Network at https://www.energy.gov/sites/default/files/2021-06/bbrn-health-performance-062821.pdf

DOE's Building Technologies Office has developed a resource center in the Better Buildings Solution Center, titled "Building Operations During COVID-19," to provide information to building operators about COVID-19 mitigation and the associated energy implications.

This site (https://betterbuildingssolutioncenter.energy.gov/covid19) includes fact sheets developed by the national laboratories for the hospitality, office, retail and grocery sectors. As part of this effort, DOE hosted a webinar on July 19, 2021, "Office Buildings and Ventilation: How COVID-19 and Other Pathogens Spread Between Zones," which is saved here: https://betterbuildingssolutioncenter.energy.gov/webinars/office-buildings-and-ventilation-how-covid-19-and-other-pathogens-spread-between-zones.

DOE's Weatherization and Intergovernmental Assistance Program has two studies in progress.

Multifamily Building Ventilation Study

The purpose of this pilot study is to characterize the impact that weatherization and feasible ventilation improvements have on the indoor air quality of large, centrally ventilated multifamily buildings as currently performed under the Weatherization Assistance Program (WAP) in the State of New York under their variance request (i.e., to implement ASHRAE Standard 62.2-2016 "to the greatest extent possible" in this type of multifamily building). A major goal is to determine if these practices improve or at least "do no harm to" the indoor air quality of the weatherized multifamily buildings. DOE is reviewing the initial report. Upstate New York has three remaining dwellings that require post-weatherization data collection in 2022. The final report will be submitted to DOE in June 2022.

Vermiculite Study

A field study is measuring indoor asbestos levels in homes with existing vermiculite insulation before and after blower door tests are conducted and/or insulation is installed. Worker exposures also will be measured. The study results will be used by DOE to develop additional guidance on strategies to address asbestos contamination in vermiculite insulation and how to better approach the weatherization of homes with existing vermiculite insulation, including precautions needed, and avoidance criteria.

Remaining timeline:

- Data collection (until December 2022)
- Sample analysis (by June 2023)
- Final report (by September 2023)

A research effort by DOE's Home Performance with ENERGY STAR Program continues.

Working with Wisconsin Focus on Energy (WIFOE), DOE has a healthy homes pilot study that aims to determine any noticeable effect of work carried out by WIFOE or its contractors on the indoor air quality of each home worked on—on a case-by-case or aggregated basis. WIFOE has an interest in the impact of retrofit activity on the indoor environment and the relationship between the indoor environment and asthma occurrence or relief. There are at least 50 sites, and results are expected in mid-2022. Air is collected at each home for at least one week before and one week after retrofit activity is carried out. The data collected are CO_2 concentration, $PM_{2.5}$ concentration, temperature and relative humidity.

Lawrence Berkeley National Laboratory and DOE launched the Efficient and Healthy Schools campaign, which aims to engage K–12 schools to improve energy performance and indoor air quality, with a focus on practical solutions involving HVAC and other technologies to reduce energy use and carbon emissions.

With technical support from Lawrence Berkeley National Laboratory, the campaign was developed with contributions from ED and EPA. Participants and supporters will receive our campaign newsletter on best practices and case studies. Participating schools can also engage in peer-to-peer learning, receive recognition, and contribute to the development of technical resources to HVAC solutions that improve energy performance and indoor air quality. Supporters can partner with the campaign team to promote improvements in K–12 schools and share the benefits of efficient and healthy school buildings. See https://efficienthealthyschools.lbl.gov.

Lawrence Berkeley National Laboratory gave presentations about continuing research projects.

Ventilation and Indoor Air Quality in New U.S. Homes: Preliminary Observations from a Building America Field Study

The presentation *Ventilation and Indoor Air Quality in New U.S. Homes: Preliminary Observations from a Building America Field Study* was given at the Energy & Environmental Building Alliance's High Performance Home Summit in Denver, CO, which was held September 14–16, 2021.

The presentation was about DOE's National New Home IAQ Study, which seeks to characterize IAQ and factors that impact IAQ in new homes built to current codes, including those with and without mechanical ventilation. The study addresses the following issues:

- The necessity and value of mechanical ventilation.
- Whether ventilation alone is sufficient to maintain IAQ.
- Limited data on installed performance.
- Equipment not performing to their specifications.

- Whether specifications for kitchen exhaust are adequate.

Other Presentations

LBNL also gave the following presentations in recent months:

- "Formaldehyde and Cooking Emissions in Homes"
- "Ventilation Zoning"
- "Cooking, Health and Decarbonization"
- "Where Are We Headed with Home Electrification"

Centers for Disease Control and Prevention (CDC)

National Center for Environmental Health

The Center worked with HUD's Office of Lead Hazard Control and Healthy Homes and with EPA's IED to co-brand an infographic that shows safety considerations for use of foggers and misters. All three of our agencies have received many questions about the safety of such mechanisms for dispersing pesticides and disinfectants. This coordinated approach and co-branding of a single infographic reduces duplication of efforts across agencies and simplifies messages for building managers and occupants who might be exposed to chemicals through these methods. CDC worked closely with a graphic artist to develop images that conveyed complex concepts of PPE used when applying the product via fogging or misting. The graphic was approved by all three agencies, and it is now posted on the HUD website. We are awaiting final approval to place on the CDC website.

Division of Environmental Health Science and Practice

Asthma and Community Health Branch

The branch continues to disseminate messages regarding indoor carbon monoxide poisoning and mold exposure in Louisiana and the Gulf region in the aftermath of Hurricane Ida and other recent storms. They recently posted a new fact sheet on reducing exposure to mold indoors.

Water, Food and Environmental Health Services Branch

This branch continues to promote their Building Reopening website. Several jurisdictions are reporting increases in Legionnaires' disease.

- Stagnant or standing water in a plumbing system due to building closures or decreases in occupancy can increase the risk for growth and spread of *Legionella*.
- CDC has steps to minimize risk when reopening buildings, such as flushing water systems.
- CDC reminds cooling tower operators of the importance of following best practice operation and maintenance guidance, including start-up and shutdown procedures.

New publication on racial disparities in incidence of Legionnaires' disease that cites air quality as a factor in Legionnaires' disease exposure: Hunter CM, Salandy SW, Smith JC, Edens C, Hubbard B. Racial Disparities in Incidence of Legionnaires' Disease and Social Determinants of Health: A Narrative Review. Public Health Rep. 2021.

In summary, certain housing and facility conditions may create environments conducive to *Legionella* growth. For example, an examination of *Legionella* samples in a Legionnaires' disease patient's home, workplace and hotel found that the workplace was the most likely source of exposure.

National Center for Emerging and Zoonotic Infectious Diseases (NCEZID)

Mycotic Disease Branch (MDB)

The branch recently published a paper examining hospital air sampling practices for mold. Certain molds, including *Aspergillus* species, mucormycetes and *Fusarium* species, can cause serious, invasive infections in hospitalized patients. Numerous health care–associated outbreaks have been traced to airborne mold exposures. In a survey of hospital epidemiologists, most respondents reported that their hospitals performed air sampling but that techniques and interpretations varied widely. MDB staff would be interested in hearing from federal partners with an interest and expertise in the topic.

National Institute for Occupational Safety and Health (NIOSH)

Respiratory Health Division

Field Studies Branch

The branch recently published a paper on particle and gas emissions from recycling plastic and using the material for 3D printing.

An international collaborative study of characterizing mixed exposures in school classrooms are being conducted in South Korea. Air, elevated surface dust, floor dust, and air conditioner filter dust samples have been collected from 18 classrooms in six schools out of a total of 12 schools aimed. The samples will be analyzed for bacterial and fungal DNAs, endotoxin, and ergosterol to examine classroom microbiome and the associations of the microbiomes among different types of samples within classroom. Additionally, Korean collaborators are analyzing classroom PM and the chemical composition of PM. Thus, the association between microbial community and chemical composition in PM will also be examined.

Health Effect Laboratory Division

Allergy and Clinical Immunology Branch

In August 2021, the NIOSH Report on the "Toxicity Studies of *Stachybotrys chartarum* (CAS No. *Stachybotrys*) in B6C3F1/N Mice Exposed by Inhalation" was completed and sent to the National Toxicology Program (NTP). In addition, NTP Study #C15017—"Evaluation of the Sub-chronic Toxicity of *Aspergillus versicolor*" was completed in early October, and once the data has been collected, a report will be drafted and sent to the NTP in 2022.

U.S. Department of Housing and Urban Development (HUD)

Abstracts are provided below for FY 2021 Healthy Homes Technical Study (HHTS) grant awards; the publication of findings from a HHTS grant program on the effects of mechanical ventilation on IAQ; and funding and guidance for radon testing and mitigation.

Technical Studies and Healthy Homes/Weatherization Demonstration Grant Awards

On October 13, 2021, HUD announced the award of approximately $15.7 M to 18 universities, public health, and housing organizations to conduct housing-related hazard and energy-efficiency research studies. The research grants aim to identify and improve methods for detecting and controlling lead and other housing-related health and safety hazards and will incorporate weatherization into residential lead and healthy homes interventions. Approximately $6.6 M was awarded under the HHTS Grant Program to seven institutions/research organizations (see abstracts below), approximately $4.1 M was awarded under the Lead Technical Studies Grant Program to six institutions/research organizations, and $5 M was awarded under the Healthy Homes and Weatherization Cooperation Demonstration Grant Program to public health and housing organizations/agencies (see abstracts below).

HHTS Grant Program Awards

The University of Tulsa: This study proposes to further develop the mold classification tool (MCT)—which is a DNA-based, machine learning approach for classifying the dampness/mold (D/M) status of a building based on the fungal ecology of settled dust samples—into a broadly applicable tool for home mold inspection and assessment of remediation effectiveness. The study has two objectives: (1) determine if the MCT accurately tracks the return of a home's fungal ecology from water-damaged/moldy (D/M) to normal after thorough, standardized D/M remediation has been conducted and explore associations between MCT scores with quantitative metrics of observable D/M previously correlated with health; and (2) collect pilot data for planning a future study linking successful mold remediation (assessed by MCT) and improved health among asthmatic children. The proposed study will be a longitudinal environmental intervention study of thorough D/M remediation in 50 homes with moderate to severe D/M and incorporates a 20-home control group without D/M.

Principal Investigator: Richard Shaughnessy, Ph.D., richard-shaughnessy@utulsa.edu
HUD Contact: J. Kofi Berko, Jr., j.kofi.berko@hud.gov

Berkeley Air Monitoring Group, Inc.: Researchers will assess the impact of the California Public Utilities Commission's program to replace gas and biomass-fueled appliances with electric appliances in the homes of 75 low-income households in California's San Joaquin Valley compared to 75 homes that do not receive the replacement appliances. The impact on indoor air quality will be assessed by comparing average daily indoor concentrations of $PM_{2.5}$, NO_2, CO, CO_2 and black carbon in the study homes. Researchers also will characterize and quantify impacts of key covariates on indoor pollutant concentrations, such as use of venting hoods, air exchange rates and outdoor air pollution. Another study goal is to evaluate the impact of a smart, low-cost air filtration unit on average indoor concentrations of $PM_{2.5}$, especially during wildfire smoke events.

Principal Investigator: Michael Johnson, Ph.D., mjohnson@berkeleyair.com
HUD Contact: Rhona P. Julien, rhona.p.julien@hud.gov

Duke University: This project will evaluate new approaches to quantify and reduce chemical exposures from common building materials, with an emphasis on plastic additives, pesticides, flame retardants and lead. The objective of this project is to develop methods to quantify and reduce chemical exposures from the home environment using approaches that are adaptable and customizable to individuals and households. The study will use a three-tier approach to achieve this goal: (1) advance a new wearable passive sampling device to enable quantification of personal exposures to both metals and organic compounds, (2) identify the types of building materials and housing characteristics associated with higher levels of exposure to different classes of contaminants, and (3) assess the effectiveness of a simple robotic vacuuming intervention for reducing exposure to a range of indoor contaminants that pose health risks.

Principal Investigator: Heileen Hsu-Kim, Ph.D., hsukim@duke.edu
HUD Contact: Rhona P. Julien, rhona.p.julien@hud.gov

National Center for Healthy Housing: The proposed study will test the premise that Passive House multifamily design in affordable housing offers two elements that should result in lower $PM_{2.5}$ levels in these homes compared to those in conventionally built multifamily homes: (1) a very tight building envelope that will reduce infiltration of outdoor $PM_{2.5}$ and (2) the use of a continuously running balanced energy recovery ventilator (ERV) with a high-efficiency filter to reduce indoor- and outdoor-generated $PM_{2.5}$. The primary design will be a two-group comparison study. The first group will be recently constructed multifamily affordable housing built to Passive House standards. These buildings will have a tight building envelope and a balanced ERV that provides adequate air exchange for residents. In addition, the ERV will be fitted with a MERV 13 or higher filter on the supply side of the ventilation system to remove PM in the fresh air entering the dwelling. The second group will be recently constructed multifamily affordable housing that is built to conventional energy-efficiency standards (the International Energy Conservation Code as adopted by Massachusetts). These buildings will have exhaust-only ventilation system using bath fans to provide whole-house ventilation, a common ventilation system for this building design. This second group will serve as controls for the study. The study will compare the levels of $PM_{2.5}$, CO_2, relative humidity and indoor temperature between the two groups.

Principal Investigator: David E. Jacobs, Ph.D., djacobs@nchh.org
HUD Contact: Rhona P. Julien, rhona.p.julien@hud.gov

Three3 Inc.: The study's primary objective is to address the gap between what is known about how weatherization and healthy homes interventions impact indoor environment quality (IEQ) and observed variations in asthma outcomes due targeted interventions. A second objective is to conduct an experiment to determine whether easily installable air purifiers and box fans with MERV 13 filters can appreciably improve indoor air quality in both weatherized and unweatherized low-income homes, and whether these changes impact asthma outcomes. The project will draw from a sample of individuals with active asthma already identified through an evaluation of the Tennessee Valley Authority's income-

eligible weatherization program, Home Uplift. During its initial phase, 60 households will be recruited across Tennessee's major metro areas (Knoxville, Chattanooga, Nashville and Memphis); half of the homes will be recipients of Home Uplift weatherization, and half will be unweatherized.

Principal Investigator: Bruce Tonn, Ph.D., btonn@threecubed.org
HUD Contact: Rhona P. Julien, rhona.p.julien@hud.gov

The University of Iowa: This study will develop primary prevention-based assessment tools and implementation practices to assess water as a potential contributor of lead exposure. The study objectives are to (1) build a Flint-specific assessment tool, such as a water lead risk score, to identify Flint homes that had a high risk of lead-in-water contamination; (2) adapt and generalize the water lead risk assessment tool to be more widely applicable to other communities; and (3) partner with public health agencies and Office of Lead Hazard Control and Healthy Homes grantees to further validate and promote using the water lead assessment tool to identify high-risk homes and residents, connect them to lead mitigation and public health promotion resources, and provide guidance on possible water-based intervention strategies. The first part of the study will center on Flint data and its public health application, and the second two phases will focus on Iowa data and generalizing the tool for identifying homes at high risk for lead in water contamination beyond Flint.

Principal Investigator: David Cwiertny, Ph.D., david-cwiertny@uiowa.edu
HUD Contact: Eugene A. Pinzer, eugene.a.pinzer@hud.gov

President and Fellows of Harvard College: The goal of the proposed project is to better understand how sensors and educational models can be used to promote personal mitigation by conducting a three-armed randomized control trial (RCT) in the community of Dorchester in Boston, MA. The study proposes to use an innovative combination of real-time, in-home monitors and exposure assessment methods to estimate indoor exposures to multiple chemical stressors. The assessments will be conducted across different levels of participant interaction and coupled with passive and active educational models. Using a three-armed study design, and working with their partner organization, Silent Spring Institute, they will address the following three objectives: (1) assess whether air pollutant monitors with real-time feedback alter behaviors to improve indoor air quality; (2) assess whether active education along with real-time feedback alters behaviors to further improve indoor air quality; and (3) assess whether active education, including use of a smartphone app, alters behaviors related to endocrine disrupting compounds.

Principal Investigator: Gary Adamkiewicz, Ph.D., gadamkie@hsph.harvard.edu
HUD Contact: Brenda M. Reyes, Brenda.m.reyes@hud.gov

Healthy Homes and Weatherization Cooperation Demonstration Grants

Baltimore City Department of Housing and Community Development: The Baltimore City Department of Housing and Community Development (DCHD) will partner with the Baltimore City Health Department, Maryland DHCD, Amerigroup, Green & Healthy Homes Initiative (GHHI), Civic Works and the Baltimore City HUBS Collaborative to complete whole-house interventions for low-income families and seniors in Baltimore City. DHCD and its program partners will implement a dynamic program model

for the integration of comprehensive lead hazard reduction, healthy housing interventions and weatherization strategies to create lead-safe, healthy and energy-efficient homes for low-income families in Baltimore's most at-risk communities. This will be done through increased coordination, evidence-based best practices, and improved health data tracking of client outcomes for 115 privately owned, low-income properties. The program will implement a comprehensive and strategically planned approach to demonstrate how lead hazard reduction, healthy homes, weatherization and housing rehabilitation can be coordinated to reduce Lead Hazard Reduction (LHR) program and WAP deferral rates; improve health outcomes for lead poisoning, asthma and household injury; and increase family financial and housing stability by increasing the stock of healthy, energy-efficient and affordable lead-safe housing.

Program Director: Jim Hicks, jimhicks12@gmail.com
HUD Contact: Rhona P. Julien, rhona.p.julien@hud.gov

Green & Healthy Homes Initiative, Inc.: The Green & Healthy Homes Initiative will partner with the City of Memphis Division of Housing and Community Development and Methodist Le Bonheur Community Outreach (MLCO) to implement the Memphis Healthy Homes and Weatherization Cooperation Demonstration Program (HHWCD) to (1) demonstrate that systematic coordination between the city's HUD-funded Lead-Free Memphis Program and the DOE-funded WAP is operationally feasible and (2) put in place protocols, processes and resources to systematize this coordination in the future and measure the incremental benefit and impact of more effectively coordinate service delivery. The program will build capacity in the healthy homes and energy-efficiency sectors by cross-training and cross-certifying home assessors to provide comprehensive lead inspections, energy audits and healthy homes assessments. It also will use cross-trained contractors to complete comprehensive intervention in 60 units.

Program Director: Catherine Klinger, cklinger@ghhi.org
HUD Contact: Rhona P. Julien, rhona.p.julien@hud.gov

Piedmont Triad Regional Council: The Piedmont Triad Regional Council (PTRC) will partner with City of Greensboro's Lead-Safe Housing Program, The University of North Carolina at Greensboro (UNCG) Center for Housing & Community Studies (CHCS), North Carolina Agricultural and Technical State University (NC A&T) Center for Energy Research and Technology, North Carolina Justice Center and the North Carolina State Energy Program to implement a collaborative program to address low-income housing issues related to lead-based paint, healthy homes, and energy efficiency and weatherization. They plan to implement joint applications, inspections/assessments and intervention measures that will reduce the burden on applicants to navigate multiple agencies for these services. PTRC also will utilize the NOFO barrier reduction focus with North Carolina Housing Finance Agency Rehab funding and HOME funding in most of their eight covered counties to supplement limited programs like Weatherization and increase the impact of the programs.

Program Director: Michael Blair, michaelblairaicp@gmail.com
HUD Contact: Brenda M. Reyes, brenda.m.reyes@hud.gov

Community Relations-Social Development Commission: Community Relations–Social Development Commission will partner with the City of Milwaukee Department of Health and the Wisconsin Department of Health Services to demonstrate effective strategies for coordination between the Lead Hazard Control and Healthy Homes program and the Weatherization program to maximize program efficiencies to benefit occupants, reduce WAP deferrals, demonstrate sustainable models of inter-program cooperation (including data sharing, reporting and targeting/recruiting clients), demonstrate effective models for the sustainable financing of coordinated healthy homes/weatherization interventions, and support the collection of data to evaluate the housing interventions conducted through inter-program coordination and remediation of 40 homes of vulnerable residents in Milwaukee, Wisconsin. The project will use the One-Touch software and support from GHHI to develop the project design and a database to manage a network of referrals among health and housing agencies.

Program Director: Ronald Klafka, rklafka@wi.rrr.com
HUD Contact: Brenda M. Reyes, brenda.m.reyes@hud.gov

Wayne Metropolitan Community Action Agency: Wayne Metro will partner with the Detroit Housing and Revitalization Department and use a rapid cycle impact project approach to accurately evaluate how changing process variables impact efficiency, indoor environmental quality and safety for 150 low-income homes. They plan to demonstrate effective strategies for coordination between lead hazard reduction and WAP; reduce WAP deferrals through coordination with LHR; and demonstrate sustainable models of inter-program cooperation, including data sharing, reporting and targeting/recruiting clients. The program includes an efficient process for conducting a shared home assessment and seamlessly connecting LHR participants to WAP, demonstrate sustainable models of financing coordination, coalesce support for sustaining financial support for inter-program coordination, and support the collection of data to evaluate the housing interventions conducted through inter-program coordination.

Program Director: Karen MacDonald
HUD Contact: Brenda M. Reyes, brenda.m.reyes@hud.gov

HUD Healthy Homes Technical Study Publication

Researchers at the Illinois Institute of Technology recently published (initial online edition) a paper in the journal *Science of the Total Environment* on the findings of a study funded through a HUD cooperative agreement. The researchers conducted a two-year longitudinal study designed to assess IAQ and adult asthma outcomes in 40 Chicago homes before and after installation of mechanical ventilation. The installed mechanical ventilation consisted of one of the following systems: (1) continuous exhaust only, (2) intermittent powered central fan integrated supply, or (3) continuous balanced system with an ERV. All systems resulted in reductions in the concentrations of the indoor pollutants (assessed using indoor/outdoor concentration ratios), including CO_2, NO_2 and three size fractions of PM, with greatest reductions seen for the continuous balanced system. See https://doi.org/10.1080/15459624.2020.1844892.

HUD Contact: Gene Pinzer, eugene.a.pinzer@hud.gov

Radon Funding and Guidance

The Office of Lead Hazard Control and Healthy Homes will be administering $4 M in demonstration grants to public housing agencies to test for and mitigate elevated radon levels (i.e., levels at or above the EPA action level of 4 pCi/L.) The NOFO is now in clearance and is expected to be released during the first quarter of FY 2022. The Office also is developing guidance materials on radon to include summaries of national consensus standards, infographics, videos and webinars. The Office also has strengthened the radon testing requirements for recipients of FY 2021 Lead Hazard Reduction and Healthy Homes Production Program grants (requiring testing and mitigation when elevated levels are detected).

HUD Contact: Kofi Berko, Ph.D., j.kofi.berko@hud.gov

National Institute of Standards and Technology (NIST)

NIST Net-Zero House

The NIST Net-Zero Energy Research Test Facility (NZERTF) is a two-story, four-bedroom house incorporating energy-efficient construction, space conditioning systems and appliances, as well as solar water heating and solar photovoltaics to meet the house's energy needs. For general information on the house, view the following video: http://www.youtube.com/watch?v=xSzu83fyQaQ. All publications can be found at the NIST NZERTF webpage: http://www.nist.gov/el/nzertf. A tracer gas system that measures both SF_6 and CO_2 has been installed in the home to obtain continuous air change rate measurements and to investigate the performance of CO_2 demand control ventilation and other control approaches. An ozone monitor has been installed to record ozone in each level of the home. A CO_2 heat pump water heater has been installed, and a CO_2 geothermal heat pump will be installed next year.

Contact: Lisa Ng, lisa.ng@nist.gov

In the spring of 2022, the NZERTF and NIST will host the Chemical Assessment of Surface and Air (CASA) research campaign. This follow-up on the HOMEChem research effort is led by Professor Delphine Farmer (Colorado State University) and Professor Marina Vance (University of Colorado). A team of up to 10 external research groups will use environmental and chemical perturbations in the NZERTF to investigate the chemistry of indoor environments. Chemical transformation induced by ozone, smoke and chemical additions will be investigated.

Contact: Dustin Poppendieck, dustin.poppendieck@nist.gov

Fate and Transport of Indoor Microbiological Aerosols (FaTIMA)

In response to the COVID-19 pandemic, NIST developed an online tool to enable users to consider the effects of several factors on transmission of and exposure to airborne, virus-containing aerosols. These factors include aerosol size, emission rates and variations in these rates, deposition rates (for walls, floors, ceilings and other surfaces), pathogen inactivation rate, ventilation and filtration. The tool implements a web-based version of the CONTAM simulation engine to simulate a single, well-mixed zone for a 24-hour period. Inputs enable the definition of a source—for example, infected individual(s)—to emit aerosols both continuously (breathing) and intermittently (coughing or sneezing). Room dimensions and ventilation system characteristics also are defined, including total supply, return and fraction of outdoor air flow rate. System filters and local exhaust and in-room air cleaners also can be included. An occupant is simulated in the room either continuously or intermittently over a user-defined occupancy period during the 24-hour simulation—for example, to simulate a caregiver intermittently checking on the infected occupant. The tool will calculate the airborne concentration, occupant exposure and surface loading over the 24-hour period and provide results both numerically and graphically. Transient charts show the time histories and integrated values for concentration and occupant exposure for the 24-hour period and the user-defined occupancy period. Summary charts provide relative percentages of aerosol fate (exited zone, filtered, deposited, deactivated and remain airborne), sources (continuous, intermittent and outdoors), deposition

(floor, walls, ceiling and other), and filtration (outdoor, recirculation, air cleaner and envelope penetration). A news release and links to the tool and associated documentation are provided below.

New release: https://www.nist.gov/news-events/news/2020/06/nist-airflow-model-could-help-reduce-indoor-exposure-aerosols-carrying

Link to tool: https://www.nist.gov/services-resources/software/fatima

Link to documentation: https://nvlpubs.nist.gov/nistpubs/TechnicalNotes/NIST.TN.2095.pdf

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Single-Zone Simulations Using FaTIMA for Reducing Aerosol Exposure in Educational Spaces

FaTIMA was applied to a classroom, portable classroom and assembly room. NIST evaluated the relative effectiveness of various measures to reduce exposure to infectious aerosols, including masks, increasing ventilation, increasing filtration, using portable air cleaners and using exhaust fans. Multiple controls can be implemented in spaces and HVAC systems to reduce exposure as part of a broader risk reduction strategy that might be pursued by a building owner or manager. As noted by ASHRAE, engineering and other controls should be part of a larger, layered risk reduction strategy that includes hand washing, surface cleaning, social distancing and reduced occupant density. The report can be downloaded here: https://doi.org/10.6028/NIST.TN.2150.

Contact: Lisa Ng, lisa.ng@nist.gov

Introduction to CONTAM Video Tutorials

A set of 6 tutorials has been released and provided on the NISTube video gallery. Videos can be viewed by visiting https://www.nist.gov/video-gallery and searching on the "CONTAM" keyword or accessed via the NIST Multizone Modeling website:
https://www.nist.gov/el/energy-and-environment-division-73200/nist-multizone-modeling

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Coupled IAQ and Energy Analysis in Multifamily Buildings

In August, NIST participated in the International Building Physics Conference (IBPC) 2021. A presentation will be made related to the development and application of coupled IAQ and energy modeling. The presentation, titled *On the Benefits of Whole-Building IAQ, Ventilation, Infiltration, and Energy Analysis Using Co-Simulation Between CONTAM and EnergyPlus*, is available on the NIST website at https://www.nist.gov/publications/benefits-whole-building-iaq-ventilation-infiltration-and-energy-analysis-using-co. This presentation is based on the work being performed by NIST and Boston University to model IAQ and energy in residential buildings.

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CLEAN Summit 2020 Article

This conference was a three-day event held in the summer of 2020 highlighting the interdisciplinary challenges of the COVID-19 pandemic, including challenges and pain points felt by industries working to reopen their doors to customers, lessons-learned managing risk, and tools and strategies for confident operations. The research, knowledge and standards development activities across environmental microbiology, building science and engineering, transmission, and social sciences also were discussed. A summary of the Summit can be found in a journal article, "Critical Capability Needs for Reduction of Transmission of SARS-CoV-2 Indoors," in *Frontiers in Bioengineering and Biotechnology* at https://www.frontiersin.org/articles/10.3389/fbioe.2021.641599/full.

ASHRAE Standard 62.2

The committee responsible for Standard 62.2 on residential ventilation and IAQ met by webinar in May and June to continue working on proposed changes that may be included in the 2022 version of the standard. Topics being addressed include changes to poor ambient air quality, kitchen hood capture efficiency and unvented combustion appliances. The committee will meet again in January 2022.

Contact: Steven Emmerich, steven.emmerich@nist.gov

ASHRAE Standard 189.1

The 2020 version of ASHRAE/ICC/IESUSGBC SSPC 189.1, *Standard for High-Performance Green Buildings Except Low-Rise Residential Buildings*, has been published. The standard will constitute the technical content of the *2021 International Green Construction Code*. In the area of indoor environmental quality, revisions that have been incorporated into the 2020 standard (and therefore the 2021 IgCC) include an update on the requirements for soil gas control and occupant access to views of the outdoors, as well as other changes. The 2020 standard also includes so-called "jurisdictional options" (JOs), which allow adopting jurisdictions to delete selected requirements of the standard if they so choose; the goal of these JOs is to increase adoption of the IgCC.

The committee holds monthly web meetings, which are open to all interested parties. More information on the 189.1 committee activities can be found on the ASHRAE website, where you can sign up for notifications of public reviews and other information at https://www.ashrae.org/resources--publications/free-resources/listserves.

Contact: Andrew Persily, andyp@nist.gov

ASHRAE Guideline 44P

The ASHRAE committee developing a guideline titled *Protecting Building Occupants from Smoke During Wildfire and Prescribed Burn Events* has been meeting by webinar monthly, with a goal of publishing the guideline in the summer of 2022. The committee was asked to develop an interim framework to address urgent needs as building owners and managers prepare for the 2021 wildfire season. This document, titled

Planning Framework for Protecting Commercial Building Occupants from Smoke During Wildfire Events, is now available online from ASHRAE at https://tinyurl.com/yxyuqh72.

Contact: Steven Emmerich, steven.emmerich@nist.gov

ASHRAE Guideline 45P

The ASHRAE committee developing a guideline titled *Measurement of Whole Building Performance for Occupied Buildings Except Low-Rise Residential Buildings* has been meeting by webinar every three weeks. The committee is formatting the ASHRAE *2010 Performance Measurement Protocols for Commercial Buildings* into a guideline.

Contact: Lisa Ng, lisa.ng@nist.gov

ASHRAE Position Documents

ASHRAE initiated a new *Position Document on Indoor Carbon Dioxide*, which is being drafted and is expected to be approved in early 2022. ASHRAE has also initiated efforts to revise its Position Documents on *Infectious Aerosols* and on *Limiting Indoor Mold and Dampness in Buildings*.

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CO_2 Monitoring Outreach

The use of CO_2 monitoring in schools has increased in efforts to identify poorly ventilated classrooms across the country. The same also is true for many other occupied spaces. NIST has summarized the challenges and usefulness of this approach in two outreach webinars. On October 7, Dustin Poppendieck presented a webinar to the Collaborative on Health and the Environment (https://www.healthandenvironment.org/webinars/96581) on the uncertainty associated with using CO_2 for classroom ventilation evaluation. On October 29, Andrew Persily will give a talk on using CO_2 monitoring to manage ventilation in buildings as part of the International Society of Indoor Air Quality and Climate (ISIAQ) webinar series on managing buildings in the context of airborne disease transmission (https://mms.isiaq.org//Calendar/moreinfo.php?eventid=65631). An extended webinar on the same topic is being sponsored by EPA in mid-November (date to be announced by EPA).

ASHRAE Green Guide Version VI

The sixth revision of the ASHRAE Green Guide is underway. Version VI will target more experienced building professionals, whereas the previous versions contained more introductory content. NIST is taking the lead editorial roles on the IEQ and Water Efficiency chapters.

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ASTM: D22.05 Subcommittee on Indoor Air

The subcommittee has several new guides and methods that are now official ASTM documents.

- **D8345 Standard Test Method for Determination of an Emission Parameter for Phthalate Esters and Other Non-Phthalate Plasticizers from Planar Polyvinyl Chloride Indoor Materials for Use in Mass Transfer Modeling Calculations.** This is the first ASTM test method to determine mass transfer parameters for semi-volatile organic compound emissions from building materials.

- **D8407 Standard Guide for Measurement Techniques for Formaldehyde in Air.** The new guide highlights the sampling rate, detection limits, advantages and limitations of each technique. This allows the user to select or learn about the most appropriate technique for their application. The new standard will help manufacturers and laboratories to pick the most appropriate technique for their application.

- **D8405 Standard Test Method for Evaluating $PM_{2.5}$ Sensors or Sensor Systems Used in Indoor Air Applications.** The method provides a mechanism for evaluating the performance of $PM_{2.5}$ sensors or sensor systems for indoor applications through laboratory-based testing. The standard is intended to provide researchers and other users a consensus standard that will allow for a standardized approach for evaluating consumer grade $PM_{2.5}$ sensors.

Other existing standards are continually undergoing review and revision on a 5-year rotation.

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The Subcommittee on Indoor Air is also in the process of revising D6245 Standard Guide for Using Indoor Carbon Dioxide Concentrations to Evaluate Indoor Air Quality and Ventilation.

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