



# ASHRAE VIRTUAL ANNUAL CONFERENCE

▶▶▶▶ June 28-30, 2021

## 2021 ASHRAE Virtual Annual Conference

June 28th - June 30th, 2021

### Monday, June 28

Monday, June 28, 12:30 PM - 1:30 PM

#### Seminar

### Fundamentals of Climate Change

*Track: Fundamentals and Applications*

**Sponsor: 2.5 Global Climate Change, 4.2 Climatic Information, 2.10**

*Chair: Elizabeth Tomlinson, P.E., Member, TKDA, St. Paul, MN*

As climate change impacts our built environment today, ASHRAE members seek to improve the design of tomorrow's buildings. This June, ASHRAE is publishing the new Fundamentals chapter, Climate Change. Along with climate science and mitigation, the chapter introduces climate adaptation. Planning for tomorrow's climate is a hot topic for public and private owners, consultants and citizens. This session provides an industry update on building design and climate risk management. Presenters include leaders from ASHRAE's 2021 Fundamentals Handbook chapter Climate Change, US Army and International Code Council.

**1. Notice: New 2021 Fundamentals Handbook Climate Change Chapter**

*Elizabeth Tomlinson, P.E., Member, TKDA, St. Paul, MN*

**2. US Army Installation Climate Resilience**

*Steve Dornbos, Ph.D., American Association for the Advancement of Science, Milwaukee, WI*

**3. Adapting Codes and Standards to Address Changing Climate Risk**

*Ryan Colker, J.D., International Code Council, Washington, DC*

Monday, June 28, 2:00 PM - 3:30 PM

#### Seminar

### Cleanroom Fan Energy Savings Through Variable Airflow

*Track: Design, Control, and Operation of Critical Environments*

**Sponsor: 9.11 Clean Spaces, MTG.ACR**

*Chair: Vincent Sakraida, P.E., Associate Member, Skanska, Evansville, IN*

This seminar presents the needed design steps for a cleanroom with variable airflow, cleanroom airflow and particulate CFD modeling that illustrates the impact cleanroom variable airflow has on airflow patterns and particulate generation. Speakers present the latest updates on the NEBB Cleanroom Performance Testing standard for testing variable airflow cleanrooms.

**1. Real-Time Particle Concentration Sensing to Automatically Control Airflow Rate for Cleanrooms/Labs to Drastically Reduce Fan Energy Consumption**

*Wei Sun, P.E., Fellow ASHRAE, Engsysco Inc., Ann Arbor, MI*

**2. CFD Analysis of ACH on Particle Removal Efficiency for Cleanrooms**

*Kishor Khankari, Ph.D., Fellow ASHRAE, AnSight LLC, Ann Arbor, MI*

**3. Required Steps for Testing and Balancing a Variable Airflow Cleanroom**

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*Vincent Sakraida, P.E., Associate Member, Skanska, Evansville, IN*

2:00 PM - 3:30 PM

**Seminar**

**Solving BACnet/SC Management Challenges with Managed BACnet**

*Track: HVAC&R Systems and Equipment*

**Sponsor: 1.4 Control Theory and Application, 7.5 Smart Building Systems, MTG.CYB**

*Chair: Carol Lomonaco, Member, Johnson Controls, Milwaukee, WI*

BACnet has grown since its inception, to become the standard for control systems. As devices using the recently released BACnet/SC (Secure Connect) make their way to enterprise networks, challenges arise for BAS and IT. Challenges to interoperably and securely managing their fleet of devices. This seminar provides critical information on plans in the BACnet ecosystem to secure the entire BACnet stack. The seminar discusses stakeholders that will be involved in these systems and explains the components of a new initiative called Managed BACnet designed to provide an IT-centric holistic cybersecurity framework for building automation and control systems.

**1.Evolution of Cybersecurity in BACnet from Inception to Mass Deployment**

*James Lee, Cimetrics, Inc., Boston, MA*

**2.The Landscape of Stakeholders in Fully Managed and Secure Control Systems**

*Anto Budiardjo, Cimetrics, Inc., Asheville, NC*

**3.Components of a Managed BACnet System You Need to Care about**

*Ken Gilbert, Automated Logic, Kennesaw, GA*

2:00 PM - 3:30 PM

**Seminar**

**Research Programs and Funding Opportunities Part 1: U.S. Department of Energy (DOE) Building America and Advanced Research Projects Agency-Energy (ARPA-E)**

*Track: Research Summit*

**Sponsor: CRC**

*Chair: Kristen Cetin, Ph.D., P.E., Member, Michigan State University, Okemos, MI*

The National Director of the U.S. Department of Energy (DOE) Building America program and Program Director at the Advanced Research Projects Agency-Energy (ARPA-E) provide an overview of current programs, including funding priorities and opportunities. Relevant core programs are also highlighted. Following the presentation, there will be a live Q&A. This session is geared towards researchers, young faculty and senior graduate students pursuing academic careers at U.S. institutions, but the information provided is valuable to principal investigators in any stage of their career. This is Part 1 of a 2 part series.

**1.Arpa-E Investments in Building Energy Efficiency**

*Marina Sofos, Ph.D., Advanced Research Projects Agency-Energy, Washington, DC*

**2.U.S. Department of Energy Building America Program Overview**

*Eric Werling, Member, U.S. Department of Energy, Washington, DC*

Monday, June 28, 4:00 PM - 5:00 PM

**Panel**

**Walking the Talk: Achieving Verified Net Zero Goals and Why It Matters**

*Track: Future Proofing - Renewable, Regenerative, and Resilient*

*Chair: Selina Holmes, U.S. Green Building Council, Washington, DC*

In 2020, a year when public health and safety was paramount, net zero goals also rose to the forefront as many prioritized climate action in their COVID-19 recovery strategies. In the first nine months of 2020, the number of net zero emissions commitments roughly doubled totaling 823 cities, 101 regions and 1,541 companies. This panel discussion focuses on buildings as the top contributor to global CO2 emissions and USGBC's LEED Zero program. Panelists discuss the impact and cost of strategies implemented by building projects to achieve LEED Zero certification in water, energy, carbon and waste.

**1.Walking the Talk: Achieving Verified Net Zero Goals and Why It Matters Panelist 1**

*Emma Hughes, U.S. Green Building Council, Washington, DC*

**2.Walking the Talk: Achieving Verified Net Zero Goals and Why It Matters Panelist 2**

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*Guido Petinelli, Petinelli Inc., Curitiba, Brazil*

**3.Walking the Talk: Achieving Verified Net Zero Goals and Why It Matters Panelist 3**

*Chris Ladner, Entegritty, Little Rock, AR*

4:00 PM - 5:00 PM

**Panel**

**Maintaining Control during a Pandemic: Lessons Learned from Adapting Building Automation Systems to Meet Changing Recommendations**

*Track: Fundamentals and Applications*

**Sponsor: 1.4 Control Theory and Application**

*Chair: Elise Backstrom, Associate Member, Exyte U.S, Inc., Phoenix, AZ*

Panelists speak to experience on changing control strategies and adapting building automation systems for the COVID pandemic, as well as discuss key take aways and lessons learned potentially applicable for future situations.

**1.Panelist 1**

*Christopher Benson, P.E., Member, The University of Utah, Salt Lake City, UT*

**2.Panelist 2**

*JoeDon Breda, P.E., Ohio State University Medical Center, Columbus, OH*

**3.Panelist 3**

*Anthony Bermudez, Russell Sigler, Inc., Riverside, CA*

4:00 PM - 5:00 PM

**Forum**

**Post Pandemic Resiliency Measures for Transportation Facilities**

*Track: Future Proofing - Renewable, Regenerative, and Resilient*

**Sponsor: 5.9 Enclosed Vehicular Facilities**

*Chair: Jesse Harder, P.E., Member, HNTB Corporation, Oakland, CA*

With the emergence of COVID-19, transportation agencies must provide safe and healthy transit mobility. Appropriate safety measures, procedures and protocols, if implemented, can promote safe public transit and increase the resiliency of systems. The probability of contagion spread in an enclosed space can be determined with numerical modeling tools and testing. Effective measures aim to achieve a sustained reduction of the viral load in the air we breathe. This forum explores mechanical ventilation and air sanitization measures which are principal systems to support safe enclosed environments; in the transit industry this is especially applicable to enclosed vehicles, stations and facilities.

4:00 PM - 5:00 PM

**Forum**

**Is there a Magic Formula for Combining Multiple Air Cleaning Technologies to Improve Air Quality?**

*Track: HVAC&R Systems and Equipment*

**Sponsor: 2.3 Gaseous Air Contaminants and Gas Contaminant Removal Equipment, 2.9 Ultraviolet Air and Surface Treatment**

*Chair: Ashish Mathur, Ph.D., UVDI, Valencia, CA*

There are multiple air cleaning technologies being used in the industry to improve IAQ in various combinations. These include particle filtration, activated carbon, photo-catalytic oxidation, UVGI and ionizers. With so many technologies to choose from and a lack of published literature or industry guidance, it becomes confusing for the design engineer to specify an appropriate technology combination. This workshop reviews how multiple air cleaning technologies are combined today and discusses the unanswered questions. The workshop also elicits industry feedback to determine what research/test methods/guidelines need to be developed to evaluate the combination of these technologies.

Monday, June 28, 7:00 PM - 8:30 PM

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## Seminar

### Impact of IoT on Building Controls

*Track: HVAC&R Systems and Equipment*

**Sponsor: 7.5 Smart Building Systems, 1.4 Control Theory and Application, MTG.CYB**

*Chair: Carol Lomonaco, Member, Johnson Controls, Milwaukee, WI*

Commercial buildings have for some time been controlled by building management systems that monitor and control equipment. Newer to that market are enabled pieces of equipment with embedded factory installed IoT controls that can intelligently control themselves throughout their operation with minimal input from a supervisory controller or building management workstation software. With this comes the inclusion of intelligent sensors for temperature, humidity, etc. which facilitates this new technology and has created an opportunity for some buildings to operate even more efficiently. This IoT technology has opened buildings up to potential risks in security that need to be recognized.

**1. Cybersecurity for the Connected Commercial Building**

*Patrick Villaume, Member, Patterson Kelley, East Stroudsburg, PA*

**2. Cultural Changes Are Needed for IoT Cybersecurity in Commercial Buildings**

*Fred Gordy, Member, Intelligent Buildings, LLC, Villa Rica, GA*

7:00 PM - 8:30 PM

## Seminar

### Plant and Animal Environments: What Makes Them So Unique?

*Track: HVAC&R for Indoor Plants & Animals*

**Sponsor: 2.2 Plant and Animal Environment, MTG-CEA**

*Chair: Nadia Sabeh, Ph.D., P.E., Member, Dr. Greenhouse Inc., Sacramento, CA*

They are not human environments. Metabolic heat rates are different. Ventilation rates are different and so are the temperature and humidity targets. This seminar covers the unique considerations for designing and operating an HVAC system for a vertical farm, primary enclosure or animal shelter.

**1. Why We Carrot All: Berry Important Conditions for Growing Plants Indoors**

*Nadia Sabeh, Ph.D., P.E., Member, Dr. Greenhouse Inc., Sacramento, CA*

**2. Moooving Air and Making Cows (and other farm animals) Comfortable**

*Morgan Hayes, Ph.D., Affiliate, University of Kentucky, Lexington, KY*

**3. Meow What? Addressing Unique Design Conditions for Companion Animal Spaces**

*Niss Feiner, CHD, Member, Delta-T Designs, Oro-Medonte, ON, Canada*

**4. Ten Cardinal Parameters of Plant Health and Vitality**

*Jesse Porter, Member, InSpire Transpiration Solutions, San Francisco, CA*

**5.10 Cardinal Parameters of Plant Health and Vitality**

*Robbie Batts, Affiliate, InSpire Transpiration Solutions, San Francisco, CA*

**Tuesday, June 29**

Tuesday, June 29, 7:00 AM - 8:30 AM

## Seminar

### COVID-19 Particle Removal by Air Filter Devices

*Track: Fundamentals and Applications*

**Sponsor: 2.4 Particulate Air Contaminants and Particulate Contaminant Removal Equipment**

*Chair: Kyung-Ju Choi, Ph.D., Member, Clean & Science, Louisville, KY*

The COVID-19 virus attaches to mucus protein molecules in water droplets or to small particles that are larger than the virus itself. This seminar provides the basic principles of filtration to prevent COVID-19 spread and to describes the effectiveness of face coverings.

**1.A Study of Viral Filtration Performance of Residential HVAC Filters**

*John Zhang, Ph.D., Member, 3M, St. Paul, MN*

**2. Measuring the Performance of Community Face Coverings in Europe and Beyond**

*Paolo Tronville, Ph.D., Fellow ASHRAE, Politecnico di Torino, Torino, Italy*

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### **3.Laboratory Test Data Comparison on Commonly Used Face Coverings**

*Robert Singer, Member, Blue Heaven Tech, Louisville, KY*

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#### **Seminar**

### **Energy Management Best Practices, Case Studies and Lessons Learned from Real-world Data Center Operation**

*Track: Design, Control, and Operation of Critical Environments*

**Sponsor: 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment, 7.6 Building Energy Performance, TC 7.3, TC7.5**

*Chair: Eric Yang, P.E., Member, Energy System Group, Washington, DC*

This session includes energy management best practices, case studies and lessons learned from real-world data center operation. Presentations address how controls systems, smart building technologies and data analytics are helping data centers operate more efficiently and reliably via real world examples and case studies. Common pitfalls in the data center operation are also discussed.

#### **1.Harnessing the Power of Data Analytics for Reliable and Efficient Data Center Operations at LBNL's High-Performance Computing (HPC) Center**

*Jingjing Liu, P.E., BEAP, Lawrence Berkeley National Laboratory, Berkeley, CA*

#### **2.Is Your Legacy Data Center Ready to Improve Energy Efficiency through the Use of Data Analytics, AI/ML and Intelligent Controls Optimization?**

*John Dumler, P.E., Member, Digital Realty, Atlanta, GA*

#### **3.Classic Pitfalls to Avoid in Data Center Operation**

*Mark Seymour, P.E., Member, Future Facilities, London, United Kingdom*

Tuesday, June 29, 12:00 PM - 2:00 PM

#### **Seminar**

### **Grid-Interactive Buildings: Impacts on Energy Use and Comfort**

*Track: Research Summit*

**Sponsor: 7.5 Smart Building Systems, 1.4 Control Theory and Application, 7.6 Building Energy Performance**

*Chair: Michael Brambley, Ph.D., Fellow Life Member, Pacific Northwest National Laboratory, United States of America, Richland, WA*

As more variable renewable wind and solar photovoltaic power generation is added to the electric power grid, management of building power demand will likely be increasingly looked upon as one of the ways to compensate for the variability of both solar and wind power. This seminar explores approaches being used currently and under development to control building demand for this purpose with a special focus on impacts on energy consumption, efficiency and comfort in grid-interactive buildings. This seminar includes two presentations on commercial buildings and one on homes.

#### **1.Using Electricity Markets to Value Tradeoffs between Energy Consumption and Flexibility**

*David Blum, Ph.D., Lawrence Berkeley National Laboratory, Berkeley, CA*

#### **2.What Are the Impacts on the HVAC System When It Provides Frequency Regulation?: A Comprehensive Case Study with a Medium Office Building**

*Zheng O'Neill, Ph.D., P.E., Member, Texas A&M University, College Station, TX*

#### **3.Demand Reduction and Energy Impacts in Grid-Interactive Homes**

*Austin Rogers, Ph.D., Affiliate, Pacific Northwest National Laboratory, Richland, WA*

12:00 PM - 2:00 PM

#### **Seminar**

### **Occupants, Building Operation and Environment During COVID-19**

*Track: Future Proofing - Renewable, Regenerative, and Resilient*

**Sponsor: 2.1 Physiology and Human Environment**

*Chair: Shichao Liu, Ph.D., Associate Member, Worcester Polytechnic Institute, Worcester, MA*

The COVID-19 pandemic has been momentarily disrupting many facets of our daily life, including indoor environmental quality, the ways to design and operate building mechanic systems, psychological well-being, learning and even planning and

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operational performance due to social distancing. This seminar aims to share with stakeholders the insights of these influenced facets supported by data collection during COVID-19. A surge of research documenting, including the four talks in this seminar, prepare us better for future pandemics.

**1.Impact of Noise on Occupants in Multi-Unit Residences during COVID-19**

*Maedot Andargie, University of Toronto, Ontario, ON, Canada*

**2.Resilient Features of HVAC System Design and Operation during a Pandemic**

*Chandra Sekhar, Ph.D., Fellow ASHRAE, National University of Singapore, Singapore, Singapore*

**3.How Indoor Environment and Stress Affect Online Learning during COVID-19**

*Shichao Liu, Ph.D., Associate Member, Worcester Polytechnic Institute, Worcester, MA*

**4.The Role of Distance in Planning and Operational Performance for Voting Systems**

*Jennifer Lather, Ph.D., Associate Member, University of Nebraska-Lincoln, Omaha, NE*

12:00 PM - 2:00 PM

**Seminar**

**Is More Better? Air Change Rate for Health Hazard Control in Critical Environments**

*Track: Design, Control, and Operation of Critical Environments*

**Sponsor: MTG.ACR, 9.6 Healthcare Facilities**

*Chair: James Bennett, Ph.D., Member, CDC/NIOSH, Cincinnati, OH*

The impact of Air Change Rate (ACH) on contaminant control is intuitively positive. However, many indoor environments are greatly affected by variables that ACH may obscure. Airborne pathogen removal effectiveness in critical environments is one instance. The high-occupancy of aircraft cabins or the low-occupancy of operating or patient rooms both have high prescribed ACH but possibly differing levels of protection. While higher ACH is generally protective, negatives include faster build-up to maximum contaminant concentration, higher local velocities and turbulence for contaminant spread, and, exposure to younger more viable pathogens. These limitations will be explored in healthcare, transportation and industrial settings.

**1.Moving Beyond More Is Better Toward Data-Driven Design and Commissioning**

*Travis English, P.E., Member, Kaiser Permanente, Anaheim, CA*

**2.ACH: The Wrong Infection Control Parameter; Low RH: Too Long Ignored**

*Douglas Walkinshaw, Ph.D., P.E., Fellow Life Member, Indoor Air, Ottawa, ON, Canada*

**3.Variables That Surpass ACH in Laboratory and Healthcare Environments**

*Kishor Khankari, Ph.D., Fellow ASHRAE, AnSight LLC, Ann Arbor, MI*

**4.Looking Past Air Change Rate to Achieve Effective Ventilation**

*James Bennett, Ph.D., Member, CDC/NIOSH, Cincinnati, OH*

12:00 PM - 2:00 PM

**Seminar**

**The State of the Art of Thermally Driven Heat Pumping and Cooling System in the Age of Decarbonization**

*Track: Future Proofing - Renewable, Regenerative, and Resilient*

**Sponsor: 8.3 Absorption and Heat Operated Machines, 6.7 Solar Energy Utilization, TC6.7**

*Chair: William Ryan, Ph.D., P.E., Member, University of Illinois at Chicago, Chicago, IL*

This seminar covers information on any absorption or other heat operated system used for cooling and/or heating, for domestic hot water, space conditioning or industrial applications and focuses on how these technologies can participate and can be correctly evaluated on both efficiency and environmental terms in a low carbon future.

**1.Design Optimization of a Thermally Integrated Solid Oxide Fuel Cell and Triple Effect Absorption Chiller**

*Alejandro Lavernia, Student Member, Advanced Power and Energy Program at University of California Irvine, Irvine, CA*

**2.A Better Solution for Decarbonizing Building Heat?**

*Michael Garrabrant, Member, Stone Mountain Technologies, Johnson City, TN*

**3.Ultra-Efficient Membrane-Based Ionic Liquid Dehumidification System**

*Saeed Moghaddam, Ph.D., University of Florida, Nanoengineered Energy Systems (NES) Laboratories, Gainesville, FL*

**4.Hybrid Design of a Distribution Warehouse in Coal Country USA**

*Douglas Davis, Member, Caribbean - Antilles Power Depot, Sab Juan, PR*



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Tuesday, June 29, 3:00 PM - 4:00 PM

**Seminar**

**Update on Progress of the Task Force on Building Decarbonization**

*Track: Future Proofing - Renewable, Regenerative, and Resilient*

*Chair: Don Brandt, Member, Trane, Inc. (Retired), Phoenix, AZ*

The Task Force on Building Decarbonization was formed by President Chuck Gulledge and President Elect Mick Schwedler in Feb of 2021 under the leadership of presidential members Don Colliver and Tom Phoenix. We have broken the members down into 12 teams to tackle the responsibilities to which we have been assigned, including providing recommendations on best practices, identifying existing and developing new resources, and bringing ASHRAE's technical expertise to the policy discussion. This seminar addresses how ASHRAE is bringing its unique perspective to address one of our industry's most challenging climate questions of the 21st century.

Tuesday, June 29, 4:00 PM - 5:00 PM

**Panel**

**What do Indoor Farmers Need and Want from their HVAC System?**

*Track: HVAC&R for Indoor Plants & Animals*

**Sponsor: 2.2 Plant and Animal Environment, MTG-CEA**

*Chair: Nadia Sabeh, Ph.D., P.E., Associate Member, Dr. Greenhouse, Inc., Sacramento, CA*

Controlling the indoor plant environment is vital for producing healthy and productive crops indoors. The HVAC system must not only control temperature, humidity, and airflow, it also needs to stay within budget, fit within the building and site constraints, and be relatively easy to operate and maintain. Our group of panelists have grown a variety of plants in greenhouses, vertical farms, and repurposed buildings, all of which have unique design criteria and operating requirements.

**1.I Grow Cannabis in an Old Orange Packing Facility in California**

*Wayne Bishop, 7 Points, Woodlake, CA*

**2.I Grow Cannabis, Tomatoes, and Flowering Plants in Oklahoma**

*Jay Whitney, Alterra Wellness, Haskell, OK*

**3.I Transformed a Target Store into a Vertical Farm**

*Jake Counne, Wilder Fields, Calumet City, IL*

4:00 PM - 5:00 PM

**Panel**

**Is Controlled Environment Agriculture the Future of Secure and Sustainable Food Production?**

*Track: HVAC&R for Indoor Plants & Animals*

**Sponsor: 2.2 Plant and Animal Environment**

*Chair: Nadia Sabeh, Ph.D., P.E., Associate Member, Dr. Greenhouse, Inc., Sacramento, CA*

How will we feed 9 Billion people on earth in 2050 in the face of climate variability, water scarcity, soil depletion and mass migrations? Will space travelers carry their food or grow their food on long missions to Mars and beyond? This panel of experts discusses the challenges and opportunities of using controlled environment agriculture (CEA) to secure food production with fewer resources and in more extreme conditions.

**1.The Future of Growing Food for Humans on Earth and in Space**

*Gene Giacomelli, University of Arizona, Tucson, AZ*

**2.Securing Food Production in the North Arctic**

*Corey Ellis, The Growcer, Ottawa, ON, Canada*

**3.Cultivating Insects to Feed 9 Billion**

*Lydia Palma Miner, Ph.D., Dr. Greenhouse Inc., Sacramento, CA*

4:00 PM - 5:00 PM

**Panel**

**All Animals Are Not Created Equal**

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*Track: HVAC&R for Indoor Plants & Animals*

**Sponsor: 2.2 Plant and Animal Environment**

*Chair: Morgan Hayes, Ph.D., Affiliate, University of Kentucky, Lexington, KY*

Ventilation for animal spaces are challenging and vary significantly between species. This panel allows engineers who focus on environmental control animal spaces to discuss their approaches and targets when building environments for these animals.

**1. Animal Energetics/Beef Production**

*Tami Brown-Brandl, Ph.D., University of Nebraska, Lincoln, NE*

**2. Swine Production**

*Brett Ramirez, Ph.D., Member, Iowa State University, Ames, IA*

**3. Poultry Production**

*Richard Gates, Iowa State University, Ames, IA*

**4. Economics/Dairy Production**

*Joe Zulovich, Ph.D., P.E., Affiliate, University of Missouri, Columbia, MO*

4:00 PM - 5:00 PM

**Panel**

**To Serve Humanity: The Efforts of ASHRAE Chapters to Help Reduce Risks of Building Related COVID-19 Transmissions**

*Track: Future Proofing - Renewable, Regenerative, and Resilient*

**Sponsor: 7.3 Operation and Maintenance Management, Environmental Task Force**

*Chair: Sonya Pouncy, Member, Building Vitals, Detroit, MI*

The ASHRAE mission is “to serve humanity by advancing the arts and sciences of heating, ventilation, air conditioning, refrigeration and their allied fields.” How do we do that, in general? And, how do we do that in the face of a foe like COVID-19? Panelist members from 5 chapters and 3 countries discuss their chapters’ efforts to be a technical resource to their local communities as they respond to pandemic. Panelists share their strategies, what worked and what didn’t, as well as future planned efforts to raise the profile and reliance on ASHRAE at local community levels.

**1. Brazil Chapter's Experience**

*Felipe Accorsi, Member, LG Electronics, Porto Alegre, Brazil*

**2. Toronto Chapter's Experience**

*Doug Cochrane, P.E., Member, Independent, Toronto, ON, Canada*

**3. Gold Coast Chapter's Experience**

*John M Constantini, P.E., Member, Independent, Merritt Island, FL*

**4. Montreal Chapter's Experience**

*Audrey Dupuis, Member, Pageau Morel, Montreal, QC, Canada*

**5. Detroit Chapter's Experience**

*Sonya Pouncy, Member, Building Vitals, Detroit, MI*

Tuesday, June 29, 7:00 PM - 8:30 PM

**Seminar**

**Reducing Ozone: A Critical Factor in Improving IAQ**

*Track: Fundamentals and Applications*

**Sponsor: 2.3 Gaseous Air Contaminants and Gas Contaminant Removal Equipment**

*Chair: Kyung-Ju Choi, Ph.D., Member, Clean & Science, Louisville, KY*

Ozone has adverse health effects such as lung diseases, asthma and increased mortality. Moreover, ozone oxidation byproducts such as carbonyls, formaldehyde and secondary organic aerosols can be more harmful than ozone itself. ASHRAE Standard 62.1-2019: Ventilation for Acceptable Indoor Air Quality, requires the minimum ozone removal efficiency to be 40%, and that the ozone concentration limit be lowered down to 100 ppb. It is critically important to reduce the ozone concentration in indoor environments.

**1. Performance of Ozone Removal Air Cleaning Devices**

*Mengjia Tang, The University of Texas at Austin, Austin, TX*

**2. Beyond Ozone: Cleaning Outdoor Air for IAQ**

*Chris Muller, Member, Muller Consulting, Lawrenceville, GA*

**3. Ozone Emission Sources and Surface Removal in Indoor Environments**



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*Jialei Shen, Student Member, Syracuse University, Syracuse, NY*

**4.Impact of Operating Conditions on Performance of Ozone Removal Air Cleaning Devices**

*Atila Novoselac, Member, University of Texas at Austin, Austin, TX*

## Wednesday, June 30

Wednesday, June 30, 7:00 AM - 8:30 AM

### Seminar

## Development of Reference Building Information Model (BIM) Test Cases for Improving Usage of Software Interoperability Schemas

*Track: Future Proofing - Renewable, Regenerative, and Resilient*

**Sponsor: 1.5 Computer Applications, MTG.BIM Building Information Modeling**

*Chair: Stephen Roth, P.E., Member, Carmel Software, San Rafael, CA*

This seminar discusses the results of ASHRAE RP-1810 "Development of Reference Building Information Model (BIM) Test Cases for Improving Usage of Software Interoperability Schemas". The key objective of this research project was to develop a series of standardized test cases for BIM and building performance software tool vendors to employ so as to ensure that valid modelling data can be used by other building performance software. This research project also included the development of a robust, accessible, web-based validation software tool for simple data validation and basic model checking.

**1.Why BIM and BEM Software Interoperability Is More Important Than Ever and the Research behind It**

*Stephen Roth, P.E., Member, Carmel Software, San Rafael, CA*

**2.Discuss Why Schema Validation Is so Important for Successful BIM to BEM Workflows**

*Weili Xu, Ph.D., Associate Member, BuildSimHub, Pittsburgh, PA*

**3.Discuss the Overall Goals of ASHRAE RP-1810 and How They Were Accomplished**

*Krishnan Gowri, Ph.D., BEMP, Fellow ASHRAE, Intertek Building Science Solutions, Bothell, WA*

Wednesday, June 30, 11:30 AM - 1:30 PM

### Seminar

## How to Run Effective Meetings

*Track: Professional Development*

*Chair:*

How to Run Effective Meetings

**1.The Secret to Lead Successful, Engaging and Productive Meetings**

*Karine Leblanc, Member, USACD, Industry, CA*

11:30 AM - 1:30 PM

### Seminar

## Up, Down and All Around: Modeling Airflow in Indoor Plant and Animal Environments

*Track: HVAC&R for Indoor Plants & Animals*

**Sponsor: 2.2 Plant and Animal Environment, 4.10 Indoor Environmental Modeling, MTG-CEA**

*Chair: Nadia Sabeh, Ph.D., P.E., Associate Member, Dr. Greenhouse, Inc., Sacramento, CA*

The global human population is projected to reach nearly 10 billion people over the next 20 years. Indoor farming provides an innovative solution to help meet the growing demands for food, by allowing year-round production of crops and livestock in a controlled environment. Air distribution is essential for creating a healthy and productive environment for plants and animals, which are frequently produced in high densities. This session introduces the challenges of distributing conditioned air in plant and animal environments and presents strategies for creating uniform conditions based on simulation studies using computational fluid dynamics (CFD).

**1.The Challenges of Distributing Air in an Indoor Plant Environment**

*Nadia Sabeh, Ph.D., P.E., Associate Member, Dr. Greenhouse, Inc., Sacramento, CA*

**2.Analysis and Enhancement of Environmental Uniformity in CEA Production System**

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*Murat Kacira, Dr. Greenhouse, Inc., Sacramento, CA*

**3. Modeling Air Distribution in a Vertical Farm Using Computational Fluid Dynamics**

*Christian Rohr, CPP Wind Engineering Consultants, Windsor, CO*

**4. Ventilation Challenges for Animal Environments**

*Joe Zulovich, Ph.D., P.E., Affiliate, University of Missouri, Columbia, MO*

**5. Animal Processing Facilities: Increasing Effectiveness of HVAC Air Distribution Using CFD**

*Steven Thomasson, Member, Price Industries, Winnipeg, MB, Canada*

11:30 AM - 1:30 PM

**Seminar**

**Fault Detection and Diagnosis in Guidelines and Specifications and Their Application**

*Track: Future Proofing - Renewable, Regenerative, and Resilient*

**Sponsor: 7.5 Smart Building Systems**

*Chair: Liping Wang, Ph.D., P.E., Member, University of Wyoming, Laramie, WY*

Common faults in building systems can result in high maintenance costs, occupant discomfort, and energy waste. Fault detection and diagnosis (FDD) in building systems detect and identify operational faults based on the analysis of measured system behaviors. This seminar updates attendees on the FDD resources in ASHRAE Guideline 36 and Energy Management and Information System from Lawrence Berkeley National Lab and demonstrates the implementation of the fault auto-correction algorithms in FDD software products and field testing results.

**1. New Resources for Fault Detection and Diagnostics Application in Commercial Buildings**

*Guanjing Lin, Ph.D., Associate Member, Lawrence Berkeley National Laboratory, Berkeley, CA*

**2. Guideline 36: Automatic Fault Detection and Diagnostics for VAV AHU**

*Justin Mezzadri, Carrier, Charlotte, NC*

**3. Development and Implementation of Fault-Correction Algorithms in Fault Detection and Diagnostics Tools**

*Yimin Chen, Lawrence Berkeley National Lab, Berkeley, CA*

11:30 AM - 1:30 PM

**Seminar**

**Update on the ANSI Z9.5 Laboratory Ventilation Standard**

*Track: Design, Control, and Operation of Critical Environments*

**Sponsor: 9.10 Laboratory Systems**

*Chair: James Coogan, P.E., Associate Member, Siemens Smart Infrastructure, Chicago, IL*

need to rework this --- The Laboratory Ventilation Standard, ASSP Z9.5, is in revision, with publication expected in 2022. The seminar discusses the version currently in public review. One speaker explores what changes will mean for organizations using the standard. The session also addresses the relationship to other standards.

**1. Changes in the Standard from the View of a Safety Officer**

*Markus Schaufele, Northwestern University, Evanston, IL*

**2. ANSI Z9.5 and Ductless Hood Performance Requirements**

*Kenneth Crooks, Erlab, Inc., Rowley, MA*

**3. Relationships between Z9.5 and Other Standards**

*James Coogan, P.E., Associate Member, Siemens Smart Infrastructure, Chicago, IL*

Wednesday, June 30, 2:00 PM - 3:00 PM

**Seminar**

**Leadership Skills and Management Skills: You Need Both!**

*Track: Professional Development*

**Sponsor: 1.7 Business, Management & General Legal Education**

*Chair: Pam Duffy, P.E., Member, Spark One Solutions, LLC, Dallas, TX*

Many engineers never receive formal leadership or people management training. Developing yourself to become the leader and manager you have the potential to be will change everything for you, your team and your business. It will add to your

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effectiveness, subtract from your weaknesses, divide your workload and multiply your impact. Get 20 lessons in leadership and management in 60 minutes from two ASHRAE Distinguished Lecturers.

**1.Ten Lessons to Develop Your Leadership in 30 Minutes**

*Karine Leblanc, Member, USACD, Industry, CA*

**2.Ten Tips to Becoming a Better Manager**

*Pam Duffy, P.E., Member, Spark One Solutions, LLC, Dallas, TX*

2:00 PM - 3:00 PM

Seminar

**Infrared Heating and Grow Facilities**

*Track: HVAC&R for Indoor Plants & Animals*

**Sponsor: 6.5 Radiant Heating and Cooling, 2.2 Plant and Animal Environment**

*Chair: Devin Abellon, P.E., Member, Uponor, Centennial, CO*

This seminar explains the effectiveness of Infrared Radiant heat systems for large areas such as grow facilities, aircraft hangars, distribution centers, manufacturing areas and warehouses. Infrared heating has an added benefit over forced air heating in that, there is the infrared factor. This, along with re-radiance, is described in detail during this seminar.

**1.Infrared Heating**

*Kevin Mahoney, Specified Air, Comstock Park, MI*

**2.Applying Gas-Fired Infrared Radiant Heat in Greenhouses, Including Cannabis Greenhouses**

*Don Larsson, Member, Specified Air Solutions, Virginia Beach, VA*

2:00 PM - 3:00 PM

Seminar

**Smoother Workflow for Controls Sequence Delivery: Standardizing and Digitizing the Process of Controls Sequences**

*Track: Fundamentals and Applications*

**Sponsor: 1.4 Control Theory and Application, 2.8 Building Environmental Impacts and Sustainability**

*Chair: Taraneh Shoorideh, P.E., Member, P2S Inc, Long Beach, CA*

This session includes two talks, connected with the mutual theme of making the design, programming, implementation and delivery of control system standard and digitize, and overall smoother. The first speaker describes Guideline 36-High-Performance Sequence of Operation for HVAC system and lessons learned from implementation of this guideline. The second speaker describes the new efforts from ASHRAE 231P and DOE to develop a tool and process to digitize the controls delivery.

**1.Using Guideline 36 and Getting Better at It**

*Jim Coogan, P.E., Member, Siemens Building Technology, Buffalo Grove, IL*

**2.Digitizing the Process of Controls Sequence Design and Delivery**

*Paul Ehrlich, P.E., Member, Building Intelligence Group, Portland, OR*

2:00 PM - 3:00 PM

Seminar

**Research Programs and Funding Opportunities Part 2: U.S. Department of Energy (DOE) Building Technologies Office (BTO) and the National Science Foundation (NSF)**

*Track: Research Summit*

**Sponsor: CRC**

*Chair: Kristen Cetin, Ph.D., P.E., Member, Michigan State University, East Lansing, MI*

Representatives from the National Science Foundation (NSF) Civil, Mechanical and Manufacturing Innovation Division (CMMI), and from the U.S. Department of Energy Building Technologies Office provide an overview of current programs, including funding priorities and opportunities. Relevant core programs are also highlighted. Following the presentation, there will be a live Q&A. This session is geared towards researchers, young faculty and senior graduate students pursuing academic careers at U.S. institutions, but the information provided will be valuable to principal investigators in any stage of their career. This is Part 2 of a 2 part series.

**1.Research Programs, Initiatives and Opportunities at Doe's Building Technologies Office**

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*Amir Roth, Department of Energy, Washington, DC*

**2. Research Overview and Funding Opportunities within the National Science Foundation**

*Caglar Oskay, National Science Foundation, Washington, DC*