IAQ 2016
Defining Indoor Air Quality: Policy, Standards and Best Practices
Co-Organized by ASHRAE and AIVC
September 12 - 14, 2016
Alexandria, VA

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Updated: September 8, 2016
### Schedule for Sunday, September 11

**Registration Hours:** Noon - 5:00 pm  
**Speaker’s Lounge:** 2:00 pm – 5:00 pm  
**Welcome Reception:** 5:00 pm – 6:00 pm

- [ashrae.org/iaq2016](http://ashrae.org/iaq2016)  
- [www.ashrae.org/app](http://www.ashrae.org/app)

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### Monday, September 12

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<td>Developing a Target Indoor Pollutants (TIP) List</td>
<td>Approaches and Tools for Better IAQ</td>
<td>Characterization of IAQ Performance of Products and Systems 1</td>
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<td>Capturing Contaminants for Residential Cooking</td>
<td>Healthy Homes: Introducing the Healthy Home Evaluator Credential</td>
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Monday, September 12, 8:00 AM-9:00 AM

OPENING SESSION AND KEYNOTE 1
On the Quest for Indices Defining Indoor Air Quality: What is a Reasonable Approach?
Room: Presidential Ballroom

Paweł Wargocki, Technical University of Denmark, Kongens Lyngby, Denmark

Different approaches and indices have been used to define indoor air quality. The most frequently used are ventilation rate and concentration of carbon dioxide. Other approaches define the levels of dissatisfaction with indoor air quality or concentration of airborne volatile organic compounds. Yet, the questions remain unanswered as to what the premise should be for defining indoor air quality, which outcome/modality should be used for that purpose, and whether we can agree on a simple metric. The basic human requirements need to be always warranted and full spectrum of pollutants considered. Strategy for attaining indoor air quality index will be proposed.

Chair: William Bahnfleth, Ph.D., P.E., Presidential Fellow ASHRAE, Pennsylvania State University, University Park, PA

Monday, September 12, 9:15 AM – 10:45 AM

CONFERENCE PAPER SESSION 1A: Approaches and Tools for Better IAQ
Room: Kennedy

Chair: Charlene Bayer, Ph.D., Member, Hygieia Sciences LLC, Atlanta, GA

1. Quality Assurance in Building Ventilation Systems
Marco C. Hofman, ISSO – Dutch Building Services Knowledge Centre, Rotterdam, Netherlands

2. Optimizing IAQ in Green Buildings
Dhvani Parikh, Ph.D.1, Larissa Oaks1 and Sara Cederberg, AIA1, (1)U.S. Green Building Council, Washington, DC

3. The Evolution of the BCA Green Mark Scheme in Singapore: A Paradigm Shift from an Energy Focused Rating System to an Occupant Centric Criteria with Higher Emphasis on IAQ
Jangyoung Lee1 and Kwok Wai Tham, Ph.D.2, (1)Building and Construction Authority, Singapore, Singapore, (2)National University of Singapore, Singapore, Singapore

4. IAQ Certification Programs: Early Results of the Pivot from Reactive to Proactive
Elliott Horner, Ph.D., Member1, John Shan, Ph.D.2, Dimpy Daroch3 and Tony Worthan, MPH1, (1)UL Environment, Marietta, GA, (2)UL Environment, Shanghai, China, (3)UL Environment, New Delhi, India
**CONFERENCE PAPER SESSION 1B: Characterization of IAQ Performance of Products and Systems 1**

**Room: Roosevelt**

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

1. **Impact of Environmental Tobacco Smoke on Membrane-Based Energy Recovery Ventilators: Water Vapor Transport and Contaminant Crossover**
   Amin Engarnevis, Student Member, Alexander Sylvester, Student Member, Ryan Huizing, P.Eng., Steven Rogak, Ph.D., P.E. and Sheldon Green, Ph.D., P.E., (1)University of British Columbia, Vancouver, BC, Canada, (2)dPoint Technologies, Vancouver, BC, Canada

2. **Temperature-Based Ventilation Control**
   Michael Lubliner, Member, Paul W. Francisco, Member, Brennan Less, Iain Walker, Ph.D., Fellow ASHRAE and Zachary Merrin, Member, (1)Washington State University Extension Energy Program, Olympia, WA, (2)University of Illinois at Urbana-Champaign, Champaign, IL, (3)Residential Building Systems Group, Lawrence Berkeley National Laboratory, Berkeley, CA, (4)Lawrence Berkeley National Laboratory, Berkeley, CA

3. **Know Where Your Air Comes from: Common Problems with High Rise Residential Ventilation**
   Scott Bondi, Ph.D., P.E., Member and Sean O'Brien, P.E., Member, (1)Simpson Gumpertz & Heger, New York, NY

   Junjing Yang, Ph.D., Associate Member, Chandra Sekhar, Ph.D., Fellow ASHRAE, Kok Wai Cheong, Ph.D., and Benny Raphael, Ph.D., (1)National University of Singapore, Singapore, Singapore, (2)IIIT Madras, Chennai, India

5. **Experimental Evaluation of the Pollutant Distribution in an Operating Theater of an University Hospital of Rome**
   Annunziata D'Orazio, Ph.D., Maria Pia Galea, Fulvio Maddaloni, Leo Poggi and Marco Fellin, Ph.D., (1)Sapienza University of Rome, Rome, Italy, (2)Campus Bio-Medico Hospital University, Rome, Italy; (3)CNR-IVALSA, San Michele all'Adige, Italy

**FORUM 1C: Developing a Target Indoor Pollutants (TIP) List**

**Room: Presidential Ballroom**

Chair: Bob Thompson, EPA, Research Triangle Park, NC

Developing a TIP list (Target Indoor Pollutants): Getting the benefits of the NAAQS but with consensus development and voluntary compliance. Given that the US population spends 90% of its day indoors where pollutant levels are often 2-5 times higher than outdoors, the choice of which building materials and consumer products to use, and how the indoor air is cleaned and ventilated, have a significant role on human health and well-being and climate change. A consensus driven TIP list is critically needed to ensure a strategic and effective approach to reducing sources and developing mitigation technologies.

**Panelist 1**
Chris Pyke, U.S. Green Building Council, Washington, DC

**Panelist 2**
Andrew Persily, Ph.D., Member, National Institute of Standards and Technology, Gaithersburg, MD

**Panelist 3**
David Rowson, U.S. Environmental Protection Agency, Washington DC
Monday, September 12, 11:15 AM – 12:15 PM

SEMINAR 2A: International Urban IAQ (China & India)

Room: Kennedy
Chair: Paul Francisco, Member, University of Illinois at Urbana-Champaign, Champaign, IL

Indoor Air Quality in many parts of the world is impacted significantly by high population density and outdoor air pollution. This in turn means that strategies, such as ventilation, that may work in North America do not work as well in these locations. This session focuses on two such locations, urban environments in China and India. In both of these locations outdoor particulate matter levels can be more than an order of magnitude higher than in most of North America. This session will discuss the challenges in these locations as well as common solutions and how effective these solutions are.

1. IAQ in Urban India
Richie Mittal, Overdrive Engineering Pvt Ltd, New Delhi, India

2. IAQ in Urban China
Mengyan Gong¹ and Yinping Zhang, Ph.D.², (1)National Institute of Standards and Technology, Gaithersburg, MD, (2)Tsinghua University, Beijing, China

STEERING COMMITTEE SESSION 2B: Demand-Controlled Ventilation: Assessment Methods and Potential

Room: Presidential Ballroom
Chair: Rémi Carrié, Ph.D., Member, ICEE, Lyon, France

1. Demand-Controlled Ventilation: Managing Its Key Parameters to Challenge IAQ and Energy Aspects
Emmanuel Val¹ and Jean-Luc Savin¹, (1)AERECO, Marne la Vallée, France

2. Smart Ventilation: Theoretical Requirements, Potentials and Practical Issues
Iain Walker, Ph.D., Fellow ASHRAE, Lawrence Berkeley National Laboratory, Berkeley, CA

STEERING COMMITTEE SESSION 2C: The Policymaker’s Perspective: Exploring How Congress, the Federal Government and States Strive to Improve IAQ

Room: Roosevelt
Chair: Mark Ames, Associate Member, ASHRAE, Washington, DC

1. The Federal Government’s Role in IAQ
Janet McCabe, U.S. Environmental Protection Agency, Washington, DC

2. How States Address IAQ
Cole Stanton, Indoor Air Quality Association, Atlanta, GA

3. Congress’ Role in Addressing IAQ
Mark Ames, Associate Member, ASHRAE, Washington, DC
Lunch 12:30 PM - 1:30 PM

Monday, September 12, 1:30 PM - 2:00 PM

KEYNOTE 2
From Project to Portfolio: Drivers and Barriers to Scaling up IAQ Performance from 1,000+ Property Companies and Funds around the World

Room: Presidential Ballroom

Chris Pyke, Global Real Estate Sustainability Benchmark, Washington, DC

The green building industry uses leadership standards to define superior performance for individual projects and buildings. As a result, we have ample evidence that high performance green buildings represent superior real estate assets. Institutional investors have recognized this success, and they are now interested in the performance of entire real estate portfolios. GRESB provides institutional investors tools to assess, score, and compare portfolio-level performance. In this session, we will explore new GRESB data from over 750 property companies and funds with an aggregate asset value over $3 trillion USD. We will consider areas of relative strength and weakness in the adoption of IEQ-related practices around the world.

Chair: William Bahnfleth, Ph.D., P.E., Presidential Fellow ASHRAE, Pennsylvania State University, University Park, PA

Monday, September 12, 2:15 PM - 3:30 PM

CONFERENCE PAPER SESSION 3A: Characterization of IAQ Performance of Products and Systems 2 / IAQ Impacts of Climate Change

Room: Roosevelt

Chair: Bob Thompson, EPA, Research Triangle Park, NC

1. Disinfection Performance of an Ultraviolet Coil Irradiation System in a Hot and Humid Climate
Chandra Sekhar, Ph.D., Fellow ASHRAE 1, Li Ting Soh2, Vivien Goh2, Hooi Ming Yap2, Yi Wang1, Ramona A Gutiérrez2, Lee Ching Ng2, Kok Wai Cheong, Ph.D.1 and William P. Bahnfleth, PhD, P.E., FASHRAE, FASME, Fellow ASHRAE 3, (1)National University of Singapore, Singapore, Singapore, (2)Environmental Health Institute, National Environmental Agency, Singapore, Singapore, (3)Pennsylvania State University, State College, PA

2. Climate Change and IAQ in the Pacific Northwest
Max Kirk, Ph.D., Associate Member 1, Brian Lamb1, Shelley Pressley1, Tom Jobson1, Von Walden1, Diane Cook1, Madeline Fuchs1, Patrick O’Keefe1, Yibo Huangfu1, Nathan Lima1 and Beiyu Lin1, (1)Washington State University, Pullman, WA

3. Climatic Adaptation via Simulation of Building Energy Performance
Stamatis Zoras, Ph.D. 1, Sotiris Veranoudis2 and Argyro Dimoudi3, (1)Democritus University of Thrace, Xanthi, Greece
SEMINAR 3B: Residential 1

Room: Presidential Ballroom
Chair: Lawrence Schoen, P.E., Fellow ASHRAE, Schoen Engineering Inc, Columbia, MD

Torkan Fazli, Student Member and Brent Stephens¹, (1)Illinois Institute of Technology, Chicago, IL

2. Best Practices: Residential PM2.5 Exposure Interventions
Terry Brennan, Member¹ and Brent Stephens², (1)Camroden Associates, Inc., Westmoreland, NY, (2)Illinois Institute of Technology, Chicago, IL

3. ASHRAE Residential IAQ Guide
Lawrence Schoen, P.E., Fellow ASHRAE, Schoen Engineering Inc, Columbia, MD

4. Pilot Study of Range Hood Effectiveness at Reducing Nitrogen Oxides and Particle Number Concentrations from Natural Gas Cooking Burners in Homes
Brett Singer, Ph.D., Member¹, Randy Maddalena, Ph.D.¹, Woody Delp, Ph.D.¹ and David Lorenzetti, Ph.D.¹, (1)Lawrence Berkeley National Laboratory, Berkeley, CA

5. Ventilation in New New Zealand Houses
Inga J. Smith, Ph.D.¹, Stephen McNeil², Timothy W. Bishop¹, Timothy Divett, Ph.D.¹ and Muthasim Fahmy, Ph.D.³, (1)University of Otago, Dunedin, New Zealand, (2)BRANZ, Wellington, New Zealand, (3)Scion, Rotorua, New Zealand

STEERING COMMITTEE SESSION 3C: Where Are We Going with IAQ Metrics?

Room: Kennedy
Chair: Max H. Sherman, Lawrence Berkeley Laboratory, Berkeley, CA

1. LBL's IAQ Metrics Development
Iain Walker, Ph.D., Fellow ASHRAE, Lawrence Berkeley National Laboratory, Berkeley, CA

2. To CO2 or Not to CO2
Andrew Persily, Ph.D., Fellow Life Member, NIST, Gaithersburg, MD

3. Characterizing IAQ Performance
Kevin Teichman, Ph.D., Environmental Protection Agency, Washington, DC

Monday, September 12, 4:00 PM - 5:30 PM

CONFERENCE PAPER SESSION 4A: IAQ Monitoring and Field Measurements Results

Room: Presidential Ballroom
Chair: Eva M King, Ph.D., Member IAQA, Indoor Biotechnologies Inc, Charlottesville, VA

1. Long-Term Monitoring of IAQ in a High-Rise Multi-Family Building with Pressurized Corridor Ventilation in Vancouver, BC
James Montgomery, Ph.D.¹, Lorne Ricketts² and Graham Finch, P.Eng., Associate Member², (1)RDH Building Science Inc., Vancouver, BC, Canada, (2)RDH Building Engineering Ltd., Vancouver, BC, Canada

2. Attached Garages: IAQ Implications and Solutions
Zachary Merrin, Member, University of Illinois at Urbana-Champaign, Champaign, IL
3. Practical Strategies for Achieving IAQ in Green Buildings and High Performance Buildings
Marwa Zaatari, Ph.D., Member, enVerid Systems, Boston, MA

Ihab Elzeyadi, Ph.D., HBDP, Member, University of Oregon, Eugene, OR

STEERING COMMITTEE SESSION 4B: Capturing Contaminants for Residential Cooking

Room: Kennedy
Chair: Wouter Borsboom, TNO, Delft, Netherlands

1. Developing a Test Method for Kitchen Range Hood Capture Efficiency
Iain Walker, Ph.D., Fellow ASHRAE, Lawrence Berkeley National Laboratory, Berkeley, CA

2. Case History: Visual Feedback Reduces Marital Stress and Allows IAQ Improvement
Lew Harriman, Fellow ASHRAE, Mason Grant, Portsmouth, NH

3. Exposure on Particulate Matter in Real Cooking Situations, and Can We Reduce It?
Wouter Borsboom, TNO, Delft, Netherlands

4. Capture Efficiency of Range Hoods, an Industrial Perspective
Daniel Forest, Venmar, Drummondville, QC, Canada

STEERING COMMITTEE SESSION 4C: Healthy Homes: Introducing the Healthy Home Evaluator Credential

Room: Roosevelt
Chair: Larry Zarker, Member, Building Performance Institute, Inc, Malta, NY

1. Healthy Home Evaluation: Why It Matters
Kevin Kennedy, Member IAQA, Children's Mercy Hospital and Clinics, Kansas City, MO

2. Maximizing Energy and Non-Energy Benefits Using a Comprehensive Energy and Health Assessment Tool
Ruth Ann Norton, Green & Healthy Homes Initiative, Baltimore, MD

3. Healthy Homes: The Healthy Home Evaluator Credential Discussion
Larry Zarker, Member, Building Performance Institute, Inc, Malta, NY
Tuesday, September 13

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<td>Evolution and State of the Art of the Residential Ventilation Standard for North America (ASHRAE 62.2)</td>
<td>General IEQ Issues</td>
<td>Characterization of IAQ Performance of Products and Systems 3</td>
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<td>Keynote: David Jacobs</td>
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<td>Indoor Air Quality Association and ASHRAE: New Approaches to Government Affairs Advocacy</td>
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KEYNOTE 3
Public Health Priorities for Indoor Air Quality

Room: Presidential Ballroom

David Rowson, U.S. Environmental Protection Agency, Washington, D.C.

The U.S. EPA's mission is to protect human health and the environment, and poor indoor air quality (IAQ) is a major environmental health risk. This keynote address briefly describes EPA's current legislative and appropriation priorities for IAQ, and presents emerging public health priorities for IAQ including climate change, energy-efficiency measures in buildings, particulate matter as an indoor pollutant of concern, and IAQ metrics.

Chair: William Bahnfleth, Ph.D., P.E., Presidential Fellow ASHRAE, Pennsylvania State University, University Park, PA
Tuesday, September 13, 9:00 AM – 10:30 AM

CONFERENCE PAPER SESSION 5A: Characterization of IAQ Performance of Products and Systems 3

Room: Roosevelt

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

Adams Rackes, Student Member¹, Tom Ben-David, Student Member¹ and Michael S. Waring, Ph.D., Associate Member¹,
¹Drexel University, Philadelphia, PA

2. Measured Space-Conditioning Energy and Indoor RH in a Mechanically-Ventilated Lab Home with Fixed and Variable-Capacity Cooling Systems Located in a Hot and Humid Climate
Charles Withers Jr., Florida Solar Energy Center, Cocoa, FL

3. Modeling Monetization of Collateral IAQ Improvements from UVGI for Coil Cleaning
Joseph F. Irrantello, P.E., Member¹ and William Bahnfleth, P.H.D., P.E., Presidential Fellow ASHRAE¹,
¹Pennsylvania State University, University Park, PA

4. Data Driven Persistent Monitoring of Indoor Air Systems
Sambuddha Ghosal¹, Chao Liu, Ph.D.¹, Ulrike Passe, AIA, Associate Member¹, Shan He¹ and Soumik Sarkar, Ph.D.¹,
¹Iowa State University, Ames, IA

CONFERENCE PAPER SESSION 5B: General IEQ Issues

Room: Kennedy

Chair: Zuraimi Sultan, National Research Council Canada, Ottawa, ON Canada

1. An International Project on IAQ Design and Control in Low Energy Residential Buildings
Carsten Rode, Ph.D., Member¹, Marc Ábadie², Menghao Qin³, John Grunewald⁴, Jakub Kolarik, Ph.D.¹, Jelle Laverge⁵ and
Jianshun Zhang, Ph.D., Fellow ASHRAE⁶, (¹)Technical University of Denmark, Kgs. Lyngby, Denmark, (²)Université de La Rochelle, La Rochelle, France, (³)Nanjing University, Nanjing, China, (⁴)Technical University of Dresden, Dresden, Germany, (⁵)Ghent University, Gent, Belgium, (⁶)Syracuse University, Syracuse, NY

2. Benefits of Intelligent Computational Methods for Big Data Analysis on IEQ Research
Mika Raatikainen, University of Eastern Finland, Kuopio, Finland

3. Optimizing the Scheduled Operation of Window Opening and Blind to Enhance IAQ and Visual Comfort
Muhammad Ahmad, Ph.D.¹, Jean-Laurent Hippolyte, Ph.D.¹, Monjur Moursheed, Ph.D.¹, Yacine Rezgui, Ph.D.¹ and
Jonathan Reynolds², (¹)School of Engineering, Cardiff University, Cardiff, United Kingdom of Great Britain and Northern Ireland,
(²)School of Engineering, Cardiff University, Cardiff, United Kingdom

4. Do the Students in High Performance Incentive (HPI) Schools Demonstrate More Academic Improvement Than Their Peers in Non-HPI Schools?
Josephine Lau, Ph.D., Member², Shihan Deng, Student Member¹, Houston Lester¹, James Bovaird, Ph.D.¹, Lily Wang, Ph.D.¹,
P.E.¹ and Clarence Waters, Ph.D.¹, (¹)University of Nebraska - Lincoln, Lincoln, NE
STEERING COMMITTEE SESSION 5C: Evolution and State of the Art of the Residential Ventilation Standard for North America (ASHRAE 62.2)

Room: Presidential Ballroom
Chair: Paul W. Francisco, Member, University of Illinois at Urbana-Champaign, Champaign, IL

1. Where ASHRAE 62.2 Has Been
Steven J. Emmerich, Member, National Institute of Standards and Technology, Gaithersburg, MD

2. ASHRAE 62.2 and the State of the Science
Brett Singer, Ph.D., Member, Lawrence Berkeley National Laboratory, Berkeley, CA

3. Using ASHRAE 62.2 in New Homes
Elliot Seibert, Steven Winter Associates, Washington, DC

4. Current Topics for ASHRAE 62.2
Paul W. Francisco, Member, University of Illinois at Urbana-Champaign, Champaign, IL

5. Where ASHRAE 62.2 Is Going: The Long View
Eric Werling, Member, U.S. Department of Energy, Washington, DC

Tuesday, September 13, 10:45 AM - 12:00 PM

STEERING COMMITTEE SESSION 6A: Future of IAQ Sensors and Controls

Room: Kennedy
Chair: Eric Werling, Member, U.S. Department of Energy, Washington, DC

1. Future of IAQ Sensors and Controls
Charlene Bayer, Ph.D., Member, Hygieia Sciences LLC, Atlanta, GA

2. Future of IAQ Sensors and Controls
Gordon Sharp, Member, Aircuity Inc, Newton, MA

3. Future of IAQ Sensors and Controls
Brett Singer, Ph.D., Member, Lawrence Berkeley National Laboratory, Berkeley, CA

STEERING COMMITTEE SESSION 6B: IEA EBC Annex 68 Project: IAQ Design and Control in Low Energy Residential Buildings

Room: Presidential Ballroom
Chair: Carsten Rode, Ph.D., Member, Technical University of Denmark, Kgs. Lyngby, Denmark

1. Evaluating the IAQ of Low-Energy Residential Buildings
Marc Abadie, Ph.D., Université de La Rochelle, La Rochelle, France

2. The Combined Effects of Temperature and Humidity on Initial Emittable Formaldehyde Concentration of Fiberboard
Menghao Qin, Nanjing University, Nanjing, China
Jianshun Zhang, Ph.D., Fellow ASHRAE, Syracuse University, Syracuse, NY

4. Design for “High IAQ” in Residences: Current Status and Outlook for the Future
Jakub Kolarik, Ph.D., Technical University of Denmark, Kgs. Lyngby, Denmark

5. Field Measurements and Case Studies
Jelle Laverge, Ghent University, Gent, Belgium

STEERING COMMITTEE SESSION 6C: Practical Strategies for Achieving IAQ in High Performance Buildings

Room: Roosevelt
Chair: Zuraimi Sultan, National Research Council Canada, Ottawa, ON Canada

1. Occupants’ Satisfaction, Acute Health Symptoms and Performance in Certified Office Buildings
Pawel Wargocki, Technical University of Denmark, Kongens Lyngby, Denmark

2. Practical Strategies for Achieving IAQ in Green Buildings and High Performance Buildings
Marwa Zaatari, Ph.D., Member, enVerid Systems, Boston, MA

3. Optimizing IAQ in Green Buildings
Brendan Owen, USGBC, Atlanta, GA

4. Operational IAQ Monitoring and Management Protocols Across Google’s Global Portfolio
Lauren Riggs1 and Ed Baylosis1, (1)Google, Inc, Mountain View, CA

Lunch 12:00 PM - 1:00 PM

Tuesday, September 13, 1:00 PM - 1:30 PM

KEYNOTE 4
Bending the Healthcare Cost Curve: Indoor Air Quality and Healthy Housing

Room: Presidential Ballroom
David Jacobs, Ph.D., Member, National Center for Healthy Housing, Washington, DC

This presentation will examine how good indoor environmental quality and quality housing can support health, potentially reduce health care costs, and why this connection is essential for economic and human development. Key gaps in knowledge as well as disconnects in housing investment and health care policies remain, and are pronounced in respiratory health and ventilation system design. A World Health Organization project to produce new international healthy housing guidelines, as well as recently completed studies will be reviewed. In particular, a recently published study comparing new and older ASHRAE residential ventilation standards during weatherization showed that improved ventilation rates, moisture balance, and indoor air quality yielded significant health improvements for children, who had fewer headaches, eczema and skin allergies and also for adults who had improvements in psychological distress. These findings have profound implications for both ventilation policy and health policy. Creation of new dynamic links between ventilation engineers and housing and health professionals is needed to improve the evidence base.

Chair: William Bahnfleth, Ph.D., P.E., Presidential Fellow ASHRAE, Pennsylvania State University, University Park, PA
CONFERENCE PAPER SESSION 7A: Infiltration

Room: Roosevelt

Chair: Wane Baker, Trane, La Crosse, WI

1. Development of a Numerical Air Infiltration Model Based on Pressurization Test Applied on a Church
Abolfazl Hayati, Ph.D.; Jan Akander, Dr.ing.; and Magnus Mattsson, Dr.ing., (1) University of Gävle, Gävle, Sweden, (2) University of Gävle, SE-801 76 Gävle Sweden

2. Experimental Study of Multizone Air Leakages in Low Energy Houses
Gaëlle Guyot, Ph.D., Member; Jérémy Ferlay, P.Eng.; Thibaud Bello, P.Eng.; Evelyne Gonze, Ph.D., P.E.; and Monika Wolosyn, Ph.D., P.E., (1) Cerema DTer CE, Isle d'Abeau, France, (2) Savoie Mont-Blanc University, Le Bourget du Lac, France

3. Analyses of about 90,000 Airtightness Measurements Performed in France on Residential and Non-Residential Buildings from 2008 to 2014
Adeline Bailly, Gaëlle Guyot, Ph.D., Member and Valérie Leprince, Ph.D., (1) Cerema DTer CE, Isle d'Abeau, France, (2) Pleiaq, Meyzieu, France

4. On the Origin of Leakage-Infiltration Ratios Previously Hidden By Means of Natural Obfuscation
Benjamin Jones, Max H. Sherman, and Andrew Persily, Ph.D., Member, (1) University of Nottingham, Nottingham, United Kingdom of Great Britain and Northern Ireland, (2) Lawrence Berkeley Laboratory, Berkeley, CA, (3) National Institute of Standards and Technology, Gaithersburg, MD

SEMINAR 7B: Residential 2

Room: Kennedy

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

1. Healthy Efficient New Gas Homes (HENGH): Survey and Pilot Test Results
Max H. Sherman, Wanyu Chan, Ph.D., Brett Singer, Ph.D., Member and Iain Walker, Ph.D., Fellow ASHRAE, (1) Lawrence Berkeley Laboratory, Berkeley, CA, (2) Lawrence Berkeley National Laboratory, Berkeley, CA

2. Ventilation Retrofits for Energy Savings in High Rise Multi-Family Buildings
David Warfield, OPMP, Member, ASHRAE and IAQA, Wilmington, DE

Brett Singer, Ph.D., Member, Wanyu Chan, Ph.D., Jennifer Logue, Ph.D., Neil Klepeis, Ph.D., and Max H. Sherman, (1) Lawrence Berkeley National Laboratory, Berkeley, CA, (2) Center for Behavioral Epidemiology and Community Health, San Diego, CA, (3) Lawrence Berkeley Laboratory, Berkeley, CA

4. Measurement-Based Evaluation of Ventilation, Filtration, and Air Cleaning Systems in a Modern California Detached House
Brett Singer, Ph.D., Member, Douglas Black, Ph.D., Hugo Destaillats, Ph.D., Woody Delp, Ph.D., and Iain Walker, Ph.D., Fellow ASHRAE, (1) Lawrence Berkeley National Laboratory, Berkeley, CA, (2) Lawrence Berkeley National Laboratory, Berkeley, CA, USA, Berkeley, CA
STEERING COMMITTEE SESSION 7C: IAQ Standards around the World: Where We Are and Where We Want to Be

Room: Presidential Ballroom
Chair: Andrew Persily, Ph.D., Member, National Institute of Standards and Technology, Gaithersburg, MD

1. ASHRAE Ventilation and IAQ Standards: A Short History
   Andrew Persily, Ph.D., Member, National Institute of Standards and Technology, Gaithersburg, MD

2. CEN and ISO Ventilation and IAQ Standards
   Bjarne W. Olesen, Ph.D., Fellow ASHRAE, Technical University of Denmark, Kongens Lyngby, Denmark

3. Review of Asian IAQ Standards
   Chandra Sekhar, Ph.D., Fellow ASHRAE, National University of Singapore, Singapore, Singapore

4. AIVC Activities in Relation to Standards, Regulations and Implementation in Practice
   Peter Wouters, Ph.D., Member, Belgian Building Research Institute, Brussels, Belgium

5. U.S. Environmental Protection Agency IAQ Guidance
   Laura Kolb, U.S. Environmental Protection Agency, Washington, DC

6. IAQ Standards of the Future: Recent Research on the Connections Between Ventilation and Health
   Pawel Wargocki, Technical University of Denmark, Kongens Lyngby, Denmark

Tuesday, September 13, 3:30 PM – 5:00 PM

CONFERENCE PAPER SESSION 8A: IAQ Metrics

Room: Kennedy
Chair: Arnold Janssens, Ph.D., Gent University, Gent Belgium

1. Indoor Exposure to Particulate Matter - the State of the Science
   David Butler, Ph.D. and Guru Madhavan, Ph.D., (1)National Academies of Sciences, Engineering, and Medicine, Washington, DC

   Tom Ben-David, Student Member and Michael S. Waring, Ph.D., Associate Member, (1)Drexel University, Philadelphia, PA

3. Characterizing IAQ Performance Using a Graphical Approach
   Kevin Teichman, Ph.D., Andrew Persily, Ph.D., Member and Steven Emmerich, Member, (1)Environmental Protection Agency, Washington, DC, (2)National Institute of Standards and Technology, Gaithersburg, MD

4. Allergen Exposures and the Quest for a Healthier Home
   Eva M. King, Ph.D., Member IAQA, Indoor Biotechnologies Inc, Charlottesville, VA
CONFERENCE PAPER SESSION 8B: Residential Paper Session

Room: Presidential Ballroom
Chair: Charlene Bayer, Ph.D., Member, Hygieia Sciences LLC, Atlanta, GA

1. Carbon Monoxide Measurements in Homes
Paul W. Francisco, Member1, Scott Pigg, Member2, Dan Cautley, Member2, William B. Rose, Fellow ASHRAE1, David Jacobs, Ph.D., Member3 and Salvatore Cali4, (1)University of Illinois at Urbana-Champaign, Champaign, IL, (2)Seventhwave, Madison, WI, (3)National Center for Healthy Housing, Washington, DC, (4)University of Illinois at Chicago, Chicago, IL

2. Developing a Capture Efficiency Test Method for Residential Range Hoods
Iain Walker, Ph.D., Fellow ASHRAE1, Max H. Sherman2, Brett Singer, Ph.D., Member3, Woody Delp, Ph.D.1 and Chris Stratton1, (1)Lawrence Berkeley National Laboratory, Berkeley, CA, (2)Lawrence Berkeley Laboratory, Berkeley, CA

3. PM 2.5 in Dutch Dwellings and the Effect of Mitigation Actions
Piet Jacobs1, Wouter Borsboom1 and Richard Kemp1, (1)TNO, Delft, Netherlands

4. Are Residential Whole House Mechanical Ventilation Systems Reliable Enough to Mandate Tight Homes?
Jeffrey K. Sonne1, Charles R. Withers1 and Robin K. Vieira1, (1)Florida Solar Energy Center, Cocoa, FL

5. The Latest Developments in Residential Combustion Safety Testing
Paul W. Francisco, Member1, Larry Brand, Member2, Dan Cautley, Member3, Brett Singer, Ph.D., Member4 and Stacy Gloss1, (1)University of Illinois at Urbana-Champaign, Champaign, IL, (2)Gas Technology Institute, Davis, CA, (3)Seventhwave, Madison, WI, (4)Lawrence Berkeley National Laboratory, Berkeley, CA

6. How the Building America IAQ Roadmap Will Help Define IAQ for High Performance Homes
Eric Werling, Member1 and Iain Walker, Ph.D., Fellow ASHRAE2, (1)U.S. Department of Energy, Washington, DC, (2)Lawrence Berkeley National Laboratory, Berkeley, CA

STEERING COMMITTEE SESSION 8C: Indoor Air Quality Association and ASHRAE: New Approaches to Government Affairs Advocacy

Room: Roosevelt
Chair: Cole Stanton, Indoor Air Quality Association, Atlanta, GA

1. Indoor Air Quality Association and ASHRAE: New Approaches to Government Affairs Advocacy
Jim Scarborough1 and Cole Stanton2, (1)ASHRAE, Washington, DC, (2)Indoor Air Quality Association, Atlanta, GA
**Wednesday, September 14**

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<td>Natural Ventilation</td>
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**Wednesday, September 14, 8:00 AM - 8:30 AM**

**KEYNOTE 5**

**Reviving the “Lost Step” in IH Remediation Protocols and Remediation Plans**

**Room: Presidential Ballroom**

**Howard E. Wolf,** IICRC Standards Chairman, Richfield, WI

For years, the restoration, cleaning and remediation industries have moved towards reliance on improvements in equipment and chemical technology to perform their services. This has caused the focus on source removal to be blurred. The revised ANSI/IICRC standards attempt to return the focus to traditional source removal, including mechanical cleaning processes. Mr. Wolf will discuss the position of the revised S500 Water Damage Restoration and S520 Mold Remediation standards on mechanical processes and chemical technology to reduce airborne contaminant load; thereby, reducing the reliance on air filtration devices and other control measures. It has become a “lost step” in many protocols and remediation plans.

Chair: William Bahnfleth, Ph.D., P.E., Presidential Fellow ASHRAE, Pennsylvania State University, University Park, PA

**Wednesday, September 14, 8:45 AM - 10:30 AM**

**CONFERENCE PAPER SESSION 9A: Ventilation and IAQ Measurement Methods**

**Room: Kennedy**

Chair: Eva M King, Ph.D., Member IAQA, Indoor Biotechnologies Inc, Charlottesville, VA

**1. Reliability of Ventilation System Inspection for Dwellings: Comparisons of Measurements and Controls Protocols Tested during in-Situ Campaigns of the PROMEVENT Project**

Adeline Bailly\(^1\) and Sylvain Berthault, P.Eng.\(^2\), (1)Cerema DTer CE, Isle d’abeau, France, (2)Cerema DTer CE, Autun, France

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2. Testing a Powered Flow Hood on a Variety of Registers
Niek-Jan Bink, Ph.D., ACIN instrumenten, Rijswijk, Netherlands

3. A New Method for Indoor Air Measurement
Clifford Cooper¹ and Kathleen Cooper¹, (1)The VERTEX Companies Inc., Air Quality Services, Kingston, NY

Adams Rackes, Student Member¹ and Michael S. Waring, Ph.D., Associate Member¹, (1)Drexel University, Philadelphia, PA

5. Airtightness of Buildings - Considerations Regarding the Zero-Flow Pressure and the Least Square Regression
Peter Wouters, Ph.D., Member¹ and Christophe Y. Delmotte², (1)Belgian Building Research Institute, Brussels, Belgium, (2)Belgian Building Research Institute, Limelette, Belgium

6. In-Situ, Real-Time and High Performance Optical Analyzer for Low Cost IAQ Diagnoses
Julie Delahaye, Ph.D.¹, Cyrrille Levy, F R E ng², Hélène Buée, F R E ng² and Johann Georges des Aulnois, F R E ng², (1)Engie, Saint-Denis, France, (2)Blue Industry and Science, Saint-Denis, M.E., France

7. Performance Validation of Low-Cost Air Quality Sensors
Donghyun Rim, Ph.D., Associate Member¹ and Amanda Green, Student Member¹, (1)Pennsylvania State University, University Park, PA

SEMINAR 9B: High Performance Buildings and Applications

Room: Roosevelt
Chair: Bjarne W. Olesen, Ph.D., Fellow ASHRAE, Technical University of Denmark, Kongens Lyngby, Denmark

Neal Walsh, Aeroseal LLC, Centerville, OH

2. IAQ Investigation of a Deployable US Army Low-Energy, High-Performance Building
Lauren Koban¹, Darius Javan² and Philip Dacunto, P.E.³, (1)United States Military Academy, West Point, NY

3. IAQ in Standard 189.1: Is It Really High Performance?
Andrew Persily, Ph.D., Member, National Institute of Standards and Technology, Gaithersburg, MD

4. Application of Low-Cost Particle Sensors for Monitoring of IAQ in Buildings
Mir Seliman Waez, Student Member¹, Steven Eckels, Ph.D., Member¹ and Christopher Sorensen, Ph.D.³, (1)Kansas State University, Manhattan, KS

5. Improving IAQ with an Innovative New Photo-Electrochemical Technology and Reducing Energy Consumption in Buildings
Dilip Goswami, Transformair, San Francisco, CA

SEMINAR 9C: IEQ and Health

Room: Presidential Ballroom
Chair: Wane Baker, Trane, La Crosse, WI

1. Wood Floorings Emissions and Their Effect on IAQ
Marco Fellin, Ph.D.¹ and Martino Negri, Ph.D.¹, (1)CNR-IVALSA, San Michele all'Adige, Italy

2. Managing Legionella and Dangerous Outbreaks with Preventative Maintenance
Ray Field, C Eng. Goodway Technologies, Stamford, CT
3. Classification of Building Dampness
Ed Light, Member1 and Veronica Stanley1, (1)Building Dynamics, LLC, Ashton, MD

Ed Light, Member1 and Veronica Stanley1, (1)Building Dynamics, LLC, Ashton, MD

5. Summary of Recent National Institute for Occupational Safety and Health (NIOSH) Health Hazard Evaluations (HHEs) in Schools
Nancy Clark Burton, Ph.D., Member3, Elena Page, M.D.1 and John Gibbins1, (1)CDC/NIOSH, Cincinnati, OH

Wednesday, September 14, 11:00 AM - 12:30 PM

CONFERENCE PAPER SESSION 10A: Modeling Air Movement and Pollutant Transport

Room: Kennedy
Chair: Lawrence Schoen, P.E., Fellow ASHRAE, Schoen Engineering Inc, Columbia, MD

Lisa Ng, Ph.D., Member1, Stuart Dols, Member3, Dustin Poppendieck, Ph.D.1 and Steven Emmerich, Member1, (1)National Institute of Standards and Technology, Gaithersburg, MD

James McGrath, Ph.D., National University of Ireland, Galway, Galway, Ireland

3. Passenger Vehicle Ventilation and Secondhand Smoke Particulate Measurements
David Bohac, P.E., Member1, Emily Waldhart1 and Zheng Zhou, Ph.D.3, (1)Center For Energy & Environment, Minneapolis, MN

4. The Study of Human Feelings about Cabin Air Quality
Susu Jia1, Junjie Liu, Ph.D., Member1 and Jian Kang1, (1)Tianjin University, Tianjin, China

5. Comparing Between CFD Simulation and Experimental Results of Wind Speed Conditions in Passages Between Residential Buildings
Fenghua Fan1 and Junjie Liu, Ph.D., Member1, (1)Tianjin University, Tianjin, China

STEERING COMMITTEE SESSION 10B: Continuous Assessment of IEQ using an Innovative Pre-/Post-Occupancy Evaluation Protocol for High Performance Buildings

Room: Roosevelt
Chair: Ihab Elzeyadi, Ph.D., HBDP, Member, University of Oregon, Eugene, OR; Todd DiNoia, Ph.D., Saint-Gobain Northboro Research and Development Center, Northboro, MA

1. Closing the Building Design-Operation Loop: Innovative Spatial IEQ Assessment Methods and Applications
Ihab Elzeyadi, Ph.D., HBDP, Member, University of Oregon, Eugene, OR

2. Collaborative IEQ Assessments for an Office Park Campus
Stanley Gatland II, Member, Saint Gobain Corporation, Philadelphia, PA
CONFERENCE PAPER SESSION 10C: Natural Ventilation

Room: Presidential Ballroom

Chair: Willem de Gids, VentGuide, Amsterdam Netherlands

1. Predicted Ventilation Rate and Thermal Comfort in a Naturally Ventilated Gymnasium in the Northeastern United States
Zheng Cheng, Student Member1, William Bahnfleth, Ph.D., P.E., Presidential Fellow ASHRAE2 and Lingling Li1, (1)Harbin Institute of Technology, Harbin, China, (2)Pennsylvania State University, University Park, PA

2. A Probabilistic Representation of Wind Data for Natural Ventilation Estimation
James Lo, Ph.D., Member, Drexel University, Philadelphia, PA

3. A Study on Airing Through the Porches of a Historical Church: Measurements and IDA-ICE Modelling
Abolfazl Hayati, Ph.D.1, Magnus Mattsson, Dr.Ing.2 and Mats Sandberg, Dr.Ing.3, (1)University of Gävle, Gävle, Sweden, (2)University of Gävle, SE-801 76 GÄVLE, Sweden, (3)Indoor Environment, University of Gävle, Gävle, Sweden, Gävle, Sweden

Wednesday, September 14, 12:30 PM -- 1:15 PM

CLOSING SESSION

Closing Remarks by Chair
Voting Session
Invitation to Future Conferences
Adjournment