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

Partner Organizations

SPONSORS

Gold Sponsor

Bronze Sponsors

Conference Sponsor

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 www.ashrae.org/app

Monday, September 12

	Presidential Ballroom	Kennedy	Roosevelt
8:00 AM – 8:30 AM	Opening Session		
8:30 AM– 9:00 AM	Keynote: Pawel Wargocki		
9:15 AM– 10:45 AM	Developing a Target Indoor Pollutants (TIP) List	Approaches and Tools for Better IAQ	Characterization of IAQ Performance of Products and Systems 1
10:45 AM – 11:15 AM	Morning break		
11:15 AM – 12:15 PM	Demand-controlled Ventilation: Assessment Method's and Potential	International Urban IAQ (China and India)	The Policymaker's Perspective: Exploring How Congress, the Federal Government, and States Strive to Improve IAQ
12:30 PM – 1:30 PM	Lunch		
1:30 PM – 2:00 PM	Keynote: Chris Pyke		
2:15 PM – 3:30 PM	Residential 1	Where Are We Going with IAQ Metrics?	Characterization of IAQ Performance of Products and Systems 2 / IAQ Impacts of Climate Change
3:30 PM – 4:00 PM	Afternoon break		
4:00 PM – 5:30 PM	IAQ Monitoring and Field Measurements Results	Capturing Contaminants for Residential Cooking	Healthy Homes: Introducing the Healthy Home Evaluator Credential

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

Pawel 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 Oaks[1] and Sara Cederberg, AIA[1], (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 Lee*[1] 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., Member*[1], John Shan, Ph.D.[2], Dimpy Daroch[3] and Tony Worthan, MPH[1], (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[1], **Alexander Sylvester, Student Member**[1], Ryan Huizing, P.Eng.[2], Steven Rogak, Ph.D., P.E.[1] and Sheldon Green, Ph.D., P.E.[1], (1)University of British Columbia, Vancouver, BC, Canada, (2)dPoint Technologies, Vancouver, BC, Canada*

2. Temperature-Based Ventilation Control
*Michael Lubliner, Member[1], Paul W. Francisco, Member[2], Brennan Less[3], Iain Walker, Ph.D., Fellow ASHRAE[4] and **Zachary Merrin, Member**[2], (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**[1] and Sean O'Brien, P.E., Member[1], (1)Simpson Gumpertz & Heger, New York, NY*

4. Personalized Ventilation: Personalized Exhaust Ventilation Strategy for Reducing the Risk of Airborne Cross Infection in Healthcare Centre Consultation Rooms
*Junjing Yang, Ph.D., Associate Member[1], **Chandra Sekhar, Ph.D., Fellow ASHRAE[1],** Kok Wai Cheong, Ph.D.[1] and Benny Raphael, Ph.D.[2], (1)National University of Singapore, Singapore, Singapore, (2)IIT Madras, Chennai, India*

5. Experimental Evaluation of the Pollutant Distribution in a Operating Theater of an University Hospital of Rome
*Annunziata D'Orazio, Ph.D.[1], Maria Pia Galea1, Fulvio Maddaloni[2], Leo Poggi[2] and **Marco Fellin, Ph.D.[3],** (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,** US 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 Gong**[1] 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 Val**[1] and Jean-Luc Savin[1], (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 Soh[2], Vivien Goh[2], Hooi Ming Yap[2], Yi Wang[1], Ramona A Gutiérrez[2], Lee Ching Ng[2], 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 Lamb[1], Shelley Pressley[1], Tom Jobson[1], Von Walden[1], Diane Cook[1], Madeline Fuchs[1], Patrick O'Keeffe[1], Yibo Huangfu[1], Nathan Lima[1] and Beiyu Lin[1], (1)Washington State University, Pullman, WA*

3. Climatic Adaptation via Simulation of Building Energy Performance
***Stamatis Zoras, Ph.D.**[1], Sotiris Veranoudis[1] and Argyro Dimoudi[1], (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

1. Development of a Nationally Representative Set of Combined Building Energy and IAQ Models for U.S. Residences
***Torkan Fazli, Student Member**[1] and Brent Stephens[1], (1)Illinois Institute of Technology, Chicago, IL*

2. Best Practices: Residential PM2.5 Exposure Interventions
***Terry Brennan, Member**[1] and Brent Stephens[2], (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., Member**[1], 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 McNeil[2], Timothy W. Bishop[1], 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 Ricketts[2] and Graham Finch, P.Eng., Associate Member[1], (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*

4. In Praise of Performance: Assessing IEQ Performance of a LEED Platinum Buildings Between Prediction and Verification
***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 Effiency 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

	Presidential Ballroom	Kennedy	Roosevelt
8:00 AM– 8:30 AM	Keynote: David Rowson		
9:00 AM– 10:30 AM	Evolution and State of the Art of the Residential Ventilation Standard for North America (ASHRAE 62.2)	General IEQ Issues	Characterization of IAQ Performance of Products and Systems 3
10:30 AM – 10:45 AM	Morning break		
10:45 AM – 12:00 PM	IEA EBC Annex 68 Project: IAQ Design and Control in Low Energy Residential Buildings	Future of IAQ Sensors and Controls	Practical Strategies for Achieving IAQ in High Performance Buildings
12:00 PM -1:00 PM	Lunch		
1:00 PM– 1:30 PM	Keynote: David Jacobs		
1:45 PM – 3:00 PM	IAQ Standards around the World: Where We Are and Where We Want to Be	Residential 2	Infiltration
3:00 PM – 3:30 PM	Afternoon break		
3:30 PM – 5:00 PM	Residential Paper Session	IAQ Metrics	Indoor Air Quality Association and ASHRAE: New Approaches to Government Affairs Advocacy

Tuesday, September 13, 8:00 AM – 8:30 AM

KEYNOTE 3

Public Health Priorities for Indoor Air Quality

Room: Presidential Ballroom

David Rowson, *US Environmental Protection Agency, Washington, DC*

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

1. Toward Making Ventilation Decisions Based on Expected Outcomes: A Flexible Multi-Criteria Framework
Adams Rackes, Student Member[1]*, Tom Ben-David, Student Member*[1] *and Michael S. Waring, Ph.D., Associate Member*[1]*, (1)Drexel 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 Firrantello, P.E., Member[1] *and William Bahnfleth, Ph.D., P.E., Presidential Fellow ASHRAE*[1]*, (1)Pennsylvania State University, University Park, PA*

4. Data Driven Persistent Monitoring of Indoor Air Systems
Sambuddha Ghosal[1]*, Chao Liu, Ph.D.*[1]*, Ulrike Passe, AIA, Associate Member*[1]*, Shan He*[1] *and Soumik Sarkar, Ph.D.*[1]*, (1)Iowa 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., Member[1]*, Marc Ábadie*[2]*, Menghao Qin*[3]*, John Grunewald*[4]*, Jakub Kolarik, Ph.D.*[1]*, Jelle Laverge*[5] *and Jianshun Zhang, Ph.D., Fellow ASHRAE*[6]*, (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 Mourshed, Ph.D.*[1]*, Yacine Rezgui, Ph.D.*[1] *and* ***Jonathan Reynolds***[2]*, (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., Member[1]*, Shihan Deng, Student Member*[1]*, Houston Lester*[1]*, James Bovaird, Ph.D.*[1]*, Lily Wang, Ph.D., 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*

3. Predicting IAQ in Low Energy Houses: The Role of Standard Testing and Benchmarking
***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 Riggs[1] and **Ed Baylosis**[1], (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

Tuesday, September 13, 1:45 PM – 3:00 PM

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.[1], *Jan Akander, Dr.Ing.*[1] *and Magnus Mattsson, Dr.Ing.*[2], *(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[1], *Jérémy Ferlay, P.Eng.*[1], *Thibaud Bello, P.Eng.*[1], *Evelyne Gonze, Ph.D., P.E.*[2] *and Monika Woloszyn, Ph.D., P.E.*[2], *(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[1], *Gaëlle Guyot, Ph.D., Member*[2] *and Valérie Leprince, Ph.D.*[3], *(1)Cerema DTer CE, Isle d'abeau, France, (2)Cerema DTer CE, Isle d'Abeau, France, (3)PLEIAQ, Meyzieu, France*

4. On the Origin of Leakage-Infiltration Ratios Previously Hidden By Means of Natural Obfuscation
Benjamin Jones[1], *Max H. Sherman*[2] *and Andrew Persily, Ph.D., Member*[3], *(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[1], *Wanyu Chan, Ph.D.*[2], *Brett Singer, Ph.D., Member*[2] *and Iain Walker, Ph.D., Fellow ASHRAE*[2], *(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
Davidge Warfield, OPMP, Member*, ASHRAE and IAQA, Wilmington, DE*

3. Population Impact Assessment Modeling Framework (PIAMF): Evaluating the Effects of Infiltration, Ventilation, and Filtration, on PM2.5 Exposure in US Housing Stock
Brett Singer, Ph.D., Member[1], *Wanyu Chan, Ph.D.*[1], *Jennifer Logue, Ph.D.*[1], *Neil Klepeis, Ph.D.*[2] *and Max H. Sherman*[3], *(1)Lawrence Berkeley National Laboratory, Berkeley, CA, (2)Center for Behavioral Epidemiology and Community Health, San Deigo, 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[1], *Douglas Black, Ph.D.*[1], *Hugo Destaillats, Ph.D.*[2], *Woody Delp, Ph.D.*[1] *and Iain Walker, Ph.D., Fellow ASHRAE*[1], *(1)Lawrence Berkeley National Laboratory, Berkeley, CA, (2)Lawrence Berkley National Laboratory, Berkley, 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**, US 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., Ghent University, Gent Belgium

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

2. Empirical Predictive Modeling of the Impact of Ventilation and Filtration on Energy Cost and Monetized IAQ Exposure in Offices in the U.S
***Tom Ben-David, Student Member**[1] and Michael S. Waring, Ph.D., Associate Member[1], (1)Drexel University, Philadelphia, PA*

3. Characterizing IAQ Performance Using a Graphical Approach
***Kevin Teichman, Ph.D.**[1], Andrew Persily, Ph.D., Member[2] and Steven Emmerich, Member[2], (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, Member[1], *Scott Pigg, Member*[2], *Dan Cautley, Member*[2], *William B. Rose, Fellow ASHRAE*[1], *David Jacobs, Ph.D., Member*[3] *and Salvatore Cali*[4], *(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 ASHRAE[1], *Max H. Sherman*[2], *Brett Singer, Ph.D., Member*[1], *Woody Delp, Ph.D.*[1] *and Chris Stratton*[1], *(1)Lawrence Berkeley National Laboratory, Berkeley, CA, (2)Lawrence Berkeley Laboratory, Berkeley, CA*

3. PM2.5 in Dutch Dwellings and the Effect of Mitigation Actions
Piet Jacobs[1], ***Wouter Borsboom***[1] *and Richard Kemp*[1], *(1)TNO, Delft, Netherlands*

4. Are Residential Whole House Mechanical Ventilation Systems Reliable Enough to Mandate Tight Homes?
Jeffrey K. Sonne[1], *Charles R. Withers*[1] *and Robin K. Vieira*[1], *(1)Florida Solar Energy Center, Cocoa, FL*

5. The Latest Developments in Residential Combustion Safety Testing
Paul W. Francisco, Member[1], *Larry Brand, Member*[2], *Dan Cautley, Member*[3], *Brett Singer, Ph.D., Member*[4] *and Stacy Gloss*[1], *(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, Member[1] *and Iain Walker, Ph.D., Fellow ASHRAE*[2], *(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 Scarborough[1] *and Cole Stanton*[2], *(1)ASHRAE, Washington, DC, (2)Indoor Air Quality Association, Atlanta, GA*

Wednesday, September 14

	Presidential Ballroom	Kennedy	Roosevelt
8:00 AM– 8:30 AM	Keynote: Howard Wolf		
8:45 AM– 10:30 AM	IEQ and Health	Ventilation and IAQ Measurement Methods	High Performance Buildings and Applications
10:30 AM – 11:00 AM	Morning break		
11:00 AM – 12:30 PM	Natural Ventilation	Modeling Air Movement and Pollutant Transport	Continuous Assessment of IEQ using an Innovative Pre-/Post-Occupancy Evaluation Protocol for High Performance Buildings
12:30PM -1:15 PM	Closing Session		

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*

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 Cooper**[1] and Kathleen Cooper[1], (1)The VERTEX Companies Inc., Air Quality Services, Kingston, NY*

4. Spatial Resolution and Sensor Accuracy in Networks for Routine IAQ Monitoring: Are More Sensors Better?
***Adams Rackes, Student Member**[1] and Michael S. Waring, Ph.D., Associate Member[1], (1)Drexel University, Philadelphia, PA*

5. Airtightness of Buildings – Considerations Regarding the Zero-Flow Pressure and the Least Square Regression
***Peter Wouters, Ph.D., Member**[1] and Christophe Y. Delmotte[2], (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], Cyrille Levy, FREng[1], Hélène Buée, FREng[1] and Johann Georges des Aulnois, FREng[2], (1)Engie, Saint-Denis, France, (2)Blue Industry and Science, Saint-Denis, ME, France*

7. Performance Validation of Low-Cost Air Quality Sensors
***Donghyun Rim, Ph.D., Associate Member**[1] and Amanda Green, Student Member[1], (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

1. Ventilation Rehabilitation in Existing Buildings. Innovations Spark New Trend in NYC Building Retrofitting
***Neal Walsh**, Aeroseal LLC, Centerville, OH*

2. IAQ Investigation of a Deployable US Army Low-Energy, High-Performance Building
***Lauren Koban**[1], Darius Javan[1] and Philip Dacunto, P.E.[1], (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 Member**[1], Steven Eckels, Ph.D., Member[1] and Christopher Sorensen, Ph.D.[1], (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, CEng**, Goodway Technologies, Stamford, CT*

3. Classification of Building Dampness
Ed Light, Member[1] *and Veronica Stanley*[1]*, (1)Building Dynamics, LLC, Ashton, MD*

4. Critical Review of ASHRAE Standards Addressing VOC Mixtures
Ed Light, Member[1] *and Veronica Stanley*[1]*, (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., Member[1]*, Elena Page, M.D.*[1] *and John Gibbins*[1]*, (1)CDC/NIOSH, Cincinnati, OH*

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

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

1. Evaluating IAQ and Energy Impacts of Ventilation in a Net-Zero Energy House Using a Coupled Model
Lisa Ng, Ph.D., Member[1]*, Stuart Dols, Member*[1]*, Dustin Poppendieck, Ph.D.*[1] *and Steven Emmerich, Member*[1]*, (1)National Institute of Standards and Technology, Gaithersburg, MD*

2. A Computational Evaluation of the Impacts of Radon Concentrations in Energy Retrofit Buildings in Ireland
James McGrath, Ph.D.*, National University of Ireland, Galway, Galway, Ireland*

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

4. The Study of Human Feelings about Cabin Air Quality
Susu Jia[1]*, Junjie Liu, Ph.D., Member*[1] *and Jian Kang*[1]*, (1)Tianjin University, Tianjin, China*

5. Comparing Between CFD Simulation and Experimental Results of Wind Speed Conditions in Passages Between Residential Buildings
Fenghua Fan[1] *and Junjie Liu, Ph.D., Member*[1]*, (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 Corportation, 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 Member[1], **William Bahnfleth, Ph.D., P.E., Presidential Fellow ASHRAE**[2] and Lingling Li[1], (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 GÃ„VLE, Sweden, (3)Indoor Environment, University of Gävle, Gavle, Sweden, Gavle, Sweden*

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

CLOSING SESSION

Closing Remarks by Chair

Voting Session

Invitation to Future Conferences

Adjournment