

ASHRAE IAQ 2013

Environmental Health in Low Energy Buildings October 15 - 18, 2013 Vancouver, British Columbia, Canada

Co-sponsored by ISIAQ

Tuesday October 15th

5:00 – 6:30 PM

Are We Putting Enough Energy into Making Buildings Healthy?

William Bahnfleth, Ph.D., P.E., Fellow ASHRAE, ASME Fellow, Pennsylvania State University, 2013–14 ASHRAE president

Wednesday, October 16

8:00 – 9:00 AM

Do We Know Much about Low Energy Buildings and Health?

Mark J. Mendell, Ph.D., Lawrence Berkeley National Laboratory and California Department of Public Health

Morning Parallel Technical Sessions (9:10 – 10:50 AM)

Environmental Health in Low Energy Buildings

Indoor Air Quality in High-Performing Building Case Studies: A Wealth of Intent, A Dearth of Data

Kevin Teichman, Ph.D., Andrew Persily, Ph.D., Fellow ASHRAE and Steven Emmerich, Member

Benefits of Improved Residential Regulations on Reducing Outdoor Particulate Matter Indoors in Canada

Zuraimi Sultan, Ph.D., Member, David Alas and Zhongchao Tan, Ph.D., P.E., Member

Natural Ventilation in California Offices: Estimated Health Effects and Economic Consequences

Spencer Dutton, Ph.D., David Banks, Ph.D., Member, Samuel. L Brunswick, Student Member and William. J. Fisk, P.E., Fellow ASHRAE

Panel Discussion - Environmental Health in Low Energy Buildings

Mark J. Mendell, Ph.D., Lawrence Berkeley National Laboratory, Kay Kreiss, M.D., National Institute for Occupational Safety and Health, & William. J. Fisk, P.E., Lawrence Berkeley National Laboratory

Air Cleaning and Filtration

Assessment of Two Control Strategies for Reducing Human Exposure to Airborne Particles while Sleeping in Low-Energy Homes

Jordan D. Clark, Student Member, Atila Novoselac, Ph.D., Member and Richard L. Corsi, Ph.D., P.E., Member,

Inefficiency of Passive Plant-Based Systems for Indoor Air Cleaning

Benjamin Hanoune, Ph.D., Mélanie Nicolas, Ph.D., Julien Guilhot, Ph.D., Gaëlle Bulteau, Ph.D., Marie-Amélie Cuny, Ph.D. and Damien Cuny, Ph.D.

Stand-Alone Air Filters Improve Indoor Air Quality in a First Nations Community

Gary Mallach, Scott Weichenthal, Ryan Kulka, Amanda Wheeler, Hongyu You, Melissa St-Jean, Andrew Black and Donald Sharp, Ph.D.

Effectiveness of an In-Duct Electrostatic Precipitator in Nanoparticle Removal with Consideration of Ozone Emissions

Donghyun Rim, Ph.D., Dustin Poppendieck, Ph.D., Lance A. Wallace, Ph.D. and Andrew K. Persily, Ph.D., Member

The Relationship between Filter Pressure Drop, Indoor Air Quality, and Energy Consumption in Rooftop HVAC Units

Marwa Zaatari, Student Member, Jeffrey Siegel, Member and Atila Novoselac, Member

Mid-Morning Parallel Technical Sessions (11:10AM – 12:30 PM)

Commercial and Institutional Buildings (Part 1)

Indoor Environmental Quality, Occupants' Perception, Prevalence of SBS Symptoms and Sick Leave in a Green Mark Platinum versus a Non-Green Mark Rated Building

Kwok Wai Tham, Ph.D., Pawel Wargocki, Ph.D., Member and Sheryl Tan

The IAQ and Energy Impacts of Reducing Formaldehyde Emissions in Commercial Buildings

Lisa C. Ng, Ph.D., Associate Member, Andrew K. Persily, Ph.D., Member, Steven Emmerich, Member and Kevin Teichman, Ph.D.

Formaldehyde Concentrations and Control in Retail Buildings

Éléna L. Nirlo, Student Member, Neil Crain, Ph.D., Richard Corsi, Ph.D., P.E., Member and Jeffrey A. Siegel, Ph.D., Member

Impact of PM 2.5 on Low Energy Buildings and Indoor Air Quality

Luke Leung, P.E., Member, Sergio Sadaba, Jason Kirkpatrick, Associate Member and Ray Clark

Tools (Models, Measurements and More) (Part 1)

Robust Climate Design Combines Energy Efficiency with Occupant Health and Comfort

Stanley R. Kurvers, P.Eng., Arjen Raue, P.Eng., Joe L. Leyten, P.Eng., Eric. R. van den Ham, P.Eng. and Sarah Juricic

Environmental Control and Sick Building Syndrome: A Low Carbon Open Plan vs. a Cellular Plan Workplace

Sally S. Shahzad, Ph.D., John Brennan, P.E. and Dimitris Theodossopoulos, Ph.D., P.E.

Integration of Dynamic Ventilation and Air Cleaning for Healthy Environments in a Low Energy Building

KwangHoon Han, Ph.D., Associate Member and Jensen Zhang, Ph.D., Fellow ASHRAE

Critical Sensible and Latent Effectiveness for Membrane Type Energy Recovery Ventilator (ERV) in Cold Climates

Peng Liu, Hans Martin Mathisen, Dr.Ing. and Maria Justo Alonso

Afternoon Parallel Technical Sessions (1:30 – 3:00 PM)

Commercial and Institutional Buildings (Part 2)

Optimizing Classroom Ventilation Rates: Impact of Substandard Ventilation on Student Academic Achievement

Ulla P. Haverinen-Shaughnessy, Ph.D. and Richard Shaughnessy, Ph.D.

Low Energy Design and Improved IAQ in Healthcare

Paul Marmion, P.Eng., Life Member and Ray Pradinuk

Low Carbon vs. Victorian School Design: Indoor Air Quality, Energy and Health Responses

Lia Chatzidiakou, Dejan Mumovic, Alex J. Summerfield, Ph.D. and Sung Min Hong

ASHRAE/IES Standard 90.1-2013: Changes and Potential Impacts on Indoor Environmental Quality

John Hogan, P.E., Member

Moisture and Health

β -N-acetylhexosaminidase as a Marker of Fungal Cell Biomass

Ragnar Rylander, M.D. and Thomas Hulander, Dr.Ing., P.Eng.

Comparative Effectiveness of Heat and Energy Recovery Ventilators at Improving Indoor Air Quality and Ventilation Rates in Canadian Single Family Homes with Asthmatic Children

Daniel G. Aubin, Ph.D., Doyun Won, Ph.D., Hans Schleibinger, Ph.D., Pierre Lajoie, M.D., Denis Gauvin, Member, Veronique Gingras and Don Fugler, P.Eng.

Fungal Exposure in Homes of Patients with Sarcoidosis and Asthma

Ragnar Rylander, M.D., Marjeta Terceelj, M.D., Barbara Salobir, M.D., Life Member, Mirjana Zupancic, M.D. and Zoltan Narancsik, M.D.

Indoor Moisture Conditions in Multifamily Dwellings: Measurements and Analysis

Hans Bagge, Ph.D. and Dennis Johansson, Ph.D.

Wednesday Afternoon Extra Session (3:30-4:15 PM oral summaries, 4:15-6:15 PM posters)

Predicting the Performance of Gaseous Air Cleaners: Modeling and Validation

Mitra Bahri, Student Member, Vida Safari, Damon Matthews, Ph.D., Fariborz Haghighat, Ph.D., P.E., Fellow ASHRAE and Ali Gholizadeh Touchaei

Performance of Thermal-catalytic Oxidization Technology for Formaldehyde Removal at Typical Indoor Environment

Xu Han, Student Member, Jingjing Pei, Ph.D., Associate Member, Yi Lu, Student Member and Zhiqiang Wang, Ph.D.

Development and Validation of a Laboratory-Scale Air Handling Unit (AHU) for the Study of Aerosols Behaviour on Prototype Fibrous Filters

Luisa F. González, Aurélie Joubert, Ph.D., Claire Delahaye, P.E., Yves Andrès, Ph.D., Nelsie Berthelot, Ph.D., Xavier Chaucherie, M.D. and Laurence Le Coq, Ph.D.

Costs and Benefits of Improved HVAC Air Filtration

James F. Montgomery, Student Member, Steven N. Rogak, Ph.D. and Sheldon I. Green, Ph.D.

Health Risk of Formaldehyde and Acetaldehyde Formation in HVAC Integrated UV-PCO Air Cleaner

Donya Farhanian, Student Member and Fariborz Haghighat, Ph.D., Fellow ASHRAE

Modeled Air Quality and Energy Use Impacts of UVGI for Cooling Coil Biofouling Mitigation

Joseph Firrantello, P.E., Associate Member, Jason DeGraw, Ph.D., Associate Member and William Bahnfleth, Ph.D., P.E., Fellow ASHRAE

Energy Savings Potential of Controlling Residential Whole-House Ventilation System Operation Based on Outside Temperature

Michael R. Lubliner, Member

Reducing the Cost of Comfort in K-12 Schools through Computer Simulation

Patrick Wilkinson, P.E., Member, Dean Perry, Member and Helen Lieng, Member

Modeling Gaseous Pollutant Distribution using the Zonal Approach: Case Study of an Office Space

Katia Cordeiro Mendonca, Ph.D., Marc Olivier Abadie and Patrice Blondeau

Sensor Placement for Predicting Airflow Around Buildings to Enhance Natural Ventilation

Maria Papadopoulou, Student Member, Benny Raphael, Ph.D., Chandra Sekhar, Ph.D., Fellow ASHRAE and Ian F.C. Smith, Ph.D.

Effect of Air Distribution Methods on Solid Particle Dispersion in Rooms with Forced Ventilation

Andrius Jurelionis, Lina Seduikyte, Laura Gagyte, Tadas Prasauskas, Edvinas Krugly, Darius Ciuzas and Dainius Martuzevicius

Information Tools to Manage and Improve Laboratory Ventilation Systems

James Coogan, P.E., Member

Manual for Indoor Air Environment and Ventilation in Schools

Asako Hasegawa, Ph.D., Member, Hiroshi Yoshino, Ph.D., Fellow ASHRAE, Satoru Muramatsu, Satoru Nagasawa, Takashi Kurabuchi, Ph.D., Yasushi Kondo, Ph.D., Hiroki Kitayama, Akihiro Nagata, Go Iwashita, Ph.D., Yukari Iino and Tomonobu Goto

A Review of Continuous Indoor Air Quality and Energy Consumption Measurements and Challenges

Jukka-Pekka Skön, Mika Raatikainen and Mikko Kolehmainen

A Review of Home Automation Systems and Communication Protocols, Case: Comparison of Suitable Home Automation Systems for Research Project Purposes in Residential Buildings

Mika Raatikainen, Jukka-Pekka Skön and Mikko Kolehmainen

Influence of Factors on Microbial Growth on Ventilation Air Filter Media

Junjie Liu, Ph.D. and Qian Li, Student Member

Thursday, October 17

8:00 – 9:00 AM

Building Energy and Reactivity

Richard Corsi, Ph.D., P.E. University of Texas, Austin, Indoor Air 2011 president

Morning Parallel Technical Sessions (9:10-1050 AM)

Sources and Chemistry

On-site Dynamic Study of Indoor VOCs Emissions from Material in New High Environmental Quality Buildings

Valérie Desauziers Sr., Ph.D., Delphine Bourdin, Christophe Cantau, Ph.D. and Pierre Mocho Sr., Ph.D.

Pollutants Characterization in Low Energy Public Buildings in France

Coralie Schoemaeker, Hanoune Benjamin, Nadine Locoge, Marie Verrière, Nathalie Leclerc and C. Schneider

Phthalates and Polybrominated Diphenyl Ethers in Retail Stores

Ying Xu, Ph.D., Member, Jorge Urquidi, Student Member, Yirui Liang, Student Member and Jeffrey Siegel, Ph.D., Member

Impact of Residential Weatherization on Indoor Secondary Organic Aerosol and Total Organic Aerosol Concentrations

Michael S. Waring, Ph.D., Associate Member

The Influence of Scale on Surface Resistance to Ozone Reactions with Building Surfaces

Dustin Poppendieck, Ph.D.

Tools (Models, Measurements and More) (Part 2)

An Innovative Low Cost IR System for Real-Time Measurement of Human Thermal Comfort

Gian Marco Revel, Ph.D., P.E., Marco Arnesano, Dr.Ing., P.Eng. and Filippo Pietroni, Dr.Ing

Tracking Long-Term Occupant IEQ Outcomes: A Longitudinal Survey Tool

Jared Langevin, Student Member, Patrick L. Gurian, Ph.D. and Jin Wen, Ph.D., Member

Sensitive Homes: Remote Sensing and Monitoring Integral to Homes

Loveleen Atwal, Student Member, Rodrigo Mora, Ph.D., Associate Member and Gamal Mustapha

A Graphical Approach to Evaluating High-Performing Buildings: Indoor Air Quality, Energy, Water, and Waste

Kevin Teichman, Ph.D., Andrew K. Persily, Ph.D., Member and Steven Emmerich, Member

IEQ Research Needs for Low Energy Homes

Tom Phillips and Hal Levin, Fellow ASHRAE

Mid-Morning Parallel Technical Sessions (11:10 AM-12:30 PM)

Microorganisms and Infection

Dissemination of Exhaled Plumes During the Use of Nasal Cannulae and Simple Oxygen Masks by Healthy Volunteers – Potential Issues for Low Energy Healthcare Institutions

Julian Wei-Tze Tang, M.D., Gerald Koh, M.D., Andre Nicolle, Ph.D., Christian Klettner, Ph.D., Liang De Wang, Ashlynn Y.L. Tan, Muhammad Amin, David Cheong, Ph.D., Member, Chandra Sekhar, Ph.D., Member and Kwok Wai Tham, Ph.D.

CFD Analysis to Assess Performance Variability of In-Duct UV-C Systems

Azael Capetillo, Cath Noakes, Ph.D., P.E., Member and P.A. Sleigh, Dr. Ing.

Optimizing Upper-Room UVGI Systems for Infection Risk and Energy

Catherine Noakes, Ph.D., P.E., Amirul Khan, Ph.D. and Carl Gilkeson, Ph.D.

Residential Buildings (Part 1)

Building Design and Operational Choices that Impact Indoor Exposures to Outdoor Particulate Matter inside Residences

Brent Stephens, Ph.D., Associate Member, Illinois Institute of Technology, Chicago, IL

Effectiveness of Ventilation Interventions at Improving Indoor Air Quality and Ventilation Rates in Canadian Single Family Homes with Asthmatic Children

Daniel G. Aubin, Ph.D., Doyun Won, Ph.D., Hans Schleibinger, Ph.D., Pierre Lajoie, M.D., Denis Gauvin, Veronique Gingras and Don Fugler, P.Eng.

Environmental Factors Associated with the Winter-Season Microorganisms Found in Single Family Residences

Shelly L. Miller, Ph.D., Member, Patricia B. Keady, Jonathan Awerbuch, Oluwaseun S. Oyatogun, Suraj Prabhu, Noah Fierer, Ph.D., Joanne B. Emerson, Ph.D., Rob Dunn, Ph.D. and Holly Menninger, Ph.D.

Relationships Between Indoor Environmental Quality Parameters and Energy Related Parameters: Measurements from 72 Apartments in Sweden

Dennis Johansson, Ph.D. and Hans Bagge, Ph.D.

Afternoon Parallel Technical Sessions (1:30-3:00 PM)

IEQ Factor Interactions (Part 1)

The Interaction and Connection between Buildings, HVAC System, and Indoor Environmental Quality

Robert Bean PL(Eng.) R.E.T., Member

Experimental Characterization of the Human Convective Boundary Layer in a Calm Indoor Environment

Dusan Z. Licina, Student Member, Know Wai Tham, Ph.D., Chandra Sekhar, Ph.D., Fellow ASHRAE and Jovan Pantelic, Ph.D.

A Novel Energy Efficient Demand-Based Ventilation System for Critical Contaminant and Overall IAQ Control

Korbaga F. Woldekidan, Student Member, Jianshun Zhang, Ph.D., Fellow ASHRAE and Yan Lu, Ph.D.

Workshop - Low Energy Hospitals – Potential Risks and Solutions for Good Infection Control

Julian Tang (University of Alberta), Yuguo Li (University of Hong Kong), Cath Noakes (University of Leeds), Michael Hodgson (OSHA)

Thursday Afternoon Extra Session (3:30-4:15 PM oral summaries, 4:15-6:15 PM posters)

Impacts of Different Air Conditioning Schemes on Indoor Air Quality, Energy Consumption, Environmental Emissions and Economics of a Small Office Building in a Hot-Humid Climate

Ahmed H. Abdel-Salam, Student Member, Mohamed R.H. Abdel-Salam, Melanie T. Fauchoux, Ph.D., Associate Member, Gaoming M. Ge, Ph.D. and Carey J. Simonson, Ph.D., P.E., Member

Human-Environment Interaction: Potential Use of Pupil Size for Visual Environmental Controls

Joon-Ho Choi, Ph.D., Member, Rui Zhu, Student Member and Angella Johnson, Student Member

Proof of Concept Build Tight, Ventilate Right

Jelle Laverge and Arnold Janssens, Ph.D., Member

Energy Savings and IAQ Associated with System Efficiency Improvements in Iowa's HVAC SAVE Program

Scott W. Yee and J. Baker

Measurement of the Thermal Environment in Transitional Settlements with High Building Density after 2008 Wenchuan Earthquake in China

Luhong Huang, Ph.D., Enshen Long and Jinlong Ouyang

Airflow in High-rise Multi-unit Residential Buildings with Respect to Ventilation and IAQ

Lorne Ricketts, Student Member and Graham Finch, P.Eng., Associate Member

Elevated Radon in Concrete Residential Buildings

Henry H. Slack, Member and Janise Palmer

Energy Performance of the Residential Buildings: Evaluation of Air Tightness and Prediction of Indoor Environmental Quality

Lina Seduikyte, Jolanta Sadauskiene, Dr.Ing., Valdas Paukstys, Dr.Ing., Andrius Jurelionis, Dr.Ing., Dainius Martuzevicius, Ph.D. and Tadas Prasauskas

Thermal Environment in Panel Residential Buildings After Refurbishment

Hana Pustayova and Dusan Petras, Ph.D., Member

Measured Impact of Ventilation Rate Determination Strategy on IAQ Parameters

Paul W. Francisco, Member, Salvatore Cali, David Jacobs, Ph.D., Member, William B. Rose, Fellow ASHRAE, Zachary Merrin and Loreen Targos

HVAC Ventilation Stops for Building Energy Saving: Consequences on Microbial Air Quality Downstream Lab-scale Filters

Audrey Forthomme, Aurélie C. Joubert, Yves Andrès, Xavier Simon, Philippe Duquenne, Denis Bemer and Le Coq Laurence

Determination of Radon Exhalation Rates from Construction Materials using VOC Emission Test Chambers

Matthias Richter, Dr.Ing. and Oliver Jann, Dr.Ing

A Simulation Tool for Semivolatile Organic Compounds in Buildings

Zhishi Guo, Ph.D., U.S. EPA, Research Triangle Park, NC

Passive Removal of Secondary Pollutants due to Squalene Oxidation in a Primary School: A Mathematic Analysis

Shichao Liu, Student Member and Atila Novoselac, Ph.D., Member

Ensuring Thermal Comfort in Low Energy Buildings with Numerical Simulations

Conrad Voelker, Dr.Ing. and Oliver Kornadt

Friday, October 18

8:00 – 9:00 AM

What Can Europe Teach Us?

Pawel Wargocki, Ph.D., Danish Technical University, ISIAQ president

Morning Parallel Technical Sessions (9:10-10:30 AM)

IEQ Factor Interactions (Part 2)

Advanced Integrated Indoor Air Quality and Thermal Air Movement Strategies

Adams Rackes, Student Member and Michael S. Waring, Ph.D., Associate Member

The Impact of Windows on Thermal Comfort

Brittany Hanam, P.Eng., Associate Member and Susan Hayes, P.Eng., Associate Member

Contaminant Transport in Membrane Based Energy Recovery Ventilators

Ryan Huizing, P.Eng., Hao Chen, Ph.D. and Frankie Wong

Residential Buildings (Part 2)

Indoor Air Quality and Ventilation in Residential Deep Energy Retrofits

Iain Walker, Ph.D., Fellow ASHRAE and Brennan Less, Student Member

Improving Energy Efficiency of Housing Stock: Demonstration of Impacts on Indoor Environmental Quality and Public Health in Northern Europe

Dainius Martuzevicius, Tadas Prasauskas, Mari Turunen, Virpi Leivo, Anu Aaltonen, Edvinas Krugly, Darius Ciuzas, Maria Pekkonen, Mihkel Kiviste, Lina Seduikyte and Ulla Haverinen-Shaughnessy

Bedroom IAQ: Where Do We Stand?

Jelle Laverge, Marc Delghust and Arnold Janssens, Ph.D., Member

An Investigation of Indoor Air Quality in UK Energy Efficient Homes: A Case Study

Grainne McGill, Student Member, Menghao Qin, Dr.Eng. and Lukumon Oyedele

ASHRAE IAQ 2013 Closing Session (11:00 AM-12:00 PM)

ASHRAE IAQ 2013 Conference Steering Committee Co-Chairs

Steven Emmerich, National Institute of Standards and Technology, Gaithersburg, MD USA

Hal Levin, Building Ecology Research Group, Santa Cruz, CA USA

ASHRAE IAQ 2013 Conference Steering Committee

Jean Cox-Ganser, National Institute for Occupational Safety and Health, Morgantown, WV USA

Paul Francisco, University of Illinois at Urbana-Champaign, Urbana-Champaign, IL USA

Michael Hodgson, Occupational Health and Safety Administration, Washington DC USA

Michael Humphreys, Oxford Brookes University, Oxford ENGLAND

Mark Jackson, University of Texas, Austin TX USA

Kay Kreiss, National Institute for Occupational Safety and Health, Morgantown, WV USA

Yuguo Li, University of Hong Kong, Hong Kong CHINA

Glenn Morrison, Missouri University of Science & Technology, Rolla MO USA

Larry Schoen, Schoen Engineering, Columbia MD USA

Chandra Sekhar, National University of Singapore, SINGAPORE

Max Sherman, Lawrence Berkeley National Laboratory, Berkeley CA USA

Jeffrey Siegel, University of Toronto, Toronto, ON CANADA

Dennis Stanke, Trane, La Crosse, WI USA

Zuraimi Sultan, National Research Council, Canada, Ottawa CANADA

Pawel Wargocki, Technical University of Denmark, Kongens Lyngby, DENMARK

Jianshun Zhang, Syracuse University, Syracuse NY USA

Thomas Kuehn, University of Minnesota, Minneapolis, MN USA - ASHRAE CEC Liaison

Special thanks and recognition to those not on the IAQ 2013 steering committee that assisted in the technical peer review of IAQ 2013 Conference Papers and Extended Abstracts:

Dr. Alireza Afshari, Chalmers University – Technology, Goteborg SWEDEN

Dr. Edward Arens, Lawrence Berkeley National Laboratory, Berkeley CA

Rahul Athalye, Pacific Northwest National Laboratory, Richland WA

Parham Azimi, Illinois Institute of Technology

Dr. Marilyn Black, UL Air Quality Sciences, Atlanta GA, Chicago, IL

Dr. Gail Brager, University of California, Berkeley CA

Wenhao Chen, California Dept. of Public Health, Richmond CA

Dr. Joon-Ho Choi, University of Southern California, Los Angeles CA

Josh Eddy, Big Ass Fans, Lexington KY

Dr. Elliott Gall, University of Texas, Austin TX

William Fisk, Lawrence Berkeley National Laboratory, Berkeley CA

Anthony Floyd, City of Scottsdale, Scottsdale AZ

Glenn Friedman, Taylor Engineering, Alameda, CA

Klas Haglid, Haglid Engineers and Associates, Ridgewood NJ

Roger Hedrick, Architectural Energy Corporation, Boulder CO

Dr. Andrew Hoisington, US Air Force Academy, Colorado Springs CO

Gemma Kerr, InAIR Environmental Ltd., Ottawa, ON CANADA

Dr. Essam Khalil, Cairo University, EGYPT

Hummy Khan, Howard County Public School System, Ellicott City MD

Shahana Khurshid, University of Texas, Austin TX

Jelle Laverge, Ghent University, Ghent BELGIUM

Dr. Tom Lawrence, University of Georgia, Athens GA

Jim Lewis, Maryland Department of the Environment, Baltimore MD

Richard Lord, Carrier Corporation, Murfreesboro TN

Dr. William McCoy, Phigenics, Naperville IL

Jon McHugh, McHugh Energy Consultants Inc., Fair Oaks, CA

Lan Chi Nguyen Weekes, InAIR Environmental Ltd., Ottawa, ON CANADA

Dr. Liam O'Brien, Carleton University, Ottawa ON CANADA

Dr. Andrew Persily, National Institute of Standards and Technology, Gaithersburg MD

Dr. Wan Man Pun, Nanyang Technological University, SINGAPORE

Dr. Lew Radonovich, US Department of Veterans, Washington DC

Dr. Harvey Sachs, American Council for an Energy Efficient Economy, Washington DC

Dr. Stefano Schiavon, Lawrence Berkeley National Laboratory, Berkeley CA

Peter Simmonds, IBE Consulting Engineers, Marina Del Rey CA

Dr. Brent Stephens, Illinois Institute of Technology, Chicago IL

Dr .Yuexia Sun, University of Texas, Tyler TX

Dr. Iain Walker, Lawrence Berkeley National Laboratory, Berkeley CA

Dr. Jiping Zhu, Health Canada, Ottawa ON CANADA