Curriculum Vitae

Brent Stephens, Ph.D.
Professor of Architectural Engineering and Department Chair
Department of Civil, Architectural, and Environmental Engineering
Illinois Institute of Technology
3201 South Dearborn Street
Alumni Memorial Hall 228E
Chicago, IL 60616
Phone: (312) 567-3629
Email: brent@iit.edu

Director, Built Environment Research Group
Web: http://www.built-envi.com
Twitter: @built_envi

May 2020

Table of Contents

1 Curriculum Vitae

1.1 Demographic information

Name:	Brent Stephens, Ph.D.
Title:	Professor and Department Chair
Department:	Department of Civil, Architectural, and Environmental Engineering
Program(s):	Architectural Engineering and Environmental Engineering
Campus address:	Illinois Institute of Technology 3201 S Dearborn Street Alumni Memorial Hall Room 228E Chicago, IL 60616 Office: (312) 567-3629 E-mail: brent@iit.edu Research group website: http://built-envi.com

1.2 Education

Doctor of Philosophy:	University of Texas at Austin
Department:	Civil Engineering
Date:	May 2012
Dissertation title:	"Characterizing the impacts of air-conditioning systems, filters, and building envelopes on exposures to indoor pollutants and energy consumption in residential and light-commercial buildings"
Honors:	Thrust 2000 Endowed Fellowship (2007-2011) National Science Foundation IGERT Trainee Fellowship (2009-2011) Graduate School Continuing Fellowship (2011-2012)
Master of Science:	University of Texas at Austin
Department:	Environmental and Water Resources Engineering
Date:	May 2009
Thesis title:	"Energy implications of filters in residential and light-commercial HVAC systems"
Honors:	Thrust 2000 Endowed Fellowship (2007-2011) ASHRAE Graduate Student Grant-in-Aid (2008)
Bachelor of Science:	Tennessee Technological University
Department:	Civil Engineering
Date:	May 2007
Honors:	University Service Scholarship (2002-2006) Asia Khatun Endowment Scholarship (2005) J.R. Wauford Scholarship (2006)

1.3 Professional history

Time period:	August 2012 – Present
Titles:	Professor (2020-present) Department Chair (2018-present) Associate Professor (2016-2020) Assistant Professor (2012-2016)
Institution:	Illinois Institute of Technology (IIT)
Department:	Department of Civil, Architectural and Environmental Engineering (CAEE)
Programs:	Architectural Engineering (ARCE), Environmental Engineering (ENVE)
Responsibilities:	Responsibilities in this position, excluding Chair duties, primarily include: building an externally funded research group, the Built Environment Research Group (http://built-envi.com); serving as Principal Investigator on externally funded research projects; supervising and mentoring postdoctoral, graduate, and undergraduate researchers; teaching undergraduate and graduate courses in civil, architectural, and environmental engineering; advising undergraduate and graduate students; developing and writing research proposals; writing and editing manuscripts for publication in peer-reviewed journals; presenting research results at national and international conferences, universities, national laboratories, and other industry, academic, and professional communities; serving as a peer reviewer for journals, conferences, and proposal panels; serving on departmental and university committees; and networking within the city of Chicago and beyond to promote research and education in CAEE at IIT. From 2016 to 2018, I served alongside Professor Jamshid Mohammadi and Associate Professor Paul Anderson on the CAEE department's Transition Leadership Team (appointed by Armour College of Engineering Dean DePaola) to manage the everyday affairs of the department and to focus on strategic planning for CAEE. In addition to the responsibilities listed above, shared responsibilities in this role included: managing and hiring faculty and staff; advising incoming first-year and transfer students; coordinating accreditation reports; developing/formalizing departmental policies and procedures; running faculty meetings; and co-teaching the CAE 110 and 111 Introduction to the Profession sequence of courses. In September 2018, I was appointed CAEE Department Chair. In addition to the TLT responsibilities listed above, additional responsibilities include: developing and implementing faculty hiring plans; advocating for students and student organizations; managing faculty, staff, and student complaints, grievances, and other issues; short-term and long-term space planning for the department; overseeing and managing the curriculum, including the course schedule; coordinating with program directors to manage course offerings and assignments, including adjunct faculty assignments, and teaching assistants; contributing to the planning and running of events (e.g., annual advisory board meetings, orientations, and departmental career fairs); seeking and obtaining feedback from graduates and recent alumni; and more.

Accomplishments: Major accomplishments to date include the following:

- **External research funding:** Received **$3,398,596** in external research funding as PI or co-PI on 23 projects totaling approximately $4.8 million across all co-PIs. These projects have been funded by the U.S. Environmental Protection Agency (EPA); the Alfred P. Sloan Foundation; the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE); the Centers for Disease Control (CDC) through the National Institute for Occupational Safety and Health (NIOSH); the Department of Housing and Urban Development (HUD); the Air-Conditioning, Heating and Refrigeration Institute (AHRI); the Council on Tall Buildings and Urban Habitat (CTBUH); the National Air Filtration Association (NAFA) Foundation; and others. Four unrestricted gifts in support of my research have also come from industry supporters (totaling **$37,400**). I have also received **$65,000** in internal funding from IIT, including two WISER Interdisciplinary Seed Funding Grants (one with co-PI Rodger Cooley, College of Architecture and another with co-PIs Matthew Shapiro, Political Science, and Hao Huang, Social Sciences) and a Starr-Fieldhouse Fellowship for one student.
- **Peer-reviewed publications:** Published a total of **60** peer-reviewed journal articles, editorials, and commentaries in my career, **52** of which have been published while at IIT (and **35** have current/former students/postdocs as co-authors).
- **Teaching:** Taught six courses (CAE 331/513 Building Science, CAE 463/524 Building Enclosure Design, ENVE 576 Indoor Air Pollution, CAE 553 Measurements and Instrumentation in Architectural Engineering, and CAE 110 and 111 Introduction to the Profession I and II) with a mean enrollment of 22 students, receiving a mean instructor rating of **4.74** and a mean course rating of **4.57** out of 5.0 as the sole instructor (I have also co-taught both CAE 553 and CAE 110/111). Acknowledged as an ***Exceptional Professor*** **in 2016** from the IIT chapter of the American Society of Civil Engineers (ASCE) and received the ***2019 IIT ASCE Chapter Outstanding Professor Award***.
- **Mentoring:** Mentored 2 postdoctoral researchers, graduated 3 Ph.D. students (6 in progress), graduated 7 M.S. students (2 in progress), mentored 15+ undergraduate student researchers (primarily through the Armour College of Engineering Program for Undergraduate Research in Engineering, PURE), and mentored several external Ph.D. and M.S. students from other departments, colleges, and universities. I have advised ASHRAE, Architectural Engineering Institute (AEI), and Engineers Without Borders (EWB) student groups at IIT, as well as interdisciplinary teams that have placed as high as 2nd (3 times) in the Department of Energy's Race to Zero student design competition. My former Ph.D. students are currently working as: (1) a postdoc at Harvard T.H. Chan School of Public Health (Parham Azimi); (2) a postdoc at Lawrence Berkeley National Laboratory (Haoran Zhao); and (3) vice president at HKS, Inc. (Tommy Zakrzewski).
- **Professional service:** Served as: Secretary of the International Society for Indoor Air Quality and Climate (ISIAQ) (2016-present); Chair of the ISIAQ Scientific and Technical Committee (STC) 21 on Ventilation (2014-2018); Member (2014-2018) and Research Subcommittee Chair (2016-present) of ASHRAE Technical Committee (TC) 2.4 on Particulate Air Contaminants and Particulate Contaminant Removal Equipment; and as ISIAQ's first Mentorship Program coordinator (2013-2014). Served as chair of sessions and workshops at national and international conferences, including serving as Technical Chair of Indoor Air 2018 (Conference President: Michael Waring, Drexel University; over 800

attendees). Served on the Editorial Boards for the *Journal of Exposure Science and Environmental Epidemiology* (2017-present), *Buildings* (2018-present), and *Indoor Air* (2019-present).

- **Awards:** Awarded the ASHRAE New Investigator Award in 2015 ($100,000 over two years). Published what has become the most downloaded paper in the history of the journal *Atmospheric Environment*. My graduate students have won Grant-in-Aid awards from ASHRAE ($10,000 each to Parham Azimi and Torkan Fazli in 2015 and Haoran Zhao in 2017), a scholarship from the Association of Energy Engineers Foundation two years in a row ($2,000 to Tommy Zakrzewski in both 2015 and 2016), and multiple student poster competitions at international conference (Dan Zhao, Healthy Buildings USA 2015 and Parham Azimi, International Society of Exposure Science 2015).
- **Marketing and outreach:** My work has been mentioned in popular and scientific media including *The New York Times*, *Le Monde*, *Chicago Tribune*, *The Atlantic*, *Fast Company*, *Popular Mechanics*, *Telegraph*, *Daily Mail*, *Fox News*, *Discovery News*, *Consumer's Digest*, *IEEE Spectrum*, *Nature*, *Environmental Health Perspectives*, CBS Chicago, and *IIT Magazine*. I have also given invited presentations to two National Academy of Sciences workshops, a plenary lecture at Engineering Sustainability 2017, and two webinars for the U.S. EPA.
- **Consulting:** Served as a consultant to the U.S. Environmental Protection Agency (EPA) Indoor Environments Division (IED) to provide support for creating indoor air quality technical materials, provide research, analysis, writing, and review support on papers, projects, and messaging relating to indoor pollutants, and to promote EPA's materials through conferences, workshops, webinars, and other activities. Major products include revisions to the U.S. EPA's Guide to Air Cleaners in the Home and Flood Cleanup Guidance documents.
- **Service to IIT:** Served as program director for Architectural Engineering (2014-present) and Environmental Engineering (2019-present). Started a new M.S. program in Architectural Engineering (2015) and a joint Ph.D. specialization with the College of Architecture (2014). Served on the University Research Council (2016-2018); several faculty search committees; and as the primary freshman and undergraduate transfer student advisor (2018-present). Served on the CAEE department's Transition Leadership Team (appointed by Armour College of Engineering Dean DePaola) to manage the everyday affairs of the department and to work on strategic planning for CAEE (2016-2018). Appointed Department Chair for CAEE in September 2018 (2018-present). Won the Authentic Experience Award from Admissions during the 2019 Faculty Appreciation Luncheon.

Time period:	August 2007 – May 2012
Title:	Graduate Research Assistant
Institution:	University of Texas at Austin
Department:	Department of Civil, Architectural and Environmental Engineering
Responsibilities:	Responsibilities in this position included conducting independent research on energy and indoor air quality in buildings. Ph.D. adviser: Dr. Jeffrey A. Siegel.

1.4 Contributions to teaching

1.4.1 Teaching philosophy

I adhere to four main principles in the classroom: (1) mutual respect, (2) clear organization, (3) stimulating presentation, and (4) multiple directions. I believe it is imperative to show respect for the intellectual pursuits of students, which in turn help engender respect for the instructor. With a mutual respect between student and teacher, both can show their respect for the course material and the knowledge and ideas that are represented. If both students and teachers can maintain a sense of respect, the classroom can be an effective learning environment. I also believe it is imperative to remain organized. I strive to always develop course materials and individual lectures in a coherent and logical manner, ensuring that a story is always told, and that the story has a narrative and message that is always related back to the discipline and the field of study. In the case of architectural or environmental engineering, that narrative and message should always relate back to the utmost goal: effectively ensuring the safety and health of people and the planet by low-impact design and operation of engineered systems. I also believe it is important to recognize how information is presented, understood, and translated by students. I generally assume that, at any given time, students with multiple learning styles are in my classroom. Therefore, I strive to convey information such that it is accessible and stimulating to as many senses as possible: visually stimulating but not distracting, auditorily clear and concise, and as hands-on as possible. Finally, I also believe there is room for multiple directions of communication in teaching. Some course material is better suited to primarily one-way approaches (i.e., from teacher to student), while other course material inherently requires more back-and-forth discussion or hands-on components. Engaging students in a variety of ways not only helps students learn to recognize when they understand topics and when they need more information, but also aids in evaluating the learning, understanding, and changing conceptions of students. I strive to be flexible in response to student feedback throughout the progress of each course, and I strive to anonymously survey each course to receive feedback during the semester while adjustments can still be made.

Further, I draw on literature on best practices in engineering education to (1) incorporate active and cooperative project-based learning approaches in which students work together in groups on specific projects to increase their understanding of important phenomena, and (2) create a knowledge-centered classroom environment in which students get real hands-on experience in measuring and critically analyzing data with the intent of challenging their initial mental models of important processes and phenomena. I strive to foster deep learning, where understanding is emphasized far more than memorizing or recalling, rather than surface- or strategic-learning, in order to train students to be successful engineers and scholars. I believe that all students can learn and that it is the teacher's responsibility to find ways to help all students do so. I believe in placing high intellectual demands on all students, but also in giving students plenty of opportunities to revise and improve their work before receiving a grade. During the course of my teaching career, I realize I will make mistakes in the classroom, but I will use those mistakes to collectively enhance everyone's learning. I also maintain an open-door policy outside of classroom hours in order to be as accessible as possible to those who matter most: the students.

1.4.2 Teaching accomplishments

I have taught the following courses at Illinois Tech:

- CAE 331/513 Building Science (6 times)
- CAE 463/524 Building Enclosure Design (6 times)
- ENVE 576 Indoor Air Pollution (5 times)
- CAE 553 Measurements and Instrumentation in Architectural Engineering (1 time solo; 1 time co-teaching)

- CAE 110 and CAE 111 Introduction to the Profession (2 times co-teaching, took over teaching solo as Department Chair in Fall 2018; 2 times solo)

In each class I strive to make the topic as compelling as possible, framing the course topics within the overall bigger picture of why the topics matter. For example, for CAE 331/513 Building Science, buildings use more energy in the U.S. than any other individual sector, are responsible for more greenhouse gas emissions, and represent the environments in which we spend almost 90% of our time. Because buildings impact energy, the environment, the economy, and human health, I continually argue that it is crucial for architectural engineers to understand the fundamental physics of how buildings utilize energy, impact the indoor environment, human health, and productivity, and how we can make them more sustainable. Further, I strive to make connections throughout coverage of all course topics, often relating on week 12 back to what we first introduced on week 1 and touched on again in week 6. I think this improves consistency in the course material and triggers recall from students. I have also introduced several hands-on projects in each of my courses, which emphasize active and cooperative learning. In each class I also ensure to have at least one guest speaker, typically involving practicing professionals in Chicago. This serves to confirm the utility of topics covered throughout the course, highlight what projects industry members are working on, and showcase promising students and our program to influential members of the profession in the city. Guest speakers have included Bruce Kaskel, Principal at WJE (CAE 463/524 Building Enclosure Design); Tommy Zakrzewski, Engineer at Buro Happold, now VP at HKS Inc (CAE 331/513 Building Science); Ian Cull, President, Indoor Sciences, Inc. (ENVE 576 Indoor Air Pollution); and Stephanie Kunkel and Parham Azimi, postdoctoral researchers in my lab at the time (ENVE 576 Indoor Air Pollution).

Throughout my experiences teaching these three classes multiple times, I have received the following select personal statements from former students via email, which capture myriad successes of each course:

"Throughout this course, I think I found my future career…."

- June Young Park, B.S. Architectural Engineering, 2014 (CAE 463) – currently a PhD student at the University of Texas at Austin

"I really enjoyed your class and it was definitely one of the best I've taken at IIT."

- Jay Shetty, MAS Architectural Engineering, 2014 (CAE 524) – currently a Senior Civil Engineer at the Metropolitan Water Reclamation District (MWRD)

"I really enjoyed the whole semester with you and this class."

- Sunyoung Oh, MAS Architectural Engineering, 2014 (CAE 524) – currently a Designer at SOM

"It was a great pleasure to have [Dr. Stephens] as a very knowledgeable, well rounded, and attention to detail instructor. This course opened many doors in both architecture and engineering careers because the quality and quantity of tools we learned in his course. I wish IIT would offer more classes similar to CAE 524 and instructors like Dr. Stephens to help push students more and better understanding building systems."

- Allison Toonen-Talamo, MAS Architectural Engineering, 2015 (CAE 524) – currently an Associate at Klein & Hoffman

"I enjoyed both the building enclosure and building science class from this year. From my perspective, it was a perfect combination of architecture and engineering, and its what I was hoping to find through the architectural engineering program."

- Kimberly Lis, B.S. Architectural Engineering, 2015 (CAE 331 and CAE 463) – currently an Associate at WJE

"I would like to thank you for a great semester. I'm really glad that I had the opportunity to be in your building envelope design class. It is one of the best classes I've taken during my academic career. The skills and knowledge of useful softwares that I received is invaluable and would prove to be of great benefit in my professional career. I also deeply appreciate your time and support when it comes to teaching the class and helping with the projects and the homeworks."

- Dhaval Gadani, MAS Construction Engineering and Management, 2015 (CAE 524) – currently a Project Manager at Safti First Fire Rated Glazing Solutions

"I am greatly honored to have had the opportunity to learn from you and witness your personal drive, passion and investment in teaching topics in building science."

- Julie Chandler, MAS Architectural Engineering, 2016 (CAE 524) – currently an Energy Efficiency Engineer at DNV GL

1.4.3 Teaching evaluations

Results from course evaluations for courses that I've (a) taught individually and (b) co-taught are provided below. In the courses I've taught individually, I have had an average enrollment of approximately 22 students and received an average instructor rating of **4.74** and a mean course rating of **4.57** out of 5.0. Both are considerably higher than the IIT average of ~4.25 and ~4.15 since I started in 2012. I was acknowledged as an *Exceptional Professor* by the IIT chapter of the American Society of Civil Engineers (ASCE) in 2016 and awarded the *Outstanding Professor Award* as the best professor in the CAEE Department from ASCE-IIT in 2019.

(a) Individually taught course evaluations

Course No.	Course Name	Term	Enrollment	Mean Instructor Rating	Mean Course Rating
CAE 463/524	Building Enclosure Design	Fall 2012	21	4.81	4.62
		Fall 2013	13	4.86	4.86
		Spring 2014	13	4.67	4.67
		Spring 2015	19	4.73	4.80
		Spring 2016	20	4.71	4.43
		Spring 2018	13	4.67	5.00
CAE 331/513	Building Science	Fall 2013	30	4.45	4.09
		Fall 2014	40	3.79	3.62
		Fall 2015	21	4.70	4.80
		Fall 2016	15	4.44	4.56
		Fall 2017	35	4.62	4.23
		Fall 2018	33	4.85	4.20
		Fall 2019	21	4.83	4.50
ENVE 576	Indoor Air Pollution	Spring 2013	9	5.00	4.57
		Fall 2014	17	4.94	4.94
		Fall 2015	18	5.00	4.92
		Fall 2016	13	5.00	5.00
		Fall 2017	13	5.00	4.80
CAE 553	Measurements in ARCE	Fall 2018	10	5.00	4.85
CAE 110	Intro to the Profession I	Fall 2018	48	4.50	3.80
		Fall 2019	50	4.67	4.38
CAE 111	Intro to the Profession II	Spring 2020	47		
		Mean	**21.7**	**4.74**	**4.57**

Notes: I was on parental leave in Spring 2017 and did not teach any courses. In Fall 2018, my required teaching load was reduced to 1 course per year as Department Chair, although I have tended to exceed that requirement by teaching CAE 110/111 Introduction to the Profession in addition to CAE 331/513 Building Science. Also, in Fall 2018 and Spring 2019, IIT switched to a new student evaluation system; scores from the new system are converted from a 0-100% basis to a 0 to 5 point basis for consistency.

Further, below is a selection of comments from anonymous evaluations of my individually taught courses:

- *"Probably one of the best Professors at IIT. Engages students and challenges them to learn without being unreasonable."*
- *"Very good at explaining topics, extremely involved in student affairs, helpful and encouraging."*
- *"Great and clear presentation skills."*
- *"IAQ is an incredibly interesting topic and one that should not be exclusive to Environmental engineers. I think this course could have massive appeal to Architects and Architectural Engineers as its involvement in the built environment can teach students important factors relevant in the job and construction field."*
- *"Is one of the only professors I have had to take the effort to learn the names of everyone in the class, which may be a small gesture, but it means a lot."*
- *"I wish all IIT professors would prepare us for our major as well as Brent does."*
- *"Great passion. Engaging lectures that are themselves interesting. More than happy to go the extra mile to help out students."*
- *"Already has become one of my favorite professors at IIT. Keeps lectures very interesting, has done a great job teaching building science, and is very fair."*
- *"Best professor and best lectures I've had at IIT."*
- *"Very knowledgeable, easy to talk to."*
- *"Great teaching, excellent professor."*
- *"A very good speaker and answers questions very clearly. His in class demonstrations were great and showed exactly what equipment and how things worked."*
- *"Instructor was very knowledgeable on the subject. He was also very curious and interested in any questions that were brought up by students that he may not know the answer too. Was also very easy to get a hold of if I had any questions and very understanding of extenuating circumstances with working full time and taking graduate courses."*
- *"Dr. Stephens is very good at keeping the class engaged. He adds in humor to the class that makes it a little less difficult to last through a two and a half hour class."*
- *"Professor Stephens is my favorite professor in the CAE department. His classes are well taught and very relevant to architectural engineering. He is willing to meet outside of class to assist with problems not only related to course material but also to help with advising/ career path options within the industry."*
- *"Best professor in department."*
- *"Really good instructor, he really knows about the course. All his classes are well prepared as well as the development of the course."*
- *"Best Professor ever!"*
- *"He is the best professor I have ever seen in my educational background. His way of teaching is unique in its own way, I just love to attend his classes."*
- *"Organized every class. Very knowledgeable on the subject and understood what we needed to come out of the class with."*
- *"Great professor. He really enjoys the topics he teaches which makes me more enthusiastic about them."*

- *"Best professor I've ever met. Very enthusiastic in giving lecture."*
- *"Makes class fun and clearly explains concepts."*
- *"Very understanding and a great instructor. Could tell he cared about our futures and wanted all of us to do well."*
- *"An amazing resource for not only academic advising but almost any curiosity students might find within CAEE. Incredibly easy to work with and is an amazing professor."*
- *"Dr. Stephens is a very engaging and exciting lecturer. This class was the highlight of my week."*
- *"The professor is extremely helpful and motivating!"*
- *"He knew the materials and was able to explain it in a manner that was simple to understand. He provided his notes so students were able to follow during lectures. He was able to answer students questions and further explain material if someone did not understand."*

(b) Co-taught course evaluations

Course	Term	Enrollment	Mean Instructor Rating	Mean Course Rating	Lead Instructor
CAE 110 Intro to the Profession I	Fall 2017	33	4.50	3.90	Anderson
CAE 111 Intro to the Profession II	Spring 2018	27	4.00	4.33	Anderson
CAE 553 Measurements in Arch Eng.	Spring 2018	7	5.00	5.00	Heidarinejad
CAE 111 Intro to the Profession II	Spring 2019	42	3.75	4.20	Stephens

1.4.4 Course overviews

CAE 331/513 Building Science

Taught each fall semester, CAE 331/513 explores the fundamentals of building science and the physical phenomena that affect building design and performance. Topics include heat transfer, psychrometrics, indoor air quality, indoor thermal comfort, air infiltration, solar radiation, and heating and cooling load calculations. Upon completion of this course, students are expected to be able to:

1. Describe the role of building components and building environmental systems in energy consumption, peak electricity demand, thermal comfort, and human exposures to pollutants.
2. Describe the role of buildings and environmental systems in building design and construction.
3. Describe and quantify fundamental heat and mass transfer processes in buildings, including conduction, convection, radiation, thermodynamics, fluid flow, and mass balances.
4. Calculate heating and cooling loads in buildings.
5. Understand types of HVAC equipment for residential and commercial construction.
6. Understand basic ventilation and indoor air quality concepts.
7. Describe basic building diagnostic field tests (e.g., blower door tests).
8. Critically analyze claims about building components and environmental systems from product manufacturers, contractors, and building designers.

Students are evaluated primarily based on their performance on homework assignments and exams. I have also experimented with student blogging and group projects. I have recently opened this course to students from the College of Architecture as well in order to improve teaching of building science concepts more widely across the university.

CAE 463/524 Building Enclosure Design

CAE 463/524 explores the design of building enclosures, elements of which include walls, floors, roofs, and intentional openings. Topics include the design of building exteriors, including the control of heat flow, air and moisture penetration; building movements; energy conserving designs; and deterioration. Analytical

techniques and building codes are discussed through case studies and design projects. Upon completion of this course, students are expected to be able to:

1. Design and assess building enclosure elements for heat transfer, airflow, and moisture control.
2. Be proficient in current building codes and standards as they pertain to building enclosure design.
3. Critically analyze designs for advanced building enclosures for their impacts on energy use, airflow, and potential moisture issues.
4. Be proficient with several software tools used in building enclosure design.

Students are evaluated primarily based on their performance on homework assignments, exams, and group and individual projects. Many homework assignments involve the use of software programs including THERM, WUFI, BEopt + EnergyPlus, and eQUEST. The group project involves hands-on assessments of the enclosures of buildings on IIT's main campus in terms of heat, air, and moisture performance. Students gain hands-on experience with tools such as infrared cameras and blower doors. The individual project is a written research project on high performance building enclosures, which involves review of the peer-reviewed literature in their area of interest. This course is also open to students from the College of Architecture.

ENVE 576 Indoor Air Pollution

ENVE 576 explores important concepts of indoor airborne pollutants, including their physical and chemical properties, emission sources, and removal mechanisms. Topics include indoor air pollution sources, indoor pollutant levels, monitoring instruments and designs; indoor pollution control strategies: source control, control equipment and ventilation; energy conservation and indoor air pollution; exposure studies and population time budgets; effects of indoor air population; risk analysis; models for predicting source emission rates and their impact on indoor air environments. Upon completion of this course, students are expected to be able to:

1. Describe particle-phase, gas-phase, and biological pollutants found in indoor environments
2. Model indoor pollutant emission, transport, and control
3. Manipulate and perform calculations with aerosol distributions and gas-phase compounds
4. Analyze indoor pollutant control technologies and determine their effectiveness
5. Read and critically analyze articles in the technical literature on indoor air pollution
6. Prepare and review written and oral technical communication

Students are evaluated primarily based on their performance on homework assignments, exams, blog posts, and a group project. The group project involves written and oral communication that is rooted in the peer-reviewed literature in areas related to the course topic.

CAE 553 Measurements and Instrumentation in Architectural Engineering

CAE 553 provides hands-on experience with energy and indoor air quality measurements in buildings including experimental design, data analysis, and experimental statistics. Measurements and techniques covered include: thermal performance (e.g., thermal conductivity and resistance, heat flux, and temperature); fluid flows and HVAC characteristics (e.g., velocity, pressure, and airflow); energy performance (e.g., current, voltage, and power draw); whole building diagnostics (e.g., blower door and duct blaster); and indoor air quality (e.g., tracer gas techniques for air exchange, particle measurements, and gas measurements). Course combines lectures and field measurements in buildings on campus. Upon completion of this course, students are expected to be able to:

1. Describe the theory behind measurements and instrumentation commonly used in architectural engineering.
2. Conduct hands-on measurements of thermal performance, fluid flows, HVAC characteristics, energy performance, ventilation, indoor air quality, and airtightness.
3. Plan experimental investigations of energy, ventilation, and indoor air quality in buildings.
4. Visualize and analyze building performance data, applying statistical methods to collected data.
5. Understand building performance data acquisition systems.
6. Conduct uncertainty analysis and calculate error propagation.

7. Understand common approaches to quality assurance and quality control in building data collection.

Students are evaluated primarily based on their performance on homework assignments and laboratory assignments (both individual and group).

CAE 110 and 111 Introduction to the Profession I and II

CAE 110 and 111 provide an introduction to civil, architectural, and environmental engineering through the lens of infrastructure (i.e., the built environment that makes our society possible). In addition, the class also introduces the steps required to successfully complete an engineering degree in CAEE and how to prepare for a post-graduate career. The class focus is on developing the skills to become a professional learner and a successful student, increasing team learning skills, self-reflection, enhancing ethical perception and decision-making abilities, and understanding the responsibilities as an engineer. Learning objectives include:

1. Become a self-learner, a professional student with specific goals and the tools to reach those goals.
2. Synthesize and apply new learning approaches that work in college through the use of creative techniques.
3. Understand the professional skills that engineering companies are looking for in a prospective hire.
4. Recognize that engineering disasters are crucial learning experiences in engineering.
5. Understand what types of engineering degrees are available at IIT and IIT's basic requirements for graduation.
6. Understand what licensure in engineering entails and how to achieve it.
7. Understand and value the vital role that ethics plays in all engineering work.
8. Understand the quality of work required of an engineer and the responsibility that comes with that work.

This course is an introduction to the engineering profession. Students are evaluated primarily based on their performance on homework assignments, quizzes, oral presentations, and group projects. The group project involves written and oral communication on the topic of engineering failures and the engineering design and construction process.

1.4.5 Mentoring and supervision of researchers

I am currently supervising and mentoring 6 full-time Ph.D. students. I have graduated 2 postdocs, 3 Ph.D. students, 7 M.S. students (2 of whom were co-advised), and directly supervised over 15 undergraduate research students and 1 high school student.

1.4.5.1 Postdoctoral researcher supervisions

Researcher	Degree	Program	Years	Research topic
Stephanie Kunkel[1]	Postdoc	CAE	2014-2016	Bioaerosol fate, transport and control
Parham Azimi[2]	Postdoc	CAE	2016-2018	Ventilation, IAQ, and asthma (HUD)

[1]Microbiology of the Built Environment Postdoctoral Fellowship, Alfred P. Sloan Foundation; currently a Senior Scientist at Abbott Labs

[2]Currently a postdoctoral researcher at the Harvard T.H. Chan School of Public Health

1.4.5.2 Ph.D. supervisions in progress

Student	Degree	Program	Years	Dissertation topic
Torkan Fazli[1]	Ph.D.	CE	2014-present	Climate change, indoor air, and health
Dan Zhao	Ph.D.	ENVE	2014-present	Measuring and modeling microbial growth on building materials
Akram Ali[2] (PT[3])	Ph.D.	CE	2015-present	Open source building sensor network
Afshin Faramarzi[4]	Ph.D.	CE	2016-present	Optimization methods in building energy and IAQ control
Yicheng Zeng	Ph.D.	ENVE	2018-present	Energy implications of improving indoor air quality
Insung Kang[2]	Ph.D.	CE	2018-present	Residential ventilation, IAQ, and asthma

[1]Received ASHRAE Graduate Student Grant-In-Aid Award ($10,000 scholarship)
[2]Co-advised by Dr. Mohammad Heidarinejad
[3]PT = part-time for a portion of his PhD studies
[4]Secondary advisor (Primary advisor: Dr. Mohammad Heidarinejad)

1.4.5.3 Ph.D. supervisions completed

Student	Degree	Program	Years	Dissertation topic
Parham Azimi[1,2,3]	Ph.D.	ENVE	2013-2016	Advances in indoor aerosols
Tommy Zakrzewski[4]	Ph.D.	CE (PT)	2012-2017	District energy system design tools
Haoran Zhao[1,5]	Ph.D.	ENVE	2014-2018	Measuring outdoor pollutant infiltration into homes

[1]Received ASHRAE Graduate Student Grant-In-Aid Award ($10,000 scholarship)
[2]Received ASHRAE Homer Addams Award for his involvement in ASHRAE Research Project RP-1691 ($5,000 award in 2017)
[3]Currently a postdoctoral researcher at the Harvard T.H. Chan School of Public Health
[4]Received Association of Energy Engineers Foundation (FAEE) William "Bill" Maschburn Scholarship twice: $2,000 scholarship in both 2015 and 2016. Currently a Vice President at HKS, Inc.
[5]Currently a postdoctoral researcher at Lawrence Berkeley National Laboratory (LBNL)

1.4.5.4 M.S. supervisions in progress

Student	Degree	Program	Years	Thesis topic
Kari Abromitis	M.S.	ARCE	2018-	Ventilation systems, IAQ, and asthma
Chris Riley	M.S.	ARCE	2018-	Novel radiator control system
Marina Beke	M.S.	ARCE	2020-	Air filtration and COPD

1.4.5.5 M.S. supervisions completed

Student	Degree	Program	Graduated	Thesis topic
Zeineb El Orch	M.S.	CAE	2013	Modeling the infiltration of outdoor particulate matter

Maria G. Soriano[1]	M.S.	CAE	2013	On-site wind and PV design for O'Hare International Airport
Tiffanie Ramos[2]	M.S.	ENVE	2014	Building science measurements in the Hospital Microbiome Project
Honnie Leinartas	M.S.	CAE	2014	Prioritizing Chicagoland housing retrofits for 50% energy savings
Akram Ali	M.S.	ARCE	2015	Open source building science sensors
Yicheng Zeng	M.S.	ENVE	2018	In-situ HVAC filter testing
Brett Horin[3]	M.S.	ARCE	2018	CFD and predictive models for natural ventilation controls

[1]Co-advised by Dr. Jamshid Mohammadi
[2]Starr/Fieldhouse Fellowship winner, 2013
[3]Co-advised by Dr. Mohammad Heidarinejad

1.4.5.6 Special project supervisions completed

Student	Degree	Program	Year	CAE or ENVE 497/597 topic
Alex Ballester	M.E.	ARCE	2013	597: Building energy simulation
Alvaro Gonzalez	M.E.	ARCE	2013	597: Building energy simulation
Janis Hubert	M.E.	ARCE	2014	597: Building energy simulation
June Young Park	B.S.	ARCE	2014	497: DOE student design challenge
Andi Mele	M.E.	ARCE	2015	597: Thermal bridging of enclosures
Elizbeth Mullin	B.S./M.E.	ARCE	2015	497: Fire alarms in MSV
Saeid Khodaei	M.E.	ARCE	2015	597: Air filtration for cookstoves
Han Jiang	M.E.	ENVE	2016	597: Microenvironmental NO_x
Jiayao Xu	M.E.	ENVE	2016	597: Microenvironmental NO_x
Lindsey Rice	B.S./M.E.	ARCE	2017	597: OpenStudio energy modeling
Mehdi Ashayeri	Ph.D.	ARCH	2017	597: Double skin façade evaluation
Andoni Ramos	M.E.	ARCE	2017	597: Energy efficiency trade-offs
Zhihui Shao	M.E.	ENVE	2017	597: I/O pollutant modeling
Dan Zhao	Ph.D.	ENVE	2017	597: Microbial growth on materials
Haoran Zhao	Ph.D.	ENVE	2017	597: Outdoor pollutant transport
Khadijah Nesbitt	B.S.	ARCE	2017/18	497: Arch. Eng. lab improvement
Emily Barnett	B.S./M.E.	ARCE	2017	597: Arch. Eng. lab improvement
Michael Desch	B.S./M.E.	ARCE	2017/18	597: Arch. Eng. lab improvement
Larry Dorn	M.E.	CEM	2017/18	597: Arch. Eng. lab improvement
Stephen Foss	M.E.	ARCE	2017	597: Building enclosure details
Jaime Marin	M.E.	MMAE	2018	597: Building energy modeling
Sneha Mahadev	M.E.	CEM	2018	597: Building energy modeling
Anna Mounier	M.E.	ARCE	2018	597: Campus energy models
Esther Rodriguez	M.E.	MMAE	2018	597: Bottom-up LEED approach
Sean Killarney	M.E.	ARCE	2018	597: Building hands-on HVAC lab
Ajay Kotur	M.E.	ARCE	2018	597: Building hands-on HVAC lab
Roger Fortune	M.E.	ARCE	2019	597: Historical building retrofits
Keonho Li	M.E.	ARCE	2019	597: DSF energy/CFD simulation
Lobna Mitkees	Ph.D.	ARCH	2019	597: Thermal comfort, Crown Hall
Gurmandeep Saggu	M.E.	ARCE	2019	597: Hands-on HVAC lab

1.4.5.7 Other graduate defense, comprehensive committees, and undergraduate mentoring

I have served as an external committee member (and at times, de facto primary research advisor) for the following thesis and dissertation committees:

1. Irina Susorova, Ph.D., College of Architecture, IIT, 2013*
   - Primary adviser: Mahjoub Elnimeiri, College of Architecture, IIT
   - Thesis topic: "Assessing the thermal performance of vegetative facades"
2. Abraham Kruger, M.S., Building Construction, College of Architecture, Georgia Institute of Technology, 2013
   - Primary adviser: Javier Irizarry, Georgia Institute of Technology
   - Thesis topic: "The impact of filter loading on residential HVAC systems"
3. Karen Dannemiller, Ph.D., Environmental Engineering, Yale University, 2014
   - Primary adviser: Jordan Peccia, Yale University
   - Dissertation topic: "Integrating measurements of environmental fungal communities with human health outcomes"
4. Se Yen Lai, M.S., Civil Engineering, IIT, 2014
   - Primary adviser: Ralph Muehleisen, Argonne National Laboratory
   - Thesis topic: "A parametric study of the thermal performance of different wall systems at various climate zones"
5. Aysan Khorraminejad, Ph.D., College of Architecture, IIT, 2014
   - Primary adviser: Matthew Herman, College of Architecture, IIT
   - Thesis topic: "Natural ventilation using a solar chimney and phase change materials"
6. Peng Du, Ph.D., College of Architecture, IIT, 2015*
   - Primary adviser: Antony Wood, College of Architecture, IIT, and the Council on Tall Buildings and Urban Habitat (CTBUH)
   - Dissertation topic: "Sustainability implications of downtown high-rise vs. suburban low-rise living"
7. Gilberto Osornio Nieto, Ph.D., College of Architecture, IIT, 2018
   - Primary adviser: Matthew Herman, College of Architecture, IIT
   - Dissertation topic: "Integrating radiant cooling systems with natural ventilation in predominantly glazed facades in hot and warm climates"
8. Andres Pinzon Latorre, Ph.D., College of Architecture, IIT, 2017
   - Primary adviser: Peter Land, College of Architecture, IIT
   - Dissertation topic: "Thermal comfort of low-income patio houses in Colombia"
9. Chunyi Wang, Ph.D., Drexel University, 2019
   - Primary adviser: Michael Waring, Drexel University
   - Dissertation topic: "Secondary organic aerosol formation indoors: Experimental and modeling investigations of impacts of surface reactions and equilibrium partitioning processes"
10. Narjes Abbasabadi, Ph.D., College of Architecture, IIT, 2019*
    - Primary adviser: Rahman Azari, College of Architecture, IIT
    - Dissertation topic: "An integrated data-driven framework for urban energy use modeling"
11. Mehdi Ashayeri, Ph.D., College of Architecture, IIT, 2020*
    - Primary adviser: Rahman Azari, College of Architecture, IIT
    - Dissertation topic: "A framework for urban resilience"
12. Lobna Mitkees, Ph.D., College of Architecture, IIT, ongoing*
    - Primary adviser: myself
    - Dissertation topic: "Personal conditioning systems in a historical building"
13. Sheng Wang, Ph.D., Drexel University, ongoing
    - Primary adviser: James Lo, Drexel University

- Dissertation topic: "Method of quantifying wind-driven natural ventilation flowrate and the development of systematic analysis on the relationship between the flowrate and building configuration"

14. Zahida Khan, Ph.D., College of Architecture, IIT, ongoing*
    - Primary adviser: myself
    - Dissertation topic: "Human spatial behavior and microclimates"

I have served as an undergraduate research adviser in the ACE PURE/MIND programs for the following students:

1. Dina Curioni, CAEE, 2014, Building science performance assessment in Carman Hall
2. Deion Debose, CAEE, 2013-2015, Open source building science sensors
3. Laurit Dide, CAEE, 2013, Hospital Microbiome Project
4. Boyang "Bobo" Dong, ECE, 2014, Open source building science sensors
5. Utsav Gandhi, ChBE, 2013, Indoor air quality in developing countries
6. Sara Glade, CAEE, 2013, Emissions of ultrafine particles from desktop 3D printers
7. Hailey Kunkel, CAEE, 2013, Energy and life cycle cost impacts of duct designs in homes
8. Roxanne Myers, CAEE, 2013, Development of a hot box thermal testing facility
9. Matthew Thomas, CAEE, 2013, Developing of an in-situ filter performance testing facility
10. Nina Townley, CAEE 2013-2014, Building science performance assessment in Carman Hall
11. Benjamin Waccholz, CAEE, 2013, Developing a system to measure outdoor pollutant infiltration
12. Rou Yi Yeap, ChBE, 2014*, Energy implications of high pressure elements in residential HVAC
13. Zachary Zanzinger, CAEE, 2014, Open source building science sensors
14. Jihad Zeid, ChBE, 2014-2015, Measuring outdoor pollutant transport into an apartment unit
15. C.W. (Chris) Riley, MMAE, 2017-2018, Developing an automated shading system for glazing units and automatic radiator controls
16. Erica Acton, CAEE, 2019 (co-advised by Dr. Mohammad Heidarinejad), Energy savings for radiators using building sensors and controls
17. Urwa Irfan, CAEE, 2020 (co-advised by Dr. Mohammad Heidarinejad), Energy savings for radiators using building sensors and controls

I have served as research adviser to one undergraduate student from the IIT-Paris program:

1. Claire Pouzet, 2015, EVIP*, Ultrafine particle and VOC emissions from desktop 3D printers

I have served as research adviser to one high school student from the Illinois Math and Science Academy:

1. Mylee Rolock, 2014 and 2015, IMSA, Open source sensors and indoor air quality modeling

*Students and researchers marked with an asterisk have been co-authors on peer-reviewed journal articles published, under review, or in preparation for submission.

1.5 Academic concentrations and research interests

My academic concentrations and research interests involve **energy, air quality, and human health in the built environment**. My research in my Built Environment Research Group (BERG; www.built-envi.com) lies within the disciplines of **building science, indoor air quality, and environmental health**. I have five major areas of investigation that relate chiefly to improving understanding of the physics, chemistry, and microbiology of indoor environments and how they impact building performance, human exposure, and human health.

1.5.1 Sources, fate, transport, and control of indoor air pollutants

We spend the vast majority of our time in buildings in which we are exposed to a wide variety of indoor air pollutants of both indoor and outdoor origin. My research in this area seeks to identify and quantify the sources, fate, transport, and control of indoor air pollutants. I have focused on developing and applying methods to quantify and evaluate indoor emission sources and control strategies, and to understand how building design and operation influence the fate, transport, and control of indoor air pollutants such as indoor aerosols (including bioaerosols), reactive gases (such as ozone and nitrogen dioxide), and nonreactive gases (including volatile organic compounds, aldehydes, and others). Key contributions in this area to date include quantifying sources of indoor pollutants (including outdoor pollutant infiltration; desktop 3D printers; and bioaerosols from human respiratory activities), as well as evaluating control strategies such as filtration in heating, ventilating, and air-conditioning (HVAC) systems and understanding trade-offs between energy efficiency and indoor air quality. We continue to advance knowledge of the physics, chemistry, and microbiology of indoor air as a core interest in my research group.

1.5.2 Human exposure to air pollutants and health risk assessment

Research on fundamental mechanisms that influence the fate, transport, and control of indoor pollutants necessitates continued exploration of the impacts of these mechanisms on the practice of human exposure assessment and understanding/quantifying human health risks. My work in this area has primarily involved evaluating the contribution of indoor air pollutants to long-term mortality, disease burden, cancer risks, and infectious disease risks to building occupants. My recent research in this domain has sought to understand the magnitude of human exposures to pollutants of both indoor and outdoor origin, the quantitative health impacts associated with exposures, and the extent of exposure misclassification that occurs in epidemiology studies if indoor fate, transport, and control mechanisms are not accurately accounted for.

1.5.3 Building energy efficiency and sustainable building design and operation

Crucial to improving the sustainability of our built environment is improving energy efficiency in buildings. In this research area I conduct modeling and measurements to support policy decisions for improving energy efficiency in buildings, such as identifying cost-optimal building retrofits in existing residential buildings. We also conduct modeling and measurements to understand the energy implications of improvements to thermal comfort or indoor air quality in buildings, or conversely, the comfort and indoor air quality implications of improvements to energy efficiency and sustainability in buildings. Integral to this effort is large-scale modeling of energy and air quality across the building stock, wich can be used to inform both policy and practice.

1.5.4 Building science and IAQ measurements and methods

Crucial to understanding how buildings operate and function is the development and application of extensive building science measurement capabilities. Much of my research in this area has involved long-term quantification of building environmental and operational parameters or developing novel methods to quantify pollutant fate and transport inside buildings. Our work in building science measurements cuts across domains of energy engineering, indoor air sciences, microbial ecology, and electrical engineering.

1.5.5 Inexpensive, open source building environmental sensors and controls

Finally, another key research area in my group is the development, evaluation, and application of low-cost open source building environmental sensors. Our primary research effort in this area is the Open Source Building Science Sensors (OSBSS) project and the subsequent *Elemental* wireless sensing platform. Both

efforts involve development of an Arduino-based platform for designing and building arrays of inexpensive, open source sensors and data loggers designed to reduce the costs of recording long-term building environmental and operational measurements while also improving capabilities and functionality. We have developed sensors to measure air temperature and relative humidity, surface environmental conditions, CO_2 concentrations, human proximity, human occupancy via doorway beam breaks, illuminance levels, and more. We continue to improve functionalities and document detailed instructions for building your own breadboard based sensor online at www.osbss.com, while our new wireless platform, which utilized more advanced printed circuit board sensor designs, is available online at https://github.com/elemental-platform. In addition to the sensing platform, we have also developed a novel radiator control system for older, existing buildings that leverages building environmental measurements to automatically control manual radiator valves based on a set schedule, indoor environmental conditions, and/or human occupancy.

1.6 Publications

My citation statistics* from Google Scholar are as follows:

- 2861 citations
- h-index: 26
- i10-index: 43

*Data current as of May 28, 2020

1.6.1 Papers published in peer-reviewed journals

1. Faramarzi, A., Heidarinejad, M., **Stephens, B.**, Mirjalili, S. Equilibrium Optimizer: A Novel Optimization Algorithm. Accepted to *Knowledge-Based Systems*, November 2019.
2. Ali, A., Coté, C., Heidarinejad, M., **Stephens, B.** 2019. *Elemental*: An open-source wireless hardware and software platform for building energy and indoor environmental monitoring and control. *Sensors* 19(18). DOI:10.3390/s19184017.
3. Susorova, I., **Stephens, B.**, Skelton, B. 2019. The effect of balcony thermal breaks on building thermal and energy performance: field experiments and energy simulations in Chicago, IL. *Buildings*, 9(9):190. DOI:10.3390/buildings9090190.
4. **Stephens, B.**, Azimi, P., Thoemmes, M.S., Heidarinejad, M., Allen, J.G., Gilbert, J.A. 2019. Microbial exchange via fomites and implications for human health. *Current Pollution Reports* 5:198-213.
5. Yim, S.H.L., Gu, Y., Shapiro, M., **Stephens, B.** Air quality and acid deposition impacts of local emissions and transboundary air pollution in Japan and South Korea. Accepted to *Atmospheric Chemistry and Physics: Discussions*. DOI:10.5194/acp-2019-175.
6. Zhao, H., Gall, E.T., **Stephens, B.** 2019. Measuring the penetration factor for ambient nitrogen oxides through the building envelope. *Environmental Science and Technology* 53(16):9695-9704.
7. Abbasabadi, N., Azari, R., Ashayeri, M., **Stephens, B.**, Heidarinejad, M. 2019. An integrated data-driven framework for urban energy use modeling (UEUM). *Applied Energy*, 243:113550.
8. Fazli, T., Zeng, Y., **Stephens, B.** 2019. Fine and ultrafine particle removal efficiency of new residential HVAC filters. *Indoor Air* 29(4):656-669.
9. Chin, K., Laguerre, A., Ramasubramanian P., Pleshakov, D., **Stephens, B.**, Gall, E.T. Primary emissions, ozone reactivity, and byproduct emissions from building insulation materials. Accepted in *Environmental Science: Process & Impacts* (Special Issue on Indoor Chemistry). DOI: 10.1039/C9EM00024K.
10. Lax, S., Cardona, C., Zhao, D., Winton, V.J., Goodney, G., Gao, P., Gottel, N., Hartmann, E., Henry, C., Thomas, P.M., Kelley, S.T., **Stephens, B.**, Gilbert, J.A. 2019. Microbial and metabolic succession on common building materials under high humidity conditions. *Nature Communications*, 10:1767.

11. Azimi, P, **Stephens, B.** 2018. A framework for estimating the US mortality burden of fine particulate matter exposure attributable to indoor and outdoor microenvironments. Accepted in the *Journal of Exposure Science and Environmental Epidemiology*.
12. Gilbert, J.A., **Stephens, B.** 2018. Microbiology of the built environment. *Nature Reviews Microbiology* 16:661-670.
13. Azimi, P., Zhao, H., Fazli, T., Zhao, D., Faramarzi, A., Leung, L., **Stephens, B.** 2018. Pilot study of the vertical variations in outdoor pollutant concentrations and environmental conditions along the height of a tall building. *Building and Environment* 138:124-134.
14. Cardona, C., Lax, S., Larsen, P., **Stephens, B.**, Hampton-Marcell, J., Edwardson, C., Henry, C., Van Bonn, B., Gilbert, J.A. 2018. Environmental sources of bacteria differentially influence host-associated microbial dynamics. *mSystems* 3(3):e00052-18.
15. Fazli, T., **Stephens, B.** 2018. Development of a nationally representative set of combined building energy and indoor air quality models for U.S. residences. *Building and Environment* 136:192-212.
16. **Stephens, B.** 2018. Evaluating the sensitivity of the mass-based particle removal calculations for HVAC filters in ISO 16890 to assumptions for aerosol distributions. *Atmosphere* 9(3):85.
17. Thompson et al., and The Earth Microbiome Project Consortium (**Stephens, B.**, member). 2017. A communal catalogue reveals Earth's multiscale microbial diversity. *Nature* 551:457-463.
18. Du, P., Wood, A., Ditchman, N., **Stephens, B.** 2017. Life satisfaction of downtown high-rise vs. suburban low-rise living: A Chicago case study. S*ustainability* 9(6):1052.
19. Xu, J., Jiang, H., Zhao, H., **Stephens, B.** 2017. Mobile monitoring of personal NO_x exposures during scripted daily activities in Chicago, IL. 2017. *Aerosol and Air Quality Research* 17(8):1999-2009.
20. Lax, S., Sangwan, N., Smith, D., Larsen, P., Handley, K., Richardson, M., Landon, E., Siegel, J.A., Alverdy, J., Knight, R., **Stephens, B.**, Gilbert, J.A. 2017. Bacterial colonization and succession in a newly opened hospital. *Science Translational Medicine* 9(391):eaah6500.
21. Kunkel, S., Azimi, P., Zhao, H., Stark, B. **Stephens, B.** 2017. Quantifying the size-resolved dynamics of indoor bioaerosol transport and control. *Indoor Air* 27(5):977-987.
22. Zhao, H., **Stephens, B.** 2017. Using portable particle sizing instrumentation to measure the penetration of fine and ultrafine particles through residential building enclosures. *Indoor Air* 27(1):218-229.
23. Zakrzewski, T., **Stephens, B.** 2017. Generalized natural gas reciprocating engine part-load performance curves for cogeneration applications. *Science and Technology for the Built Environment* 23(7):1151-1158.
24. Azimi, P., Fazli, T., **Stephens, B.** 2017. Predicting concentrations of ultrafine particles and volatile organic compounds resulting from desktop 3D printer operation in a small office environment and the impact of potential control strategies. *Journal of Industrial Ecology* 21(S1):S107-S119.
25. Bibby, K., Adams, R.I., Bhangar, S., Dannemiller, K., Eisen, J., Fierer, N., Gilbert, J.A., Green, J.A., Marr, L., Miller, S.L., Siegel, J.A., **Stephens, B.**, Waring, M.S. 2016. Ten questions concerning the microbiomes of buildings. *Building and Environment* 109:224-234.
26. **Stephens, B.** 2016. What have we learned about the microbiomes of indoor environments? *mSystems* 1(4):e00083-16. (Mini-review)
27. Du, P., Wood, A., **Stephens, B.** 2016. Empirical operational energy analysis of downtown high-rise vs. suburban low-rise lifestyles: A Chicago case study. *Energies* 9(6):445.
28. Ali, A., Zanzinger, Z., Debose, D., **Stephens, B.** 2016. Open source building science sensors (OSBSS): A low-cost Arduino-based platform for long-term data collection in indoor environments. *Building and Environment* 100:114-126.
29. Azimi, P., Zhao, D., **Stephens, B.** 2016. Modeling the impact of residential HVAC filtration on indoor particles of outdoor origin (RP-1691). *Science and Technology of the Built Environment* 22(4):431-462.
30. Azimi, P., Zhao, D., Pouzet, C., Crain, N., **Stephens, B.** 2016. Emissions of ultrafine particles and volatile organic compounds from commercially available desktop 3D printers with multiple filaments. *Environmental Science and Technology* 50(3):1260-1268.

31. Zhao, H., **Stephens, B.** 2016. A method to measure the ozone penetration factor in residences under infiltration conditions: Application in a multi-family apartment unit with multiple ozone monitors. *Indoor Air* 26(4):571-581.
32. Du, P., Wood, A., **Stephens, B.**, Song, X. 2015. Life-cycle energy implications of downtown high-rise vs. suburban low-rise living: an overview and quantitative case study for Chicago. *Buildings* 5:1003-1024.
33. Fazli, T., Yeap, R.Y., **Stephens, B.** 2015. Modeling the energy and cost impacts of excess static pressure in central forced-air heating and air-conditioning systems in single-family residences in the U.S. *Energy and Buildings* 107:243-253.
34. Zhao, D., Azimi, P., **Stephens, B.** 2015. Evaluating the long-term health and economic impacts of central residential air filtration for reducing premature mortality associated with indoor fine particulate matter (PM2.5) of outdoor origin. *International Journal of Environmental Research and Public Health* 12:8448-8479.
35. Leinartas, H., **Stephens, B.** 2015. Optimizing whole house deep energy retrofit packages: A case study of existing Chicago-area homes. *Buildings* 5:323-353.
36. Dedesko, S., **Stephens, B.**, Gilbert, J.A., Siegel, J.A. 2015. Methods to assess human occupancy and occupant activity in hospital patient rooms. *Building and Environment* 90:136-145.
37. Ramos, T., Dedesko, S., Siegel, J.A, Gilbert, J.A., **Stephens, B.** 2015. Spatial and temporal variations in indoor environmental conditions, human occupancy, and operational characteristics in a new hospital building. *PLoS ONE* 10(3): e0118207.
38. **Stephens, B.**, Adams, R.I., Bhangar, S., Bibby, K., Waring, M.S. 2015. From commensalism to mutualism: Integrating the microbial ecology, building science, and indoor air communities to advance research on the indoor microbiome. *Indoor Air* 25(1):1-3. (Editorial)
39. **Stephens, B.** 2015. Building design and operational choices that impact indoor exposures to outdoor particulate matter inside residences. *Science and Technology for the Built Environment*, 21:3-13.
40. Azimi, P., Zhao, D., **Stephens, B.** 2014. Estimates of HVAC filtration efficiency for fine and ultrafine particles of outdoor origin. *Atmospheric Environment* 98:337-346.
41. **Stephens, B.** 2014. The impacts of duct design on life cycle costs of central residential heating and air-conditioning systems. *Energy and Buildings*, 82:563-579.
42. Ramos T., **Stephens, B.** 2014. Tools to improve built environment data collection for indoor microbial ecology investigations. *Building and Environment* 81:243-257.
43. Susorova, I., Azimi, P., **Stephens, B.** 2014. The effects of climbing vegetation on the local microclimate, thermal performance, and air infiltration of four building facade orientations. *Building and Environment* 76:113-124.
44. El Orch, Z., **Stephens, B.,** Waring, M.S. 2014. Predictions and determinants of size-resolved particle infiltration factors in single-family homes in the U.S. *Building and Environment* 74: 106–118.
45. Azimi, P., **Stephens, B.** 2013. HVAC filtration for controlling infectious airborne disease transmission in indoor environments: Predicting risk reductions and operational costs. *Building and Environment* 70:150-160.
46. **Stephens, B.,** Azimi, P., El Orch, Z., Ramos, T. 2013. Ultrafine particle emissions from desktop 3D printers. *Atmospheric Environment* 79:334-339.
47. Susorova, I., Angulo, M., Bahrami, P., **Stephens, B.** 2013. A model of vegetated exterior facades for evaluation of wall thermal performance. *Building and Environment* 67:1-13.
48. Shogan, B.D., Smith, D.P., Packman, A.I., Kelley, S.T., Landon, E.M., Bhangar, S., Vora, G.J., Jones, R.M., Keegan, K., **Stephens, B.**, Ramos, T., Kirkup, B.C., Levin, H., Rosenthal, M., Foxman, B., Chang, E.B., Siegel, J.A., Cobey, S., An, G., Alverdy, J.C., Olsiewski, P.J., Martin, M.O., Marrs, R., Hernandez, M., Christley, S., Morowitz, M., Weber, S., Gilbert, J. 2013. The Hospital Microbiome Project: Meeting Report for the 1st Hospital Microbiome Project, Chicago, USA, January 15th, 2013. *Standards in Genomic Sciences* 8(3). doi:10.4056/sigs.4187859.

49. **Stephens, B.**, Siegel, J.A. 2013. Ultrafine particle removal by residential HVAC filters. *Indoor Air* 23(6):488-497.
50. Gall, E.T., Carter, E.M., Earnest, C.M., **Stephens, B.** 2013. Indoor Air Pollution in Developing Countries: Research and Implementation Needs for Improvements in Global Public Health. *American Journal of Public Health* 103(4):e67-72.
51. **Stephens, B.**, Siegel, J.A. 2012. Penetration of ambient submicron particles into single-family residences and associations with building characteristics. *Indoor Air* 22(6):501-513.
52. **Stephens, B.**, Gall, E.T., Siegel, J.A. 2012. Measuring the penetration of ambient ozone into residential buildings. *Environmental Science and Technology* 46(2):929-936.
53. **Stephens, B.**, Siegel, J.A. 2012. Comparison of test methods for determining the particle removal efficiency of filters in residential and light-commercial central HVAC systems. *Aerosol Science and Technology* 46(5):504-513.
54. Carter, E., Earnest, C.M., Gall, E.T., and **Stephens, B**. 2012. Progress and priorities in reducing indoor air pollution in developing countries. *Indoor Air* 22(1):1-2. (Editorial)
55. Rhodes, J.D., **Stephens, B.**, Webber, M.E. 2011. Using a database of energy audits to investigate the impacts of common air-conditioning design and installation issues on peak power and energy consumption in Austin, Texas. *Energy and Buildings* 43(11):3271-3278.
56. **Stephens, B.**, Siegel, J.A., Novoselac, A. 2011. Operational characteristics of residential and light-commercial air-conditioning systems in a hot and humid climate zone. *Building and Environment* 46(10):1972-1983.
57. **Stephens, B.**, Carter, E.M, Gall, E.T., Earnest, C.M., Hun, D.E., Jackson, M.C., Walsh, E.A. 2011. Home Energy-Efficiency Retrofits. *Environmental Health Perspectives* 119(7):A283 (Correspondence article)
58. **Stephens, B.**, Novoselac, A., Siegel, J.A. 2010. The effects of filtration on pressure drop and energy consumption in residential HVAC systems (RP-1299). *HVAC&R Research* 16(3):273-294.
59. **Stephens, B.**, Siegel, J.A., Novoselac, A. 2010. Energy implications of filtration in residential and light-commercial buildings (RP-1299). *ASHRAE Transactions* 116(1):346-357.
60. Carter, E., Earnest, C., Gall, E., Guerrero, P., Hun, D., Jackson, M., Lo, J., **Stephens, B.**, Walsh, E. 2009. Priorities in indoor environmental science and health, as students see them. *Indoor Air* 19(6):444-445. (Editorial)

1.6.2 Papers under review in (or in preparation for submission to) peer-reviewed journals

1. Faramarzi, A., **Stephens, B.**, Heidarinejad, M. Assessing ventilation control strategies in underground parking garages. Submitted to *Building Simulation*.
2. Zhao, D., Raba, D., Cardona, C., Gottel, N., Winton, V., Thomas, P., Kelley, S., Gilbert, J., **Stephens, B.** The influence of material chemical composition on microbial dynamics of wetted building materials. Submitted to *Scientific Reports*.
3. Ashayeri, M., Abbasabadi, N., Heidarinejad, M., **Stephens, B.** Predicting intraurban $PM_{2.5}$ concentrations based on human activity patterns and enhanced machine learning approaches. Submitted to *Environmental Research*.
4. Xu, Y., Tandon, R., Ancheta, C., Arroyo, P., Gilbert, J.A., **Stephens, B.**, Kelley S.T. Quantitative profiling of built environment bacterial and fungal communities reveals dynamic material dependent growth patterns and microbial interactions. Submitted to *Indoor Air*.
5. Fazli, T., **Stephens, B.** The impact of climate change on energy use and indoor air quality in U.S. residences. In preparation for *PNAS*.
6. Zhao, H., **Stephens, B.** Field measurements of the transport of outdoor ozone and fine and ultrafine particulate matter into residential buildings: Impact of energy efficiency retrofits. In preparation for *Indoor Air*.
7. Yu, H., Zhao, H., **Stephens, B.**, Verma, V. The oxidative potential of size-resolved aerosols of ambient origin in indoor and outdoor environments. In preparation for *ES&T Letters*.

8. Zakrzewski, T., **Stephens, B.** Design and Optimization of Combined Heat and Power (DOCHP): A new tool for building integrated energy and thermal generation set analysis and optimization. In preparation for *Energy and Buildings*.

1.6.3 Peer-reviewed conference presentations and posters

Oral presenter is listed in *italics*:

1. *Salimian Rizi, B.*, Riley, C., Ali, A., **Stephens, B.**, Heidarinejad, M. 2020. Energy analysis of steam distribution system using a physics-based model: a campus building case study. 2020 Building Performance Analysis Conference and SimBuild (ASHRAE and IBPSA-USA).
2. *Faramarzi, A.*, Delgoshaei, P., **Stephens, B.**, Heidarinejad, M. 2020. Comparing performance of optimization methods in optimal control and design of building energy and airflow models. 2020 Building Performance Analysis Conference and SimBuild (ASHRAE and IBPSA-USA).
3. *Khan, Z.,* Azari, R., **Stephens, B.** 2020. Outdoor thermal comfort (OTC) in human interaction based studies: an overview of review. 2020 Building Performance Analysis Conference and Sim-Build (ASHRAE and IBPSA-USA).
4. *Scheu, R.*, Azimi, P., Guest, M.E., Gramigna, A., **Stephens, B.** 2018. Why equity matters: energy use and health disparities by neighborhood: stories (and data) from families living in Chicago's Bungalow Belt. American Council for an Energy-Efficient Economy (ACEEE) 2018 Summer Study on Energy Efficiency in Buildings, Pacific Grove, CA.
5. Azimi, P., Zhao, H., Fazli, T., Zhao, D., Faramarzi, A., Leung, L., ***Stephens, B***. 2018. Changes in outdoor pollutant concentrations and environmental conditions along the height of a tall building. Indoor Air 2018, Philadelphia, PA.
6. *Azimi, P.*, **Stephens, B.** 2018. Predicting influenza exposures in multi-zone indoor environments using a complex infection transmission model. Indoor Air 2018, Philadelphia, PA.
7. *Azimi, P.*, **Stephens, B.** 2018. Estimates of the U.S. mortality burden attributable to exposure to fine particulate matter in indoor and outdoor microenvironments. Indoor Air 2018, Philadelphia, PA.
8. *Zhao, H.*, **Stephens, B.** 2018. Measuring the penetration factor of outdoor NO_2 and NO_x in an unoccupied apartment unit. Indoor Air 2018, Philadelphia, PA.
9. *Zhao, H.*, **Stephens, B.** 2018. Using improved methods to measure the transport of outdoor ozone and fine and ultrafine particulate matter into residential buildings. Indoor Air 2018, Philadelphia, PA.
10. Chin, K., Pleshakov, D., **Stephens, B.**, *Gall, E.* 2018. Ozone chemistry of building enclosure insulation materials. Indoor Air 2018, Philadelphia, PA.
11. *Cardona, C.*, Lax, S., Zhao, D., Winton, V., Raba, D., Goodney, G., Gao, P., Gottel, N., Hartmann, E., Thomas, P., Kelley, S., **Stephens, B.**, Gilbert, J. 2018. Microbial community and metabolic succession on common building materials under high relative humidity conditions. Indoor Air 2018, Philadelphia, PA.
12. ***Stephens, B.***, Harriman, L., Brennan, T., Ilacqua, V. 2018. An updated review of IAQ and health outcomes of air cleaner use in homes. Indoor Air 2018, Philadelphia, PA.
13. *Fazli, T.*, **Stephens, B.** 2018. Utilizing a nationally representative model set to predict the impacts of climate change on energy performance and IAQ in U.S. residences. Indoor Air 2018, Philadelphia, PA.
14. *Fazli, T.*, Zheng, Y., **Stephens, B.** 2018. Estimates of fine and ultrafine particle removal efficiency for residential HVAC filters using in-situ size-resolved efficiency measurements. Indoor Air 2018, Philadelphia, PA.
15. *Horin, B.*, **Stephens, B.** 2018. Characterizing the natural ventilation potential of a building site using a neural network for spatial estimates of outdoor air quality. Indoor Air 2018, Philadelphia, PA.

16. *Zhao, D.*, Raba, D., Cardona, C., Gottel, N., Thomas, P., Kelley, S., Gilbert, J., **Stephens, B.** 2018. The influence of material chemical composition on microbial dynamics of wetted building materials. Indoor Air 2018, Philadelphia, PA.
17. Azimi, P., Crowder, T., Evens, A., Garascia, M., Gramigna, A., *McCreery, A.*, Scheu, R., **Stephens, B.** 2018. Healthy housing and indoor air quality: A Chicago field study. Indoor Air 2018, Philadelphia, PA.
18. *Ali, A.*, **Stephens, B.** 2018. Open-source hardware and software platform for energy and indoor environmental quality monitoring and control. Indoor Air 2018, Philadelphia, PA.
19. *Faramarzi, A.*, Heidarinejad, M., **Stephens, B.** 2018. Modeling the energy impacts of underground garage ventilation strategies. Indoor Air 2018, Philadelphia, PA.
20. *Yu, H.*, Zhao, H., **Stephens, B.**, Verma, V. 2018. Comparison of the oxidative potential of size segregated aerosols of ambient origin in indoor and outdoor environments. Indoor Air 2018, Philadelphia, PA.
21. *Zakrzewski, T.*, **Stephens, B.** Building integrated cogeneration system design sizing and analysis for climate disruption. 2018 Building Performance Analysis Conference and SimBuild, co-organized by ASHRAE and IBPSA-USA, Chicago, IL.
22. *Zakrzewski, T.*, **Stephens, B.** Influence of energy codes and performance standards in building integrated cogeneration system design sizing. 2018 Building Performance Analysis Conference and SimBuild, co-organized by ASHRAE and IBPSA-USA, Chicago, IL.
23. ***Stephens, B.*** Airborne particulate matter in residences: challenges and opportunities for control. AHR Expo Session, "Keeping Occupants Happy and Healthy Through Affordable and Flexible Air and Water Control Strategies," ASHRAE 2018 Winter Conference, Chicago, IL.
24. *Azimi, P.*, **Stephens, B.** Estimates of the annual U.S. mortality burden attributable to fine particulate matter exposure in indoor and outdoor microenvironments. American Association for Aerosol Research (AAAR) 2017, Raleigh, NC.
25. *Fazli, T.*, **Stephens, B.** Characterizing the in-situ size-resolved removal efficiency of residential HVAC filters for fine and ultrafine particles. ASHRAE 2016 Winter Conference, Orlando, FL.
26. *Azimi, P.*, Zhao, D., **Stephens, B.** Modeling the impact of residential HVAC filtration on indoor particles of outdoor origin (RP-1691). ASHRAE 2016 Winter Conference, Orlando, FL.
27. *Zhao, D.*, Azimi, P., **Stephens, B.** Modeling the impact of residential HVAC filtration on indoor PM2.5 of outdoor origin and associated chronic health risks. International Society for Exposure Science (ISES) 2015, Henderson, NV.
28. *Zhao, H.*, **Stephens, B.** Measuring the ozone penetration factor in a residence under infiltration conditions. International Society for Exposure Science (ISES) 2015, Henderson, NV.
29. *Azimi, P.*, Zhao, D., **Stephens, B.** Evaluating and controlling human exposure to ultrafine particle and VOC emissions from desktop 3D printers. International Society for Exposure Science (ISES) 2015, Henderson, NV. (**2nd place in the student poster competition**).
30. Zhao, D., Azimi, P., ***Stephens, B.*** The impact of HVAC filtration on indoor concentrations of outdoor PM2.5 inside residences. International Society for Exposure Science (ISES) 2015, Henderson, NV.
31. *Zhao, H.*, **Stephens, B.** A method to rapidly measure size-resolved particle penetration factors in residences. American Association for Aerosol Research (AAAR) 2015, Minneapolis, MN.
32. *Fazli, T.*, **Stephens, B.** Characterizing the in-situ size-resolved removal efficiency of residential and light-commercial HVAC filters for particle sizes between 0.01 and 10 μm. American Association for Aerosol Research (AAAR) 2015, Minneapolis, MN.
33. *Kunkel, S.*, Azimi, P., **Stephens, B.** Development of an experimental system for assessing indoor bioaerosol transport and control. American Association for Aerosol Research (AAAR) 2015, Minneapolis, MN.
34. *Zhao, D.*, Azimi, P., **Stephens, B.** Modeling the impact of residential HVAC filtration on indoor PM2.5 of outdoor origin and associated chronic health risks. American Association for Aerosol Research (AAAR) 2015, Minneapolis, MN.

35. *Zhao, H.*, **Stephens, B.** Measuring the ozone penetration factor in a residence under infiltration conditions. Healthy Buildings America 2015, Boulder, CO.
36. *Zhao, H.*, **Stephens, B.** Measuring the ozone penetration factor in a residence under infiltration conditions. Healthy Buildings America 2015, Boulder, CO.
37. *Azimi, P.*, Zhao, D., **Stephens, B.** Modeling the impact of residential HVAC filtration on indoor particles of outdoor origin. Healthy Buildings America 2015, Boulder, CO.
38. Ali, A., Fazli, T., Huan, J., Debose, D., Dong, B., ***Stephens, B.*** Open Source Building Science Sensors (OSBSS): An open source sensor network for indoor environmental data collection. Healthy Buildings America 2015, Boulder, CO.
39. *Zhao, D.*, Azimi, P., **Stephens, B.** Estimates of HVAC filtration efficiency for fine and ultrafine particles of outdoor origin. Healthy Buildings America 2015, Boulder, CO. (**Best student poster award**).
40. *Kunkel, S.*, Azimi, P., **Stephens, B.** Development of an experimental system for assessing indoor bioaerosol transport and control. Healthy Buildings America 2015, Boulder, CO.
41. *Fazli, T.*, Yeap, R.Y., **Stephens, B.** The energy consequences of excess static pressure in central residential heating and air-conditioning systems. Healthy Buildings America 2015, Boulder, CO.
42. ***Stephens, B.*** Built environment data collection: Updates on methods and sensor systems. Alfred P. Sloan Conference on the Microbiology of the Built Environment 2015, Boulder, CO.
43. Zhao, D., Azimi, P., ***Stephens, B.*** Modeling the impact of residential HVAC filtration on indoor $PM_{2.5}$ of outdoor origin. ASHRAE Annual Conference 2015, Atlanta, GA.
44. *Leinartas, H.A.*, **Stephens, B.** Optimization of cost-effective whole house retrofit packages for targeting 50% annual energy use reductions in existing Chicagoland homes. Engineering Sustainability 2015, Pittsburgh, PA.
45. Fazli, T., Yeap, R.Y., **Stephens, B.** The energy consequences of excess static pressure in residential heating and air-conditioning systems: differences between existing and new energy efficient homes. Engineering Sustainability 2015, Pittsburgh, PA.
46. Azimi, P., Zhao, D., **Stephens, B.** The impact of residential building characteristics on indoor particles of outdoor origin in three types of homes in multiple climates: Old homes, typical existing homes, and new sustainably built homes. Engineering Sustainability 2015, Pittsburgh, PA.
47. ***Stephens, B.*** The potential impacts of climate change on indoor air quality and health. Engineering Sustainability 2015, Pittsburgh, PA.
48. *Du, P.*, Wood, A., **Stephens, B.** Life Cycle Assessment of Urban vs. Suburban Residential Mobility in Chicago. Architectural Research Centers Consortium (ARCC) 2015 Annual Conference, Chicago, IL.
49. *Ali, A.*, Zanzinger, Z., **Stephens, B.** Open Source Building Science Sensors: an Open Source Sensor Network for Indoor Environmental Data Collection. IEEE SENSORS 2014, Valencia, Spain.
50. *Azimi, P.* and **Stephens, B.** Development and Application of a Markov Chain Model for Predicting Influenza Exposure in Indoor Environments. International Society for Exposure Science 2014, Cincinnati, OH.
51. El Orch, Z., Waring, M.S., ***Stephens, B.*** Predictions and determinants of size-resolved particle infiltration factors in single-family homes in the U.S. International Society for Exposure Science 2014, Cincinnati, OH.
52. *Zhao, D.*, Azimi, P., **Stephens, B.** Estimates of HVAC Filtration Efficiency for Fine and Ultrafine Particles of Outdoor Origin. American Filtration and Separations Society (AFS) Fall Conference 2014, Chicago, IL.
53. ***Stephens, B.*** The Impacts of Duct Design on Life Cycle Costs of Central Residential Heating and Air-Conditioning Systems. 2014 ASHRAE/IBPSA-USA Building Simulation Conference, Atlanta, GA.
54. ***Stephens, B.***, Ali, A., Debose, D., Dong, B., Fazli, T. Open Source Building Science Sensors for Indoor Microbiology. Indoor Air 2014, Hong Kong.

55. El Orch, Z., Waring, M.S., ***Stephens, B.*** Predictions and determinants of size-resolved particle infiltration factors in single-family homes in the U.S. Indoor Air 2014, Hong Kong.
56. *Ramos, T.*, Azimi, P., Dide, L., Dedesko, S., Gilbert, J.A., Siegel, J.A., **Stephens, B.** Building Science Measurements in the Hospital Microbiome Project. Indoor Air 2014, Hong Kong.
57. ***Stephens, B.*** and Azimi, P. HVAC filtration for controlling airborne influenza transmission in indoor environments: predicting risk reductions and operational costs. Indoor Air 2014, Hong Kong.
58. ***Stephens, B.*** Building design and operational choices that impact indoor exposures to outdoor particulate matter inside residences. ASHRAE IAQ 2013, Vancouver, CA.
59. ***Stephens, B.***, Azimi, P., El Orch, Z., Ramos, T., Zylstra, R., Steele, J. Ultrafine particle emissions from desktop 3D printers. The 32nd Annual Conference of the American Association for Aerosol Research (AAAR), 2013, Portland, OR.
60. ***Stephens, B.*** How do building design and operational choices impact indoor exposures to outdoor air pollution? Engineering Sustainability 2013, Pittsburgh, PA.
61. ***Stephens, B.*** The impacts of building envelopes and central air-conditioning systems on indoor exposures to outdoor submicron particulate matter. The 22nd Annual Meeting of the International Society of Exposure Science (ISES), 2012, Seattle, WA.
62. ***Stephens, B.*** and Siegel, J.A. Ultrafine Particle Removal by Central Heating and Air-Conditioning Filters in a Test House. The 31st Annual Conference of the American Association for Aerosol Research (AAAR), 2012, Minneapolis, MN.
63. *Gall, E.T.*, **Stephens, B.**, Corsi, R.L., and Siegel, J.A. The impact of effective diffusion coefficients on transport and reaction to porous indoor materials. The 2nd International Conference on Building Energy and Environment (COBEE 2012).
64. *Rhodes, J.*, **Stephens, B.**, and Webber, M.E. Energy audit analysis of residential air-conditioning systems in Austin, Texas. 2012 ASHRAE Winter Conference.
65. ***Stephens, B.*** and Siegel, J.A. Novel methods to measure the penetration of ozone and particulate matter into residences. The 21st Annual Meeting of the International Society of Exposure Science (ISES), 2011, Baltimore, MD.
66. ***Stephens, B.*** and Siegel, J.A. Penetration of particulate matter into residential buildings: relationship with building air leakage characteristics. The 30th Annual Conference of the American Association for Aerosol Research (AAAR), 2011, Orlando, FL.
67. **Stephens, B.** and *Siegel, J.A.* A refined whole-house method to determine the in-situ particle removal efficiency of HVAC filters in residences. The 30th Annual Conference of the American Association for Aerosol Research (AAAR), 2011, Orlando, FL.
68. ***Stephens, B.*** and Siegel, J.A. Comparison of HVAC filter test methods for particle removal efficiency. Indoor Air 2011, Austin, TX.
69. ***Stephens, B.***, Gall, E.T., and Siegel, J.A. A method for measuring ozone penetration through the building envelope. Indoor Air 2011, Austin, TX.
70. ***Stephens, B.*** and Siegel, J.A. Do heating and air-conditioning filters affect energy use or indoor air quality? Poster: 2011 NSF IGERT Online Poster Competition (Top-10 Finalist).
71. ***Stephens, B.*** Modeling the effects of geography and climate on a net zero energy residence powered by solar PV in six climates. Engineering Sustainability 2011, Pittsburgh, PA.
72. ***Stephens, B.*** Modeling a net-zero energy residence: combining passive and active design strategies in six climates. ASHRAE 2011 Winter Conference, Las Vegas, NV.
73. ***Stephens, B.***, Siegel, J.A., and Novoselac, A. Energy implications of filtration in residential and light-commercial buildings (RP-1299). Poster: ASHRAE 2010 Winter Conference, Orlando, FL.
74. ***Stephens, B.***, Novoselac, A., and Siegel, J.A. 2009. Impacts of HVAC filtration on air-conditioner energy consumption in residences. In the Proceedings of Healthy Buildings 2009, Syracuse, NY.

1.6.4 Peer-reviewed technical reports

1. Azimi, P., Zhao, D., **Stephens, B.** 2015. Modeling the impact of residential HVAC filtration on indoor particles of outdoor origin. Final report for ASHRAE Research Project RP-1691.
2. Fazli, T., Zhao, H., **Stephens, B.** 2015. Evaluating the moisture removal performance of Super Dry desiccants in footwear applications. Final report to Indoor Sciences, Inc.
3. **Stephens, B.** 2014. The impact of duct design on life cycle costs of central residential heating and air-conditioning systems. Final report for AHRI Project No. 8002.
4. **Stephens, B.**, Siegel, J.A., Novoselac, A. 2010. Energy implications of filtration in residential and light-commercial construction. Final report for ASHRAE Research Project RP-1299.

1.6.5 Other publications (e.g., op-eds, blog posts, reports, popular magazines, etc.)

1. Harriman, L. **Stephens, B.**, Brennan, T., 2019. New guidance for residential air cleaners. *ASHRAE Journal*, September 2019.
2. **Stephens, B.**, Corsi, R. Cutting EPA indoor air pollution research will cost money and lives. Op-ed in *The Hill*, February 2018. http://thehill.com/opinion/energy-environment/374562-cutting-epa-indoor-air-pollution-research-will-cost-money-and
3. **Stephens, B.**, Brennan, T., Harriman, L. 2016. Selecting ventilation air filters to reduce $PM_{2.5}$ of outdoor origin. *ASHRAE Journal*, September 2016.
4. Fazli, T., **Stephens, B.** 2016. In-situ residential HVAC filtration efficiency for fine and ultrafine particles. National Air Filtration Association *Air Media*, Fall 2016.
5. **Stephens, B.** 2015. Infiltration of outdoor pollutants. *Home Energy Magazine*, May/June 2015.
6. Contributor, www.microBE.net, blog posts for the Microbiology of the Built Environment Network: http://microbe.net/author/brent-stephens/.
7. **Stephens, B.** 2013. Filtration and infectious airborne disease transmission. National Air Filtration Association (NAFA) *Air Media*, Summer 2013, pages 4-16.
8. **Stephens, B.** 2013. Is that house an air filter? *Home Energy Magazine*, January/February 2013.
9. **Stephens, B.** 2012. Field measurements of filtration efficiency in homes. National Air Filtration Association *Air Media*, Summer 2012, pages 4-14.
10. Carter, E., Earnest, C.M., Gall, E.T., and **Stephens, B**. 2011. Student Symposium on Indoor Air Quality in Developing Countries: Full Meeting Report for NSF's IGERT.org: http://www.igert.org/documents/254.
11. **Stephens, B.** and Rhodes, J. 2011. "House Calls: Finding energy inefficiencies using residential energy audits." Guest blog post on Scientific American's blog network: Plugged In.
12. Rhodes, J. and **Stephens, B**. 2011. "Tighten up your house, but not too much…" Guest blog post, Scientific American's blog network: Plugged In.

1.7 Professional activities

1.7.1 Licensure

Engineer in Training: Passed Fundamentals of Engineering Exam, May 2007

1.7.2 Professional service

• Member, Residential Team, ASHRAE Epidemic Task Force	2020-present
• Member, Low-Cost Indoor Air Quality Test Method Development Advisory Working Group, U.S. Department of Energy Building America project by Newport Partners, Home Ventilating Institute, the Healthy Air Research and Certification Authority, and the South Coast Air Quality Management District	2018-present

- Member, committee to update the ASHRAE Position Document on Indoor Air Quality (IAQ) 2018-present
- Member, Technical Advisory Committee for DOE Building America New Home IAQ Study, led by Lawrence Berkeley National Laboratory 2017-present
- Secretary, International Society of Indoor Air and Climate (ISIAQ) 2016-present
- Technical Chair, Indoor Air 2018, the 15th international conference of the International Society of Indoor Air and Climate (ISIAQ), Philadelphia, PA (Conference president: Michael Waring, Drexel University; over 800 registered participants) 2016-2018
- International Advisory Committee, Healthy Buildings Europe 2017 conference, Lublin, Poland 2016-2017
- Session organizer, "The next generation of ventilation", Indoor Air 2016, Ghent, Belgium 2016
- Session co-organizer, "Indoor environment data collection with today's technology," with Michael Waring and L. James Lo, Indoor Air 2016, Ghent, Belgium 2016
- Workshop co-organizer, "Microbiology of the Built Environment Study Methods," Healthy Buildings 2015, Boulder CO, funded by the Sloan Foundation 2015
- Workshop co-organizer, "Dissemination and Integration of Microbiology of the Built Environment Research," Healthy Buildings America 2015, Boulder CO, funded by the Alfred P. Sloan Foundation 2015
- Research Subcommittee Chair, ASHRAE TC 2.4 Particulate Air Contaminants and Particulate Contaminant Removal Equipment 2016-present
- Member, ASHRAE TC 2.4 Particulate Air Contaminants and Particulate Contaminant Removal Equipment 2014-2018
- Member, Science Advisory Board, Aquarium Microbiome Project, Shedd Aquarium 2015-present
- Member, Advisory Board, Next Step Learning (ITEST), The Concord Consortium, Sponsored by NSF 2015-present
- Member, Technical Advisory Committee, "Healthy Efficient New Gas Homes," a project sponsored by the California Energy Commission and conducted by Lawrence Berkeley National Laboratory 2014-2019
- Chair, Scientific and Technical Committee 21 on Ventilation, ISIAQ 2014-2018
- Member, Scientific and Technical Committee 21 on Ventilation, ISIAQ 2014-present
- Member, Scientific and Technical Committee on Microbiology, ISIAQ 2014-present
- Healthy Buildings Europe 2015, Scientific Committee 2014-2015
- Healthy Buildings America 2015, Advisory Committee 2014-2015
- ISIAQ Mentorship Program Coordinator 2013-2014
- Scientific Program Committee (SPC), Environmental Health Conference 2012-2013
- Corresponding member, ASHRAE TC 4.3 Ventilation and infiltration 2012-present
- Workshop co-organizer, "Indoor air quality and cookstoves in developing countries," Indoor Air 2011, Austin, TX 2011
- Student organizing committee, Indoor Air 2011, Austin, TX 2011

1.7.3 Editorial board service

- Member, Editorial Board, *Indoor Air*, 2019-present
- Member, Advisory Board, *Prometheus* (the journal of the IIT College of Architecture PhD program), 2019-present
- Member, Editorial Board, *Buildings,* 2018-present

- Member, Editorial Board, Air & Waste Encyclopedia, Air & Waste Management Association (Wiley), 2018-present
- Member, Editorial Board, *Journal of Exposure Science and Environmental Epidemiology*, 2017-present
- Guest editor, special issue on the Microbiology of the Built Environment, *Microbiome* (with Jack Gilbert), 2015
- Editorial board member, *AIMS Public Health*, 2013-2015

1.7.4 Journal reviewer

Most frequently reviewed:
- *Environmental Science and Technology*
- *Indoor Air*
- *Building and Environment*
- *Journal of Exposure Science and Environmental Epidemiology*
- *Atmospheric Environment*
- *Aerosol Science and Technology*
- *Energy and Buildings*
- *Science and Technology of the Built Environment* (formerly *HVAC&R Research*)
- *Buildings*

Reviewed, but less frequently:
- *Nature Communications*
- *Environmental Pollution*
- *Environmental Research*
- *Science of the Total Environment*
- *Environmental Science: Processes and Impacts*
- *PLoS ONE*
- *Energies*
- *Aerosol and Air Quality Research*
- *Journal of Aerosol Science*
- *Frontiers in Microbiology*
- *BMC Medicine*
- *Indoor and Built Environment*
- *Energy Policy*
- *Applied Energy*
- *IEEE Transactions of Human-Machine Systems*
- *Automation in Construction*
- *Journal of the Air and Waste Management Association*
- *Journal of Occupational Medicine and Toxicology*
- *Journal of Hazardous Materials*
- *International Journal of Environmental Health Research*
- *Microbiome*

1.7.5 Research proposal reviews and review panels

- Singapore Ministry of Education (MOE) Academic Research Fund (AcRF) (2019)

- External peer reviewer for the Alfred P. Sloan Foundation's Chemistry of Indoor Environments (CIE) program (2018-present)
- Department of Energy National Lab Call (2019)
- NSF review panels (2016 and 2017)
- External peer reviewer for Dr. Rachael Jones, University of Illinois at Chicago (UIC) School of Public Health, proposal to CDC/NIOSH (2015)
- U.S. Environmental Protection Agency (EPA) review panels (2014 and 2015)
- External peer reviewer for the Alfred P. Sloan Foundation's Microbiology of the Built Environment (MoBE) program (2013-2015)
- Member, American Association for the Advancement of Science (AAAS) review panel for KACST Research Competitiveness Program (2013)

1.7.6 Conference paper/abstract reviews

- Joint ISIAQ/ISES conference, 2019
- Healthy Buildings North America, 2015
- Healthy Buildings Europe, 2015
- Indoor Air, 2011, 2014, 2016, 2018
- ASHRAE Transactions, 2013

1.7.7 Report reviews and other reviews

- External peer reviewer, "Illustration of Key Considerations Determining Hazardous Indoor Inhalation Exposures," Lawrence Livermore National Laboratory Report, Michael Dillon and Richard Sextro (2019)
- External peer reviewer, "Development of CPSC Nano-Particle Modeling Tools," NIST Technical Report (2018)
- External peer reviewer, "Optimization of ventilation energy demands and indoor air quality in artight ZEBRAlliance homes," Final Report to the Department of Energy by Oak Ridge National Laboratory (2013)
- External peer reviewer, "Measurement-based evaluation of installed residential filtration system performance," Lawrence Berkeley National Laboratory (LBNL) report LBNL-6607E (2014)

1.7.8 Invited talks

1. "Microbial exchange in the built environment." Presentation to Occupant Behavior and Microbiology of the Built Environment workshop, Notre Dame, South Bend, IN, September 2019.
2. "Estimating the mortality burden of fine particulate matter exposure attributable to indoor and outdoor microenvironments." U.S. Environmental Protection Agency IAQ Science Series Webinar, with Parham Azimi, June 2019 (over 750 attendees registered and 359 live participants).
3. "Particle filtration fundamentals." Presentation the 2019 National Home Performance Conference session on High MERV Filters in Central Air Handler: Opportunities & Challenges, Chicago, IL, April 2019.
4. "Energy and air quality in buildings." Presentation to the UIC Summer Institute on Sustainability and Energy, Illinois Institute of Technology, Chicago, IL, August 2018.
5. "Can we improve the indoor environment and cut carbon emissions at the same time?" Presentation to the WISER Joint Symposium on Carbon Management, Illinois Institute of Technology, Chicago, IL, April 2018.
6. "Moving to mass-based HVAC filtration metrics." Presentation to the National Air Filtration Association (NAFA) Technical Seminar, Kansas City, MO, April 2018.

7. “Critically reading and writing articles and visual display of quantitative information.” Presentation to ARCH 602 Crafting a Dissertation, Illinois Institute of Technology, Chicago, IL, March 2018.
8. “Airborne particulate matter in residences: challenges and opportunities for control.” Presentation to ASHRAE AHR Expo special session, Chicago, IL, January 2018.
9. “Research developments on rapid assessment tools for building/home inspections.” Presentation to Sloan Microbiology of the Built Environment Research to Practice Workshop, Orlando, FL, January 2018.
10. “Updates to the EPA Guide to Air Cleaners in the Home.” Presentation to Filtration 2017, Chicago, IL, October 2017.
11. “Energy and air quality in the built environment.” Presentation to the Illinois Tech College of Architecture PhD program seminar, Chicago, IL, October 2017.
12. “Energy implications of indoor agriculture.” Presentation to Illinois Tech IPRO 497 course, UFarmIIT: Innovative Automation Using Renewable Energy, taught by Prof Hamid Arastoopour, Chicago, IL, October 2017.
13. “Energy and air quality in the built environment.” Presentation to the Illinois Tech Department of Electrical and Computer Engineering Seminar Series, Chicago, IL, September 2017.
14. “Energy and air quality in the built environment.” Presentation to the Illinois Tech Homecoming Research Showcase, Chicago, IL, September 2017.
15. “Energy and air quality in the built environment.” Presentation to the Illinois Tech Summer Immersion Program, Chicago, IL, September 2017.
16. “Indoor exposures to outdoor air pollution.” Lunch plenary speaker presentation to the Engineering Sustainability 2017 conference, Pittsburgh, PA, April 2017.
17. “Indoor exposures to outdoor air pollution.” Presentation to the University of Illinois at Urbana-Champaign Environmental Engineering Graduate Seminar, February 2017.
18. “Combining measurements and models to predict the impacts of climate change and weatherization on indoor air quality and chronic health effects in U.S. residences.” Presentation to the 2016 U.S. Environmental Protection Agency (EPA) Science to Achieve Results (STAR): Indoor Air & Climate Change Progress Review Meeting, Howard University, December 2016.
19. “Outdoor pollutant penetration through building enclosures.” Presentation to Tremco Roofing lecture, Illinois Institute of Technology, October 2016.
20. “What have we learned about the microbiomes of indoor environments?” Webinar and discussion for the U.S. Environmental Protection Agency (EPA), September 2016.
21. “Perspectives on microbial interactions in built environments,” Presentation to the National Academies Committee on Microbiomes of the Built Environment: From Research to Application, June 2016, Washington, DC.
22. “Microbiology of the built environment (MoBE) research and architectural engineering,” Presentation to the Sloan MoBE Early Career Workshop, Chicago, IL, April 2016.
23. “Understanding the mechanistic drivers of indoor exposures to outdoor air pollution,” Presentation to the graduate environmental engineering seminar, Virginia Tech, April 2016.
24. “Open source building science sensors (OSBSS): An open source platform for indoor environmental data collection,” Presentation to Dr. Linsey Marr’s graduate air pollution class, Virginia Tech, April 2016.
25. “Open source building science sensors (OSBSS): An open source platform for indoor environmental data collection,” Presentation to College of Architecture PhD program, Illinois Institute of Technology, March 2016.
26. “Outdoor air and (non-combustion) appliances as sources of indoor particulate matter (PM),” Presentation to the IOM National Academies Workshop on the Health Risks of Indoor Exposure to particulate Matter, February 2016, Washington, DC.
27. “Understanding the mechanistic drivers of indoor exposures to outdoor air pollution,” Presentation to the graduate environmental engineering seminar, Washington State University, February 2016.
28. “Introduction to indoor air quality (IAQ),” Webinar series for IPMM 510, Illinois Institute of Technology, November 2015.

29. "Open source building science sensors (OSBSS): An open source platform for indoor environmental data collection," Web presentation to Dr. Jing Du's Construction IT graduate course at Texas A&M University, October 2015.
30. "Building science measurements for microbiology of the built environment studies: How and why?" Presentation for workshop, Alfred P. Sloan Foundation Microbiology of the Built Environment Study Methods, Healthy Buildings America 2015, Boulder CO.
31. "Improving built environment data collection for investigations of the microbiology of the built environment," Presentation for workshop, Alfred P. Sloan Foundation Dissemination and Integration of Microbiology of the Built Environment Research, Healthy Buildings America 2015, Boulder CO.
32. "Energy and air quality in the built environment," Presentation to Spring 2015 Portland State University Department of Mechanical Engineering Seminar Series, Portland, OR, April 2015.
33. "Energy and air quality in the built environment," Presentation to Spring 2015 University of Illinois at Chicago (UIC) Department of Civil and Materials Engineering, Chicago, IL, February 2015.
34. "Energy and air quality in the built environment," Presentation to Spring 2015 Graduate Seminar series, Illinois Institute of Technology, Chicago, IL, February 2015.
35. "Indoor concentrations of outdoor pollution," Webinar presentation to Reducing Outdoor Contaminants in Indoor Spaces (ROCIS), funded by the Heinz Endowments, Southwestern PA, November 2014.
36. "Ultrafine particle emissions from desktop 3D printers," Presentation to an NSF-sponsored workshop on the Environmental Implications of Additive Manufacturing, hosted by the University of Florida and the Woodrow Wilson International Center for Scholars, National Science Foundation, Arlington, VA, October 2014.
37. "Indoor exposures to outdoor air pollution," Presentation to Dr. Aaron Packman's Spring 2014 Northwestern University CE 260 Introduction to Environmental Engineering undergraduate course, Evanston, IL, May 2014.
38. "Indoor exposures to outdoor air pollution," Presentation to Spring 2014 University of Illinois at Chicago (UIC) Occupational and Environmental Health and Safety ERC Seminar, Chicago, IL, April 2014.
39. "Energy and air quality in the built environment," Presentation to Spring 2014 Northwestern University Environmental Engineering Graduate Seminar, Evanston, IL, February 2014.
40. "Energy and air quality in the built environment," Presentation to Spring 2014 Graduate Seminar series, Illinois Institute of Technology, Chicago, IL, February 2014.
41. "Building design and operational choices that impact indoor exposures to outdoor particulate matter inside residences." Invited presentation to ASHRAE 2014 Winter Conference, New York, NY.
42. **"**Building science measurements in the Hospital Microbiome Project." Invited presentation to ASHRAE 2014 Winter Conference, New York, NY.
43. "Filtration for the prevention of airborne infectious disease transmission," Presentation to Filtration 2013, Chicago, IL, November 14, 2013.
44. "Indoor exposures to outdoor air pollution," Presentation to the ACSA/AIA Housing Research Lecture Series Webinar, October 7, 2013.
45. "Residential HVAC filtration: energy and airflow impacts," Presentation to the ASHRAE SSPC 62.2 IAQ subcommittee, ASHRAE 2013 Annual Conference, Denver, CO, June 21, 2013.
46. "Energy and environmental impacts of buildings," Presentation to the ASCE-Illinois 3rd Annual Sustainability Workshop, Chicago, IL, June 13, 2013.
47. "Filtration and the Wells-Riley model for infectious disease transmission risk," Presentation to the 2013 National Air Filtration Association (NAFA) Technical Seminar, Louisville, KY, April 11, 2013.
48. "Energy and Air Quality in the Built Environment," Presentation to Fall 2012 Graduate Seminar series, Illinois Institute of Technology, Chicago, IL, October 24, 2012.

49. "Energy and Air Quality in the Built Environment," Presentation to Fall 2012 Graduate Seminar series, Tennessee Technological University, Cookeville, TN, September 25, 2012.
50. "Field Measurements of Filtration Efficiency in Homes," Presentation to the 2012 National Air Filtration Association (NAFA) Technical Seminar, Phoenix, AZ, April 19, 2012.
51. "Indoor Air Quality in Developing Regions of the World," Presentation to CE396L.6: Human Exposure to Indoor Air Pollution, with Ellison Carter; Instructor: Dr. Richard Corsi, The University of Texas at Austin, Austin TX, April 17, 2012.
52. "Energy and Air Quality in Austin Homes," Presentation to the Austin Energy Green Building Seminar Series, Austin, TX, January 18, 2012 (with Joshua D. Rhodes).
53. "Indoor Air Quality in Developing Regions of the World," Web presentation to Arch Eng 366: Indoor Air Pollution, with Ellison Carter; Instructor: Dr. Glenn Morrison, Missouri University of Science and Technology, from Austin, TX, December 2, 2011.
54. "Indoor Air Quality in Developing Regions of the World," Presentation to Indoor Environmental Technical Information Exchange course, with Ellison Carter, Matt Earnest, and Elliott Gall; Instructor: Dr. Richard Corsi, The University of Texas at Austin, Austin TX, March 4, 2011.
55. "Chemical Culprits from Corrosive Drywall: An Engineering Analysis," Presentation at the 2010 Indoor Air Quality Association (IAQA) Annual Meeting and Exposition, Tampa, FL, March 9, 2010.
56. "Energy and Indoor Air Quality: Implications of HVAC Filtration," Presentations to the Austin Energy Green Building Seminar Series, Austin, TX, March 5, 2010, and Tom Green & Co. Engineers, Inc., Austin, TX, January 18, 2010.
57. "Pecan Street Project: Energy Modeling," Presentation to UT School of Architecture, Seminar in Sustainable Design; Instructor: Dr. Werner Lang, The University of Texas at Austin, Austin, TX, July 21, 2009.
58. Presentation and workshop at "Steps toward a Sustainable Austin Energy" Symposium, Austin, TX, March 10, 2009. Contents available online: http://www.utexas.edu/lbj/news/story/732/

1.7.9 Consulting experience

I have worked periodically as a consultant for the following institutions and projects:

- U.S. Environmental Protection Agency (EPA) Indoor Environments Division (IED) under consulting agreement #13302-01-6 to the Scientific Consulting Group (SCG): Updating the U.S. EPA's "Guide to Air Cleaners in the Home" and "Residential Air Cleaners" technical summary, 2017-2019.
- U.S. Environmental Protection Agency (EPA) Indoor Environments Division (IED) under consulting agreement #13302-01-6 to the Scientific Consulting Group (SCG): Estimating the impact of indoor exposures to particulate matter of both indoor and outdoor origin on adverse health outcomes, 2016-present
- U.S. Environmental Protection Agency (EPA) Indoor Environments Division (IED) under consulting agreement #13302-01-6 to the Scientific Consulting Group (SCG): Reviewing and updating its flood cleanup guidance document, "Technical Report on Flood-Related Cleaning," 2015-2016.
- Indoor Sciences, Inc.: Consulting on a project to measure pollutant transport between apartment units for LEED certification testing, 2013

1.7.10 Select mentions in popular and scientific media outlets

- "Is Conference Room Air Making You Dumber?" *The New York Times*. May 2019. https://www.nytimes.com/2019/05/06/health/conference-room-air.html

- "Novel Open-Source Heating System Integrated Into Mies' Historic Alumni Hall." Illinois Tech University News. https://news.iit.edu/stories/2018/04/novel-open-source-heating-system-integrated-mies-historic-alumni-hall
- "3-D printer emissions raise concerns and prompt controls." *Chemical & Engineering News* 2018, 96(13):18-19. https://cen.acs.org/articles/96/i13/3-D-printer-emissions-raise.html
- "Health in 3D." *Canadian Occupational Safety* Magazine. http://www.cos-mag.com/occupational-hygiene/35967-are-3d-printers-bad-for-worker-health/
- "In a surprising study, scientists say everyday chemicals now rival cars as a source of air pollution." *Washington Post*. February 2018. https://www.washingtonpost.com/news/energy-environment/wp/2018/02/15/in-a-surprising-study-scientists-say-everyday-chemicals-now-rival-cars-as-a-source-of-air-pollution/
- "Mapping the Microorganisms Behind Hospital-Borne Infections." *The Atlantic*. January 2017. https://www.theatlantic.com/health/archive/2017/01/hospital-microbiome/512807/
- "Study: Some 3D Printers Emitting Harmful Particles." TV interview, CBS Chicago. February 2016. http://chicago.cbslocal.com/2016/02/24/study-some-3d-printers-emitting-harmful-particles/
- "Use A 3-D Printer? You Should Read This Study." Fast Co.Design. February 2016. http://www.fastcodesign.com/3056315/use-a-3-d-printer-you-should-read-this-study
- "3D printer study drills down on potentially harmful emissions." *Chicago Tribune*. February 2016. http://www.chicagotribune.com/bluesky/originals/ct-3d-printer-emissions-health-risks-bsi-20160203-story.html
- "Paging Dr. Building." *IIT Magazine*, Spring 2015 (IIT at 125 anniversary edition). http://magazine.iit.edu/spring-2015/paging-dr-building
- "Ultrafine particles emitted by commercial desktop 3D printers." European Commission, Science for Environment Policy Thematic Issue: Nanomaterials' functionality. February 2015. http://ec.europa.eu/environment/integration/research/newsalert/pdf/nanomaterials_functionality_48si_en.pdf
- "Shedd Aquarium, Renowned Microbiologists Team Up to Pioneer First Aquarium Microbiome Project." Shedd Aquarium, 2015: http://www.sheddaquarium.org/About-Us/Press-Room1/Press-Releases/2015-Press-Releases/AMP/
- Brief mention in *Nature*: http://www.nature.com/news/seven-days-6-12-february-2015-1.16893
- "Rethinking Sterile: The Hospital Microbiome." *Environmental Health Perspectives*, 2014: http://ehp.niehs.nih.gov/122-a182/
- "Manipulating the Unseen Microbial Ecosystem—The Future of Hospitals?" PBS NOVA Next: http://www.pbs.org/wgbh/nova/next/nature/hospital-microbiome/
- "What passengers are breathing on Metra train cars." CBS Chicago investigation, 2014. http://chicago.cbslocal.com/2014/05/01/what-passengers-are-breathing-on-metra-train-cars/
- "3D printing indoors is as bad for you as smoking a cigarette inside." Gizmodo: http://gizmodo.com/3d-printing-indoors-is-as-bad-for-you-as-smoking-a-ciga-894193776
- "Airborne particles from 3D printers could be as harmful to your health as cigarette smoke." DailyMail: http://www.dailymail.co.uk/news/article-2378687/Airborne-particles-3D-printers-harmful-health-cigarette-smoke.html
- "3D printers could cause strokes, researchers warn." The Telegraph: http://www.telegraph.co.uk/technology/news/10204982/3D-printers-could-cause-strokes-researchers-warn.html
- "3D Printing is Headed to Space." Popular Mechanics: http://www.popularmechanics.com/science/space/nasa/how-it-works-3d-printing-in-space-15758828
- "Nanoparticles Emitted from 3D Printers Could Pose a Risk." IEEE Spectrum: http://spectrum.ieee.org/nanoclast/semiconductors/nanotechnology/nanoparticles-emitted-from-3d-printers-could-pose-a-risk

- "Will A 3-D Printer Destroy Your Lungs?" Fast Company: http://www.fastcoexist.com/1682760/will-a-3d-printer-destroy-your-lungs
- "Le versant sombre des imprimantes 3D." Le Monde: http://www.lemonde.fr/sciences/article/2013/08/26/le-versant-sombre-des-imprimantes-3d_3466650_1650684.html
- "Bringing a Building to Life: Architectural engineers shape structures from concept to completion and beyond." *Magazine of the Society of Women Engineers*, Spring 2013. http://www.bernards.com/wp-content/uploads/2013/04/04-18-13-SWE-Spring-2013.pdf

1.8 Contributions to administration and university service

1.8.1 Service to the university (IIT)

- Member, IIT Armour College of Engineering Dean Search Committee — 2020-present
- Authentic Experience Award, IIT Faculty Appreciation Luncheon — 2019
  - For work with admissions in 2018-2019
- Member, IIT College of Architecture Dean Search Committee — 2018-2019
- Member, American Institute of Architects (AIA) Design and Health Research Consortium, IIT Team (with Rahman Azari, Architecture, and Nichole Ditchman, Psychology) — 2018-present
- Faculty mentor, Architectural Engineering Institute (AEI) — 2017-2019
- Member, University Research Council — 2016-2018
- Faculty mentor, DOE Race to Zero student home design competition — 2016-present
- Faculty mentor, Engineers Without Borders (EWB) — 2014-2018
- Began a joint Ph.D. specialization between CAEE and the College of Architecture (CoA) in Technologies of the Built Environment — 2014
- Mentor, ACE Program for Undergraduate Research in Engineering (PURE) — 2013-present
- Camras scholarship interviewer — 2013-present
- Rettaliata Classroom Design Development Committee — 2013
- Rettaliata Interactive Learning Design Development Committee — 2013
- ACE Student-Led Project program adviser, greenhouse design/construction — 2013
- ASHRAE-IIT student chapter faculty advisor — 2012-present

1.8.2 Service to the department (CAEE)

- Department Chair, CAEE — 2018-present
- Freshman and transfer student advisor (with Dr. Steve Kleps) — 2018-present
- Program Director, Environmental Engineering — 2019-present
- Chair, Architectural Engineering faculty search committee — 2017
- Member, CAEE Leadership Transition Team (interim chair committee) — 2016-2018
- Member, CAEE chair search committee — 2016-2017
- Member, CAEE graduate seminar committee — 2015-present
- Interviewed staff and students for CAEE chair review — 2015
- Consultant to CAE 495 Senior Design Capstone — 2015-present
- Faculty search committee, Construction Engineering & Management, CAEE — 2014
- Started a new thesis-based M.S. Architectural Engineering degree — 2014
- Program Director, Architectural Engineering — 2014-present
- US DOE Net Zero Energy Student Design Competition, faculty advisor — 2014-present
- Introduction to CAEE, Discover IIT Day — 2012-present

- B.S./M.E./M.S./Ph.D. advisor for IIT Architectural Engineering program 2012-present
- Member, architectural engineering program curriculum committee 2012

1.9 Professional honors, listings, awards, and research support

1.9.1 Research grants and contracts awarded at IIT

To date, I have received **$3,398,596** in external research funding as PI or co-PI on 23 projects totaling approximately $4.8 million across all co-PIs. Ninety-one percent (91%) of my external research funding ($3,081,354) has been awarded with me as the lead PI. These projects have been funded by the U.S. Environmental Protection Agency (EPA); the Alfred P. Sloan Foundation (APSF); the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE); the Centers for Disease Control (CDC) through the National Institute for Occupational Safety and Health (NIOSH); the Department of Housing and Urban Development (HUD); the Air-Conditioning, Heating and Refrigeration Institute (AHRI); the Council on Tall Buildings and Urban Habitat (CTBUH); the National Air Filtration Association (NAFA) Foundation; and others. I have also received **$37,400** in unrestricted gifts in support of my research and **$65,000** in internal funding from IIT. A full summary of my awarded external research funding is provided below.

Summary of total external research funding ($3,358,596 awarded directly as PI or co-PI):

1. 2019-present (awarded October 10, 2019): Air filtration to improve indoor air quality (IAQ) and chronic obstructive pulmonary disease (COPD) outcomes in a high-risk urban population of U.S. military veterans. U.S. Department of Housing and Urban Development (HUD). Role: PI (**$1,000,000**). Co-PIs: Mohammad Heidarinejad (IIT); Israel Rubinstein (University of Illinois at Chicago and Jesse Brown Veterans Affairs Medical Center); Anne Evens (Elevate Energy).
2. 2019-present: Novel radiator control system. Franklin Energy. Role: PI (**$81,125**). Co-PI: Mohammad Heidarinejad (IIT). Amended April 2020 with addition **$40,000**.
3. 2018: Garage demand control ventilation study. Nagle Energy Solutions. Role: Co-PI (my portion: **$4,406**). PI: Mohammad Heidarinejad (IIT) (Total project budget: $21,000).
4. 2017-2018: Open source wireless building sensors and controls. Franklin Energy Service, LLC. Role: PI (**$59,125**).
5. 2017: Undergraduate building science laboratory: HVAC systems and measurements. ASHRAE Undergraduate Program Equipment Grant. Role: PI (**$5,000**).
6. 2017-2018: Evaluating the impact of energy efficiency retrofits on long-term health and economic outcomes associated with indoor ozone and particulate matter. ASHRAE Graduate Student Grant-in-Aid Award to Haoran Zhao. Role: PI (**$10,000**).
7. 2016-present: Cost-effective approaches to upgrading residential mechanical ventilation systems to control indoor pollutants of both indoor and outdoor origin and improve asthma-related health outcomes. U.S. Department of Housing and Urban Development (HUD). Role: PI (**$699,612**). Co-PI: Elevate Energy.
8. 2016: 3D printer emissions testing. Aleph Objects, Inc. Role: PI (**$9,600**).
9. 2016: Vertical variations in indoor exposures to outdoor pollutants in tall buildings. Council on Tall Buildings and Urban Habitat (CTBUH) International Research Seed Funding. Role: PI (**$20,000**).
10. 2016: Thermoplastic polyurethane 3D filament emissions during 3D printing. Fenner Drives, Inc. Role: PI (**$3,600**).
11. 2015-2018: Mechanistic modeling of microbial metabolic succession in the built environment. Alfred P. Sloan Foundation. Role: Co-PI (IIT portion: **$279,747**). PI: Jack Gilbert (Total project budget: $880,068).
12. 2015-2017: Evaluating the impacts of building enclosures and HVAC filtration on airborne particulate matter and energy efficiency in residential buildings. ASHRAE New Investigator Award. Role: PI (**$100,000**).

13. 2015-2016: Modeling the impact of mechanical ventilation and HVAC filtration compliance pathways in ASHRAE Standard 62.2 on fine and ultrafine particles inside residences. ASHRAE Graduate Student Grant-in-Aid Award to Parham Azimi. Role: PI (**$10,000**).
14. 2015-2016: Characterizing the in-situ size-resolved removal efficiency of residential and light-commercial HVAC filters for particle sizes between 0.01 μm and 10 μm. ASHRAE Graduate Student Grant-in-Aid Award to Torkan Fazli. Role: PI (**$10,000**).
15. 2014-2019: Combining measurements and models to predict the impacts of climate change and weatherization on indoor air quality and chronic health effects in U.S. residences. U.S. Environmental Protection Agency (US EPA). Role: PI (**$499,974**).
16. 2014-2016: Evaluating and controlling airborne emissions from desktop 3D printers. Centers for Disease Control (CDC), National Institute of Occupational Safety and Health (NIOSH). Role: PI (**$140,451**).
17. 2014: Building science to advance research on the microbiology of the built environment (workshop). Alfred P. Sloan Foundation. Role: PI (**$25,447**).
18. 2014: Modeling the impact of residential HVAC filtration on indoor particles of outdoor origin. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) RP-1691. Role: PI (**$40,998**).
19. 2014-2016: Indoor bioaerosol fate, transport and control: Implications for infectious disease transmission. Alfred P. Sloan Foundation. Microbiology of the Built Environment (MoBE) Postdoctoral Fellowship advisor to Stephanie Kunkel, Department of Biological and Chemical Sciences, IIT. Role: PI (**$120,000**).
20. 2013-2015: Open source building science sensors project. Alfred P. Sloan Foundation. Role: PI (**$163,340**).
21. 2012-2014: Building science measurements for the Hospital Microbiome Project. Alfred P. Sloan Foundation. Role: Subcontract to the University of Chicago (IIT portion: **$38,089**). PI: Jack Gilbert (Total project budget: $800,000).
22. 2012: Linking HVAC filtration and the Wells-Riley approach to assessing risks of infectious airborne diseases. National Air Filtration Association (NAFA) Foundation. Role: PI (**$5,086**).
23. 2012-2013: Impact of duct design on life cycle cost of residential HVAC systems. Air-Conditioning, Heating, and Refrigeration Institute (AHRI). Role: PI (**$33,336**).

Summary of unrestricted gifts ($37,400 received):

1. 2016: Unrestricted gift in support of ongoing research into the emissions of particles and gases from desktop 3D printers and filaments. Aleph Objects (**$6,400**).
2. 2015: Unrestricted gift in support of ongoing research into the penetration of ambient pollutants into indoor microenvironments. American Petroleum Institute. (**$20,000**).
3. 2014: Unrestricted gift in support of ongoing research evaluating the moisture removal performance of desiccants. Indoor Sciences, Inc. (**$1,000**).
4. 2014: Unrestricted gift in support of ongoing research into the penetration of ambient pollutants into indoor microenvironments. American Petroleum Institute. (**$10,000**).

Summary of total internal research funding ($65,000 awarded):

1. 2017: WISER ISFG. Understanding Global Transboundary Politics and Pollution. PI: Matthew Shapiro. Role: Co-PI. (**$25,000**).
2. 2015: WISER ISFG. Towards a Center for Sustainable and Efficient Urban Agriculture. Co-PI: Rodger Cooley, College of Architecture. Role: PI. (**$25,000**).
3. 2012: Starr-Fieldhouse Fellowship. Indoor air microbial sampling and human occupancy detection inside hospital patient rooms. Student: Tiffanie Ramos, M.S. candidate. Collaborator: Dr. Jack Gilbert, Argonne National Laboratory. Role: PI. (**$15,000**).

1.9.2 Proposal submissions and funding success

As of April 2020, I have submitted over 85 research proposals for external research funding as either PI or co-PI at Illinois Institute of Technology. The total value of these proposals is ~$66 million for all PIs and co-PIs combined, of which ~$4.8 million has been awarded. I have also submitted several proposals for internal research funding (totaling $90,000) and have been awarded 3 of these projects (totaling $65,000). A full list of submitted proposals is provided below:

Sponsor	Project title	Date (year-month)	Role	Funds sought by me (total if co-PI)	Status
ASHRAE RP 1491	Cost/benefit of ozone air cleaners	12-May	PI	$142,805	Not funded
CTBUH seed funding	Simple model for stack effect	12-May	PI	$20,000	Not funded
NSF Environmental Engineering	CAREER: Advancing research and education in the transport and control of particulate matter in buildings	12-Jul	PI	$419,850	Not funded
AHRI	**Impact of duct design on life cycle costs in residences**	**12-Jul**	**PI**	**$33,336**	**Funded**
NAFA Foundation	**Linking HVAC filtration and the Wells-Riley model for infectious disease risk modeling**	**12-Sep**	**PI**	**$5,086**	**Funded**
Sloan Foundation	**Building science measurements in the Hospital Microbiome Project (subcontract to University of Chicago)**	**12-Oct**	**Co-PI**	**$38,089 ($800,000)**	**Funded**
EPA P3	Solar heated greenhouse for cold climates	12-Dec	PI	$14,972	Not funded
ASHRAE Graduate Student Grant in Aid	Tommy Zakrzewski - District energy systems	12-Dec	PI	$10,000	Not funded
ASHRAE Graduate Student Grant in Aid	Zeineb El Orch - Modeling indoor particles of outdoor origin	12-Dec	PI	$10,000	Not funded
ASHRAE Graduate Student Grant in Aid	Jun Lu - Hot box facility for measuring façade thermal performance	12-Dec	PI	$10,000	Not funded
ASHRAE Graduate Student Grant in Aid	Meng Ju - Life cycle assessment of building enclosure assemblies	12-Dec	PI	$10,000	Not funded
ASHRAE unsolicited RP	**Modeling impact of HVAC filters on indoor particles of outdoor origin**	**12-Dec**	**PI**	**$40,998**	**Funded**
Starr Fieldhouse (internal)	**Building science measurements in the Hospital Microbiome Project**	**12-Dec**	**PI**	**$15,000**	**Funded**
WISER ISFG (internal)	Energy efficient building enclosures	13-Mar	PI	$25,000	Not funded
National Institute of Standards and Technology (NIST)	Acoustic measurements of air infiltration in buildings (Co-PI Ganesh Raman)	13-Mar	Co-PI	$375,419	Not funded
Housing and Urban Development (HUD) HHTS	Cost effective assessment of outdoor pollutant infiltration and evaluation of control measures	13-Mar	PI	$750,000	Not funded
Health Effects Institute (HEI)	Residential exposure to traffic-related pollutants	13-Apr	PI	$599,995	Not funded
Sloan Foundation	**Open Source Building Science Sensors (OSBSS)**	**13-Aug**	**PI**	**$163,000**	**Funded**
Sloan Foundation	**MoBE Postdoctoral Fellow - Stephanie Kunkel - Filtration of bioaerosols**	**13-Aug**	**PI**	**$120,000**	**Funded**

CDC/NIOSH	**Evaluating and controlling UFP and VOC emissions from desktop 3D printers**	**13-Nov**	**PI**	**$140,451**	**Funded**
ASHRAE New Investigator Award	Fate and transport of indoro particulate matter	13-Dec	PI	$100,000	Not funded
ASHRAE Graduate Student Grant in Aid	Parham Azimi - Bioaerosol transmission modeling	13-Dec	PI	$10,000	Not funded
EPA Indoor Air and Climate Change	**Combining measurements and models to predict the impact of climate change and weatherization on indoor air and chronic health in homes**	**14-Jan**	**PI**	**$499,974**	**Funded**
Sloan Foundation	**Workshop - Building science to advance research in the microbiology of the built environment**	**14-Feb**	**PI**	**$25,447**	**Funded**
NSF Environmental Sustainability	Open source building environmental sensors	14-Feb	PI	$290,304	Not funded
DOE BENEFIT (LOI)	Open source building environmental sensors	14-Mar	PI	$630,000	Not funded
DOE BENEFIT (LOI)	Rare earth free permanent magnet motors for buildings	14-Mar	Co-PI	$585,000	Not funded
CTBUH seed funding	Vertical distribution of pollutants in tall buildigns (co-PI SOM)	14-May	PI	$20,000	Not funded
ASHRAE RP 1627	Evaluation of the ASHRAE Advanced Energy Design Guide	14-May	PI	$146,468	Not funded
NSF Urban Sustainability SRN	Safe and sustainable urban agriculture systems (co-PIs from WISER, IFSH, and others)	14-Apr	Co-PI	$500,000 ($12,000,000)	Not funded
NSF NRT	Data enabled urban infrastructure renewal (co-PIs from CAEE, Applied Math, Computer Science, and others)	14-Jun	Co-PI	$350,000 ($3,000,000)	Not funded
HUD HHTS (LOI)	Inexpensive sensor applications for particulate matter monitoring in homes	14-Jul	PI	$443,959	Not funded
NSF Environmental Engineering	Measuring outdoor ozone transport into indoor environments	14-Nov	PI	$329,542	Not funded
NSF CNH (coupled natural and human dynamics)	Indoor air microbial ecology (co-Pis at University of Chicago and others)	14-Nov	Co-PI	$391,041 ($1,710,274)	Not funded
ASHRAE Graduate Student Grant in Aid	**Torkan Fazli - In-situ measurements of size resolved particle removal efficiency by residential HVAC filters**	**14-Dec**	**PI**	**$10,000**	**Funded**
ASHRAE Graduate Student Grant in Aid	**Parham Azimi - Modeling the impact of filters on indoor particulate matter**	**14-Dec**	**PI**	**$10,000**	**Funded**
ASHRAE New Investigator Award	**Advancing measurements of indoor aerosol fate and transport**	**14-Dec**	**PI**	**$100,000**	**Funded**
Sloan Foundation	**Microbial surface metabolism (co-PI Jack Gilbert, University of Chicago)**	**15-Feb**	**Co-PI**	**$279,747 ($880,000)**	**Funded**
WISER ISFG (internal)	**Toward a Center for Sustainable Urban Agriculture**	**15-Mar**	**PI**	**$25,000**	**Funded**
Sloan Foundation	OSBSS Phase 2	15-Mar	PI	$224,987	Not funded
NSF NRT	Data enabled urban infrastructure renewal (co-PIs from CAEE, Applied Math, Computer Science, and others)	15-May	Co-PI	$350,000 ($2,945,650)	Not funded
ASHRAE TRP-1702	Case studies to test ASHRAE Performance Measurement Protocols	15-May	PI	$182,182	Not funded
USDA NIFA	Sustainable urban agriculture systems for increased food security (co-Pis from WISER, IFSH, and others)	15-Jun	Co-PI	$260,000 ($3,998,993)	Not funded
NSF Environmental Engineering	CAREER: Improving understanding of transport and control of indoor air pollutants	15-Jul	PI	$536,865	Not funded

Sloan Foundation	MoBE Postdoctoral Fellow - Parham Azimi - Modeling indoor microbial ecology	15-Aug	PI	$120,000	Not funded
NSF Environmental Engineering	Measuring outdoor ozone transport into indoor environments	15-Oct	PI	$298,600	Not funded
ASHRAE TRP-1691	Field measurements of filter impacts on indoor particulate matter	15-Dec	PI	$189,303	Not funded
DOE Building America	Residential Energy and Indoor Air Quality Toolkit	16-Feb	PI	$666,971	Not funded
NSF INFEWS	Energy and Water Nexus for urban food systems (PI: Araastopour)	16-Mar	Co-PI	$300,000 ($3,997,883)	Not funded
DOE BENEFIT	Human in the loop sensors	16-Apr	PI	$785,326	Not funded
Fenner Drives	**3d printer filament testing**	**16-Apr**	**PI**	**$3,600**	**Funded**
DOE IAC	Industrial assessment center at IIT	16-May	Co-PI	$349,345 ($1,746,723)	Not funded
CTBUH	**Vertical variations in pollutants in tall buildings**	**16-May**	**PI**	**$20,000**	**Funded**
HUD HHTS	**Ventilation and asthma – with Elevate Energy**	**16-Aug**	**PI**	**$699,612**	**Funded**
HUD HHTS	Moisture control – with Seventhwave	16-Aug	Co-PI	$700,000	Not funded
NSF SEAE	Ozone penetration – with PSU	16-Sep	Co-PI	$141,702 ($325,000)	Not funded
ASHRAE	**Undergraduate teaching lab improvements**	**16-Nov**	**PI**	**$5,000**	**Funded**
ASHRAE	Vertical variations in pollutants in tall buildings	16-Dec	Co-PI	$47,909 ($100,000)	Not funded
Aleph Objects	**3d printer emissions testing**	**16-Dec**	**PI**	**$9,600**	**Funded**
ASHRAE Graduate Student Grant in Aid	**Haoran Zhao – Energy and IAQ impacts of mechanical ventilation in homes**	**17-Mar**	**PI**	**$10,000**	**Funded**
ASHRAE Graduate Student Grant in Aid	Afshin Faramarzi – Novel optimization method for office building energy consumption	17-Mar	PI	$10,000	Not funded
NSF INFEWS	Urban farming: Food, energy, water nexus	17-Mar	Co-PI	$204,000 ($2,559,202)	Not funded
WISER ISFG (internal)	**Global transboundary politics and pollution**	**17-Mar**	**Co-PI**	**$10,000 ($25,000)**	**Funded**
ARPA-E	Building occupancy sensors	17-Aug	Co-PI	$140,000 ($2+ million)	Not funded
NSF Environmental Engineering	Transport of outdoor ozone into residential indoor environments	17-Oct	Co-PI	$158,935 ($330,000)	Not funded
Franklin Energy	**Wireless building sensors and controls**	**17-Nov**	**PI**	**$59,125**	**Funded**
Nagle Energy Solutions	**Garage demand ventilation control**	**18-Apr**	**Co-PI**	**$4,406 ($21,000)**	**Funded**
ASHRAE	ASHRAE 1819-TRP DCV multiple zone VAV	18-May	Co-PI	$9,500 ($109,862)	Not funded
ASHRAE	ASHRAE URP HUD supplement	18-May	PI	$199,064	Not funded
DOE Building America	Fault detection with SMART265	18-Jun	PI	$812,078	Not funded
NSF INFEWS	Urban food systems efficiency	18-Sep	Co-PI	$2,596,120	Not funded
DOE	Urban pumped hydropower	18-Nov	Co-PI	$5,000 ($115,000)	Not funded
ASHRAE	Updated climate data	18-Dec	Co-PI	$4,600 ($114,200)	Not funded
Franklin Energy	**Novel radiator control system**	**18-Dec**	**PI**	**$81,125**	**Funded**

NIOSH R03	Pollutant exposures in makerspaces	19-Feb	Co-PI	$71,500 ($143,000)	Not funded
ASHRAE	TRP 1836 building energy efficiency measures	19-Apr	Co-PI	($97,709)	Not funded
NSF	CPS: IAQ testbed	19-Apr	Co-PI	($486,173)	Not funded
NIOSH	R01 antibiotic resistance in hospitals (UCSD)	19-May	Co-PI	$556,902 ($2 million)	TBD
DOE	BENEFIT – advanced actuators	19-Jul	PI	$939,182	Not funded
DOE	ABC – precast concrete panels	19-Aug	Co-PI	($847,201)	Not funded
HUD	**HHTS air filtration and COPD**	**19-Aug**	**PI**	**$1,000,000**	**Funded**
NSF CNH2	Urban food systems for consumers/producers	19-Nov	Co-PI	(1,600,000)	TBD
NSF EEID	Antibiotic resistance in hospitals (UCSD)	19-Nov	Co-PI	($2,362,706)	TBD
NSF RED	STREAMS in CAEE	20-Feb	PI	$2,000,000	TBD
ASHRAE IRG	Oxidative potential of indoor PM (UIUC)	20-Apr	Co-PI	$40,000 ($100,000)	TBD
Franklin Energy	**Novel radiator control system (amendment)**	**20-Apr**	**PI**	**$40,000**	**Funded**

1.10 Membership in professional societies (past and/or current)

- American Association for Aerosol Research (AAAR)
- American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
- International Society of Exposure Science (ISES)
- International Society of Indoor Air Quality and Climate (ISIAQ)
- National Air Filtration Association (NAFA)