Curriculum Vitae

Michael S. Waring, Ph.D.
Assistant Professor
Department of Civil, Architectural and Environmental Engineering
College of Engineering
Drexel University
3141 Chestnut St.
Philadelphia, PA 19104
Phone: (215) 895-1502
Email: msw59@drexel.edu
Website: http://indoor-envi.com

Research Interests

Indoor air quality and building sustainability; Control of indoor aerosols; Secondary impacts of control technologies and strategies; Aerosol dynamics, fate, and transport indoors and in HVAC systems; Indoor oxidative chemistry; Indoor formation of nano and fine aerosols; Impacts of dynamic ventilation strategies on building energy use and indoor air quality; Bio-filtration; Indoor microbiome

Education

Ph.D.	Civil Engineering, University of Texas at Austin, 2009 Dissertation: "Indoor Secondary Organic Aerosol Formation: Influence of Particle Controls, Mixtures, and Surfaces"
M.S.E.	Environmental Engineering, University of Texas at Austin, 2006 Thesis: "Smoking Bans as Particle Source Control and HVAC Component Loading due to Airborne Particle Mass Deposition"
B.S.E.	Architectural Engineering, University of Texas at Austin, 2005
B.A.	English (Special Honors) and Economics, University of Texas at Austin, 2000

Professional Appointments and Preparation

Assistant Professor, Drexel University	9/2009 to Present
Guest Researcher, National Institute for Occupational Safety and Health	9/2008 to 12/2008
Harrington Dissertation Fellow, University of Texas at Austin	9/2008 to 9/2009
NSF IGERT Trainee, University of Texas at Austin	9/2006 to 9/2008

Publications

Articles published in peer-referred journals

1. Stephens, B., Adams, R.I., Bhanger, S., Bibby, K., Waring, M.S. Editorial: From commensalism to mutualism: Integrating the microbial ecology, building science, and indoor air communities to advance research on the indoor microbiome. Indoor Air (accepted).

2. Youssefi, S., **Waring, M.S.** 2014. Transient secondary organic aerosol formation from limonene ozonolysis in indoor environments: Impacts of air exchange rates and initial concentration ratios. Environmental Science and Technology, DOI: 10.1021/es5009906.

3. Russell, J. Hu, Y., Chau, L. Pauliushchyk, M., Anastopoulos, I., Anandan, S., **Waring, M.S.** 2014. Indoor biofilter growth and exposure to airborne chemicals induce similar changes in the root bacterial communities of plants. Applied and Environmental Microbiology, AEM-00595.

4. **Waring, M.S.**, Wells, J.R. 2014. Volatile organic compound conversion by ozone, hydroxyl radicals, and nitrate radicals in residential indoor air: Magnitudes and impacts of oxidant sources. Published early online for a special invited edition of Atmospheric Environment – Indoor Air.

5. **Waring, M.S.** 2014. Secondary organic aerosol in residences: predicting its fraction of fine particle mass and determinants of formation strength. Indoor Air, 24, 376-389.

6. El Orch, Z., Stephens, B., **Waring, M.S.** 2014. Predictions and determinants of size-resolved particle infiltration factors in single-family homes in the US. Building and Environment 74, 106-118.

7. Liu, R., Wen, J., **Waring, M.S.** 2014. Improving airflow measurement accuracy in VAV terminal units using flow conditioners. Building and Environment, 71, 81-94.

8. Rackes, A., **Waring, M.S.** 2014. Using multiobjective optimizations to discover dynamic building ventilation strategies that can improve indoor air quality and reduce energy use. Energy and Buildings, 75, 272-280.

9. Wang, C., **Waring, M.S.** 2014. Secondary organic aerosol initiated from reactions between ozone and surface-sorbed squalene. Atmospheric Environment, 84, 222-229.

10. **Waring, M.S.**, Siegel, J.A. 2013. Indoor secondary organic aerosol formation initiated from reactions between ozone and surface-sorbed d-limonene. Environmental Science and Technology, 47, 6341-6348.

11. Morawska, L., Afshari, A., Bae, G.N., Buonanno, G., Chao, C.Y.H., Hänninen, O., Hofmann, W., Isaxon, C., Jayaratne, E.R., Pasanen, P., Salthammer, T., **Waring, M.S.**, Wierzbicka, A. 2013. Indoor Aerosols: From Personal Exposure to Risk Assessment. Indoor Air, 23, 462-487.

12. Rackes, A., **Waring, M.S.** 2013. Modeling impacts of dynamic ventilation strategies on indoor air quality of offices in six US cities. Building and Environment, 60, 243-253.

13. Youssefi, S., **Waring, M.S.** 2012. Predicting indoor secondary organic aerosol mass formation with varying yields. Indoor Air, 22, 415-426.

14. **Waring, M.S.**, Wells, J.R., Siegel, J.A. 2011. Secondary organic aerosol formation from ozone reactions with single terpenoids and terpenoid mixtures. Atmospheric Environment, 45, 4235-4242.

15. **Waring, M.S.**, Siegel, J.A. 2011. The effect of a portable ion generator on indoor air quality in a residential room. Indoor Air, 21, 267-276.

16. **Waring, M.S.**, Siegel, J.A. 2010. Influence of HVAC system parameters on indoor secondary organic aerosol formation. ASHRAE Transactions, 116, 1, 556-571.

17. **Waring, M.S.**, Siegel, J.A. 2008. Particle loading rates for HVAC filters, heat exchangers, and ducts. Indoor Air, 18, 209-224.

18. **Waring, M.S.**, Siegel J.A., Corsi, R.L. 2008. Ultrafine particle removal and generation by portable air cleaners. Atmospheric Environment, 42, 5003-5014.

19. **Waring, M.S.**, Siegel, J.A. 2007. An evaluation of the indoor air quality in bars before and after a smoking ban in Austin, Texas. Journal of Exposure Science and Environmental Epidemiology, 17, 260-268.

Articles submitted for review in or in preparation for peer-referred journals

1. Youssefi, S., **Waring, M.S.** 2014. Indoor transient secondary organic aerosol formation from α-pinene ozonolysis: Impact of air exchange rate and comparison to limonene ozonolysis. In review at *Atmospheric Environment*.
2. Hamilton, M., Rackes, A., Gurian, P., **Waring, M.S.** 2014. Perceptions in the building industry of the benefits and costs and improving indoor air quality. In review at *Indoor Air*.
3. Rackes, A., Ben-David, T., **Waring, M.S.** 2014. Statistical analysis and modeling of whole-building VOC emission rates in U.S. offices. To be submitted to *Indoor Air*.
4. Johnson, A., **Waring, M.S.**, DeCarlo, P. 2014. Change of semivolatile outdoor aerosols upon transport into the indoor environment. To be submitted to *Environmental Science and Technology*.
5. Wang, C., **Waring M.S.** 2014. Predicting indoor organic aerosol concentrations in mechanical systems and occupied spaces with the volatility basis set. To be submitted to *Building and Environment*.

Articles published in refereed conference proceedings

1. Rackes, A., Ben-David, T., **Waring, M.S.** 2014. Statistical Models of Whole-Building Volatile Organic Compound Emission Rates in US Offices. Indoor Air 2014, Hong Kong.
2. **Waring, M.S.**, Wells, J.R. 2014. Role of Different Oxidants on VOC Conversion in Residences and Offices. Indoor Air 2014, Hong Kong.
3. Youssefi, S., **Waring, M.S.** 2014. Transient Secondary Organic Aerosol Formation from d-Limonene and α-Pinene Ozonolysis in Indoor Environments. Indoor Air 2014, Hong Kong.
4. Wang, C., **Waring, M.S.** 2014. Particle Generation in HVAC Systems due to Ozone/Terpene Reactions. Indoor Air 2014, Hong Kong.
5. El Orch, Z., **Waring, M.S.**, Stephens, B. 2014. Predictions and determinants of size-resolved particle infiltration factors in single-family homes in the U.S. Indoor Air 2014, Hong Kong.
6. Rackes, A., **Waring, M.S.** 2013. Advanced integrated indoor air quality and thermal air movement strategies. ASHRAE IAQ 2013 Environmental Health in Low Energy Buildings, Vancouver, Canada.
7. **Waring, M.S.** 2013. Exploring the impact of residential weatherization on indoor secondary organic aerosol formation due to ozone reactions with organic compounds. ASHRAE IAQ 2013 Environmental Health in Low Energy Buildings, Vancouver, Canada.
8. Youssefi, S., **Waring, M.S.** 2012. Predicting indoor secondary organic aerosol formation from d-limonene ozonolysis with varying yields. Healthy Buildings, July 2012, Australia.
9. Rackes, A., **Waring, M.S.** 2012. Modeling impacts of dynamic ventilation strategies on indoor air quality over the United States office sector. Healthy Buildings, July 2012, Australia.
10. **Waring M.S.**, Siegel J.A. 2011. Yields of Secondary Organic Aerosol from Reactions between Ozone and Surface-Adsorbed d-Limonene. Indoor Air 2011, Austin, TX.
11. Langevin, J., Wen, J., Hsieh, S., Novosel, D., **Waring, M.S.** 2011. Occupant Comfort, Productivity, and Personal Control in Twenty Air Conditioned Office Buildings. Indoor Air 2011, Austin, TX.
12. **Waring M.S.**, Siegel J.A. 2009. The influence of HVAC systems on secondary organic aerosol formation. Healthy Buildings 2009, Syracuse, NY.
13. **Waring M.S.**, Siegel J.A., Corsi R.L., Morrison G. 2008. Do surface reactions influence formation of secondary organic aerosol? Indoor Air 2008, Copenhagen, Denmark.

14. **Waring M.S.**, Siegel J.A. 2008. Indoor Air Quality Implications of Using Ion Generators in Residences. Indoor Air 2008, Copenhagen, Denmark.
15. Siegel J.A., **Waring M.S.**, Yu, X., Corsi R.L. 2007. Do ion generators have a role in sustainable indoor environments? ASHRAE IAQ Specialty Conference 2007, Baltimore, MD.
16. Siegel, J.A., **Waring, M.S.**, Yu, X., Corsi, R.L., 2006. Indoor air quality implications of portable ion generators. A&WMA Specialty Conference on Indoor Environmental Quality – Problems, Research, and Solutions, Research Triangle Park, NC.
17. **Waring, M.S.**, Siegel, J.A., Huang, P., 2006. An Evaluation of a Smoking Ban Ordinance in Bars in Austin, TX. Healthy Buildings 2006, Lisbon, Portugal.

Conference Presentations (only presentations I gave; my students' presentations not included)

1. **Waring, M.S.**, Wells, J.R. 2014. Role of Different Oxidants on VOC Conversion in Residences and Offices. Indoor Air 2014, Hong Kong.
2. Youssefi, S., **Waring, M.S.** 2014. Transient Secondary Organic Aerosol Formation from d-Limonene and α-Pinene Ozonolysis in Indoor Environments. Indoor Air 2014, Hong Kong.
3. Wang, C., **Waring, M.S.** 2013. Emissions of secondary organic aerosol initiated by surface reactions between ozone and squalene. AAAR 32nd Annual Conference, Portland, OR.
4. Youssefi, S., **Waring, M.S.** 2013. Impact of air exchange rates on steady state aerosol mass fractions describing secondary organic aerosol formation. AAAR 32nd Annual Conference, Portland, OR.
5. **Waring, M.S.** 2013. Exploring the impact of residential weatherization on indoor secondary organic aerosol formation due to ozone reactions with organic compounds. ASHRAE IAQ 2013 Environmental Health in Low Energy Buildings, Vancouver, Canada.
6. Youssefi, S., **Waring, M.S.** 2012. Predicting indoor secondary organic aerosol formation from d-limonene ozonolysis with varying yields. Healthy Buildings, July 2012, Brisbane, Australia.
7. Rackes, A., **Waring, M.S.** 2012. Modeling impacts of dynamic ventilation strategies on indoor air quality over the United States office sector. Healthy Buildings, July 2012, Brisbane, Australia.
8. **Waring M.S.**, Siegel J.A. 2011. Yields of Secondary Organic Aerosol from Reactions between Ozone and Surface-Adsorbed d-Limonene. Indoor Air 2011, Austin, TX.
9. **Waring M.S.**, Siegel J.A. 2009. The influence of HVAC systems on secondary organic aerosol formation. Healthy Buildings 2009, Syracuse, NY.
10. **Waring M.S.**, Siegel J.A., Corsi R.L., Morrison G. 2008. Do surface reactions influence formation of secondary organic aerosol? Indoor Air 2008, Copenhagen, Denmark.
11. **Waring M.S.**, Siegel J.A. 2008. Indoor Air Quality Implications of Using Ion Generators in Residences. Indoor Air 2008, Copenhagen, Denmark.
12. **Waring, M.S.**, Corsi, R., Siegel, J.A. 2007. Ultrafine Particle Removal and Generation by Portable Air Cleaners. ISEA Conference 2007, Durham, NC.
13. **Waring, M.S.**, Siegel, J.A., Corsi, R. 2007. Indoor Air Quality and Exposure Implications of Using an Ion Generator in a Residential Environment. ISEA Conference 2007, Durham, NC.
14. **Waring, M.S.**, Siegel, J.A. 2005. Modeling Particle Deposition to HVAC Heat Exchangers. AAAR 2005 Annual Conference, Austin, TX.

Invited Presentations

1. Anandan, S., Russell, J., **Waring, M.S.** 2012. Cleaner, Cheaper Air: Uncovering the Benefits and Mechanisms of Biowalls for Improved Indoor Air Quality. Dean's Seminar Series, College of Arts and Sciences, April 11, 2012.
2. Anandan, S., Russell, J., **Waring, M.S.** 2012. Presentation to the Delaware Valley Green Building Council on the Drexel Biowall, February 23, 2012.
3. **Waring, M.S.** 2010. Indoor Secondary Organic Aerosol Formation**:** Novel Sources, Exposure Implications, and Potential Engineering Uses. Drexel IAHR Lecture Series, April 10, 2010.
4. **Waring, M.S.** 2010. A Breath of Fresh Indoor Air Quality. Warminster Green Building Association, March 12, 2010.
5. **Waring, M.S.** 2009. Particle Research and the Gas-and-Vapor team at NIOSH. National Institute for Occupational Safety and Health, October 17, 2008.

Funded Grants and Awards

1. Commonwealth of Pennsylvania; GRID: Using Biowalls to Sustainably Reduce Human Exposure to Indoor Volatile Organic Compounds; **PI** (**Waring**), Co-PIs (Anandan and Russell, Drexel); $153,021; 1/1/2011 to 12/31/2013.
2. Department of Energy; Energy Efficient Building Hub; PI (Wen, Drexel), **Co-PIs** (**Waring** and Gurian, Drexel); $1,999,717; 2/1/2011 to 1/31/2016.
3. National Science Foundation; CAREER: Time- and Size-Resolved Formation of Secondary Organic Aerosol in Indoor Air; **PI** (**Waring**); $402,498; 4/01/2011 to 3/31/2016.
4. Drexel Office of the Provost and the Steinbright Career Development Center; Undergraduate Research Coop Support; **PI** (**Waring**); $7,052.50; Fall 2011/Winter 2012 term.
5. American Society for Heating, Refrigeration and Air-conditioning Engineers; Grant-in-Aid; **PI** (**Waring, with Ph.D. student, Rackes**)**;** $10,000; 7/1/2012 to 6/31/2013.
6. National Science Foundation; MRI: Acquisition of a Soot-Particle Aerosol Mass Spectrometer, for the Measurement of Submicron Particulate Chemical Composition; PI (DeCarlo, Drexel), **Co-PI**s (**Waring**, Burstyn, Velinsky, and Miller, Drexel); $467,925, 9/2012 to 8/2013.
7. Henry and Camille Dreyfus Foundation; CLEAR PM: Chemistry Lessons: Enabling Aerosol Realizations with Particulate Measurements; PI (DeCarlo, Drexel), **Co-PI** (**Waring**); $44,000, 12/2012 to 6/2014.
8. American Society for Heating, Refrigeration and Air-conditioning Engineers; New Investigator Award; **PI** (**Waring**); $150,000; 7/1/2013 to 6/30/2016.
9. National Science Foundation; Particulate Matter Size and Composition Change in Response to Transport from the Outdoor to Indoor Environment; PI (DeCarlo, Drexel), **Co-PI** (**Waring**); $329,164; 9/1/2014 to 8/31/2017
10. Alfred P. Sloan Foundation; Microbial Community Response to Water Damage in Residential Buildings; PI (Adams, Berkeley), **Co-PI** (**Waring**, Drexel; Eisenhard, Red Hook Initiative); $324,726 (Drexel portion is $156,748); 9/1/2014 to 2/28/2016.

Pending Grants

1. National Science Foundation; REU SITE: Engineering Cities – Sustainable Buildings; **PI** (**Waring**), Co-PI (Sjoblom, Drexel); $359,728; Submitted 8/2014.
2. National Science Foundation; Intelligent Multi-criteria Building Ventilation Control within Dynamic Urban Environments; **PI** (**Waring**), Co-PI (Wen, Drexel); $306,539; Submitted 11/2014.

Collaborators and their Affiliations

- Afshari, A. (Danish Building Research Institute/Aalborg University, Denmark)
- Anandan, S.; Bartoli, I; DeCarlo, P.; Ellis, G.; Gurian, P.; Haas, C.; Pradhan, A.; Russell, J.; Wen, J. (Drexel University, USA)
- Bae, G.N. (Korea Institute of Science and Technology, Korea)
- Bahnfleth, W. (Pennsylvania State University, USA)
- Buonanno, G. (Queensland University of Technology, Australia; University of Cassino and Southern Lazio, Italy)
- Chao, C.Y.H. (Hong Kong University of Science and Technology, Hong Kong)
- Corsi, R.L.; Siegel, J.A. (University of Texas at Austin, USA)
- Hänninen, O. (National Institute for Health and Welfare, Finland)
- Hofmann, W. (University of Salzburg, Austria)
- Isaxon, C. (Lund University, Sweden)
- Jayaratne, E.R. (Queensland University of Technology, Australia)
- Lee, S.W. (Morgan State, USA)
- Loftness, V. (Carnegie Mellon University, USA)
- Morawska, L. (Queensland University of Technology, Australia)
- Morrison, G.C. (Missouri University of Science and Technology, USA)
- Pasanen, P. (University of Eastern Finland, Finland)
- Salthammer, T. (Fraunhofer WKI, Germany)
- Stephens, B. (Illinois Institute of Technology, USA)
- Wells, J.R. (National Institute for Occupational Safety and Health, USA)
- Wierzbicka, A. (Lund University, Sweden)

Professional Affiliations

- American Society for Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE)
  - Chair of Research Subcommittee for TC 2.4: Particulate Air Contaminants and Particulate Contaminant Removal Equipment (2013 to present)
  - Voting member for TC 2.4: Particulate Air Contaminants and Particulate Contaminant Removal Equipment (2014 to present; non-voting member from 2009 to present)
- International Society of Indoor Air Quality and Climate (ISIAQ)
  - Member of STC 12: Source, monitoring and evaluation: Aerosols (2012 to present)

Professional Activities

- Invited to submit a paper for special upcoming edition on 'Indoor Air' for the journal, Atmospheric Environment.

- Invited Participant, Workshop sponsored by the Alfred P. Sloan Foundation program on Microbiology of the Built Environment, entitled "Building science to advance research in the microbiology of the built environment," Chicago, IL, May 22-23, 2014.
- Invited Session Chair at international conferences, including Indoor Air (2008 in Copenhagen, Denmark; 2011 in Austin, TX, USA; 2014 in Hong Kong, Special Administrative Region of China) and Healthy Buildings (2009 in Syracuse, NY, USA; 2012 in Brisbane, Australia).
- Technical Reviewer at international conferences, including Indoor Air (2011 in Austin, TX, USA; 2014 in Hong Kong, Special Administrative Region of China).
- Development Team Leader, Building Mass and Energy Balances Website at University of Texas at Austin: http://www.ce.utexas.edu/bmeb/
- Invited Participant, Workshop sponsored by the National Science Foundation and UMR Environmental Research Center for Emerging Contaminants, entitled "Interfacial Chemistry in Indoor Environments," Berkeley, CA, July 2007.
- Professional Reviews for papers submitted to *Environmental Science and Technology*, *Building and Environment*, *Indoor Air*, *Journal of Aerosol Science*, *Journal of Occupational and Environmental Hygiene*, *Environmental Engineering Science*, and the IEEE International Conference on Automation Science and Engineering.
- Professional Reviews for proposals submitted to the National Science Foundation, the Environmental Protection Agency, and the Drexel Engineering Cities Initiative.

Courses Taught

- **AE 220** – *Introduction to Heating, Ventilation, and Air Conditioning*, Instructor, undergraduate level, winter quarter: 2010, 2011, 2012, 2013, 2014
    - Description: This course includes a review of thermodynamics, moist air properties and processes, basic heat transfer, solar radiation, heating and cooling losses and load calculation, types of air conditioning systems, infiltration and ventilation, air motion and distribution.
    - Development: I have steadily developed the materials of course since taking it over in Winter 2010, including adding a new building assessment section to its laboratory section.
- **AE 390** – *Architectural Engineering Design*, Instructor (co-taught with Professor Jim Mitchell), undergraduate level, spring quarter: 2012
    - Description: Establishes a base of building systems design concepts, knowledge and performance criteria, with emphasis on the thermal, electrical, illumination and structural aspects of buildings.
- **AE 550/ENVE 465** – *Indoor Air Quality*, Instructor, graduate + undergraduate level combined, fall quarter: 2009, 2010, 2011, 2012, 2013, 2014
    - Description: Introduces basic concepts about indoor air quality, indoor air pollutants, including their sources and health effects, transport of pollutants, modeling of pollutant concentration in buildings, and ventilation as well as air cleaning systems.
    - Development: Upon taking over this course, I completely redesigned because indoor air quality is my research field and I wanted the class to reflect my own viewpoints on important topics and include the latest research in the field (including my own).

- **AE 790** – *Indoor Air Modeling and Measurements*, Instructor, graduate level, spring quarter: 2013
  - Description: Expand on basic concepts about indoor air quality, with a strong focus on indoor modeling and measurements, and help students hone their research and communication skills.
  - Development: This course was 100% initiated and developed by me, and in it, students collaborate with each other to carry out an extensive modeling and measurement project.
- **CIVE 320** – *Introduction to Fluid Flow*, Instructor, undergraduate level, spring quarter: 2010, 2011, 2014
  - Description: Covers fundamentals of fluid flow, fluid properties, hydrostatic forces, kinematics of flow, the Bernoulli equation, linear momentum, dimensional analysis, Froude and Reynolds similarity and hydraulic models and an introduction to pipe flows and friction.
  - Development: Similar to AE 220, I inherited this course and I have developed new lecture and homework materials since beginning to teach it in Spring 2010.
- **CIVE 399** – *Independent Study*, Instructor, undergraduate level
  - Students: Tom Ben-David, Michael Magee, Adams Rackes

Educational Initiatives

- Development of new cross-cutting curriculum for Mechanical Concentration for Civil Engineering MS degree (with Jim Mitchell and Jin Wen in CAEE Department)
- Development of new Architectural Engineering MS and PhD degrees (with Jim Mitchel and Jin Wen in CAEE Department)
- Development of new 'Digital Building' undergraduate Architectural Engineering concentration (with Jim Mitchell and Jin Wen in CAEE Department)

Student Supervision

Ph.D. Students

- Somayeh Youssefi, Ph.D. candidate, expected graduation early 2015
- Adams Rackes, Ph.D. candidate, expected graduation Summer 2016
  - While my graduate student, Mr. Rackes has received an American Society for Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE) Grant-in-Aid, a National Science Foundation Graduate Research Fellowship, and a Fulbright Scholarship
- Chunyi Wang, Ph.D. candidate, expected graduation Summer 2016
- Sheng Wang, Ph.D. student, expected graduation Summer 2017
- Yanan Yang, Ph.D. student, expected graduation Summer 2017
- Prateek Pant, Ph.D. student, expected graduation Summer 2017

Undergraduate Students

- Jonathan Fink (BS student, independent researcher, Oct. 2014 to present)
- Tom Ben-David (BS/MS student, independent researcher, Jan. 2013 to present)

- Mr. Ben-David is a coauthor on a paper about to be submitted: Rackes, A., Ben-David, T., **Waring, M.S.** 2014. Statistical analysis and modeling of whole-building VOC emission rates in US offices. To be submitted to Indoor Air.

- Michael Rullo (Laboratory assistant)
- Michael Magee (BS student, independent researcher, Jan. 2013 to Summer 2013)
- Roland Ngaba Mbiakop (Laboratory assistant, Fall 2012/Winter 2013)
- Margarita Pauliushchyk (BS student, research Co-op student, Fall 2011/Winter 2012)
  - Ms. Pauliushchyk is a coauthor on the following published paper: Russell, J. Hu, Y., Chau, L. Pauliushchyk, M., Anastopoulos, I., Anandan, S., **Waring, M.S.** 2014. Indoor biofilter growth and exposure to airborne chemicals induce similar changes in the root bacterial communities of plants. Applied and Environmental Microbiology, AEM-00595.
- Young Kwang Lee (BS student, STAR scholar, Summer 2011)
- Adams Rackes (BS/PhD student, independent researcher, Winter 2010 to present, Mr. Rackes is now a PhD candidate in my group)

Senior Design:

- Advisor: "High Performance Philadelphia Rowhouse" (Michael Magee), 2013-14
- Advisor: "A New Home for the College of Engineering" (Taylor Derr, Tucker Faherty, Samuel Martin, Matthew Morabito, David Simon), 2012-13
- Advisor: "A framework for the design and implementation of environmental sensor networks for promoting energy efficiency and IAQ in commercial buildings" (Adams Rackes), 2011-12
- Advisor: "A New Home for the "Drexel CAEE Department" (Robert Belardi, Matthew Helner, William Mahon, Ryan Weir), 2010-11
- Advisor: "Sustainable HVAC Design for the Drexel Smart House" (Jean Boda, Lauren Giardiello, AJ Leonard, Jamie McDonald, Michelle Robinson), 2009-10
- Technical Reviewer: "Schuylkill River Hub at Bartram's Garden," 2014-15
- Technical Reviewer: "Design for a Community Development Center Located in Zambia," 2014-15
- Technical Reviewer: "Building Energy Efficiency Retrofit for the City of Philadelphia's Parks and Rec Sector," 2014-15
- Technical Reviewer: "LNG Export Terminal at Hope Creek," 2013-14
- Technical Reviewer: "Mantua Green Resource Center Project," 2012-13
- Technical Reviewer: "The Structural and Mechanical Design of a Contemporary Art Museum," 2010-11
- Technical Reviewer: "Case Farnese Building Renovation," 2009-10

Senior Seminar:

- Advisor: "Sustainability of Underground Homes" (Leo Reilly), 2014-15.
- Advisor: "Building Data Collection" (Derek Lavigne), 2014-15.

- Advisor: "Indoor Air Quality in Libraries" (Xiaoxiao Tan), 2014-15.
- Advisor: "Critical Analysis of LEED Certified Buildings" (Gurjit Kaur), 2014-15.
- Advisor: "Integration of Fire Alarm and Building Automation Systems" (David Lemons), 2013-14.
- Advisor: "The Evolution of HVAC and Indoor Air Quality in the 20th Century" (Ivan Pineiro), 2013-14.
- Advisor: "Air Quality and Air Conditioning Techniques in Server Farms" (John Dobbs), 2012-13.
- Advisor: "LEED IEQ Category in Indoor Air Quality" (Kesla Duka), 2012-13.
- Advisor: "Waste Reduction in Existing Reheat Water Systems" (Ilya Sirordochev), 2012-13.
- Advisor: "Economic Advantages of Decoupling Sensible and Latent Loads Using Parallel Air and Hydronic Systems" (Stephen Wayland), 2012-13.
- Advisor: "Wind Turbines in Urban Environments" (John Jones), 2011-12.
- Advisor: "Pump Selection for Miramar, El Salvador" (Tejas Patel), 2011-12.
- Advisor: "Review of Porous Pavement Technologies" (Ryan Pinkowski), 2011-12.
- Advisor: "Building Technology of the Future: Biowall Filtration" (Anthony Nicastro), 2010-11.
- Advisor: "Removing Volatile Organic Compounds Using Photocatalytic Oxidation" (William Mahon), 2010-11.
- Advisor: "HVAC Air Duct Leakage" (Matt Albracht), 2010-11.
- Advisor: "Radon Remediation Techniques" (Nick Hall), 2010-11.
- Advisor: "Modeling Pollutant Removal by Biowalls" (Casey Gallagher), 2009-10.
- Advisor: "Impact of Green Rating Systems on Indoor Environmental Quality" (Lauren Giardiello), 2009-10.
- Advisor: "Emerging Alternative Energy Technologies in Building Sustainability" (Aisha Sandidge), 2009-10.
- Advisor: "Sustainability and Energy Efficiency in Building Design: Utilizing Solar Strategies and Technology to Create Off-the-Grid Structures" (Tony Chadwell), 2009-10.

Graduate Student Committees

PhD Final Defense Committees:

- Jared Langevin, Civil Engineering, defended May 2014
- Ghasideh Pourhashem, Environmental Engineering, defended November 2013
- Ran Liu, Civil Engineering, defended April 2012
- Lisa Chen Ng, Civil Engineering, defended July 2010
- Shamia Hoque, Environmental Engineering, defended June 2010

PhD Proposal Defense Committees:

- Somayeh Youssefi, Environmental Engineering, August 2014, chair

- Liam Hendricken, Civil Engineering, August 2013
- Jared Langevin, Civil Engineering, July 2012
- Ghasideh Pourhashem, Environmental Engineering, June 2012
- Ran Liu, Civil Engineering, December 2010

PhD Candidacy Exam Committees:

- Xiwang Li, Civil Engineering, November 2014
- Anita Johnson, Environmental Engineering, April 2014
- J. Doug Goetz, Environmental Engineering, December 2013
- Adams Rackes, Civil Engineering, January 2013
- Chunyi Wang, Environmental Engineering, October 2013
- Scott Jeffers, Environmental Engineering, May 2013
- Adam Regnier, Civil Engineering, June 2012
- Liam Hendricken, Civil Engineering, June 2012
- Xiwang Li, Civil Engineering, June 2012
- Shokouh Pourarian, Civil Engineering, December 2011
- Somayeh Youssefi, Environmental Engineering, September 2011, chair
- Jared Langevin, Civil Engineering, April 2011
- Ghasideh Pourhashem, Environmental Engineering, November 2010

MS Thesis Defense Committees:

- Alexander Bui, Environmental Engineering, June 2013
- Liam Hendricken, Civil Engineering, August 2011

University Service

- Member of CAEE Department Head Search Committee, 2014 to present
- Member of Drexel CAEE Department Curriculum Committee, 2014 to present
- Member of ad-hoc CAEE departmental committee to define important concepts/skills/engineering fundamentals taught in the CAEE curriculum and suggest strategies to enhance student learning and retention of those concepts/skills/engineering fundamentals, 2014 to present
- Member of Faculty Search Committee for position open related to Urban Infrastructure, Energy, and Environment, 2013-2014
- Member of Faculty Search Committee for position open related to Water-Energy Nexus, 2012-13
- Member of Drexel CAEE Department Forefront committee, 2013

- Member of Drexel CAEE Department: Mission, Vision, Values committee, 2012
- Member of Drexel CAEE Department Graduate committee, since 2011
- Faculty Advisor for American Society of Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE) Student Chapter, since 2011
- Faculty Advisor for B.S./M.S. degree for Building Systems Concentration at Drexel, since 2011
- Faculty Advisor for Drexel Liberty Scholar Program, 2011-13
- Faculty Advisor for Drexel STAR Scholar Program, 2011
- Moderator for ASCE MASC Critical Issues Seminar, hosted at Drexel University, 2011
- Member of Junior Faculty Committee, Drexel College of Engineering, 2010-11
- Faculty Lecturer for Drexel CAEE Fundamentals of Engineering (FE) Review Class, twice yearly lectures since 2010
- Faculty Attendee for Drexel CAEE New Student Days and Open Houses, regular attendance since 2009
- Faculty Lecturer for Drexel courses, CAEE 201 and 210, twice yearly lectures in each since 2009

Awards, Honors, Fellowships and Scholarships Received

- National Science Foundation CAREER Award, began in 2011
- American Society of Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE) New Investigator Award, awarded in 2012
- American Society of Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE) 2010 Willis H. Carrier Award, awarded in 2011
- American Society of Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE) 2010 Transactions Paper Award, with Jeffrey Siegel, awarded in 2011
- University of Texas Harrington Dissertation Fellowship, 2008-09
    - This is the highest fellowship from the University of Texas at Austin that a current doctoral candidate can hold: http://www.utexas.edu/harrington/graduate/selection/
- American Society of Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE) Graduate Student Grant-in-Aid, awarded in 2008
- National Science Foundation IGERT Trainee Fellowship, 2006-08
- University of Texas Innovative Instructional Technology Awards Program Gold Medal for Resource Development for BMEB, an educational web site at: http://www.ce.utexas.edu/bmeb/, 2007
- National Merit Scholar, 1996