KATHRYN HINKELMAN

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Contact Information

Department of Architectural Engineering
Sustainable Buildings and Societies Laboratory
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Academic Appointments

Pennsylvania State University
Postdoctoral Scholar, Sustainable Buildings and Societies Laboratory — Jul 2022 – Present
Research Assistant, Sustainable Buildings and Societies Laboratory — May 2019 – Jul 2022
Advisor: Dr. Wangda Zuo

University of California at Berkeley — Jan 2014 – May 2015
Research Assistant, Berkeley Energy and Sustainable Technologies Laboratory
Advisor: Dr. Alice Agogino

Education

Pennsylvania State University — Jan 2022 – Jun 2023
Ph.D. in Architectural Engineering
Concentration in Mechanical | GPA: 4.0
Dissertation Title: *Modelica modeling and ecosystem biomimicry of district energy systems*

University of Colorado Boulder — May 2018 – Dec 2021
Ph.D. Student in Architectural Engineering (attended & transferred to PSU with advisor)

University of California at Berkeley — Aug 2013 – May 2015
M.S. in Mechanical Engineering
Concentration in Design | GPA: 4.0
Thesis Title: *Environmental impact and indoor environmental quality assessment of Pinoleville Pomo Nation demonstration home: An implementation of life cycle assessment and culturally-inspired design*

University of Denver — Sep 2009 – Jun 2013
B.S. in Mechanical Engineering
Summa Cum Laude, Phi Beta Kappa, Departmental Distinction | GPA: 3.97

Research Interests

Sustainable energy systems (cities, districts, buildings), thermal-fluid science, model-based systems engineering, equation-based modeling (Modelica), ecosystem biomimicry, life cycle assessment, building controls, design thinking, systems thinking

Research Funding

National Science Foundation (NSF), Computer and Network Systems
EAGER: Collaborative Research: Modernizing Cities via Smart Garden Alleys with Application in Makassar City, **$175,000**, Award No. CNS-2025459, 07/20-06/22, PI Wangda Zuo
- Contributed to full proposal writing and concept development at the equivalent level of a co-PI

U.S. Department of Energy (DOE), Advanced Manufacturing Office
Optimal Co-Design of Integrated Thermal-Electrical Networks and Control Systems for Grid-interactive Efficient District (GED) Energy Systems, **$4,159,922**, Award No. DE-EE0009139, 06/20-12/23, PI Wangda Zuo
- Contributed to full proposal writing and concept development at the equivalent level of a co-PI
- Coordination proposal requirements across academic (CU Boulder, RPI, UT Austin), national lab (LBNL, NREL), and industry (Amzur Technologies) team members

Journal Publications

1. *(Under Review)* **Hinkelman, Kathryn**, Saranya Anbarasu, Wangda Zuo. "Exergy-Based Ecological Network Analysis for Integrated Building Energy Systems." *Building Simulation.*

2. **Hinkelman, Kathryn,** Yizhi Yang, Wangda Zuo. "Engineering Applications and Design Methodologies for Ecosystem Biomimicry: An Interdisciplinary Review Spanning Cyber, Physical, and Cyber-Physical Systems." *Bioinspiration & Biomimetics, 18:2 021001.* 10.1088/1748-3190/acb520.

3. Ildiri, Nasim, Heather Bazille, Yingli Lou, **Kathryn Hinkelman,** Whitney Gray, Wangda Zuo. 2022. "Impact of WELL Certification on Occupant Satisfaction and Perceived Health, Well-being, and Productivity: A Multi-Office Pre- Versus Post-Occupancy Evaluation." *Building and Environment,* 224: 109539. 10.1016/j.buildenv.2022.109539.

4. **Hinkelman, Kathryn**, Saranya Anbarasu, Michael Wetter, Antoine Gautier, Wangda Zuo. 2022. "A Fast and Accurate Modeling Approach for Water and Steam Thermodynamics with Practical Applications in District Heating System Simulation." *Energy,* 254:A 124227. 10.1016/j.energy.2022.124227.

5. **Hinkelman, Kathryn**, Jing Wang, Wangda Zuo, Antoine Gautier, Michael Wetter, Chengliang Fan, Nicholas Long. 2022. "Modelica-Based Modeling and Simulation of District Cooling Systems: A Case Study." *Applied Energy,* 311: 118654. 10.1016/j.apenergy.2022.118654.

6. Huang, Sen, Jing Wang, Yangyang Fu, Wangda Zuo, **Kathryn Hinkelman**, Raymond M. Kaiser, Dong He, Draguna Vrabie. 2021. "An open-source virtual testbed for a real Net-Zero Energy Community." *Sustainable Buildings and Society*, 75: 103255. 10.1016/j.scs.2021.103255.

7. Fan, Chengliang, **Kathryn Hinkelman**, Yangyang Fu, Wangda Zuo, Sen Huang, Chengnan Shi, Cary Faulkner, Xiaoqing Zhou. 2021. "Open-Source Modelica Models for the Control Performance Simulation of Chiller Plants with Water-side Economizer." *Applied Energy,* 299: 117337. 10.1016/j.apenergy.2021.117337.

8. Ye, Yunyang, **Kathryn Hinkelman**, Yingli Lou, Wangda Zuo, Gang Wang, Jian Zhang. 2021. "Evaluating the Energy Impact Potential of Energy Efficiency Measures for Retrofit Applications: A Case Study with U.S. Medium Office Buildings." *Building Simulation*, 14: 1377-1393. 10.1007/s12273-021-0765-z.

9. Ye, Yunyang, **Kathryn Hinkelman**, Jian Zhang, Wangda Zuo, and Gang Wang. 2019. "A Methodology to Create Prototypical Building Energy Models for Existing Buildings: A Case Study on U.S. Religious Worship Buildings." *Energy and Buildings,* 194: 351–365. 10.1016/j.enbuild.2019.04.037.

10. Lu, Xing, **Kathryn Hinkelman**, Yangyang Fu, Jing Wang, Wangda Zuo, Qianqian Zhang, and Walid Saad. 2019. "An Open Source Modeling Framework for Interdependent Energy-Transportation-Communication Infrastructure in Smart and Connected Communities." *IEEE Access,* 7: 55458–76. 10.1109/ACCESS.2019.2913630.

11. **Van Lieshout, Kathryn G**, Joy G Anderson, Kevin B Shelburne, and Bradley S Davidson. 2014. "Intensity Rankings of Plyometric Exercises Using Joint Power Absorption." *Clinical Biomechanics,* 29: 918–22. 10.1016/j.clinbiomech.2014.06.015.

Full-Paper Peer-Reviewed Conference Publications

1. *(Under Review)* **Hinkelman, Kathryn**, David Milner, Wangda Zuo. 2023. "Open-Source Models for Sand-Based Thermal Energy Storage in Heating Applications." *The 15th International Modelica Conference*, Aachen, Germany.

2. *(Accepted)* Milner, David, **Kathryn Hinkelman**, Wangda Zuo, Zhiwen Ma. 2023. "Sand-based thermal storage for building heating applications: a district energy case study." *The 7th International Conference ASTECHNOVA 2023*, Yogyakarta, Indonesia.

3. **Hinkelman, Kathryn**, Saranya Anbarasu, Wangda Zuo. 2023. "Ecological Network Analysis of Integrated Energy Systems with Modelica: A Novel Biomimetic Approach for Building Design

and Operation." *Building Simulation Conference*, Shanghai, China.

4. **Hinkelman, Kathryn,** Wangda Zuo, Jing Wang, Sen Huang, Michael Wetter. 2022. "Ecosystem-Level Biomimicry for the Built Environment: Adopting Systems Ecology Principles for the Control of Heterogeneous Energy Systems." *The 5th International Conference on Building Energy and Environment.* Montreal, Canada.

5. Anbarasu, Saranya, **Kathryn Hinkelman**, Wangda Zuo. 2022. "Tracing the Dependency of Water and Energy in Smart and Connected Communities through a Multi-Domain Modeling Framework." *The 5th International Conference on Building Energy and Environment.* Montreal, Canada.

6. **Hinkelman, Kathryn**, Saranya Anbarasu, Michael Wetter, Antoine Gautier, Baptiste Ravache, Wangda Zuo. 2022. "Towards Open-Source Modelica Models for Steam-Based District Heating Systems." *The 1st International workshop on Open Source Modelling and Simulation of Energy Systems*, 1-6. Aachen, Germany. 10.1109/OSMSES54027.2022.9769121.

7. **Hinkelman, Kathryn**, Jing Wang, Chengliang Fan, Wangda Zuo, Antoine Gautier, Michael Wetter, Nicholas Long. 2021. "A Case Study on Condenser Water Supply Temperature Optimization with a District Cooling Plant." *The 14th International Modelica Conference*, 587-595. Linköping, Sweden. 10.3384/ecp21181587.

8. **Hinkelman, Kathryn**, Sen Huang, Jing Wang, Wangda Zuo. 2019. "Enhancing the Implementation of a First-order Equivalent Thermal Parameter Model to Enable Accurate and Robust Building Thermal Response Prediction." *Building Simulation Conference,* 1859-1865. Rome, Italy. 10.26868/25222708.2019.210582.

9. Ye, Yunyang, **Kathryn Hinkelman**, Jian Zhang, Yulong Xie, Wangda Zuo. 2019. "A Methodology to Determine Energy Savings Impact of Building Energy Code Upgrades: A Case Study on Small Offices." *Building Simulation Conference*, 3894-3901. Rome, Italy. 10.26868/25222708.2019.210692.

10. **Van Lieshout, Kathryn G**, Cindy Bayley, Sarah O Akinlabi, Lisa von Rabenau, and David Dornfeld. 2015. "Leveraging Life Cycle Assessment to Evaluate Environmental Impacts of Green Cleaning Products." In *Procedia CIRP*, 29:372–377. Sydney, Australia. 10.1016/j.procir.2015.02.063.

Peer-Reviewed Extended Abstracts

1. Ye, Yunyang, **Kathryn Hinkelman**, Wangda Zuo, Gang Wang. 2019. "ASHRAE TRP-1771: Methodology to Evaluate Sensitive Levels of Inputs for U.S. Commercial Building Models." *ASHRAE Summer Conference*, Kansas City, MO.

2. **Van Lieshout, Kathryn G**, Owen RW Dennis, Joy G Anderson, Kevin B Shelburne, Bradley S Davidson. 2013. "Intensity Rankings of Plyometric Exercises using Joint Power Absorption." *Medicine and Science in Sports and Exercise.*

Peer-Reviewed Poster Sessions

† BEST POSTER AWARD

1. **Hinkelman, Kathryn**. "BICEPS – Biomimetic Integrated Community Energy and Power Systems." *U.S. Department of Energy Building Technologies Office (BTO) Peer Review*, Arlington, VA, April 24-28, 2023.

† 2. **Hinkelman, Kathryn**, Wangda Zuo. "Ecological Network Analysis for Architectural Engineering: How might building energy systems learn from nature?" *AEI Conference*, Denver, CO, April 12-14, 2023.

3. **Hinkelman, Kathryn**, Xing Lu, Wangda Zuo, Yangyang Fu, Jing Wang, Yingchen Zhang. "Multi-domain Modeling Framework for Future Smart and Connected Communities." *21st Century Energy Transition Symposium*, Denver, CO, April 1-2, 2019.

4. **Van Lieshout, Kathryn G**, Owen RW Dennis, Joy G Anderson, Kevin B Shelburne, Bradley S

Davidson. “Intensity rankings of plyometric exercises using joint power absorption.” *American College of Sports Medicine Annual Meeting*, Indianapolis, IN, May 28-June 1, 2013.

Non-Peer Reviewed Publications

1. **Van Lieshout, Kathryn G**. 2015. “Environmental impact and indoor environmental quality assessment of Pinoleville Pomo Nation demonstration home: An implementation of life cycle assessment and culturally-inspired design.” Master’s Thesis. *University of California, Berkeley*. 10.13140/RG.2.2.14890.90564.

2. Final Report (co-authored with Alice Agogino (PI) and student team). 2015. “Advanced UX Development Based on Innovative Technology: Integrating UX Design with the Internet of Things.” Samsung Electronics Co., Ltd. DMC R&D Center.

3. Agogino, Alice (PI). **Kathryn Van Lieshout**, Chandrayee Basu, Kyunam Kim, Julien Caubel, Elizabeth Cheng, Aparna Dhinakaran. 2014. “Model Predictive Smart Lighting Commissioning System for Emerging Demand Management.” Energy Innovations Small Grant Program: Final Report. California Energy Commission.

Presentation Sessions & Invited Talks

1. “Equation-Based Modeling and Ecosystem Biomimicry of Integrated Building Energy Systems.” *Research Seminar*, Department of Civil, Architectural and Environmental Engineering, Drexel University, May 26, 2023.

2. “BICEPS – Biomimetic Integrated Community Energy and Power Systems.” *U.S. Department of Energy Building Technologies Office (BTO) Peer Review*, Arlington, VA, April 24-28, 2023.

3. “Advancements in Multidomain Modeling and System-Level Biomimicry for the Comprehensive Design of District Energy Systems.” *Research Seminar*, Department of Systems Engineering, Colorado State University, February 2, 2023.

4. “District Heating and Cooling.” *Invited Lecture*, AE 597, Department of Architectural Engineering, Pennsylvania State University, Virtual, November 8, 2022.

5. “A Fast and Accurate Modeling Approach for Water and Steam Thermodynamics with Practical Applications in District Heating System Simulation.” *The 2022 Building Performance Analysis Conference and SimBuild,* Seminar 5: Open Source Modeling for District Energy Systems, Chicago, IL, September 14, 2022.

6. “Ecosystem-Level Biomimicry for the Built Environment: Adopting Systems Ecology Principles for the Control of Heterogeneous Energy Systems.” *The 5th International Conference on Building Energy and Environment,* Montreal, Canada, July 28, 2022.

7. “Virtual Testbed for Optimized Planning of Smart, Sustainable, and Connected Communities.” *The 2022 IEEE Power & Energy Society General Meeting*, Denver, CO, July 19, 2022.

8. “From Furnaces to Forests: Innovations in Modeling and Simulation for the Transition of Legacy District Energy Systems to Integrated Biomimetic Designs.” *Research Seminar*, Department of Mechanical Engineering & Mechanics, Drexel University, Virtual, December 20, 2021.

9. “A Case Study on Condenser Water Supply Temperature Optimization with a District Cooling Plant.” *The 14th International Modelica Conference*, Virtual, September 23, 2021.

10. “Modeling and Simulation of District Cooling Systems with Modelica.” *IBPSA-USA Denver Chapter: Student Presentations*, Virtual, May 20, 2021.

11. “A Modeling Framework to Evaluate Energy, Transportation, and Communication Interdependence in Smart and Connected Communities.” *The American Modelica Conference*, Virtual, September 22-24, 2020.

12. “A Modeling Framework to Evaluate Energy, Transportation, and Communication Interdependence in Smart and Connected Communities.” *IBPSA-USA Denver Chapter: Student Presentations,* Golden, CO, November 21, 2019.

13. "Enhancing the Implementation of a First-order Equivalent Thermal Parameter Model to Enable Accurate and Robust Building Thermal Response Prediction." *Building Simulation Conference*. Rome, Italy, September 2-4, 2019.

14. "A Modeling Framework to Evaluate Energy, Transportation, and Communication Interdependence in Smart and Connected Communities." *Intelligent Building Operations Workshop*, Boulder, CO, August 7-9, 2019.

15. "Leveraging life cycle assessment to evaluate environmental impacts of green cleaning products." *22nd CIRP Conference on Life Cycle Engineering*, Sydney, Australia, April 7-9, 2015.

Professional Experience

Innovations in Buildings (IBUILD) Graduate Research Fellow Aug 2021 – Jul 2023
U.S. Department of Energy, Building Technologies Office, Pennsylvania State University
- Independently designed, developed, and open source released the BICEPS Modelica library
- Spearheaded an interdisciplinary review on design methodologies and engineering applications on the emergent system-level ecosystem biomimicry

Research Assistant May 2019 – Aug 2021
Sustainable Buildings and Societies Laboratory with Dr. Wangda Zuo, University of Colorado Boulder
- One of 42 internationally-contributed developers for the Modelica Buildings Library, an open-source library by Lawrence Berkeley National Lab that is **the U.S. Department of Energy's next generation platform** for building & community energy modeling
- International collaborator with IBPSA Project 1, standardizing testing frameworks & advancing computational modeling & simulation capabilities for urban-scale energy systems

Mechanical-Electrical-Plumbing (MEP) Engineer Jul 2015 – Jul 2018
The Boulder Engineering Company, Boulder, CO
- Designed HVAC, power, and lighting systems for multi-family residential and commercial building projects, including restaurants, breweries, manufacturing, and medical office buildings
- Developed complete construction documents for rooftop PV systems totaling over 500 kW
- Created, evaluated, and refined new office standards through transition to 100% Revit usage
- Independently designed and coordinated entire MEP systems for office projects from requirements and schematic design through construction administration

Graduate Student Researcher Jan 2014 – May 2015
Berkeley Energy and Sustainable Technologies Lab with Professor Agogino, University of California, Berkeley
- Quantified potential energy savings from closed-loop daylighting systems for demand response
- Managed 7 design teams (38 students) on developing innovative design concepts for the Internet of Things

Undergraduate Research Assistant Jun 2012 – Jul 2013
Biomechanics Lab with Professor Davidson, University of Denver
- Spearheaded first-time research collaboration between the Engineering and Athletics Departments
- Detailed experiment, collected data, analyzed results, and presented research in quantifying plyometric intensity for sports rehabilitation

Teaching Experience

Teaching Assistant — Spring 2019
AREN 4317: Architectural Engineering Design, University of Colorado Boulder
- Provided technical support for designing mechanical HVAC and hydronic systems
- Independently taught lectures on Building Information Modeling (BIM) and interdisciplinary collaboration
- Coordinated meetings/assignments/presentations/grades for 37 students, 15 industry mentors, & 5 faculty

Teaching Assistant — Fall 2018
AREN 3540: Illumination I, University of Colorado Boulder
- Supported 41 upper-level undergrads through technical foundations of light
- Held office hours, graded assignments, and developed course materials

Graduate Student Instructor — Spring 2014
ME 110: Intro to New Product Development, University of California, Berkeley
- Guided 14 interdisciplinary teams through design process from ideation to functional prototype
- Coordinated semester finale showcase with academic and industry professionals

Graduate Student Instructor — Fall 2013
ME 107: Mechanical Engineering Laboratory, University of California, Berkeley
- Independently supervised 20 students on a mechanical system dynamics laboratory experiment
- Held weekly lab sections and assisted students on homework assignments

Academic Tutor — Jan 2011 – Jun 2012
Athletics and Recreation, University of Denver
- Tutored university athletes in subjects of Differential Equations, Calculus, and Engineering Concepts
- Taught class material that was missed due to athletic travel

Select Research Projects

Biomimetic Integrated Community Energy and Power System (BICEPS) — Aug 2021 – Jul 2023
Sponsored by DOE IBUILD Graduate Research Fellowship
- The goal of this project is to leverage biomimicry of mature natural ecosystems such as redwood forests to design and control interconnected energy systems, including thermal-fluid and electrical networks. We adopt an advanced control method and integrate nature-based solutions using exergy and ecological network analysis to inform systems designs not visible with traditional efficiency-based metrics.

Modernizing Cities via Smart Garden Alleys with Application in Makassar City — Jul 2020 – Present
Collaboration with Virginia Tech, Universitas Gadjah Mada (Indonesia), and Institut Teknologi Bandung (Indonesia)
- The goal of this research is to catalyze the transformation of Makassar City's garden alleys into smart environments by deploying a sensor network at representative green allies and conventional allies to collect data related to air quality, microclimates, and other factors; to analyze the heterogeneous data using machine learning techniques; and to then share the data and its insights with city representatives and specific communities within the city.

Support for District Energy Simulation with Modelica — Jan 2019 – Aug 2021
Collaboration with the NREL and LBNL
- The goal of this project is to create a new software analysis platform that leverages the Modelica language to enable developers of community-scale construction projects to effectively evaluate and optimize district heating and cooling systems.

BIGDATA: Collaborative Research: IA: Big Data Analytics for Optimized Planning of Smart, Sustainable, and Connected Communities Oct 2018 – Aug 2021
Collaboration with Virginia Tech
- The goal of this project is to develop a new planning framework for smart, connected, and sustainable communities that allows meeting such zero energy, zero outage, and zero congestions goals by optimally deciding on how, when, and where to deploy or upgrade a community's infrastructure.

Assessing Sustainability of Homes with the Pinoleville Pomo Nation Oct 2013 – May 2015
M.S. Project, Committee Alice Agogino and Daniel Kammen, UC Berkeley
- Designed a culturally inspired indoor environmental quality monitoring tool for tribal residents
- Developed and tested the mechanical, electrical, and software systems for the PV-powered sensors
- Evaluated the life cycle impacts of the home with geothermal heat pumps and grid-tied PV system

Retrofitting Commercial Buildings with Smart Lighting Systems Jan 2014 – Oct 2014
Sponsored by the California Energy Commission, UC Berkeley
- Computed potential energy savings from using a smart lighting system for demand response
- Performed an LCA of the smart lighting sensors and assessed the effective environmental payback

Leadership

Conference Chair Aug 2019
Intelligent Building Operations Workshop, University of Colorado Boulder
- Session chair for Modeling and Assessment Tools

Collegiate Athlete Aug 2009 – Nov 2012
Division I Women's Soccer Team, University of Denver
- Balanced intensive athletic duties of regular practice, games, and travel with a difficult course load
- Regular starter and leader to the team, finishing 22nd in the nation in senior season

Honors and Awards

IBUILD Graduate Research Fellowship, **$164,000** total, 2 years 2021-2023
U.S. Department of Energy, Energy Efficiency and Renewable Energy, Building Technologies Office
Managed by Oak Ridge National Laboratory

Borda Graduate Scholarship in Honor of Gifford H. Albright, Pennsylvania State University 2022

Gordon D. Kissinger Graduate Research Fellowship, Pennsylvania State University 2022

Harvey and Geraldine Brush Graduate Fellowship in Engineering, Pennsylvania State University 2022

Marlene & Joseph Borda Architectural Engineering Graduates Fellowship, Pennsylvania State University 2022

P.E.O. Scholar Award, **$20,000** international merit-based award 2021

International Building Performance Simulation Association (IBPSA) Project 1 Scholarship Recipient 2019

The Link Foundation Energy Fellowship Program Honorable Mention 2019

Colorado Engineering Council Silver Medal & Certificate of Merit 2013

	Pioneer Award *"The **highest honor** given to undergraduate students" at the University of Denver*	2013
	Mechanical Engineering Departmental Distinction, University of Denver	2013
	Taylor Achievement Award, Ortho Transmission, LLC	2013
	Hornbeck Scholar (7 quarters), University of Denver	2010-2013
	Dean's List (8 quarters), University of Denver	2010-2013
	A University of Denver Scholar-Athlete of the Year (4 years)	2009-2013
	NSCAA Scholar All-West Region Team	2012
	Second Team All-WAC Selection	2012
	Academic All-American First Team, Division I Women's Soccer	2011
	Preseason All-Sun Belt Conference Team	2011
	Sun Belt Conference Commissioner's List (all 3 seasons)	2009-2011
	SBC All-Conference First Team	2019
	DU Invitational All-Tournament Team	2009
	CS360's Primetime Performers of the Week (9/15)	2009

Professional Associations	ASHRAE: American Society of Heating, Refrigerating and Air-Conditioning Engineers	2017 – Present
	IBPSA: International Building Performance Simulation Association	2019 – Present
	ASEE: American Society of Engineering Education	2022 – Present
	ASCE: American Society of Civil Engineers	2023 – Present