

Joseph D. Rendall

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ACADEMIC BACKGROUND

PhD, Sustainable Energy Systems Engineering

August 2019

Texas A&M University–Kingsville

Kingsville, TX

Dissertation: *Thermal stratification in hot water tanks: a review, an empirical fit, a novel model and a prototype diffuser*

Advisor: Dr. William Worek | Co-Advisor: Dr. Kyle Gluesenkamp

MS and BS, Architectural Engineering

December 2012

University of Kansas

Lawrence, KS

MS thesis: *Thermal performance of passive-solar compartments*

BS research: *Sustainable architectural designs & eco-labeling of construction materials*

RESEARCH EXPERIENCE

Oak Ridge National Laboratory

Oak Ridge, TN

R&D Associate Staff, Multifunctional Equipment Integration Group

2022–Present

- ORNL Principal Investigator \$800K proposal for drain-source heat pump for domestic hot water and space cooling (2024 BENEFIT)
- Led awarded \$2.4 million proposal on heat pump water heating for cold climates for low-income multifamily residences (2022 Lab Call)
- Support seven projects on heat pump water heaters and thermal energy storage
- Mentored 3 undergraduate students (summer 2024)
- Coauthored 22 publications in 2024, 18 publications in 2023, and 16 publications in 2022
- 1 patent granted, 2 patents published, 1 patent nonprovisional patent application submitted

Postdoctoral Research Associate, Equipment Research Groups

2019–2022

- Submitted seven journal articles as the first author; published five during tenure
- Coauthored eight conference papers
- Led seven invention disclosures on heat transfer and fluid flow
- Submitted two nonprovisional patent applications and four elected disclosures
- Substantially influenced experimentation plans and prototype designs
- Coauthored three final project reports

PhD HERE Intern, ORISE, ORAU, Building Equipment Group

2018–2019

- Prepared three manuscripts for journal submission
- Created an experimental apparatus for fluid and heat transfer data collection
- Disclosed one invention

National Science Foundation

Kingsville, TX

Graduate Assistant, Research Experiences for Undergraduates

Summer 2016 and 2017

- Guided students to three awards—two for presentations and one for a conference paper
- Published two conference papers

University of Kansas

Lawrence, KS

Graduate Research Assistant

2010–2012

- Developed one conference presentation
- Created a 100+ channel solar-thermal field experimental setup
- Processed two years of experimental data

Undergraduate Research Assistant

2008–2009

- Produced one industry article

PUBLICATIONS

Journal Articles

- Rendall, J.**, Tamraparni, A., Shen, Z., Hun, D., Shrestha, S., “Low-cost fin-tube heat exchanger design for building thermal energy storage using phase change material” *International Communications in Heat and Mass Transfer*, Volume 159, Part B, 2024.
- Brechtel, J., **Rendall, J.**, Zhang, M., Koehler, M., Nawaz, K., Momen, A., “Compatibility of $\text{LaFe}_{13-x}\text{Mn}_x\text{Si}_y\text{H}_{1.6}$ and eutectic liquid GaInSn alloy,” 13, 10, 2, *Magnetochemistry*, 2024
- Rendall, J.**, Elatar, A., Nawaz, K., and Sun, J., “Medium-temperature phase change material integration in domestic heat pump water heaters for improved thermal energy storage,” 185, 113656 to *Renewable and Sustainable Energy Reviews*, 2023.
- Sun J., Nawaz, K., **Rendall, J.**, Elatar, A., Brechtel, J., “Heat pump water heater enhanced with phase change materials thermal energy storage: Modeling study,” *International Communications in Heat and Mass Transfer*, Volume 146, 2023.
- Rendall, J.**, Brechtel, J., Nawaz, K., Elatar, A., Sun, J., An, K., Liu, X., Asher, W., “Experimental results of embedded phase change material capsules for increasing the performance of a wrapped heat pump water heater,” *International Communications in Heat and Mass Transfer*, V. 145, Part A, 2023.
- Gao, Z., **Rendall, J.**, Nawaz, K., Abuheiba, A., and Abdelaziz, O., “Innovative modeling and simulation of membrane-based dehumidification and energy recovery equipment,” *Case Studies in Thermal Engineering*, 2023
- Rendall, J.**, Turnaoglu, T., and Patel, V. K., “Experimental Results of a Magnetically Coupled Piezoelectric Actuator to Relieve Microchannel Heat Exchanger Maldistribution,” *International Communications in Heat and Mass Transfer* 133, 105944, 2022.
- Rendall, J.**, Nawaz, K., Elatar, A., Asher, W., and Worek, W., “Performance evaluation of a wrapped around condenser for heat pump water heater applications,” *Applied Thermal Energy* 207, 118097, 2022.
- Rendall, J.**, Abuheiba, A., Gluesenkamp, K., Nawaz, K., Worek, W., and Elatar, A., “Nondimensional convection numbers modeling thermally stratified storage tanks: Richardson’s number and hot-water tanks,” *Renewable and Sustainable Energy Reviews* 150, 111471, 2021.
- Rendall, J.**, Karg-Bulnes, F., Gluesenkamp, K., Abuheiba, A., Worek, W., and Nawaz, K., “A flow-rate dependent 1D model for thermally stratified hot-water energy storage,” *Energies* 14(9), 2661, 2021.
- Rendall, J.**, Gluesenkamp, K., Abuheiba, A., Nawaz, K., Worek, W., and Gehl, T., “Empirical Characterization of Vertical-tube Inlets in Hot-water Storage Tanks,” *International Communications in Heat and Mass Transfer* 119, 104838, 2020.

Conference Papers

- Rendall, J.**, Tamraparni, A., Shen, Z., Hun, D., Shrestha, S., “Pressure sensor for state of charge measurements in latent thermal energy storage (P-SOC),” 8th International High Performance Buildings Conference, West Lafayette, IN, July 2024
- Malhotra, M., Krishnan, E., **Rendall J.**, Casey, F., “Cost reduction of heat pump water heating in cold climates for low to moderate income families” 8th International High Performance Buildings Conference, West Lafayette, IN, July 2024
- Krishnan, E., Murugan, M., **Rendall, J.**, Nawaz, K., Brechtel, J., “Performance evaluation of drain water heater recovery heat exchanger for heat pump water heaters,” 8th International High Performance Buildings Conference, West Lafayette, IN, July 2024
- Tamraparni, A., **Rendall, J.**, Shen, Z., Palani, H., Hun, D., Shrestha, S., “Novel PCM-based fin and tube heat exchanger system for building heating and cooling applications,” ASHRAE 2024 Winter Conference, Chicago, IL, Jan. 2024
- Rendall, J.**, Nawaz, K., An, K., Malhotra, M., Casey, F., Worek, W., Li, Y., Sun, J., Elatar, A., Rooney, T., Klein, G., Brechtel, J., “Heat pump water heating for multifamily buildings in cold climates to reduce the energy burden for residents with low to moderate incomes,” ASHRAE 2024 Winter Conference, Chicago, IL, January, 2024
- Nguyen, T., **Rendall, J.**, Kowalski, S., “Numerical study of liquid piston compression using large-eddy simulation and volume-of-fluid approach” ASME 2023 International Mechanical Engineering Congress and Exposition, October, 2023
- Rendall, J.**, Asher, W., Brechtel, J., Li, K., Yang C., Sun, J., and Nawaz, K., “Experimental Results of Density Controlled Phase Change Material Capsules for Increased First Hour Rating for Heat Pump Water Heaters,” *Herrick Conferences*, 2022.
- Kowalski, S., **Rendall, J.**, Abuheiba, A., Cheekatamarla P., and Momen, A., “Initial Design and Experimental Results of a Novel Near-Isothermal Compressor for Heat Pump Applications,” *Herrick Conferences*, 2022.
- Sun, J., Nawaz, K., **Rendall, J.**, Brechtel, J., and Elatar, A., “Model-based Co-Simulation of Heat Pump Water Heater with Embedded Phase Change Materials Thermal Energy Storage,” *Herrick Conferences*, 2022.
- Nawaz, K., **Rendall, J.**, Elatar, A., and Sun, J., “Propane as working fluid for heat pump water heaters – opportunities and challenges,” *Herrick Conferences*, 2022.
- Kumar, N., **Rendall, J.**, Turnaoglu, T., Gluesenkamp, K., Patel, V., Abuheiba, A., and Gehl, T., “Experimental measurements of evaporation and condensation mass transfer resistances for surfaces in dishwashers,” *Herrick Conferences*, 2021.
- Gluesenkamp, K., Kumar, N., **Rendall, J.**, Patel, V., Gehl, T., Abuheiba, A., Turnaoglu, T., and Wu, G., “Novel dishwasher with thermal storage and thermoelectric heat recovery,” *Herrick Conferences*, 2021.
- Karg, F. B., Gluesenkamp, K., and **Rendall, J.**, “Comparison of plug flow and multimode stratified tank modeling approached regarding computational efficiency and accuracy,” *IMECE*, 2020.
- Chin, S., **Rendall, J.**, Liu, X., and Shen, H., “The effect of fenestration system on building energy and daylighting performance – An experimental study in humid subtropical climate,” *ASHRAE*, 2018.

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Ferster, B., Shen, H., and **Rendall, J.**, “Optimization modeling for passive cooling in South-Texas,” *Building Simulation*, 2017.

Rendall, J., and Chong, O., “A proposed eco-labeling method for building design,” *ASCE*, 2009.

DOE Reports

Rendall, J., Nguyen, T., Cheekatamarla, P., Thornton, A., Kowalski, S., “Liquid piston with spray cooling near-isothermal compressor” 2024.

Gluesenkamp, K., Malhotra, M., **Rendall, J.**, Turnaoglu, T., Gehl, A., “Heat Recovery System for Domestic Dishwashers – Final Report” 2024.

Munk, J., Hunt, W., Gehl, T., and **Rendall, J.**, “Field Performance of R-1234yf Heat Pump Water Heaters,” Report, 2023.

Rendall, J., Abuheiba A., and Gao, Z., “Final Report: Membrane-Based Air Conditioning System,” 2022.

Zhang, M., **Rendall, J.**, Nawaz, K., Patel, K., Murphy, B., and Momen, A., “Final Report – Novel Solid-State Thermo-Magneto Generator Utilizing Low-Temperature Geothermal Fluid Resources,” 2021.

Abuheiba, A., Momen, A., Zhang, M., **Rendall, J.**, Barcza, A., and Vieyra, H., “BENEFIT FOA FY2015 – Solid State Magnetocaloric Air Conditioner – Final Report,” 2020.

Book Chapters

Kunkel, K., Wuebbles, D., **Rendall, J.**, et al. “Climate Change”, *2021 ASHRAE Handbook-Fundamentals*, ASHRAE, 2021.

Presentations (invited)

Advanced Water Heating Initiative (Equity and Commercial working groups)

November 2024, February 2023 & August 2023

Research Experiences for Undergraduates (TAMU-K NSF)
Summer 2020

Presentations (presenting author)

Pressure sensor for state of charge measurement in latent thermal energy storage (P-SOC)

July 2024, *8th International High Performance Buildings Conference*, West Lafayette, IN

Heat pump water heating for multifamily buildings in cold climates to reduce the energy burden for residents with low to moderate incomes

January 2024, *ASHRAE Winter Conference*, Chicago, IL

Cost compression of heat pump water heaters for multifamily housing in cold climates

April 2023, *DOE PEER Review 2023*, Arlington, VI

Control scheme for load shifting with PCM integrated heat pump water heater

February 2023, *2023 Hot Water Forum*, San Diego, CA

An experimental method to determine the thermal contact resistance and state of charge of PCM materials via pressure sensors in a heat flux meter apparatus

September 2022, *35th International Thermal Conductivity Conference & International Thermal Expansion Symposium*, Lowell, MA

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Experimental results of density controlled phase change material capsules for increased first hour rating for heat pump water heaters

July 2022, *19th International Refrigeration and Air Conditioning Conference*, West Lafayette, IN

An experimental method to determine the contact thermal resistance of PCM undergoing large volume change

July 2022, *19th International Refrigeration and Air Conditioning Conference*, West Lafayette, IN

Selection of phase change and thermochemical materials for heat pump water heater thermal energy storage applications

June 2022, *ASHRAE Annual Conference*, Toronto, CA

First hour rating improvements to a wrapped heat pump water heater with embedded thermal energy storage

March 2022, *Hot Water Forum*, Washington, DC

The measurements of evaporation and condensation mass transfer resistances for surfaces in residential dishwashers

May 2021, *18th International Refrigeration and Air Conditioning 2020*, West Lafayette, IN

The impact of the dip-tube anti-siphon hole on tank performance metrics

March 2021, *Hot Water Forum*, Nashville, TN

PATENTS

Rendall, J., Shrestha, S., Tamraparni, A., Gehl, A., Atchley, J., Hun, D., Shen, Z., “State of Charge Sensor for Phase Change Material Thermal Energy Storage” (US20240310082A1) 2024

Rendall, J., Gluesenkamp, K., Gehl, A., Atchley, J., “Hydraulically Opened Cone Vertical Tube Diffuser with Slanted Anti-Siphon Hole” (US11768012B2) 2023

Rendall, J., Nawaz, K., Asher, W., Elatar, A., Sun, J., Brechtel, J., Liu, X., An, K., Zhang, M., “Density Controlled Phase Change Capsules” (US20230082570A1) 2023

Rendall, J., Tamraparni, Shrestha, S., Shen, Z., Hun, D., An Optimized Heat Exchanger and Methods for Designing the Same (submitted nonprovisional application) 2023

LEADERSHIP EXPERIENCE

ASHRAE

Voting Member, Climate Change TC 2.05 2019–Present

Member, Student President, Student Vice President 2009–2019

Student Vice President 2011

Student President 2010

ASME

Member 2016–2022

ADS PhD Student Group, Texas A&M University–Kingsville

Secretary 2016–2017

Engineers Without Borders

Joseph D. Rendall

Traveling Mentor, Construction Lead 2012–2017

Teachers' Change-maker, STiR Education

Associate Member 2015

Sparks Student Group, National Teachers' College Kaliro

Mentor 2014

Leader Shape Winter Conference

Attendee 2011

Toastmasters International

Member 2010

SPECIALIZED TRAINING

DOE IMPEL+ Training, Lawrence Berkeley National Laboratory

IMPEL+ Innovator **Virtual**
8 hours, 2020

Oak Ridge National Laboratory

Inventor-Corps Lite **Oak Ridge, TN**
9 hours, 2019

CFD Essentials by Chris Greenshields 40 hours, 2019

Texas A&M University–Kingsville

Culturally Aware Teaching **Kingsville, TX**
12 hours, 2017

Teaching Development 10 hours, 2017

Peace Corps Uganda

Lusoga Language **Kaliro, Uganda**
240 hours, 2015

Teaching Boot Camp 160 hours, 2013

Belgium Development Agency

Active Teaching and Learning **Kaliro, Uganda**
120 hours, 2014

SOFTWARE/HARDWARE SKILLS

- COMSOL Multiphysics (proficient)
- OpenFOAM (basic)
- LabVIEW (proficient)
- NI CDAQ (proficient)
- MATLAB (proficient)
- Camtasia (basic)
- Benchlink Data Acquisition (proficient)
- AutoCAD (basic)
- REVIT MEP (basic)
- Microsoft PowerPoint/Excel/Word (well practiced)

SCHOLARSHIPS, AWARDS, FELLOWSHIPS, AND CERTIFICATIONS

Finalist, R&D 100 Award, “Heat Exchanger for Low-Conductivity Phase Change Materials” 2024

Higher Education Research Experiences, ORAU/ORISE, Building Technologies

Research and Integration Center at Oak Ridge National Laboratory (~\$100,000) 2018–2019

Doctoral Student Support, Texas A&M University–Kingsville (\$3,000 per year) 2016–2019

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All Star in Research, Texas A&M University–Kingsville (awarded)	2018
Excellence in Teaching Award, Texas A&M University–Kingsville (nominated)	2017
Hoglund Scholarship, University of Kansas (\$3,000)	2012–2013
Steves Memorial Scholarship, University of Kansas (\$2,500)	2012
Ruben Zadigan Scholarship, University of Kansas (\$1,500)	2011
Robinson Fellowship, University of Kansas (\$1500)	2010
Bradshaw Graduate Scholarship, University of Kansas (\$1500)	2010
Engineering in Training Certification, State of Kansas (certification)	2010
Undergraduate Research Award, University of Kansas (\$500)	2009