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COLLEGIATE BUILDING SCIENCE COMPETITION

Professor Team Webinar #3

July 11, 2024

Yeonjin Bae, ORNL
Kim Trenbath, NREL

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BUILDING TECHNOLOGIES OFFICE
OAK RIDGE National Laboratory
NREL NATIONAL RENEWABLE ENERGY LABORATORY
Pacific Northwest NATIONAL LABORATORY

Agenda

- JUMP into STEM Competition
- Program Updates
- Share Your Experience
- 2024-2025 Challenge Topic
- Q&A

Management Team

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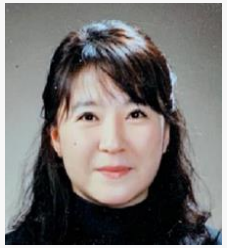
U.S. Department of Energy (DOE) Building Technologies Office (BTO)

Nicholas Ryan

Oak Ridge National Laboratory Building Technologies Research and Integration Center



Dr. Yeonjin Bae

Bill Eckman

Jason Schmidt

National Renewable Energy Laboratory Building Technologies and Science Center

Dr. Kim Trenbath

Allison Georgeson

Dr. Nehemiah Emaikwu

Pacific Northwest National Laboratory Building Simulation & Design, Building Systems

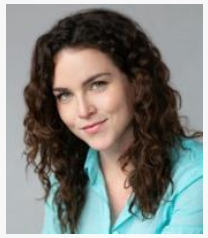
Dr. Sarah Newman

Carmen Cejudo

Dr. Yeobeom Yoon

Claire Cressman

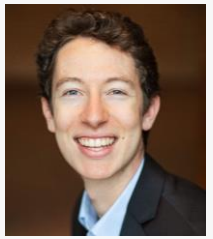
Dr. Mini Malhotra



Dr. Kerry Rippy

Alyssa Bersine

Willy Heredia



Benjamin Bruxvoort

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JUMP into STEM Competition

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Student Competitions for Building Technology Innovation

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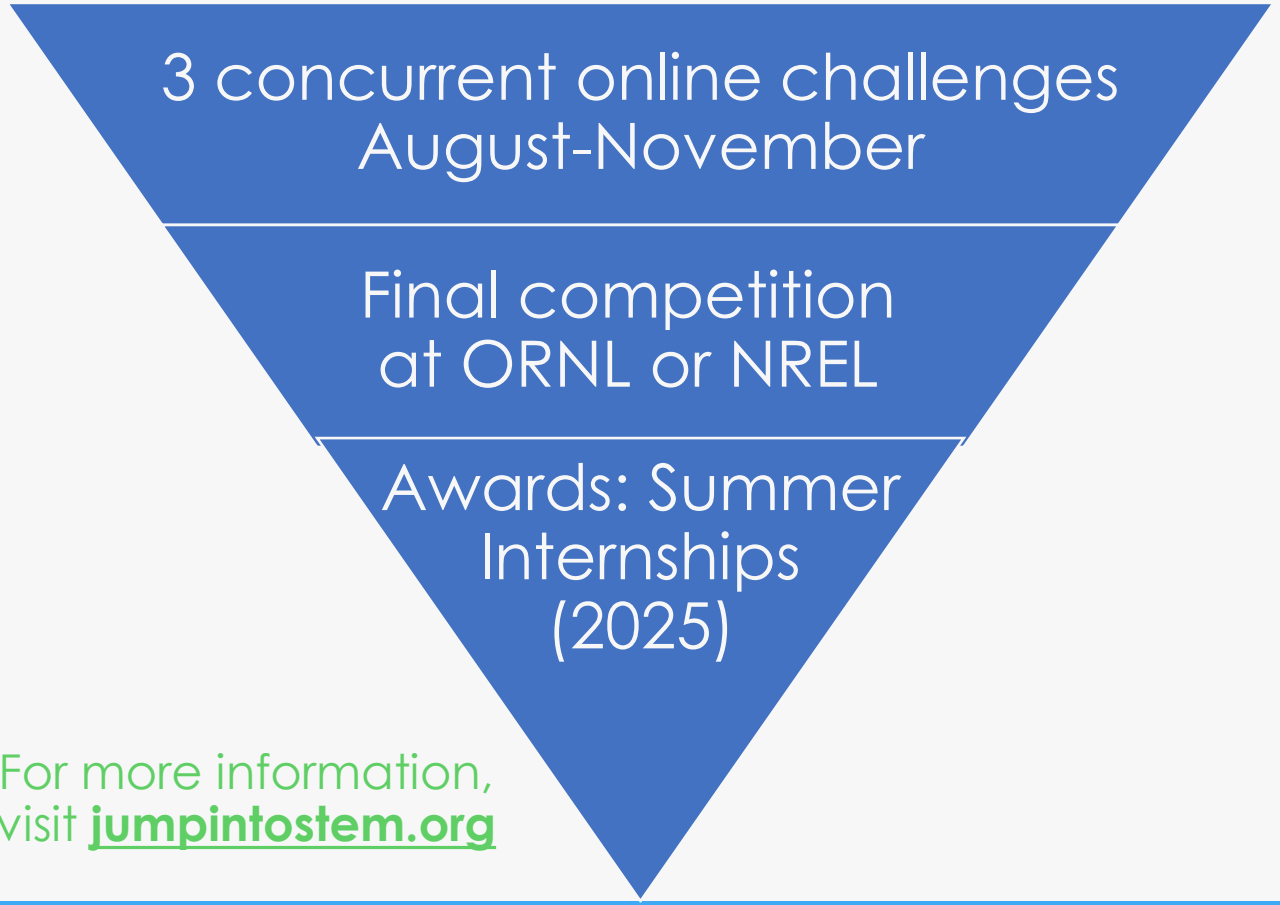

For more information, visit **jumpintostem.org**

How it works:

- Fall semester: three building science challenges for innovation
- Supported with technical overview slide deck for each challenge
- Webinars
  - Professor team webinars
  - Student webinars
  - Industry team webinars
- Finalists compete in Final Competition at ORNL or NREL for paid summer internships at ORNL, NREL or PNNL

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JUMP into STEM Supporting Resources and Webinars

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JUMP into STEM website

- Go-to location for students and professors
- www.jumpintostem.org

JUMP emails (jump@ornl.gov & jump@mailer.ornl.gov)

- Challenge topic
- Webinar
- Winner announcement

Professor webinar

- 6-7 Professor team webinars
- Potential challenge topics
- Program updates

Professor Team recruiting video

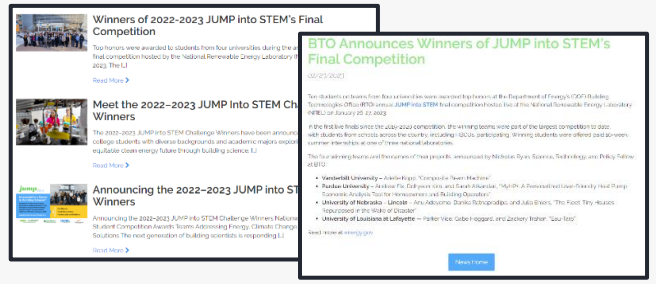
Professor Team slides and flyer

Student webinars

- Student webinars
  - How to create successful submission
  - JUMP into STEM Student Webinar

Share the recording

Share the JUMP into STEM news



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Share Your Experience

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Liane A Hancock
University of Louisiana at Lafayette
Architectural and Environmental Engineering

Dr. Davide Ziviani
Purdue University
Mechanical Engineering

1. Introduction of Topics
2. Course Integration
3. Student Engagement
4. Experience and Feedback
5. Advice for Colleagues
6. Challenges and Highlights
7. Additional Insights

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Share Your Experience

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1. Introduction of Topics
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Share Your Experience

Dr. Nelson Fumo
University of Texas at Tyler
Mechanical Engineering

Nelson Fumo, 2024, "The JUMP into STEM - The Second Experience", Proceedings of the 2024 ASEE Gulf-Southwest Annual Conference West Texas A&M University, Canyon, TX

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2024-2025 JUMP into STEM Program Updates

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Invited to ASHRAE Seminar Session

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- 2023-2024 Thermal Energy Storage Challenge Level Winners were invited to present their winning ideas at ASHRAE 2024 Annual conference

Seminar 31: Presentation 1: Kiln Thermal Energy Storage

Presenting Author: Bruce Lindsay, PE, Trane Technologies, Melbourne, FL, USA
Author: Rebekah Shields, Worcester Polytechnic Institute, Worcester, MA, USA

Seminar 31: Presentation 2: Reducing Barriers to Achieve an Energy Efficient Lifestyle for Low Income Families in the US

Presenting Author: Andreas Hoess, Graduate Research Assistant, Purdue University, W LAFAYETTE, IN, USA

Seminar 31: Presentation 3: Keepin' It Cool (or Hot)

Presenting Author: Jared Williams, Embry Riddle Aeronautical University, Daytona Beach, FL, USA

Student Webinars

- A series of student webinars will be provided
- Webinar 1 (Early September)
  - JUMP into STEM overview
  - Challenge topics and evaluation criteria
  - **Technology-to-Market support**
  - Submission template
- Webinar 2 (October)
  - Submission guidance
  - Internship application
  - National laboratories
  - Previous winners
- Industry Team Webinars

Industry Partner Visit

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- **A new benefit** for competition winners and Industry Partners
- **Two days of direct engagement** between JUMP into STEM interns and 2023-2024 Gold or Platinum Sponsor(s).
  - Internship project presentations
  - An extended tour of Clayton's Appalachia production facility in Andersonville, TN
  - Networking sessions
  - Virtual Early Career Panel with JCI

Clayton home building group
Johnson Controls

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The 2024-2025 DRAFT Challenges

2024-2025 Challenge Topics!

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- **The three challenge topics are:**
  - **Driving Affordability**
  - **No Peaking! Managing Peak Power Demand in Buildings**
  - **Occupant Comfort in Extreme Environments**

  Thank you for your feedback on selecting this year's challenge topics!

- **2024-2025 Challenge launch date: August 6, 2024**

Challenges

- **Background**
- **Technical Overview**
- **The Challenge**
- Requirements
- Evaluation Criteria

That's a Wrap!

08/01/2023

The objective of this challenge is to improve the **building envelope performance** of new or existing residential buildings by reducing energy consumption in a cost-effective and accessible way.

Background

In the heat of summer, does your air conditioner seem to run all the time? In winter, do cold drafts in your house make it impossible to get comfortable? Your house may be energy inefficient due to the performance of the building envelope. The **building envelope**—consisting of the walls, roof, foundation, and windows—separates the interior living conditions from the exterior weather and is the single largest contributor to primary energy use in residential buildings.[1] Nearly 60% of total residential building energy is used to provide occupant comfort by heating, cooling, and ventilating the living space.[2] The performance of the building envelope disproportionally affects communities that lack the resources to improve the quality of the building envelope through remediation techniques.[3]

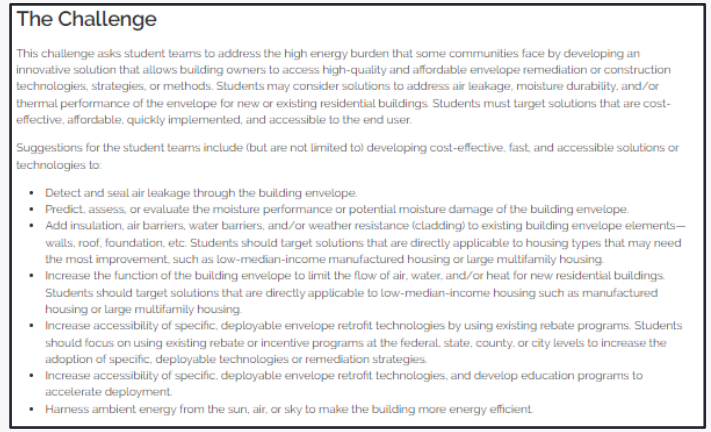
Source: GettyImages

One of the primary functions of the building envelope is to control the flow of matter and energy—specifically, the flow of moisture, air, and heat between the interior and exterior.[4] Failure to control this flow can cause reductions in energy efficiency, durability issues, decrease in occupant comfort, and reduced indoor air quality, which can lead to mold and cause significant health issues.[5] The flow of moisture (both liquid water and vapor) is typically controlled using water-resistive barriers, ventilation air gaps, and drainage planes. The flow of air is typically controlled using air-resistive barriers and air sealing techniques. The flow of heat is controlled using insulation and solar reflectance. While new building construction can easily benefit from novel technologies and methods, many of these control methods can be difficult, cost-inhibitive, or sometimes even impossible to implement into existing buildings.[6]

More than 50% of existing residential buildings in the United States were built before 1980 when energy conservation codes were first introduced,[7] and they lack modern efficient technologies that effectively control the flow of matter and energy. However, less than 2% of U.S. buildings are **remediated** each year[8] to improve the energy efficiency, primarily because the cost to retrofit commonly exceeds several thousand dollars[9] and often falls entirely on the building owner. In some cases, the building owner may have a high **energy burden** and may not have the resources to improve the quality of the building envelope to lower energy consumption. Energy burden is the percentage of a household's gross annual income spent on energy costs (including electricity, natural gas, and other home-heating fuels).[10] A person is considered energy burdened if they spend 6% or more of their annual income on energy costs.[11] Lower income households are disproportionally impacted by energy burden—households that make $15,000 or less per year spent on average 21% of their income on utilities and may forgo other life necessities in order to address issues with the envelope.[12] To increase energy efficiency and address energy burden, innovative solutions must be developed that provide access to energy-efficient, cost-effective, and accessible building envelopes.

Example of the *background*

Examples of the *Technical Overview*



The Challenge

This challenge asks student teams to address the high energy burden that some communities face by developing an innovative solution that allows building owners to access high-quality and affordable envelope remediation or construction technologies, strategies, or methods. Students may consider solutions to address air leakage, moisture durability, and/or thermal performance of the envelope for new or existing residential buildings. Students must target solutions that are cost-effective, affordable, quickly implemented, and accessible to the end user.

Suggestions for the student teams include (but are not limited to) developing cost-effective, fast, and accessible solutions or technologies to:

- Detect and seal air leakage through the building envelope.
- Predict, assess, or evaluate the moisture performance or potential moisture damage of the building envelope.
- Add insulation, air barriers, water barriers, and/or weather resistance (cladding) to existing building envelope elements—walls, roof, foundation, etc. Students should target solutions that are directly applicable to housing types that may need the most improvement, such as low-median-income manufactured housing or large multifamily housing.
- Increase the function of the building envelope to limit the flow of air, water, and/or heat for new residential buildings. Students should target solutions that are directly applicable to low-median-income housing such as manufactured housing or large multifamily housing.
- Increase accessibility of specific, deployable envelope retrofit technologies by using existing rebate programs. Students should focus on using existing rebate or incentive programs at the federal, state, county, or city levels to increase the adoption of specific, deployable technologies or remediation strategies.
- Increase accessibility of specific, deployable envelope retrofit technologies, and develop education programs to accelerate deployment.
- Harness ambient energy from the sun, air, or sky to make the building more energy efficient.

Example of the *challenge*

https://www.jumpintostem.org/challenge/thats-a-wrap/

Driving Affordability

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The Challenge

This challenge asks student teams to improve the affordability of energy-efficient technologies by developing innovative solutions to reduce costs to stakeholders. Students may consider solutions to improve the affordability of installing, retrofitting, operating, or maintaining high-efficiency building equipment or building envelopes.

Suggestions for the student teams include (but are not limited to) improving affordability by doing the following:

- Developing new, low-cost building appliances or equipment that can be easily incorporated into new construction or used to replace older equipment for building retrofits
- Developing new, low-cost insulation materials for building envelopes that can be easily incorporated into new construction or used to retrofit older buildings
- Developing new, low-cost active building envelope systems that better control the flow of heat through the envelope and that can be easily incorporated into new construction or integrated into existing buildings
- Developing proactive maintenance strategies that extend the service life of or reduce unexpected costs of building equipment or the building envelope
- Developing predictive analytical or automated decision-making tools to better predict energy demand and operate building equipment or active building envelope systems to reduce energy costs
- Developing advanced control methods for building equipment or active building envelope systems to reduce the peak energy demands of buildings and reduce energy costs
- Developing building construction methods that reduce cost and accelerate construction of energy-efficient buildings
- Addressing inefficiencies in the building construction process to reduce expected or unexpected costs or delays while maintaining high quality and energy efficiency
- Developing low-cost retrofit techniques or technologies that enable cost-effective improvements to the building envelope or upgrades to building equipment to improve the energy performance of existing buildings

No Peaking! Managing Peak Power Demand in Buildings

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The Challenge

This challenge asks student teams to develop an innovative solution that will significantly reduce peak power demand in buildings. Students can focus on reducing thermal loads or improving HVAC systems for LMI communities. Teams should first develop a focused problem statement for a specific building type and location (weather region and power generation sources) and then develop a technical solution or process.

Suggestions for student teams include (but are not limited to) the following:

- Develop new cost-effective, high-efficiency systems that can replace or complement HVAC systems.
- Develop technologies or processes to improve the building envelope for existing buildings.
- Develop technologies or processes that cost-effectively add energy storage to buildings.
- Improve heat pumps to maintain high efficiency during extreme cold days and reduce reliance on backup electric heaters.
- Develop a cost-effective combination of envelope improvements, heat pump efficiency, energy storage, and advanced controls to minimize power consumption during peak periods.

Occupant Comfort in Extreme Environments

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The Challenge
Students should develop a solution that improves occupant comfort in extreme climates or weather events, especially occupants in vulnerable communities. Teams should first build out a focused problem statement for a specific stakeholder group (i.e., climatic zone) and then develop a technical solution that meets the needs of the population.

Suggestions for student teams include (but are not limited to) the following:

- Methods for real-time sensing and response to occupant indoor thermal comfort needs.
- Advanced humidity control and measurement of occupant comfort in high humidity climates.
- Advanced home or individual room designs that extend period of thermal comfort following an extreme weather event.

Feedback on challenge topics

- Any feedback on challenge topics?

- Any suggestions for your students?

Next Meeting

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Professor Team Webinar #4 for all professor team members

- Will be scheduled in mid-August
- First-day class material will be sent prior to the professor team Webinar

Professor Team Webinar #4

- Program updates
- Submission requirements and evaluation criteria

Thank you!

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Questions?

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Q&A