JUMP into STEM
Professor Team Webinar #2

May 17, 2023

Yeonjin Bae, ORNL
Kim Trenbath, NREL

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Today's Agenda

- JUMP into STEM Overview
- JUMP into STEM Professor Team

- 2023-2024 Potential Challenge topics
- Feedback on potential challenge topics
- Q&A

Professor Team Webinar

- Professor team webinar #1 for new professor team members
  - Recordings and the slide deck are available here
  - https://jumpintostem.org/professors/

Professor Team Webinar

JUMP into STEM Overview

- BTO-sponsored building science collegiate competition
- Student teams respond to one of three challenges
- Promotes ideation and diversity
- Awards include mentoring and paid internships
- 2023-2024 is sixth year of student competition

For more info:
www.jumpintostem.org

Process of the JUMP into STEM Competition

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Recruiting Professor Team

- Email notification
- Webinars for new and returning professors
- Supporting materials for course

Announcement of Challenge Topics

- Email notification
- Webinars for professor team
- Webinar for potential participants
- Share materials on the official website

Idea Submissions

- Submit the idea
- Apply for the internship opportunity

Judge

- Assign judges to each submission
- Select the winner and runner-up team in each challenge topic
- Select the finalist teams

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Final Competition

- The Final Competition will be held in person at ORNL (January, 2024)
- Two-day event
  - Student team presentation
  - Networking sessions
  - Early-career support
  - Professor collaboration opportunities
  - Industry connection session
  - Tours of the National laboratory

Industry Sponsorship



- Industry sponsorship funds student travel to the final competition
- Gold and Platinum Sponsors
  - Invited to participate as a judge during the competition
  - Eligible to participate in the JUMP into STEM Industry Partner Visit Program

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JUMP into STEM Professor Team

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2023-2024 Professor Team

Join the JUMP into STEM Professor Team!

Your Role and Activities:

- The Professor Team connects DOE's goals within the Challenges to university students.
- Engage with JUMP into STEM team to provide feedback on potential challenges and updates during the competition
- Incorporate at least one (1) challenge into an appropriate Fall 2023 course as part of the student's grade
- Support students on research and submissions
- Promote JUMP into STEM to other university stakeholders.

JUMP into STEM participants Jarrett Thomas and Jai Huntley, and Hampton University Professor Laura Battaglia

For more info:
https://jumpintostem.org/professors/

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The 2022-2023 Professor Team

2022–2023 Professor Team

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★ New to the Team in 2022

★ HBCU/MSI/HSI

Dr. Benjamin Schafer★
Johns Hopkins University
Civil and Systems Engineering

Dr. Yang-Seon Kim
Wichita State University
Mechanical Engineering

Dr. Mohammad Bolhassani★
City College of New York
Architecture

Dr. Yao Yu
North Dakota State University
Construction Management and Engineering

Dr. Shuang Cui
University of Texas at Dallas
Mechanical Engineering

Dr. Tom Lawrence
University of Georgia
Professor of Practice

Dr. Zheng O'Neill
Texas A&M University
Mechanical Engineering

Dr. Soojin Yoon
Oklahoma State University
Engineering Technology

Dr. Omar Asensio
Georgia Institute of Technology
School of Public Policy

Dr. Raymond Tesiero ★
North Carolina A&T State University
Civil, Architectural & Environmental Engineering

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★ HBCU/MSI/HSI

Lyria Bartlett
University of Missouri
Architectural Studies

Dr. Moe Alahmad
University of Nebraska-Lincoln
Electrical Engineering

Dr. Lori Troxel
Vanderbilt University
Civil/Environmental Engineering

Dr. Nurhidajat Sisworahardjo
University of Tennessee, Chattanooga
Electrical Engineering

Dr. Saniya LeBlanc ★
George Washington University
Architecture

Dr. Mariantonieta Gutierrez Soto
Pennsylvania State University
Architectural Studies

Dr. Karl Ricanek ★
University of North Carolina Wilmington
Computer Science

Dr. Kyle Konis ★
University of Southern California
Architecture

Dr. Houlong Zhuang ★
Arizona State University
Mechanical and Aerospace Engineering

Dr. Mohammed Ben-Idris ★
University of Nevada, Reno
Electrical & Biomedical Engineering

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★ HBCU/MSI/HSI

Dr. Ahmed Ouf ☆★
Alabama A&M University
Community and Regional Planning

Dr. Sagata Bhawai ☆★
California State University, Fresno
Construction Management

Dr. Arvind Narayanaswamy ☆
Columbia University
Mechanical Engineering

Dr. Behnam Shadravan ☆★
Florida A&M University
Construction Engineering Technology

Nea Maloo ☆★
Howard University
Architecture

Dr. Thomas D. Tran ☆
Indiana Tech
Mechanical Engineering

Dr. Patrick Tebbe ☆
Minnesota State University
Mechanical Engineering

Dr. Nancy Landreville ☆
University of Maryland Global Campus
Applied Mgmt and Decision Science

Dr. Hebatalla Nazmy ☆
Oklahoma State University
Design, Housing & Merchandising

Dr. Jessica April Ward ☆★
Prairie View A&M University
Architecture

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Dr. Merlyn Pulikkathara ★★
Prairie View A&M University
Physics

Dr. Davide Ziviani ★
Purdue University
Mechanical Engineering

Dr. Sulakshana Thanvanthri ★★
Springfield Technical Community College
Engineering and Physical Science

Dr. Weihuan Zhao ★★
University of North Texas
Mechanical Engineering

Dr. Heather E. Dillon
University of Washington
Mechanical Engineering

Dr. Kevin P. Hallinan ★
University of Dayton
Mechanical and Aerospace Engineering

Dr. Aslihan Karatas ★★
University of Illinois at Chicago
Civil, Materials, and Environmental Engineering

Dr. Rania Labib ★★
Prairie View A&M University
Architecture

Michael Goldschmidt ★
University of Missouri
Architectural Studies

Dr. Nelson Fumo ★
University of Texas at Tyler
Mechanical Engineering

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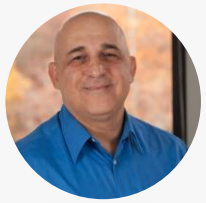

Dr. Ali Razban ☆
Indiana University Purdue University
Mechanical and Energy Engineering

Dr. Chengde Wu ☆
Iowa State University
Architecture

Dr. Olu Olatidoye ★
Clark Atlanta University
Sponsored Program Administration

Dr. Hongyu Zhou
University of Tennessee
Tickle College of Engineering

Dr. Ali Bazzi ☆
University of Connecticut
Engineering

Dr. Negar Heidari Matin ☆
University of Oklahoma
Architecture

Dr. Karl Heine
Embry-Riddle Aeronautical University
Mechanical Engineering

Dr. Greg Eades ☆
North Carolina State University
Mechanical Engineering

JUMP into STEM Videos

- Check out latest videos of JUMP into STEM!

https://jumpintostem.org/professors/

https://jumpintostem.org/final-event-jan-2023/

Next Steps

- Interested in joining the Professor Team?
- Please email me by **May 19**
  - Yeonjin Bae (baey@ornl.gov)
  - Include names of Fall courses that might include a JUMP into STEM challenge

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JUMP into STEM Challenge Topics

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2022–2023 Challenge Topics

It's Electric

https://jumpintostem.org/challenge/2022_its_electric/

Curb Your Carbon

https://jumpintostem.org/challenge/2022_curb-your-carbon/

Sustainable and Resilient

https://jumpintostem.org/challenge/2022_sustainable-resilient/

Challenges

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

Sustainable and Resilient

08/15/2022

Note that this challenge was for the Fall 2022 competition.

The objective of this challenge is to develop novel technical solutions to improve the resilience and sustainability of the built environment and identify ways for each proposed solution to enable underserved communities to adapt, persist, and recover from extreme weather and persistent stress, such as those caused by climate change[1].

Background

People around the world are experiencing an increase in the intensity and frequency of extreme weather events[1] and persistent stresses on the environment, society, and economy [2]. Extreme weather events are not always singular or isolated; they can occur in complex combinations and/or rapid succession [3]. Depending on the exposure (i.e., presence of people, livelihoods, assets, buildings, services, infrastructure, etc.) and vulnerability of the affected region and communities, an extreme weather event may become a disaster; damage the natural and built environment and infrastructure; and pose a threat to public health, safety, and well-being[4]. The impact of extreme weather and persistent stress is significantly greater on **underserved, marginalized, and vulnerable** communities, which often lack the resources and capacity to recover[5]. Climate change will increase the number of extreme weather events[6]. There is an urgent need to design more resilient and sustainable buildings and infrastructure that mitigate the impact of extreme weather events, especially in disadvantaged communities[7].

Source: iStock

The core idea of **sustainability** is to reduce negative impacts on the environment. Sustainability focuses on improving quality of life through practices that minimize damage to the environment[8]. **Resilience** relates to adaptation to change and focuses on disaster preparedness, mitigation, and recovery[9]. *Resilience is typically viewed as the response to low-probability, high-impact events, whereas sustainability is the response to high-probability events for which the impacts are spread out over the infrastructure life cycle*[10]. A resilient and sustainable design focuses on the response of systems to both extreme weather and persistent stress utilizing sustainable design principles.

Building-scale strategies for improving resilience can address one or more aspects of building structure, enclosure, systems, operations, and building use[11]. Community-level strategies for improving resilience of building stock and infrastructure may require a multipronged approach, including mandatory upgrades, incentive programs, funding mechanisms, and education/outreach programs[12].

Example of the *background*

Examples of the *Technical Overview*

Example of the *challenge*

The Challenge

Addressing this challenge requires understanding the vulnerability that various communities face from extreme weather and persistent stressors and then addressing that vulnerability by comprehensively considering equity, resilience, and sustainability. Students may consider strategies for improving resilience and sustainability of buildings and infrastructure at the building or community scale for new construction, existing buildings, or communities. The solutions must have resilience as the primary objective with sustainability as a component of resilience and must justify trade-offs considered for reconciling any divergent goals of resilience and sustainability.

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

- Develop innovative design and construction solutions for improving the resilience of buildings
- Develop smart controls for improving the resilience of building infrastructure and the electricity grid
- Develop integrated technical and planning solutions for improving community resilience.

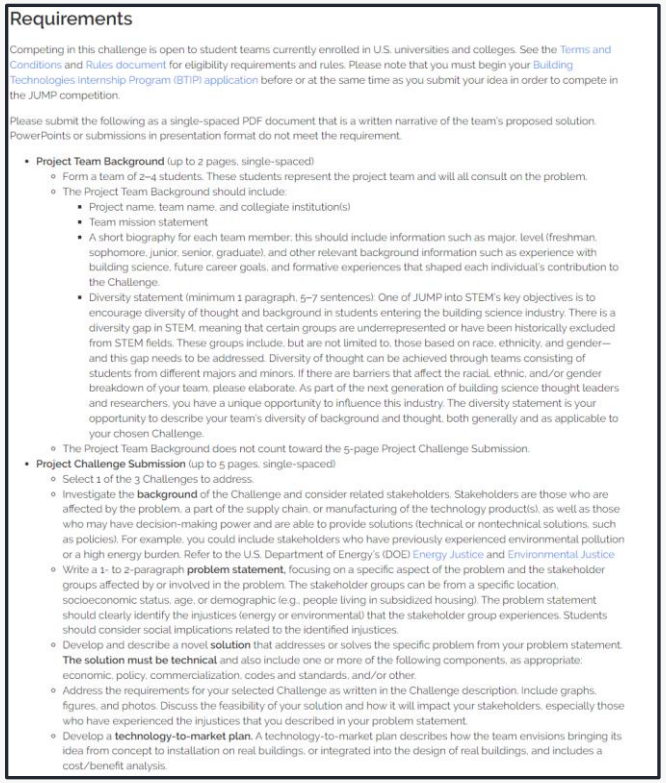
Student submissions should:

- Describe the scope and context of the problem based on a current or emergent problem(s) in the United States
- Identify affected communities, making sure to include underserved, marginalized, and/or vulnerable communities
- Develop a novel technical solution to address the problem at a clearly defined building or community scale; the solution must include technical and nontechnical aspects such as policy or economic solutions and may focus on new or existing buildings or planned or existing communities
- Discuss how issues of equity are incorporated into strategies to improve resilience and sustainability
- Discuss appropriate and expected impacts (including any unintended consequences) and benefits of the proposed solution; these may include quantifiable and nonquantifiable benefits[13] such as health and safety of the affected population, size of the community affected, number of households relocated, avoided cost of losses, loss of businesses, and loss of lives

https://jumpintostem.org/challenge/2022_sustainable-resilient/

Challenges

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



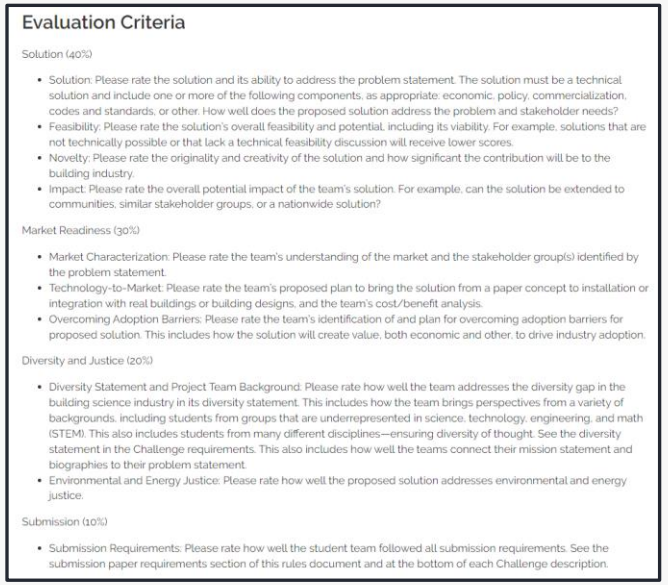
Requirements

Competing in this challenge is open to student teams currently enrolled in U.S. universities and colleges. See the Terms and Conditions and Rules document for eligibility requirements and rules. Please note that you must begin your Building Technologies Internship Program (BTIP) application before or at the same time as you submit your idea in order to compete in the JUMP competition.

Please submit the following as a single-spaced PDF document that is a written narrative of the team's proposed solution. PowerPoints or submissions in presentation format do not meet the requirement.

- **Project Team Background** (up to 2 pages, single-spaced)
  - Form a team of 2–4 students. These students represent the project team and will all consult on the problem.
  - The Project Team Background should include:
    - Project name, team name, and collegiate institution(s)
    - Team mission statement
    - A short biography for each team member; this should include information such as major, level (freshman, sophomore, junior, senior, graduate), and other relevant background information such as experience with building science, future career goals, and formative experiences that shaped each individual's contribution to the Challenge.
    - Diversity statement (minimum 1 paragraph, 5–7 sentences): One of JUMP into STEM's key objectives is to encourage diversity of thought and background in students entering the building science industry. There is a diversity gap in STEM, meaning that certain groups are underrepresented or have been historically excluded from STEM fields. These groups include, but are not limited to, those based on race, ethnicity, and gender—and this gap needs to be addressed. Diversity of thought can be achieved through teams consisting of students from different majors and minors. If there are barriers that affect the racial, ethnic, and/or gender breakdown of your team, please elaborate. As part of the next generation of building science thought leaders and researchers, you have a unique opportunity to influence this industry. The diversity statement is your opportunity to describe your team's diversity of background and thought, both generally and as applicable to your chosen Challenge.
  - The Project Team Background does not count toward the 5-page Project Challenge Submission.
- **Project Challenge Submission** (up to 5 pages, single-spaced)
  - Select 1 of the 3 Challenges to address.
  - Investigate the **background** of the Challenge and consider related stakeholders. Stakeholders are those who are affected by the problem, a part of the supply chain, or manufacturing of the technology product(s), as well as those who may have decision-making power and are able to provide solutions (technical or nontechnical solutions, such as policies). For example, you could include stakeholders who have previously experienced environmental pollution or a high energy burden. Refer to the U.S. Department of Energy's (DOE) Energy Justice and Environmental Justice
  - Write a 1- to 2-paragraph **problem statement**, focusing on a specific aspect of the problem and the stakeholder groups affected by or involved in the problem. The stakeholder groups can be from a specific location, socioeconomic status, age, or demographic (e.g., people living in subsidized housing). The problem statement should clearly identify the injustices (energy or environmental) that the stakeholder group experiences. Students should consider social implications related to the identified injustices.
  - Develop and describe a novel **solution** that addresses or solves the specific problem from your problem statement. **The solution must be technical** and also include one or more of the following components, as appropriate: economic, policy, commercialization, codes and standards, and/or other.
  - Address the requirements for your selected Challenge as written in the Challenge description. Include graphs, figures, and photos. Discuss the feasibility of your solution and how it will impact your stakeholders, especially those who have experienced the injustices that you described in your problem statement.
  - Develop a **technology-to-market plan**. A technology-to-market plan describes how the team envisions bringing its idea from concept to installation on real buildings, or integrated into the design of real buildings, and includes a cost/benefit analysis.

Examples of the *Requirements*



Evaluation Criteria

Solution (40%)

- Solution: Please rate the solution and its ability to address the problem statement. The solution must be a technical solution and include one or more of the following components, as appropriate: economic, policy, commercialization, codes and standards, or other. How well does the proposed solution address the problem and stakeholder needs?
- Feasibility: Please rate the solution's overall feasibility and potential, including its viability. For example, solutions that are not technically possible or that lack a technical feasibility discussion will receive lower scores.
- Novelty: Please rate the originality and creativity of the solution and how significant the contribution will be to the building industry.
- Impact: Please rate the overall potential impact of the team's solution. For example, can the solution be extended to communities, similar stakeholder groups, or a nationwide solution?

Market Readiness (30%)

- Market Characterization: Please rate the team's understanding of the market and the stakeholder group(s) identified by the problem statement.
- Technology-to-Market: Please rate the team's proposed plan to bring the solution from a paper concept to installation or integration with real buildings or building designs, and the team's cost/benefit analysis.
- Overcoming Adoption Barriers: Please rate the team's identification of and plan for overcoming adoption barriers for proposed solution. This includes how the solution will create value, both economic and other, to drive industry adoption.

Diversity and Justice (20%)

- Diversity Statement and Project Team Background: Please rate how well the team addresses the diversity gap in the building science industry in its diversity statement. This includes how the team brings perspectives from a variety of backgrounds, including students from groups that are underrepresented in science, technology, engineering, and math (STEM). This also includes students from many different disciplines—ensuring diversity of thought. See the diversity statement in the Challenge requirements. This also includes how well the teams connect their mission statement and biographies to their problem statement.
- Environmental and Energy Justice: Please rate how well the proposed solution addresses environmental and energy justice.

Submission (10%)

- Submission Requirements: Please rate how well the student team followed all submission requirements. See the submission paper requirements section of this rules document and at the bottom of each Challenge description.

Examples of the *Evaluation Criteria*

https://jumpintostem.org/challenge/2022_sustainable-resilient/

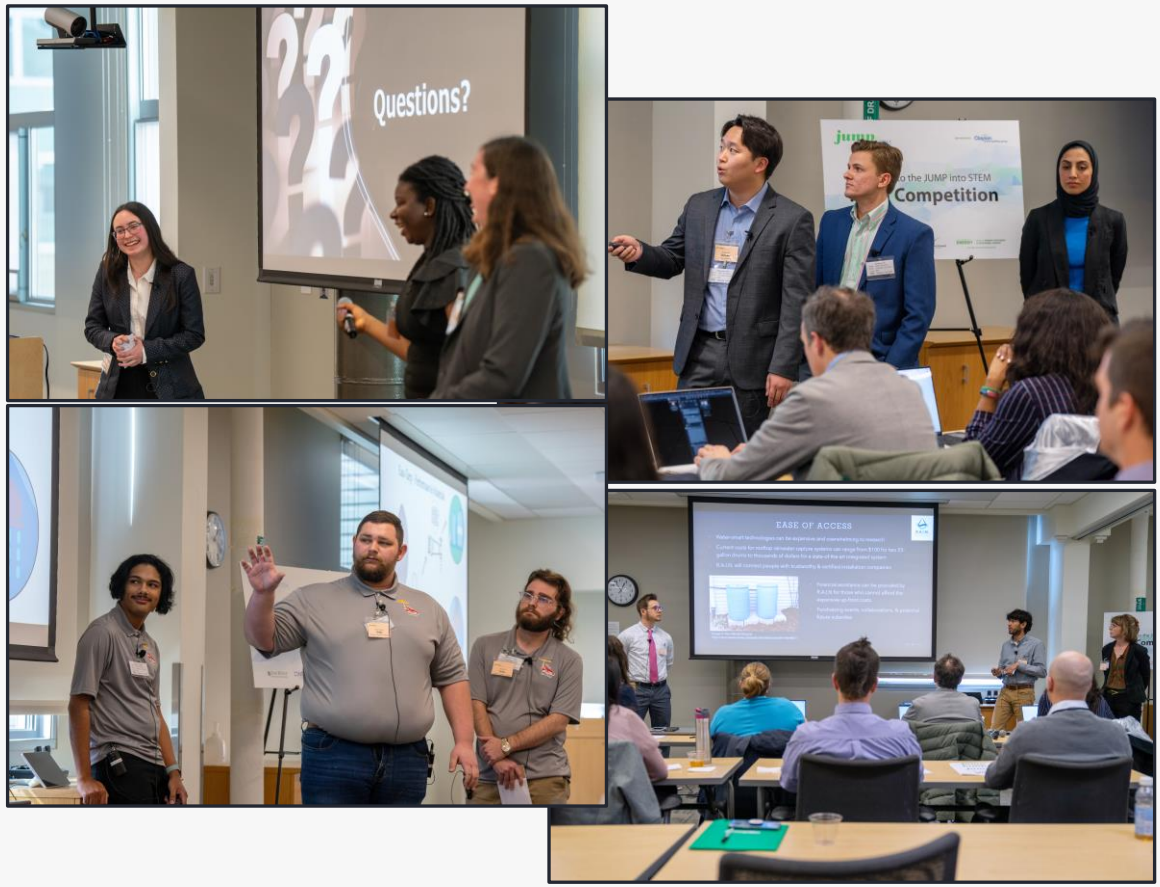
Idea Submission

Forming teams

- Teams of 2 – 4 students
  - Undergraduate or graduate
  - Multiple majors and/or minors

Diversity of thought and background

- This will be evaluated based on the diversity statement that is required as part of the submission
  - Underrepresented groups in STEM (including, but not limited to race, ethnicity, gender)
  - How the team contributes to diversity in building science



Idea Submission (cont.)

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Project Team Background

- 2-page max
- Project name, team name, and collegiate institution
- Team's mission statement
- Short bio for each team member
- Diversity statement
  - minimum 1 paragraph, 5–7 sentences

Required file format:
Single-spaced MS Word document

Project Challenge Submission

- 5-page max
- Provide a **background** of your selected Challenge and related stakeholders
- **Problem statement:**
  - Identify stakeholder(s)
  - identify the injustices (energy or environmental)
- **Solution**
  - Technical solution + one or more of the following components
    - Economic, policy, commercialization, codes and standards, and/or other
- **Technology-to-market plan**
  - cost/benefit and market adoption barrier analysis

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The 2023-2024 DRAFT Challenge Topics

2023–2024 Potential Challenge Topics

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1. Equitable Electrification

To decarbonize buildings, power generation needs to be renewable and buildings need to use electricity instead of natural gas. This requires retrofits in many existing buildings. At present—while the country works to define its electrification-enabling policies—the cost to operate buildings fully from electricity may be prohibitively expensive for some income levels and regions.

Develop a technical solution for equitable electrification that includes at least one holistic component and addresses the need for processes, technologies, research, and policies.

2. Decarbonization

Human-caused climate change is in large part the result of unnatural release of carbon into the atmosphere and ocean. The construction and operation of buildings contribute both operational and embodied carbon. To halt and reverse the effects of human-caused climate change, decarbonization solutions are needed that reduce and mitigate operation and/or embodied carbon in buildings.

Develop a technical solution that reduces operational and/or embodied carbon in buildings. The solution could engage with chemistry, building processes, upcycling and the circular economy of materials, design solutions that are technical in nature, industry structures, and more.

3. Thermal Energy Storage

Building thermal energy storage technologies store energy in the form of heat or cooling for later use. These systems are often charged and discharged hourly, daily, or weekly, but some are designed for annual discharges. Thermal energy storage allows for energy to be consumed at times when there is high renewable penetration on the electricity grid and/or when the cost of electricity is low. Different scales of storage systems can be added to buildings, enabling grid efficiency and building decarbonization.

Develop a technical thermal energy storage solution for buildings to further advance efficiency and decarbonization. Include a commercialization pathway on how to bring these technologies to market and connect them to existing buildings.

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2023–2024 Potential Challenge Topics

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4. Affordable Indoor Air Quality

Healthy indoor air is a necessity, yet many existing buildings—including those in underserved communities—struggle with attaining health and comfort at a price reasonable for occupants. Sometimes indoor air quality or energy efficiency is sacrificed for the other (i.e., increasing air exchanges, which increases energy use, to achieve better indoor air quality). Unhealthy indoor environments could be contaminated by mold, lead, air infiltration, and airborne particles, and exposure to these can exacerbate a person's medical problems. There is a need for solutions that improve both air quality and energy efficiency to be implemented in communities and buildings.

Develop a holistic solution with a technical component to improve indoor air quality and energy efficiency in buildings in an underserved community or communities. Prioritize community engagement so the implementation of the solution is successful.

5. Overcoming Implementation Barriers

In order to achieve decarbonization by 2050, building energy efficiency and decarbonization solutions need to be embraced and adopted by technology manufacturers, distributors, contractors, designers, and building owners—a diverse group of stakeholders. There are silos and communication gaps across these groups.

Identify a building technology solution and learn the processes needed to fully implement the technology in the real world by pursuing one of more of the following: hands-on laboratory experience for technology development, shadowing someone who works in the trades or shadowing a facility manager, or interviewing building technology companies (e.g., HVAC) about distribution channels. The result should be skills and knowledge on how to bridge the gap between conceptual ideas and real-world implementation.

Based on the experience, identify barriers that the commercialization of new energy-efficient technologies face. Develop a holistic solution to achieving building energy efficiency and decarbonization, focusing on market deployment based on the gained real-world experience.

2023–2024 Potential Challenge Topics

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6. Efficiency First: Windows and Envelope Improvements for Underserved Communities

The highest energy burdens are with underserved and disadvantaged communities. In some cases, their buildings need significant improvement to walls and windows, preventing air leakage that leads to high heating and cooling bills. Energy efficiency gains through improved building envelopes and windows can be the first step in achieving a decarbonized future because it reduces wasted energy. However, retrofits can be costly and there are barriers to deploying more efficient technologies. For example, available window installers may not offer energy-efficient alternatives to customers.

Develop a window or wall (envelope) solution to reduce high energy burden in disadvantaged communities. In addition, develop a marketing plan or educational materials that inform installers and sellers of the benefits of the technology.

7. Cybersecurity for Grid Resilience

Technology advances have led to critical information infrastructure that both the grid and building systems rely upon. This infrastructure requires cybersecurity to ensure secure and reliable cyber transmission of information, electricity grid operations, and building controls. In some cases, technological advances for controls and operations allow for streamlined processes, and the lack of security has left these areas vulnerable.

Develop a technical solution that addresses the need for buildings and the grid to be secure and reliable.

2023–2024 Potential Challenge Topics

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8. Electrification Goals: Electric Vehicle Charging Solutions

The increased penetration of electric vehicles (EV) accelerates electrification, but challenges the electricity infrastructure and grid's ability to support EV charging at buildings. In some neighborhoods, community-level feeders can only support a limited number of EV fast chargers, while some residential panels require expensive upgrades to charge EVs. There is a need for effective and efficient EV charging infrastructure and solutions to support the growing number of EVs in both residential and commercial buildings and considering underserved communities.

Develop a solution to address the EV charging challenge as it relates to buildings.

9. Transforming the Grid Edge at Buildings

Building controls can enable buildings to contribute to grid stability. Buildings have the ability to reduce, shift, and modulate their loads, reducing the impact at high electricity peaks for example. Building controls are a central requirement for these grid-interactive efficient buildings. Only 13% of small- to medium-sized commercial buildings have adopted building automation systems, leaving over 75% primed for the opportunity. There is a need for interoperable and affordable solutions.

Develop a technical grid-edge solution with a strong emphasis on the deployment of the technology into small- to medium-sized commercial buildings.

Feedback on challenge topics

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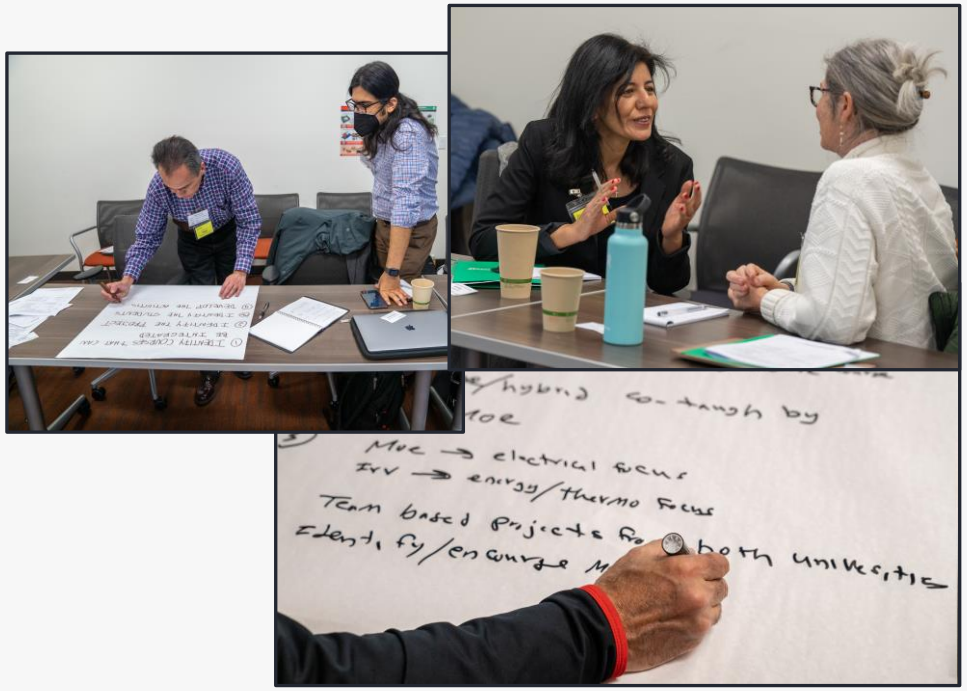
- Do these topics (at least one topic) cover your class?
- Which challenge topics can you provide in your class or to your students' group?
  1. **Equitable Electrification**
  2. **Decarbonization**
  3. **Thermal Energy Storage**
  4. **Affordable Indoor Air Quality**
  5. **Overcoming Implementation Barriers**
  6. **Efficiency First: Windows and Envelope Improvements for Underserved Communities**
  7. **Cybersecurity for Grid Resilience**
  8. **Electrification Goals: Electric Vehicle Charging Solutions**
  9. **Transforming the Grid Edge at Buildings**



Feedback on challenge topics (cont.)

- Any suggestions for your students?
- Any feedback on challenge topics?

Next Meeting

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Professor Team Webinar #3 for all professor team members

- Will be scheduled on late-June

Professor Team Webinar #3

- Selected challenge topics
- Program updates
- DRAFT submission requirements and evaluation criteria

THANK YOU!

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Q&A