The Building Energy Smart Technologies (BEST) Center

May 2023 Newsletter

Updates from the BEST Center

April 2023 IAB Meeting Summary

Thanks to everyone who joined us in Boulder, CO April 20-21 for the semiannual IAB meeting! We had 54 total attendees including 9 IAB members, 17 BEST Center faculty and PIs, 14 students, and 13 guests.

Six projects were recommended by the IAB for funding for the 2023-2024 funding year:

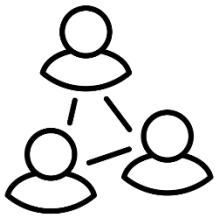
Project Name	Project PI(s)
1. Sustainable Air Source Heat Pump Systems for Electrified Transition Markets in the Multi-Family Buildings Sector	J. González (AU/CCNY), P. Ramamurthy (CCNY)
2. Development of Automated Electrification Retrofit Analysis Tool	M. Krarti, J. Zarske (CUB), D. Prahl (CCNY)
3. Evaluation of Field Methods for Assessment of Architectural Window Degradation	J. Zhai (CUB), R. Tenent (NREL)
4. Testing and Evaluation of Thermal Energy Storage Panels Integrated with Heat Pumps	M. Krarti (CUB), R. Kishore (NREL)
5. Evaluation of Hygrothermal and Energy Efficiency and Condensation Risk of Secondary Windows	J. Zhai, M. Krarti (CUB), R. Tenent, K.Kiatreungwattana (NREL)
6. Making Reinforcement Learning Practical for Building Control through Human Feedback	G. Henze (CUB)

Based on feedback from IAB members during the meeting, BEST Center leadership are increasing student recruitment and engagement efforts, proposing a new workflow for developing annual research themes, updating branding and recruiting materials, updating how IAB members engage with research projects, and will be providing quarterly status reports on center finances, recruitment, and project updates. The IAB recommended Sachin Nehete (Rheem) serve as 2023-2025 IAB chair, and Silvia Khurrum (ConEdison) has agreed to serve as IAB vice-chair.

The next IAB meeting is tentatively scheduled for November 30 to December 1, 2023 in New York City. Starting next year, the IAB proposed we hold the April meeting in-person, rotating between university sites, and hold the December meeting virtually.

Summer IAB Recruiting Efforts

Branding: Starting in May, BEST Center leadership began transitioning marketing and recruiting materials using the updated branding guidelines. Keep an eye on the website as new overview slides, brochures, and other marketing materials are generated.



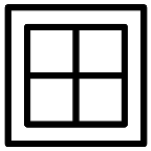
New Member Outreach: Since the April IAB meeting, a recruiting strategy was developed in collaboration with Jack Mason, President of Mason Energy + Management LLC. Our initial priority is bolstering membership in existing verticals: Controls, HVAC & Thermal Systems, and Electrical Systems. Later in the summer, we will begin outreach to companies representing new verticals, such as architecture, indoor air quality, lighting, and materials.

If you have connections with potential new IAB members, please connect with the BEST Center Manager, Nick Clements (nicholas.clements@colorado.edu).

Research Highlights

BEST Center Publications

- Madison Likins-White, Robert C. Tenent, Zhiquiang (John) Zhai (2023). Degradation of Insulating Glass Units: Thermal Performance, Measurements and Energy Impacts. *Buildings* 13(2), 551. https://doi.org/10.3390/buildings13020551.



"This paper reviews current durability literature, various standards for window performance ratings and weathering methods, existing in situ insulating glass unit (IGU) energy performance measurement techniques, and whole-building energy effects. The challenges and disparities among various studies are analyzed and discussed. The authors hope that further work in this area will lead to the development of improved in situ test methods to assess IGU degradation in the field and link this knowledge to improved energy performance modeling approaches."

Other Recent Faculty Publications

- Emily K. Schwartz, Moncef Krarti (2023). Comparative Analysis Optimal Designs for Passive, Electrified, and Net Zero Energy Residential Buildings. *Engineering for Sustainable Buildings and Cities*, 4(2), 021001. https://doi.org/10.1115/1.4062325.
- Almaimani, Ayad, Alaa Alaidroos, Moncef Krarti, Emad Qurnfulah, Alok Tiwari (2023). Evaluation of Optimal Mechanical Ventilation Strategies for Schools for Reducing Risks of Airborne Viral Infection. *Buildings* 13(4), 871. https://doi.org/10.3390/buildings13040871.
- Jie Li, Yuan Zhang, Zian Peng, Xiaofeng Zhang, John Zhai, Yongqiang Luo, Baochang Liu, Xiaoqin Sun, Saleh Nasser Al-Saadi (2023). Thermal Performance of a plate-type latent heat thermal energy storage heat exchanger – An experimental investigation and simulation study. *Journal of Energy Storage* 65(15), 107295. https://doi.org/10.1016/j.est.2023.107295.
- Sourav Dey, Thibault Marzullo, Xiangyu Zhang, Gregor Henze (2023). Reinforcement learning building control approach harnessing imitation learning. *Energy and AI* 14, 100255. https://doi.org/10.1016/j.egyai.2023.100255.
- Sourav Dey, Thibault Marzullo, Gregor Henze (2023). Inverse reinforcement learning control for building energy management. *Energy and Buildings* 286, 112941. https://doi.org/10.1016/j.enbuild.2023.112941.

- Ahmed Mohamed, George Saadeh, Ali Kashefi Kaviani (2023). Impact of smart photovoltaic inverter control modes on medium-voltage grid voltage and inverter lifetime: an experimental approach. *IET Smart Grid*, Early View. https://doi.org/10.1049/stg2.12105.
- Rabindra Pokhrel, Jorge E. Gonzalez, Prathap Ramamurthy, Daniel Comarazamy (2023). Impact of Building Energy Mitigation Measures on Future Climate. *Atmosphere* 14(3), 463. https://doi.org/10.3390/atmos14030463.
- Nicholas Clements, Ilan Arvelo, Phil Arnold, Nicholas J. Heredia, Ulrike W. Hodges, Stan Deresinski, Peter W. Cook, Kerry A. Hamilton (2023). Informing Building Strategies to Reduce Infectious Aerosol Transmission Risk by Integrating DNA Aerosol Tracers with Quantitative Microbial Risk Assessment. *Environmental Science & Technology* 54(14), 5771-5781. https://doi.org/10.1021/acs.est.2c08131.

Faculty Funding

- Physics Informed Real-Time Optimal Power Flow, Kyri Baker (CU), NSF Collaborative Research Grant, Energy, Power, Control and Networks (EPCN) Program

  "This NSF project aims to develop a physics-informed real-time optimal power flow model using machine learning techniques to address the gap in providing close to optimal solutions for power plant outputs while considering practical dynamical constraints to avoid frequency fluctuations and grid instabilities."

- TEAMUP Consortium funded to develop more stable and affordable tandem solar cells, Michael McGeHee, US Department of Energy Solar Technologies Office (SETO)

  "Tandems for Efficient and Advanced Modules using Ultrastable Perovskites, or TEAMUP, a project that has just secured $9M in federal funding from the U.S. Department of Energy Solar Technologies Office (SETO), brings together a consortium of researchers from Academic (CU Boulder, Northwestern University, Arizona State University and UC Merced), Industrial (Swift Solar, Tandem PV and Beyond Silicon) and Federal Labs (the National Renewable Energy Laboratory), who have a near term solution for more efficient solar panels using a combination of the new perovskite-based systems and the existing silicon-based systems."

Faculty and Building Industry News

Faculty News

- Do You Even Decarbonize, Bro?

  ""The environmental movement has been traditionally seen as altruistic," said Kyri Baker, an assistant professor of engineering at the University of Colorado and a self-described decarb bro. "It was about giving away stuff and making sacrifices." The decarb bro flips those associations on their heads, rejecting pure doom and putting faith in business innovation and government spending to fight climate change."

- CU Boulder team takes top engineering prize in 2023 Solar Decathlon

  "An affordable, net-zero energy home designed by CU Boulder students was honored Sunday as part of the U.S. Department of Energy's 2023 Solar Decathlon Build Challenge. The home — which is still being constructed and features a unique hydrogen energy system — is part of a partnership between the university, Flatirons Habitat for Humanity and the City of Boulder as part of the ongoing Ponderosa Community Stabilization Project. The CU Boulder team took first place in the durability and resilience category and third place in the engineering category on the project, which will build a low-carbon footprint

home out of sustainable materials in Boulder this summer. The team was also recognized in the Advanced Technology category."

- Prof. Wil Srubar named Top 25 Newsmakers, Engineering News-Record

  "If Srubar hadn't become a structural engineer and bio-materials scientist running a laboratory at the University of Colorado, he would never have received a $2-million DOD grant to develop his pride-and-joy bio-block—masonry units made from micro algae-based "biocement" instead of portland cement. And were it not for all that, Prometheus Materials, which Srubar co-founded, would not have been created to produce the block."

IAB Member News

- Rheem® Family of Brands Win Silver and Bronze at the 2023 Edison Awards

  "The Rheem Renaissance™ 15-25 ton Commercial HVAC line earned silver in the Engineering & Robotics, Commercial Technology category and the Rheem ProTerra® Plug-in Heat Pump Water Heater earned bronze in the Consumer Solutions, Sustainable Design category."

- Eight ConEdison Employees Win Awards for Research Findings

  "Eight Con Edison employees have won coveted industry awards for research findings that can guide energy companies across the country as they seek to better serve their customers and control costs. The Con Edison researchers earned Technology Transfer Awards bestowed by the Electric Power Research Institute, or EPRI, which helps energy companies improve their service by working together on research and development."

- Xcel Energy drives forward State's electric vehicle goals with programs in Colorado

  "Xcel Energy is taking the next step in helping more customers and communities adopt electric vehicles as it furthers Colorado's 2030 EV goal by proposing its next three-year Transportation Electric Plan (TEP) to the Colorado Public Utilities Commission. The plan builds on the company's first TEP, approved in 2021, with new and enhanced electric vehicle charging programs, public charging options and rebates, and incentives to make charging easy, fast and more affordable for all customers while also supporting new innovation."

- U.S. Department of Energy and Xcel Energy announce new effort to power Colorado's federal facilities with 100% clean energy by 2030

  "The U.S. Department of Energy (DOE) and Xcel Energy announced today they signed a memorandum of understanding (MOU) to provide Federal facilities in Colorado with 100% carbon pollution-free electricity (CFE) by 2030. This marks the second such partnership announced by the Biden-Harris Administration as the Government works with the private sector across the country to lead the way on sustainability. The announcement is part of President Biden's commitment to catalyze clean-energy industries and create jobs through initiatives to achieve net-zero."

- Alpen High Performance Products' Rapidly Growing, Energy-Saving WinSert Now Spearheaded by Driver of Commercial LED Technology Adoption

  "WinSert, patented by Alpen, is a revolutionary lightweight window retrofit solution designed for commercial buildings that radically differs from conventional storm windows or traditional inserts. WinSert's two-minute installation can cost 1/10th of traditional window replacement and provide a 97% air leakage reduction, delivering superior energy savings."

- PassiveLogic Autonomous Buildings Vision Showcased at AHR 2023

"PassiveLogic is an early-stage technology company with a vision to achieve commercial building environmental and energy efficiency targets more effectively. This is to be accomplished by creating a physics-based ontology for next-generation control and AI (Artificial Intelligence) that is the basis for the design process through active building control and automation. Discussing HVAC control, PassiveLogic claims the new approach eliminates a range of today's control inefficiencies citing PID overshoot/undershoot as a prime example. The PassiveLogic system design is reliant on the development of the Quantum Alliance Digital Twin Standard described further in this article. PassiveLogic believes there is no standard in the world to define autonomous systems for buildings today."

- Managing Building Efficiency in the City That Next Sleeps

  "Data exchange and support software developed at the National Renewable Energy Laboratory (NREL) is helping community building owners—including those in New York City—meet the national drive toward decarbonization. Lauren Adams, data science researcher in NREL's Building Technologies and Science Center, said it will take teamwork to implement climate-action regulations nationwide. She leads BuildingSync®, a data collection and management tool created in the Commercial Buildings Research Group."

Building Industry News

- ASHRAE Publishes First Zero Energy and Zero Carbon Building Evaluation Standard

  "ANSI/ASHRAE Standard 228-2023, Standard Method of Evaluating Zero Net Energy and Zero Net Carbon Building Performance, sets requirements for evaluating whether a building or group of buildings meets a definition of "zero net energy" or a definition of "zero net carbon" during building operation. The standard draws from ASHRAE Standard 105, among others, to address energy and carbon flows across a site boundary, their measurement, and their balance."

- ASHRAE Completes Draft of First-Ever Pathogen Mitigation Standard

  "ASHRAE Standard 241P, Control of Infectious Aerosols provides minimum requirements for HVAC-related measures to reduce the risk of transmission of COVID-19, influenza, and other airborne viruses in homes, offices, schools, hospitals during periods of high risk. The standard offers guidance for creating healthier environments in the buildings where we work, live, and play."

Upcoming Conferences & Meetings

- ASHRAE Annual Conference 2023, June 24-28, 2023, Tampa, FL

  Nick Clements, will be presenting on Panel 3: Best Practices: Testing, Verifying, and Commissioning for Indoor Air Quality and Pathogen Mitigation on Monday June 26 from 2:30-4:00 PM with Bill Bahnfleth, Wade Conlan, Elliott Horner, Linda Lee, and Marwa Zaatari. Nick will also be running his last Environmental Health Committee meeting as chair and will be attending the following committee meetings as a voting member or corresponding member: SGPC10, GPC45P, Health and Wellness in the Built Environment PD Committee, Technology Council, TC2.1, and TC2.4.

- ASME 17th International Conference on Energy Sustainability, July 10-12, 2023, Washington DC

  Multiple BEST Center research projects from funding year 2022-2023 will be presented by CCNY students and faculty at this year's ASME International Conference on Energy Sustainability.

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