



BUILDING TECHNOLOGY & URBAN SYSTEMS ENERGY TECHNOLOGIES AREA



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Beyond Energy Efficiency for Buildings

It is my great pleasure to kick off this edition of our newsletter with exciting awards, events and updates, all underscoring the ongoing work of researchers and support staff as we continue to navigate the pandemic and wrap up our work in the last month of FY21.

Berkeley Lab recently had both an [in-person](#) and virtual visit by the U.S. Energy Secretary Jennifer Granholm. Top of the agenda was how Berkeley Lab could address climate change, especially through clean energy science and technology. See the [photo story](#) of her visit.

On August 26th Granholm participated as a special guest in the [90th Anniversary Founders Day Celebration](#). Please view the robust berkeleylabnext90.lbl.gov website which celebrates the past and imagines the future at Berkeley Lab. Access the recording online to view Granholm's remarks, along with discussion among Lab leaders about what the next 90 years may have in store, along with entertaining "Happy Birthday" video messages at berkeleylabnext90.lbl.gov/connect/videos.

Read on to learn more about the exciting work in Building Technology & Urban System Division (BTUS) including a new animation featuring FLEXLAB®; DOE Sustainability Award; a user-friendly tool named [BETTER](#) that recommends efficiency measures for buildings; a new windows research public-private partnership; and so much more.

Thanks for reading this latest edition of the BTUS newsletter, and our thoughtful best wishes go out to you and your families.

— Dr. Tianzhen Hong is a Senior Scientist, Principal Investigator and Deputy Head of the Building Technologies Department

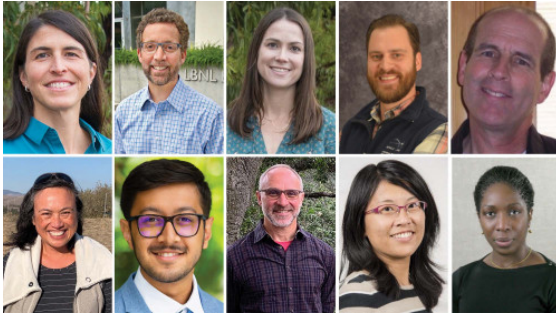
Amazing New FLEXLAB® Animation, Check It Out

A new dynamic animation provides a detailed look at FLEXLAB's testbeds, testing capabilities, and research - from optimizing energy-efficiency while providing superior comfort for building occupants, to shedding or shifting energy to support variable renewable energy generation on the grid. The ETA Program Development Office (PDO) spearheaded its development, along with the Communications Office, FLEXLAB team, and an outside consultant.



Click image above to view the animation. Learn more here: flexlab.lbl.gov/animation.

Berkeley Lab Team Wins DOE Sustainability Award



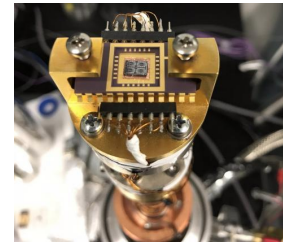
Berkeley Lab's ISO 50001 implementation team has received a 2021 U.S. Department of Energy Sustainability Award in the "Innovative Approach to Sustainability" category for the second year in a row. The Lab is currently the only ISO 50001 certified DOE lab.

Read more here: [cs.lbl.gov/news-media/news/2021/berkeley-lab-team-wins-doe-sustainability-award](https://www.lbl.gov/news-media/news/2021/berkeley-lab-team-wins-doe-sustainability-award)

Congratulations to BTUS Program Managers Jingjing Liu and Bunmi Adesola who are shown in the bottom row, far right.

Silicon Nanowire Offers Efficient High-Temperature Thermoelectric System

Berkeley Lab Research Scientist, Vi Rapp, with Stanford researchers collaborated to find a promising solution for converting waste heat to electricity. They have developed a cost-effective thermoelectric waste-heat recovery system to reduce electricity-related carbon emissions. Converting waste heat cost-effectively to electricity can provide a zero-carbon source of energy.



Learn more here: [eta.lbl.gov/news/article/silicon-nanowire-offers-efficient](https://www.lbl.gov/news-article/silicon-nanowire-offers-efficient)

BETTER Technology Garners Awards



The Building Efficiency Targeting Tool for Energy Retrofits (BETTER) tool was recently named a [2021 EarthX Climate Tech Prize](#) semi-finalist.

BETTER was developed with support from the Department of Energy (DOE) Building Technologies Office (BTO) by a multidisciplinary team of Berkeley Lab researchers bridging expertise in building science and market transformation in a public/private partnership with Johnson Controls. The result is a user-friendly tool that goes beyond benchmarking to recommend

efficiency, decarbonization, and electrification measures for global building portfolios.

Read more here: energyanalysis.lbl.gov/news-article/better-garners-award-avid-interest

How Managing Building Energy Demand Can Aid the Clean Energy Transition

A new Berkeley Lab study finds that more energy efficient and flexible buildings could be a substantial resource for the electric grid.

The comprehensive study led by researchers from the DOE's Lawrence Berkeley National Laboratory (Berkeley Lab) answers these questions, quantifying what can be done to make buildings more energy efficient and flexible in granular detail by both time (including time of day and year) and space (looking at regions across the U.S.). The research team, including BTUS Research Scientist Jared Langevin as well as scientists from the National Renewable Energy Laboratory (NREL), found that maximizing the deployment of building demand management



technologies could avoid the need for up to one-third of coal- or gas-fired power generation and would mean that at least half of all such power plants that are expected to be brought online between now and 2050 would not need to be built.

Read more: newscenter.lbl.gov/2021/07/21/how-managing-building-energy-demand-can-aid-the-clean-energy-transition

New Public-Private Partnership for Advanced Windows



Windows make up 7% of the envelope area of a home but can account for 47% of the envelope heat loss. High-performance windows thus represent a significant opportunity for consumers to be more comfortable and save money – and help reduce energy demand and greenhouse gas emissions while doing so.

Berkeley Lab is teaming up with the Northwest Energy Efficiency Alliance (NEEA), the Pacific Northwest National Laboratory (PNNL), and other organizations to create the Partnership for Advanced Window Solutions (PAWS), with the aim of accelerating nationwide adoption of highly

efficient windows, storm windows and shading systems.

Learn more: newscenter.lbl.gov/2021/07/16/berkeley-lab-pushes-its-energy-saving-windows-into-the-market

Spawn of EnergyPlus Building Energy and Controls Modeling Software Released

The U.S. Department of Energy’s Building Technologies Office, Berkeley Laboratory and the National Renewable Energy Laboratory, in collaboration with Modelon and Objexx Engineering, have released the initial version of the [Spawn of EnergyPlus](#) software, hereon referred to simply as “Spawn.” Spawn is not a replacement for EnergyPlus, at least not in the foreseeable future. Although it does perform whole-building energy simulation, it targets new use cases in advanced controls, district systems, and grid integration.



Read more here: content.govdelivery.com/accounts/USEERE/bulletins/2ea11bf

DOE Launches Phase 1 of its Industrial Technology Validation Pilot



The ITV pilot - led by Department of Energy's Advanced Manufacturing Office and a team from Berkeley Lab's Building and Industrial Applications Department - aims to catalyze industrial decarbonization and deployment of innovative technologies

Decarbonizing the industrial sector is critical to addressing the climate crisis, but market adoption of emerging technologies is often impeded due to lack of credible demonstration projects to validate costs and effectiveness. [DOE's ITV pilot](#) can mitigate these risks in part with reliable information from robust field demonstrations and independent measurement and verification (M&V). The ITV pilot serves to support our goals for agile deployment of promising new technologies to strengthen our clean energy economy and help the nation to attain its net-zero goals no later than 2050.

During DOE's Manufacturing Week July 26th, 2021, the U.S. Department of Energy (DOE) along with Secretary of

Energy, Jennifer M. Granholm [announced the selection of five innovative technology testbeds](#) to conduct field demonstrations in facilities operated by [DOE Better Plants partners](#). As part of its announcement, the ITV Pilot has officially issued a new [Request for Proposals \(RFP\)](#) seeking additional technologies that can cost-effectively transform the operational efficiency of American industry.

Click on the link above to learn about one of ITV's Phase 1 participants installation of a black liquor concentration system that uses graphene oxide membranes to efficiently remove water and concentrate valuable liquor solids.

For more information about this demonstration and to keep up to date on all ITV projects, visit: betterbuildingsolutioncenter.energy.gov/itv-phase-i-inside-look

CalTestBed Clean Energy Voucher Program

FLEXLAB® has played a key role in the [California Energy Commission \(CEC\) CalTestBed Program](#) and it was recently selected to receive the [2021 Outstanding Partnership Award from the Far West Region of the Federal Laboratory Consortium for Technology Transfer \(FLC\)](#).

CalTestBed

CalTestBed is a CEC-funded five-year, \$8.8 million program designed to connect entrepreneurs with the unique laboratory space and testing facilities in the UC system, including Berkeley Lab. Partnerships throughout Berkeley Lab and beyond (New Energy Nexus, University of California Office of the President, Momentum, Los Angeles Cleantech Incubator, etc.) have provided California entrepreneurs with resources needed to take their technology to the next level.

Testing for the 1st CalTestBed cohort is underway in various test facilities, including FLEXLAB, while scoping and contracting for the second cohort is in process. Five vouchers were redeemed at Berkeley Lab from the first cohort, and four vouchers are expected to be redeemed at Berkeley Lab in the second cohort. Upcoming activities include the annual symposium on December 1-2 and the application period for the 3rd (and final) cohort spring of 2022.

Featured Publications

Achieving Integrated Daylighting and Electric Lighting Systems: Current State of the Art and Needed Research

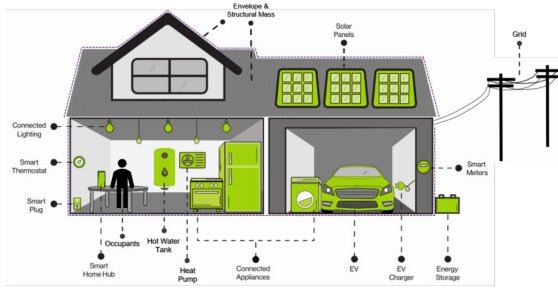
This paper identifies the main research gaps that prevent closer integration between facade and lighting systems in the built environment. It is the fruit of a DOE-sponsored collaboration between researchers at Berkeley Lab, Pacific Northwest National Laboratory, and the UC Berkeley California Institute for Energy and the Environment. Over the last two decades, automated facade and lighting systems have become more and more capable and widespread. However, outside the R&D world, they are designed, procured, installed, maintained and operated in isolation from each other. This prevents the realization of their maximum potential in terms of energy savings, greenhouse gas emission reductions, achieving comfort for building occupants, providing services to the electrical grid, and enabling resilient buildings. This potential is best achieved when building systems are operated in an integrated way, and that is especially true for the case of facade and lighting systems. This paper focuses on the R&D that is needed in order to achieve this integration at scale, and proposes a prioritization of research goals based on input from a diversity of stakeholders.

Thomson, G.D., Davis, R.G., Fernandes, L., Wang, T. **Achieving Integrated Daylighting and Electric Lighting Systems: Current State of the Art and Needed Research**. Special Issue, *Energies* 2021, 14(13), 3833.

doi.org/10.3390/en14133833

Energy Flexibility of Residential Buildings: A Systematic Review of Characterization and Quantification Methods and Applications

A recent review article, led by Han Li with co-authors of Zhe Wang, Tianzhen Hong, and Mary Ann Piette, on residential building energy flexibility characterization and quantification was published in *Advances in Applied Energy*. A total of 85 papers were selected from over 300 candidates for in-depth review that covers case studies and applications with load shifting



(60%), load shedding (19%), distributed power generation (16%), and load modulation (6%). The application scales include system (19%), building (45%), district or community (29%), and building sector (7%). Depending on the technology and application scope, flexible operations have a wide range of performance, with peak power reductions of 1%~65%, energy savings up to 60%, operational cost reduction of 1%~48%, and greenhouse gas emission reductions of up to 29%. The article also summarized the modeling

techniques, software tools, and quantification metrics used in the studies. The key research gaps identified in this article, which include (1) the lack of commonly agreed definition of energy flexibility, (2) the lack of standardized representation of the flexibility resources, and (3) the lack of mechanism to incentivize energy flexibility, could inform future researches to achieve a reliable and resilient power grid.

Li, H., Wang, Z., Hong, T., Piette, M.A. **Energy flexibility of residential buildings: A systematic review of characterization and quantification methods and applications.** *Advances in Applied Energy* 3 (2021) 100054. doi.org/10.1016/j.adapen.2021.100054

Other Recent Publications

Putra, H.C. and Hong, T. **Application of the DNAS framework expansion to occupant population synthesis.** *IBPSA Building Simulation Conference 2021. Bruges, Belgium, 2021.* buildings.lbl.gov/publications/application-dnas-framework-expansion

Touzani, S., Granderson, J. **Open Data and Deep Semantic Segmentation for Automated Extraction of Building Footprints.** *Remote Sensing.* 2021; 13(13):2578. doi.org/10.3390/rs13132578 buildings.lbl.gov/publications/open-data-and-deep-semantic/buildings.lbl.gov/publications/open-data-and-deep-semantic

Hedman, B., Jones, D., Tutterow, V. **Beneficial CHP – Is that a Thing? Considering CHP in the Context of Beneficial Electrification.** *ACEEE Summer Study for Energy Efficiency in Industry, 2021.* buildings.lbl.gov/publications/beneficial-chp-thing-considering-chp

Gerber, D.L., Musavi, F., Ghatpande, O., Frank, S., Poon, J., Brown, R.E., Feng, W. **A Comprehensive Loss Model and Comparison of AC and DC Boost Converters.** *Energies* 14.11, 2021. DOI 10.3390/en14113131 buildings.lbl.gov/publications/comprehensive-loss-model-and

See more: buildings.lbl.gov/publications

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See also: Department of Energy [Building Technologies Office](#)

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research on behalf of the United States Department of Energy (DOE). It is managed and operated by the University of California (UC). The Laboratory overlooks the University of California, Berkeley.

Berkeley Lab addresses the world's most urgent scientific challenges by advancing sustainable energy, protecting human health, creating new materials, and revealing the origin and fate of the universe. Founded in 1931, Berkeley Lab's scientific expertise has been recognized with 13 Nobel prizes. The University of California manages Berkeley Lab for the U.S. Department of Energy's Office of Science. For more information, visit www.lbl.gov.

DOE's Office of Science is the single largest supporter of basic research in the physical sciences in the United States, and is working to address some of the most pressing challenges of our time. For more information, see science.energy.gov.

