

BERKELEY LAB SUSTAINABILITY SUMMARY FOR FY 2021

Berkeley Lab pursues three broad initiatives to build institutional capacity and reach sustainability goals. These initiatives are listed below, and described in greater detail at sbl.lbl.gov.

- **Climate:** Improving buildings, greening the energy grid, and low-carbon commutes
- **Waste:** Rethinking waste through composting, recycling, and smart purchasing
- **Water:** Upgrading fixtures, stopping leaks, and encouraging conservation

Sustainability goals and requirements are summarized at sbl.lbl.gov/goals and driven by:

- Federal sustainability requirements
- Legal requirements (California State or federal law)
- Applicable provisions of the [University of California Policy on Sustainable Practices](#)

For more detail:

- The Lab's Annual Site Sustainability Plans are available at sbl.lbl.gov/reports. These reports to the federal government include greater detail on performance against more than 25 sustainability goals.
- [A Plan for a Sustainable Berkeley Lab](#) describes the full range of sustainability activities at Berkeley Lab. We invite your review of the plan and feedback using this [google form](#). And always feel free to contact us by e-mail at sbl@lbl.gov.

PERFORMANCE SUMMARY

Key sustainability performance metrics for the Lab, as of the end of fiscal year 2021, include:

- **Total reported greenhouse gas emissions** are 66% below 2008 levels and 60% below 2015 levels. See [Overall Greenhouse Gas Emissions - Performance Against Goal](#) at sbl.lbl.gov/data.
- **Lab-wide energy use intensity** excluding major process loads has decreased 29% since FY 2015.¹ With process loads included (which are switched on and off according to operating schedules), Lab-wide weather-corrected energy use intensity is 27% lower than in FY 2015. See [Change in Energy Use Intensity and Consumption from FY2015 Baseline](#) at sbl.lbl.gov/data for more detail.
- **Efficiency savings:** As of fall 2021, Berkeley Lab is maintaining annual energy savings of 13.3 million kWh (up from 12.3 million kWh reported last year) of electricity and gas savings and annual water savings of 19.9 million gallons. This produces \$1.1M in annual utility savings and the energy savings are equivalent to the output from a 33-acre PV array. The [Berkeley Lab Efficiency Savings Portfolio](#) is updated monthly at sbl.lbl.gov/data.
- **Renewables:** 25% of electricity use (and 19% of all energy use) is procured or generated from renewable sources (beyond the renewables included in the grid power mix). The renewable

¹ While energy efficiency in FY 2021 is lower due to the COVID shelter-in-place, the Lab was seeing a significant reduction in energy use intensity prior to COVID-related changes in operations: Lab-wide weather-corrected energy use intensity excluding major process loads as of April 1, 2020 was 22% lower than in FY 2015. See [Change in Energy Use Intensity and Consumption from FY2015 Baseline](#) at sbl.lbl.gov/data for more detail.

portion using federal metrics that include bonuses are 38% of electricity use and 30% of energy use. See [Renewable Energy Percent of Consumption](https://sbl.lbl.gov/data) at sbl.lbl.gov/data.

- **Waste diversion** is at 61% (down from 74% , and diversion from construction and demolition projects is at 90% (improved from 72% last year). The reduction in waste diversion appears to be driven by factors particular to the COVID shelter-in-place: less food (and compost) consumption with the closures of the cafeteria and a greater portion of onsite activity being related to laboratory (rather than office) activities where diversion is more challenging. [See Waste Diversion - Performance Against Goal](#) at sbl.lbl.gov/data.
- **Water use intensity** is 26% below 2007 levels (just missing our target of 28% below). See [Water Consumption Intensity - Performance Against Goal](#) at sbl.lbl.gov/data.

ACCOMPLISHMENTS

The Lab's sustainability efforts were **recognized by two awards in the last fiscal year**.

- [2021 DOE Sustainability Award](#) (August 2021)
To: ISO 50001 Core Team and ISO 50001 Implementation
Category: Innovative Approach to Sustainability
- [2021 DOE Sustainability Award](#) (August 2021)
To: Ongoing Commissioning Team
Category: Strategic Partnerships for Sustainability

Additional detail on these award-winning activities is provided below along with other accomplishments in fiscal year 2021.

ENERGY and CLIMATE

Energy Information and Management

- **Maintained Energy Savings:** As of fall 2021, Berkeley Lab is maintaining annual energy savings of 13.3 million kWh and annual water savings of 19.9 million gallons. These savings have been generated since 2015 and are actively maintained going forward. The energy savings are equivalent to the generation from a 8.6 MW photovoltaic array, which would occupy 26 football fields or 33 acres. These energy and water savings are being generated primarily through improvements in facility operations, delivered by the Ongoing Commissioning Team and a focused team at NERSC. The Lab has paid particular attention to reducing its natural gas use. At-the-meter, weather-corrected natural gas consumption decreased sitewide 32% since fiscal year 2015 as of the start of the COVID shelter-in-place. See [Berkeley Lab Efficiency Savings Portfolio](#) (updated monthly) and [Change in Energy Use Intensity and Consumption from FY2015 Baseline](#) (updated every six months) at sbl.lbl.gov/data for more detail.
- **ISO 50001 Certification:** Berkeley Lab is maintaining certification to ISO 50001, an international standard for managing and improving energy performance, first achieved in September 2020. The Lab was also recognized for a second year by DOE as [ISO 50001 Ready](#), a program jointly developed by DOE and Berkeley Lab's Energy Technologies Area. The Lab's Energy and Water Management System Manual and more information is available at iso50001.lbl.gov. The Lab has

made its manual publicly available to help and encourage other organizations to adopt ISO 50001.

- **Ongoing Commissioning:** The Lab continues to operate a dedicated cross-functional team of controls engineers and technicians from the Facilities Management division and Sustainable Berkeley Lab who work continuously to identify, prioritize, and resolve operational problems in buildings in order to generate energy savings and improve operations. Ongoing Commissioning savings are identified as “OCx” savings on the [Berkeley Lab Efficiency Savings Portfolio](#) that is updated monthly at [sbl.lbl.gov/data](#). The Ongoing Commissioning project profile at [sbl.lbl.gov/progress](#) and a more detailed conference paper available at [ocx.lbl.gov](#) describe the team and its approach in more detail.
- **Energy and Water Savings in High Performance Computing:** The Lab has continued work with NERSC (meeting approximately monthly) to protect savings and strengthen monitoring capabilities. The Lab has verified annual maintained savings of over 2 million kWh at NERSC - approximately 42% of the baseline “non-compute” electricity use - and over 500,000 gallons of water. See details on the NERSC Efficiency Optimization at [sbl.lbl.gov/progress](#). The NERSC Efficiency Optimization Team was presented a [2020 Department of Energy \(DOE\) Sustainability Award](#) in the Sustainable HPC/Data Center category for their ongoing performance improvements.
- **Efficiency Improvements in Berkeley Lab’s Computing Center:** The power utilization effectiveness (or PUE, a measure of the non-compute load as a percentage of the total data center load) at the Berkeley Research Computing Center (located in 50B-1275) has been reduced from an average of 1.28 to 1.18 in the last year. This means that the “overhead” energy use of the facility was reduced by 36%. These savings have been generated through ongoing energy efficiency efforts that are integrated into equipment lifecycle projects, including shutting down six computer room air conditioning (CRAC) units, turning off eight cabinets of constant-rate cooling, adding variable frequency drives to pumps, and replacing a heat exchanger with a more efficient unit.
- **No More Gasoline Blowers and Line Trimmers:** The Facilities Division and SBL piloted the use of electric battery-operated leaf blowers and line trimmers, and as of the end of FY21, has now transitioned away from fuel use in this area.
- **Site-Wide Exterior Lighting:** The Lab continues efforts to modernize exterior lighting on its main campus. See a Lighting Modernization project overview at [sbl.lbl.gov/progress](#). In FY 2021, the Lab made the decision to contract out, and established two lighting subcontracts, one for interior lighting and one for exterior lighting. COVID-19 continued to pose significant challenges to accomplishing lighting work, from staffing shortages and increased protocols that hampered



or halted onsite work, to severe supply chain challenges. Nevertheless, both projects got well underway and should be completed in FY 2022.

- **Integrated Laboratory Airflow Management:** Sustainable Berkeley Lab is working with the Lab's EHS Division to closely coordinate efforts in laboratory safety, building operations, and energy efficiency. The Lab has been piloting an enhanced ventilation management program at buildings 74 and 91 (the new Integrative Genomics Building).

- **Tools for Scaling Energy Management:** The Lab has significantly expanded implementation of an integrated development environment called Skyspark which enables energy management at scale, augments the effectiveness of energy managers, and enables piloting of artificial intelligence techniques (see next bullet,



Cutting-Edge Control

Strategies). With this tool,

the Lab is able to integrate to a wide range of legacy facility operations data sources and tag all of the data using a consistent metadata schema. For example, instead of monitoring operation for one piece of equipment such as an HVAC air handler, the tool allows for custom analytics across more than 300 air handlers across the Lab. You can find a description of the visualization above as well as other examples at da4ops.lbl.gov/visualizations.

- **Cutting-Edge Control Strategies:** Sustainable Berkeley Lab, NERSC, and the Energy Technologies Area (ETA) of Berkeley Lab are continuing a three-year research project funded by the DOE to deploy advanced mechanical system controls in a large office space (greater than 100,000 square feet). This includes multi-objective optimization for energy consumption, cost, and greenhouse gas emissions. Sustainable Berkeley Lab has also implemented intelligent fault detection and correction to tune control loop parameters used in its building automation systems, developed collaboratively with ETA through a DOE-sponsored project. This automated approach replaces a much more manual process and helps eliminate waste associated with hunting HVAC valves.

Green Building

- **High Performance New Construction:** The Lab has continued to dial in the energy performance of its Integrative Genomics Building (IGB) laboratory that opened in November 2019. This building, which won the 2020 UC Best Practice Award for Overall Sustainable Design and an a 2020 Department of Energy (DOE) Sustainability Award Honorable Mention in the Outstanding Sustainability Program/Project category, was designed to meet deep energy efficiency targets (consuming less than 36% of the energy used by the facility it replaced) and use no natural gas for space or water heating. See details about the IGB at sbl.lbl.gov/progress. Through considerable attention by the Lab's Ongoing Commissioning Team, the building is exceeding its

performance targets with operation at 31% (instead of 36%) of the energy baseline. Photovoltaic panels are planned for future installation. The building is pictured below.

- **Continued Leadership in Sustainable New Construction:** As of the end of FY 2021, the Lab is starting construction for a 78,000 square foot laboratory (BioEPIC) and planning construction of a 47,000 square foot multi-use welcome center (Seismic Safety & Modernization Project or SSM). SSM includes an all-electric commercial kitchen, making use of induction cooktops. The Lab's policy on [Sustainability Standards for New Construction](#) continues to drive many high-performance and sustainable aspects of these designs.



Transportation

- **Electric Vehicle Strategic Planning:** The Lab completed a consultant engagement that provided recommendations for electric vehicle (EV) infrastructure planning at the Lab within the context of increasing employee EV adoption and the electrification requirements of the fleet. The engagement produced three memos covering existing conditions, charging station hardware and software recommendations, and future projections of EV charging demand. The consultant recommendations include:
 - Replacing older, existing EV charging station head-end units with standardized hardware.
 - Implementing a single, enterprise software solution that provides a centralized and streamlined monitoring, control, and payment process.
 - Raising the cost per kWh for staff EV charging to better approximate local rates, allowing the Lab to begin to recoup more of infrastructure and maintenance costs.
 - Planning to leverage the potential to share charging infrastructure between personal vehicles and fleet vehicles, where a good synergy exists for making the best use of resources and electrical capacity.
 - Planning for future charging needs by continuing to expand charging infrastructure where practical and economically feasible, especially in conjunction with construction projects.

Direct Release of Greenhouse Gases

- **Continued Reductions in Sulfur Hexafluoride Emissions:** Berkeley Lab has continued a program to reduce releases of sulfur hexafluoride (SF_6), with current emissions 93% less than baseline emissions in FY 2008. Berkeley Lab switched to using N_2O gas instead of SF_6 as a tracer gas when performing fume hood acceptance testing. Also, the Lab has used a recycling unit to recapture and reuse SF_6 from major uses. The Lab now typically recaptures all SF_6 emissions from maintenance activities at the Advanced Light Source and periodic maintenance of high voltage power supplies of electron microscopes at the National Center for Electron Microscopy. The remaining releases of SF_6 are from other electron microscope work. All users of SF_6 are aware of the environmental impacts associated with this chemical and are strongly encouraged to use recovery equipment when maintaining their systems.

Renewable Energy

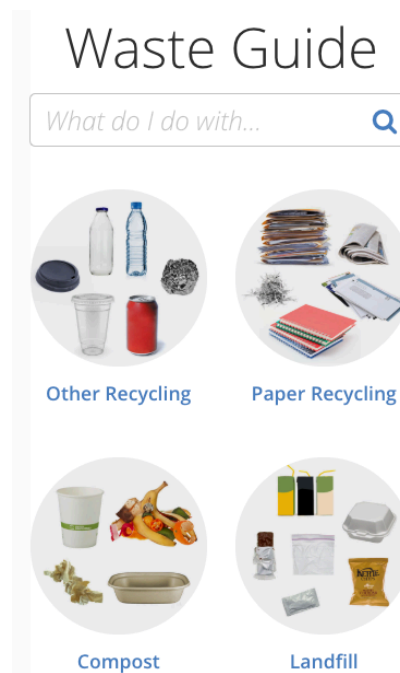
- **Decarbonizing Energy Supply:** The Lab is participating in an RFP for the development and long-term purchase of solar electricity through its federal electricity supplier and is collaborating with the UC on renewable energy projects from which it has arranged to make long-term renewable energy credit purchases (pending approval by the Berkeley Site Office). Berkeley Lab continues to purchase 20% of the output of a 3.3-MW, 10-acre solar photovoltaic array in Livermore, developed in collaboration with Lawrence Livermore National Laboratory, and completed in February 2016.

Procurement

- **Sustainable Procurement:** SBL increased its partnership with the sustainable procurement group at the Office of the Chief Financial Officer (OCFO) to prioritize ways to increase and track purchases of products that meet federal sustainable acquisition requirements. OCFO implemented a process to restrict purchases of energy consuming appliances that did not meet Energy Star criteria. The collaboration also led to updates both to the general sustainability clause that goes in all contracts to clarify requirements to subcontractors, as well as to the internal procurement guidance to make requirements clear to all buyers. These actions are due to be finalized in the calendar year 2022.

WASTE

- **Online Waste Guide:** The Lab has continued hosting an online Waste Guide (wasteguide.lbl.gov) to educate the Lab community on how to reduce, reuse, and recycle more than 250 domestic and hazardous waste items. The Guide has been very useful and popular. It provides guidance on how to dispose of items, waste reduction tips, and additional details about what happens after items are disposed.
- **Site-Wide Waste Audits:** Until January 2021, the Lab maintained its site-wide waste audit system to track building-level diversion and identify the composition of waste streams in order to better target diversion efforts. This helped identify contamination of personal protective equipment (PPE - predominantly face masks and gloves) in both recycling and compost. Based on these data, SBL updated signage and launched communications to instruct those onsite to place PPE in the landfill. Explore [Waste Diversion by Building](#) at sbl.lbl.gov/data and read about the Lab's data-driven waste diversion efforts at sbl.lbl.gov/progress.
- **Materials Management Analysis:** The Lab undertook a sitewide assessment of how discarded materials flow throughout the site. The analysis identified the areas of highest priority to decrease resource use, improve the waste management system, and increase waste diversion. Areas recommended for improvement included centralizing dumpster locations, improving



metrics and tracking of construction and demolition waste, and optimizing cardboard recycling with a baler.

- **IGB Zero Waste Team Accomplishments:** The IGB Zero Waste Team, the group that launched the Lab's first zero waste building initiative, has continued to increase education and awareness initiatives. In FY 2021, they tested pipette tip reuse systems, piloted centralized waste stations in labs, and took steps to better train lab occupants on how to properly divert materials.
- **Sort it Yourself Waste:** In summer of 2020, the Lab's custodial team ceased service of waste in office workstations to reduce touchpoints and maintain social distancing. Employees now must take their personal waste to four-stream central waste stations to sort it there. Personal waste bins are the most contaminated source of waste at the Lab, so this action has the potential to increase waste diversion as employees take more responsibility to sort the waste they generate. SBL is supporting a communications plan for the initiative which includes providing individual mini bins to help individual sorting efforts at workstations, with an expansion of efforts planned to take place once the site returns to normal operations.

WATER

- **New Water Meters:** The Lab began installation of two large meters on its main site so that it will be able to directly meter its water consumption without reliance on off-site meters maintained by UC Berkeley. The meters are expected to be operational by the end of calendar year 2021.
- **Water Reclamation Feasibility Study:** The Lab completed a feasibility study of reclaiming water from the planned cafeteria (known as SSM) for use in the NERSC cooling towers. The study concluded that a treatment plant for this water was feasible, but that it would provide greater return on investment if it processed water from the entire sewershed that includes SSM up to the Guest House as well as the north portion of the main site through Building 90. The study also identified the potential for collaboration with the UC Berkeley campus to access a source of reclaimed water. The Lab is researching these options further.