INTEGRATED DESIGN LAB

Annual Report 2022-2023

UW Center for Integrated Design
1501 E. Madison Street, Suite 200
Seattle, WA 98122

206-616-6566
https://idl.be.uw.edu/

CONTENTS

Cover Image: University of Washington's Health Science Education Building. Photo Credit: UW Image Collection
The UW Sustainability Fund supported students to conduct collaborative research on the building's dynamic electrochromic glazing

John Grade Cells Art Installation at UW Arboretum. Image Credit: UW Image Collection

LETTER FROM THE DIRECTORS

Dear Friends and Supporters of the UW IDL,

As we share our annual report with you, we reflect on the past year with immense gratitude. We also look ahead to deepening our engagement with the people, projects, and communities that inspire our work. We value the trusting relationships that we have developed over the last two decades, which provides the foundation and inspiration for our work.

This year marks our tenth year in the Bullitt Center which opened on Earth Day in 2013. The building has served as a formative context for the UW IDL. It has been both our home base and a real-world test-bed for a broad array of sustainable design ideas. It has provided us with an in-depth post-occupancy data stream and has been the basis of research on high-performance building operations. It has been the subject of extensive research studies looking at energy, climate-responsive design, daylighting, solar shading, natural ventilation, water-use, health, and occupant behavior-driven energy use. This work has resulted in over 50 publications and countless invited presentations.

The Bullitt Center has also been a catalyst for sustainable design education at the University of Washington. Its initial conception was marked with a series of UW-led design studios created to imagine what a net-zero energy building could be on the site, and it has continued to serve as a case study for innumerable students seeking to understand integrated building systems and to see real-world examples of deep-green building design. It has influenced design professionals worldwide who use it as a benchmark for what can be achieved in building performance. The building has also captured the imagination of the public who have come from five continents to participate in the tours that the IDL continues to provide. So far, we have hosted over 50,000 (!) in-person tours to visitors from around the world.

As always, we would like to take a moment to thank the organizations that make our work possible including the Northwest Energy Efficiency Alliance (NEEA), BetterBricks, our Puget Sound-regional utility partners, the Seattle Housing Authority (SHA), the City of Seattle, the American Institute of Architects, the American Society of Heating Refrigerating and Engineers (ASHRAE), the Illuminating Engineering Society (IESNA), the AEC teams that bring us into their process, and our Advisory Board which is helping us expand beyond our traditional boundaries. We look forward to a bright future of expanded collaboration, innovation, and an ever-better built environment for our region.

Christopher Meek, FAIA, IES
Professor
Director

Heather Burpee, Assoc. AIA, EDAC
Research Associate Professor
Director, Education and Outreach

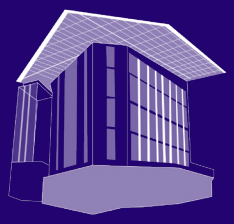
IDL at a GLANCE

WHO WE ARE

The IDL is operated by the **Department of Architecture** in the **College of Built Environments** at the **University of Washington** in the **Center for Integrated Design**. We are a self-sustaining organization of interdisciplinary faculty, staff, students, professional collaborators, and partner organizations working together to push the boundary on what's possible in sustainable building design. Our shared mission is to discover solutions that overcome the most difficult building performance barriers, and to meet the building industry's goals of moving towards radically higher performing buildings and healthy urban environments.

OUR WORK

The Integrated Design Lab's mission is underpinned by three service streams that work in tandem to promote an energy efficient, healthy built environment:



Knowledge Transfer through Education and Outreach – We share technical knowledge and lessons learned with our commercial clients and industry partners through professional education programs and public tours of the Bullitt Center.

Discovery through Research – We perform targeted research projects on high performance buildings in order to discover new technologies and strategies for healthy, energy efficient buildings.

Guidance through Technical Assistance – We apply our research findings by providing technical design assistance that translates new strategies and technologies to building project teams and industry partners.

The outcomes of our work intersect with people, policies, cities and buildings, and markets. Work examples are highlighted throughout this report. **In the past decade the Integrated Design Lab has produced:**

159 PAPERS PUBLISHED & JOURNAL ARTICLES, AND **457 CONFERENCE PRESENTATIONS**

DIRECT PROJECT INFLUENCE ON OVER **67,000,000 SQUARE FEET** OF COMMERCIAL BUILDINGS

OVER **95,630 HOURS** OF PAID GRADUATE STUDENT RESEARCH ENGAGEMENT AND MENTORSHIP

OVER **2,000 TOURS** SERVING OVER **38,500 PEOPLE VISITING** THE BULLITT CENTER

CONTACT

The UW Integrated Design Lab
1501 E. Madison Street, Suite 200
Seattle, WA 98122

206-616-6566
https://idl.be.uw.edu/

SPONSORSHIP

Interested in collaborating with the IDL? Contact us to learn more, make a tax-deductible contribution to support the lab's mission, or to create student research internships.

UW Founders Hall. Image Credit: UW Image Collection

UW Founders Hall. Image Credit: UW Image Collection

OUTCOME I: APPLIED RESEARCH

Decreasing carbon emissions requires the building sector to reduce energy waste. The UW IDL's work supports ambitious programs, evaluates new technologies, develops tools, roadmaps, and helps implement innovative projects deploying sustainable design strategies.

> "Translating new technologies and approaches to practice helps build capabilities of project teams, industry partners, and public agencies to address real-life challenges and raise the bar for high-performance design."

Luminaire Level Lighting Controls Case Studies

The UW IDL developed case studies of groundbreaking implementation of Luminaire Level Lighting Controls (LLLCs) for regional high-bay manufacturing, warehouses, and distribution centers for the Northwest Energy Efficiency Alliance. An exemplary project, Bunzl Distribution Center in Sumner, WA saves over 600,000 kWh of electricity per year with the implementation of dynamic lighting control that both enhance operations and substantially reduce maintenance cycles for lamp/luminaire replacement. This project was completed by Urban Energy Group of Seattle with significant energy efficiency incentives from Puget Sound Energy (PSE).

Parametric Tool for Retrofit Strategy Optimization

The UW IDL has developed a parametric tool with the Seattle Housing Authority that identifies energy efficient retrofit strategies for their existing low-rise affordable residential buildings. Its aim is to identify least-cost strategies that simultaneously improve energy efficiency, indoor air quality, and thermal comfort. The tool leverages energy modeling analyzing several building types and sizes and allows the housing provider to assess energy savings and cost impacts of various retrofit strategies.

Return on Investment of High Performance Design – Phase III [1]

The UW IDL partnered with the American Institute of Architects (AIA) to develop a resource of empirical research findings supporting the economic value case for high performance design – related to Investing in underserved communities. The outcome of this work will deepen AIA' s website where previous UW IDL research is consolidated. This project is an outgrowth of the UW IDL's "Rosetta Stone: A Translational Tool for Research-Informed Practice" and provides practitioners research-based evidence and knowledge directly applicable to these important topics.

ARPA-E Open Data LCA

In fall 2022, the UW IDL began working with the UW Carbon Leadership Forum on a four-year, ARPA-E funded project to develop a comprehensive life cycle analysis (LCA) framework and package of tools that can be used in whole building LCA analysis. The UW IDL's contribution has been developing frameworks and tools for calculating life cycle impacts of operational energy consumption. This DOE-funded program supports Harnessing Emissions into Structures Taking Inputs from the Atmosphere (HESTIA), which accelerates development of technologies that cancel out embodied emissions and store atmospheric carbon.

Image Credit: UW Image Collection

OUTCOME II: EDUCATION & OUTREACH

The IDL forges partnerships to advance knowledge of high-performance buildings and overcome barriers for implementation. We develop and deliver educational programs for the professional design community, the University, and the public. These programs accelerate the realization of buildings that deliver exceptional environmental performance.

Bullitt Center Tour Program [2]

This year marked the tenth anniversary of the Bullitt Center. We continued our in-person and virtual tour program offering public and private tours and we continue to have robust demand from visitors. Book a tour or check out our virtual tour on our website.

Energy Modeling for Architects

Teresa Moroseos and Chris Meek co-taught a new, parametric building energy modeling course for architects offered by the UW's Department of Architecture in Winter 2023. Students in the course were introduced to the fundamentals of setting up and running energy models in the design process. Topics covered included modeling envelope parameters, massing and glazing, internal loads, setpoints, and basic HVAC systems.

AIA Seattle Energy in Design Award

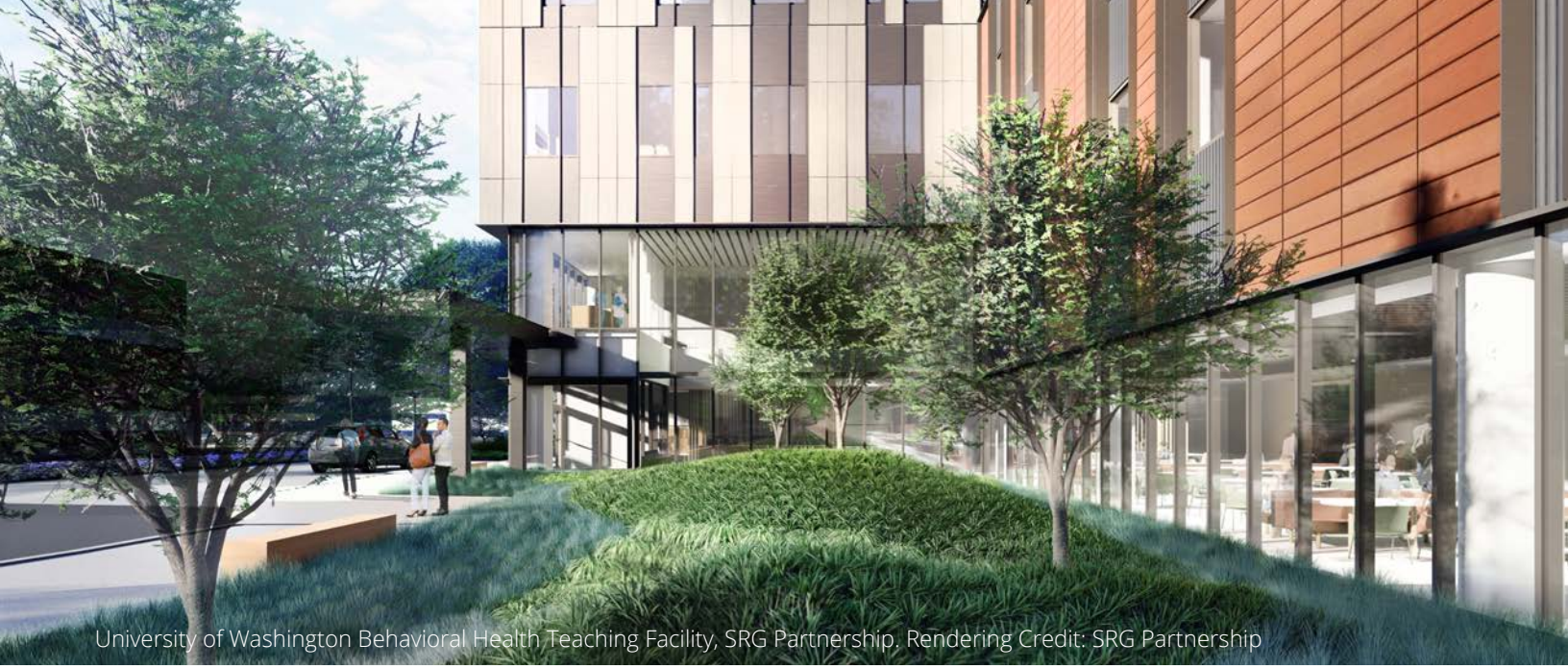
For the seventh year in a row, the UW IDL has partnered with the AIA Seattle and the Honor Committee to provide technical support for the Energy in Design (EiD) Award. This award requires energy performance data for all project submissions. The work aligns with the national-level development of the AIA Committee on the Environment (COTE) "Common App" and provides the design community with valuable feedback on the its progress towards meeting the 2030 Challenge.

Smart Buildings Exchange Panel Discussion on Healthy Buildings

Christopher Meek led a panel discussion on Indoor Environmental quality at the 2023 Smart Buildings Exchange. The panel featured Prof. Vivian Loftness with Carnegie Mellon University, Seema Bhangar with the US Green Building Council, and Dr. Stephanie Taylor with Buildings4Health, Inc. The discussion highlighted the importance of healthy indoor environments, creating and maintaining indoor environmental quality as a pre-Covid history and a post-Covid challenge. We discussed the ROI of health and comfort conditions as expressed in employee recruitment, retention, and productivity; and explored the lessons learned from a reinvigorated focus on healthy indoor air and technologies that were deployed during the pandemic and their measured or perceived benefits.

Designing for Low Emissions with Mass Timber

Prof. Christopher Meek and Assistant Prof. Tomás Mendez Echenagucia, with Post-Doctoral Scholar Teresa Moroseos led a 2023 academic Research Studio to investigate the potential of mass-timber buildings to reduce both embodied and operational CO2 emissions with the help of parametric models, building performance simulation and computational structural design tools. Using these methods, graduate students in architecture designed a series of residential buildings of varying number of units and size while studying the trade-offs between operational energy use and the embodied CO2 of the building envelope and structure over a 50-year life-cycle. The aim is to combine the design outcomes and performance data produced by all students into an online catalogue of the carbon emissions for the design of residential buildings.



University of Washington Behavioral Health Teaching Facility, SRG Partnership. Rendering Credit: SRG Partnership

OUTCOME III: TECHNICAL INFLUENCE ON DESIGN & CONSTRUCTION

The IDL's interdisciplinary faculty and students have influenced over 67 million square feet of new construction and major building renovation in the past decade. We provide technical assistance to architects, engineers, and building owners during early design phases through construction and operations with evidence-based strategies developed from research and targeted to deliver energy savings and reduced carbon emissions.

Mt. Edgecumbe Medical Center Campus, Sitka, AK -- NBBJ

The UW IDL, in collaboration with NBBJ and SOLARC Energy Group, provided technical assistance on the Mt. Edgecumbe Medical Center Campus (MEMCC). This project is a joint venture project between Southeast Alaska Regional Health Consortium (SEARHC) and Indian Health Service (IHS) to create a new healthcare campus serving the region surrounding Sitka, Alaska. It consists of a replacement Critical Access Hospital combined with new outpatient clinic spaces. UW IDL's scope includes energy evaluation, strategy development, energy modeling, and LEED evaluation and compliance.

Renton High School -- SKL Architects

The UW IDL performed glare and daylighting analysis for a renovation to Renton High School in Renton, Washington for SKL Architects. The UW IDL provide technical assistance on optimal placement and size of skylights to maximize daylighting and minimize cost. A detailed glare analysis was also performed to optimize design of exterior shading devices.

> "Technical design assistance provided by the IDL helps shape the focus of our research and connects us with the design community in the collaborative effort to pursue a better built environment."

External Venetian Blinds Performance Analysis – Draper Inc.

The IDL partnered with Draper Inc., a national manufacturer of shading products, to characterize the performance advantages of external venetian blinds (EVBs) which feature in some of the world's highest performance buildings. We developed a holistic simulation-based analysis of a series of window shade strategies for commercial building applications. These included a standard automated EVB and an EVB within and actively-ventilated double skin façade. The analysis documented key performance indicators associated with high-performing buildings for each of the different shading strategies: energy consumption, peak cooling requirements, daylight sufficiency, and the percentage of unobstructed views to the exterior. Simulations were performed in seven urban climate contexts representing the primary climate zones in North American established by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE).

Mount Vernon Library – HKP Architects

The IDL partnered with HKP Architects to provide technical daylighting and solar control design assistance on the new Mount Vernon Library Commons multi-use infrastructure project located in historic downtown Mount Vernon. Combining several community needs, this project is a catalyst for economic development. This project includes public library services, community center space, a commercial kitchen, public restrooms, and structured parking with the largest public electric vehicle charging center in the USA, park and ride, and transit stop.

Image Credit: UW Image Collection

SELECTED PRESENTATIONS & PUBLICATIONS

The IDL transfers its research findings through presentations and publications in diverse venues regionally, nationally, and internationally. These forums help to disseminate knowledge directly to design teams, professional partners, and others, bolstering the industry's technical capabilities and knowledge of high performance design.

> "Publications and presentations provide a conduit to share our research far beyond our region."

AIA Conference on Architecture A'23 [3]

Heather Burpee spoke at the American Institute of Architects Conference on Architecture A'23: "Getting Cash to Avoid a Crash: Financing Resilient Design." Practicum Presentation with Jesse Keenan (Tulane), Robin Seidel (Weston & Sampson), and Rose Grant (Rose Grant Architectural Services).

Energy in Buildings Operational vs Embodied Carbon Trade-Offs [4]

Teresa Moroseos, Chris Meek, and UW Assistant Professor Tomás Mendez Echenagucia published a paper exploring the trade-offs between operational and embodied carbon impacts on envelope design for prototypical office and residential buildings in a variety of climates, energy grids, and grid decarbonization scenarios. Envelope parameters that were studied include opaque wall insulation, glazing U-factors, infiltration rates, and window-to-wall ratios.

Facades Plus Presentation: High Performance Facades and the Energy Question [5]

In an invited presentation at the Facades+ Conference in Seattle, Christopher Meek and post-doctoral scholar Teresa Moroseos shared the IDL's recent research on excessive heat events, daylighting, and glazing as they relate to facade performance, along with a discussion of lifecycle carbon impacts of façade material choices. This presentation combined academic research with built and in-progress design projects in the region, offering the audience a perspective on how to incorporate leading building science research into their projects.

BetterBricks Building Renewal [6]

Heather Burpee and Chris Meek supported NEEA in the development of a series of BetterBricks: Building Renewal Articles that communicate the energy-efficient benefits of building deep energy retrofits. These articles are available on the Betterbricks website.

Building Owners and Managers Association (BOMA) Powerful Facilities Conference [7]

Christopher Meek and Northwest Energy Efficiency Alliance Program Manager Warren Fish co-presented Proven Technologies and Approaches for Healthy, Efficient Buildings at BOMA's Powerful Facilities Conference. This session on integrated building technologies offered building owners and managers a suite of strategies to increase energy efficiency, simplify maintenance, and improve occupant health and wellbeing. It also covered the importance of strategically sequencing upgrades, to integrate technologies from a total-building-value perspective. The primary focus areas were: evidence-based research, building envelope, advanced lighting controls, high efficiency dedicated outdoor air systems, and smart pumps.

ASHRAE Decarbonization Guide [8]

Heather Burpee is collaborating with Mazzetti and DIALOG on a forthcoming Decarbonization of Hospital Buildings Design Guide for the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE).

ASHE PDC [9]

Heather Burpee spoke at the American Society for Healthcare Engineering 2023 International Summit & Exhibition on Health Facility Planning, Design & Construction (ASHE PDC): "Decades of Energy Research in the Making: UW Behavioral Health Teaching Facility." Presentation with Pierce McVey (SRG Partnership) and Mark Stavig (Mazzetti).

Image Credit: UW Image Collection

SELECTED RECOGNITION

The UW IDL is involved in many projects through our applied research, education and outreach, and technical influence on design and construction . We are thrilled to share several projects and people that have been recognized throughout the year. The outcome of a great project or accomplishment is always a collective effort, and we congratulate those teams and individuals for these well-deserved achievements.

UW Husky Sustainability Award

Lab Co-Director Heather Burpee was recognized with a 2023 Husky Green Award. The Husky Green Awards recognize individuals and groups across all University of Washington campuses who lead the way for sustainability at the University of Washington. They are given to students, faculty and staff who show initiative, leadership, and dedication.

PSE Sponsorship

We are grateful to Puget Sound Energy (PSE) for sponsoring the UW IDL to create leads, deliver education, develop tools, convene leaders, and bring solutions in energy efficient building design. With their support we can extend our reach and shared mission with stakeholders in the design and construction industry.

UW CBE Award

Heather Burpee was recognized by the UW College of Built Environments with the "Outstanding Contribution Award." This recognition is awarded by the College Council for recognition of outstanding record in scholarship, teaching, and service.

> "Architectural awards are a critical and longstanding part of design culture -- they reveal the values of the design professions, confer legitimacy on projects and practitioners, and set future directions for industry."

UW Students win ACSA/AIA COTE Top Ten for Students Competition

Former UW Graduate students Andrew Baltimore (IDL alum) and Eric Luth were recognized for their project Watershed by the American Institute of Architects Committee on the Environment and the Association of Collegiate Schools of Architecture with an AIA COTE Top Ten for Students Competition. Jurors selected this project out of over 1,100 entries and commented that "Watershed is an enthralling design with robust information, well executed graphics and clear data. Effectively utilizing the boards to show the quantitative data-driven measures, the project represents a system thinking approach to the design, which clearly shows a rigor of understanding of analysis and environmental metrics." The project was produced in a 2022 UW Department of Architecture Research Studio led by Assoc. Prof. Gundula Proksch and Prof. Christopher Meek.

IDL Celebrates Ten Years of Operation in the Bullitt Center

The Bullitt Center is a formative context for the UW IDL. It has been our home for the past 10 years, it has served as a test-bed for our design ideas, a data stream and research subject for building operations, and a means to convey the impact and opportunities of green building design. The Bullitt Foundation observed that "in its first ten years, the Bullitt Center has generated nearly 30% more energy from solar panels on its roof than it has used, which is enough excess to power 41 homes in Seattle for a year. Since opening on Earth Day 2013, it has shown indisputably that net-positive energy buildings are possible anywhere." The Bullitt Center continues to be an inspiration and a guide to those seeking to design high-performance, energy-efficient buildings.

UW IDL STAFF

SENIOR STAFF

Christopher Meek, FAIA, IES
Associate Professor and Director

Heather Burpee, Assoc. AIA, EDAC
Research Associate Professor/Director, Education and Outreach

Teresa Moroseos, M. Arch
Postgraduate Research Analyst

Deborah Sigler
Program Coordinator for Tours and Outreach

STUDENTS

Colin Veilleux
3-Year M. Arch.

Sara Moghadasipour
2-Year M. Arch.

INSTITUTIONAL PARTNERS

Josh Pelham, Market Channel Manager
NEEA, Northwest Energy Efficiency Alliance

Renée Cheng FAIA, DPACSA, NOMA, Dean
College of Built Environments, University of Washington

Brian McClaren, Ph.D., Professor and Chair
Department of Architecture, University of Washington

PUBLICATION CITATIONS

1- "ROI of High Performance Design." The American Institute of Architects. Accessed September 1, 2023. https://www.aia.org/resources/6409378-roi-of-high-performance-design

2- Bullitt Center Video: http://idlseattle.com/educational-outreach/tours/

3- American Institute of Architects (AIA) Conference on Architecture 2023, A'23. "Getting Cash to Avoid a Crash: Financing Resilient Design." Practicum Presentation with Jesse Keenan (Tulane), Robin Seidel (Weston & Sampson), and Rose Grant (Rose Grant Architectural Services). San Francisco, CA. June 7, 2023.

4- Méndez Echenagucia, T., Moroseos, T., & Meek, C. (2023). On the trade offs between embodied and operational carbon in building envelope design: The impact of local climates and energy grids. Energy and Buildings, 278, 112589

5- Facades+Conference "High Performance Facades and the Energy Question" with Moroseos, T. (UW Architecture). Seattle, WA, 2 December 2023

6- Meek, C. (UW Architecture) and Burpee, H. "Editorial review and content development for Betterbricks: Building Renewal Articles" Delivered to NEEA, February 2023.

7- Powerful Facilities Energy Conference "Proven Technologies and Approaches for Healthy, Efficient Building" with Fish, W. (Northwest Energy Efficiency Alliance), Lynnwood, WA, 15 March 2023

8- American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), "Decarbonization of Hospital Buildings Design Guide." Burpee H, with Vernon, W. (Mazzetti), and Baum, M. (DIALOG). Forthcoming.

9- American Society for Healthcare Engineering 2023 International Summit & Exhibition on Health Facility Planning, Design & Construction (ASHE PDC): "Decades of Energy Research in the Making: UW Behavioral Health Teaching Facility." Presentation with Pierce McVey (SRG Partnership) and Mark Stavig (Mazzetti). National Healthcare Conference. Phoenix, AZ. March 2023.

ADVISORY BOARD

Anne Schopf, FAIA, Design Partner
Mahlum

Jesse Walton, AIA, CPHC, LEED AP BD+C, Associate Principal
Mahlum

Kristian Kicinski, AIA, WELL AP, Associate Principal Bassetti Architects

Duncan Griffin, AIA, LEED AP, LEAN, Managing Principal HDR Architecture, Inc.

Patrick Donnelly, AIA, LEED AP BD+C, Associate Principal
Integrus Architects

Laura Maman, AIA, Principal
Miller Hayashi Architects

Jim Hanford, AIA, LEED AP BD+C, Principal
Miller Hull

Brendan Connolly, AIA, LEED AP BD+C, Partner
Mithun

Nick McDaniel, LEED AP, Senior Associate
NBBJ

Margaret Montgomery, FAIA, LEED AP, WELL, Principal
NBBJ

Vikram Sami, AIA, BEMP, LEED AP, Dir. of Bldg. Performance
Olson Kundig

Pia Westen, AIA, LEED AP BD+C, Principal
SHKS

Myer Harrell, AIA, LEED, Principal, Dir. of Sustainability
Weber Thompson

Neha Goel, AIA, LEED, Associate
Weber Thompson

Emma Nowinski, AIA, LEED AP, Associate
Weinstein A+U

Matthew Zinski, AIA, LEED AP, Principal
Weinstein A+U

THANK YOU TO OUR SPONSORS:

FOUNDATIONAL SUPPORT

neea

PROGRAM GRANTS

U.S. DEPARTMENT OF ENERGY

The American Institute of Architects

arpa·e Advanced Research Projects Agency • ENERGY

betterbricks/

PSE PUGET SOUND ENERGY

BULLITT FOUNDATION

Seattle HOUSING AUTHORITY

Seattle City Light

National Science Foundation WHERE DISCOVERIES BEGIN

ASHRAE

AIA Seattle

FIRM PARTNERS & ADVISORY BOARD

WEINSTEIN A+U

HDR

SHKS

MILLER HULL

mahlum

bassetti architects

INTEGRUS A COLLABORATION OF YGH & INTEGRUS ARCHITECTURE

nbbj

WEBER THOMPSON

Olson Kundig

Miller Hayashi Architects

MITHŪN