Mapping the Influence of a Network: long-term market transformation through mentorship in Integrated Design

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ABSTRACT

The Integrated Design Labs (IDLs), founded by the Northwest Energy Efficiency Alliance (NEEA) in 2000, have collectively mentored over 280 graduate students who have gone on to transform the built environment in the Pacific Northwest and beyond. The interdisciplinary University network is located across Oregon, Washington, Idaho, and Montana. Each lab employs interns who learn and apply strategies for energy-efficient building design and operation. These students enter the workforce better prepared to influence the design profession, changing the workflow and design methods of the firms where they practice, providing technological skill and intellectual depth to their work. They have helped lead a sea-change in the use of daylight harvesting, building controls, energy efficiency, decarbonization, and the interplay between the building form and its systems. They have taken both traditional pathways in architecture, design and engineering, growing as leaders in their firms, and many have non-traditional journeys, influencing the built environment in many facets. This paper presents an overview of how this educational research model has enhanced energy efficiency in the Northwest. Case Studies of buildings impacted by the IDLs are presented paired with interviews of IDL alumni sharing in their own words how their education and research has impacted their design process and career trajectory. The IDL network offers a financially sustainable educational model that directly engages industry, equipping students with real-world experiences and actionable knowledge that shapes both their careers and the built environment. The cumulative impact is greater efficiency for thousands of buildings across the Northwest and beyond.

Introduction

The Integrated Design Lab Network was founded in 2000 and has been leading research and education on energy efficient design in the Northwest for the last 25 years. While building science and sustainability labs are present throughout the U.S., this network of labs is particular to the Northwest. Inspiration for the lab network came from several sources, most notably GZ (Charlie) Brown's Energy Studies in Building Laboratory in Oregon and Joel Loveland's Seattle Lighting Laboratory who had collaborated on building energy use since the 1980s (Loveland and Brown 1990). Another inspiration was from the private sector, namely Amory Lovins' Rocky Mountain Institute (Labrador 2021). There are five labs as part of this network, each associated with a state university: the Energy Studies in Buildings Laboratory (ESBL) at the University of Oregon, the Integrated Design Lab at the University of Washington (UW-IDL), the Integrated Design and Construction Lab (ID+CL) at Washington State University, the Integrated Design

Lab at the University of Idaho (UI-IDL), and the Integrated Design Lab at Montana State University (MSU-IDL). Figure 1 illustrates the geographic distribution of the IDL network founded by Northwest Energy Efficiency Alliance (NEEA).

Figure 1. The geographic distribution of the IDL network. *Source:* University of Washington Integrated Design Lab.

The initial funding for the lab network was provided by NEEA. The intention was to create a collaborative educational network to improve outreach to professional design firms and educate the next generation of design professionals. In one sense, the IDLs serve as a form of consumer education, which is key to market transformation. In this case, the consumers are the professionals who will implement these methods and ideas in their firms and careers, which leans into a theory-based approach (Blumstein, Goldstone, and Lutzenhiser 2000). The decisions that have the largest impact on the energy consumption of a building occur in the earliest stages of the design process. In a similar way, educating design professionals on the principles of efficiency has the greatest effect when they are ingrained early in their career.

What is unique about the labs is their focus on generating decades of savings through fostering human capital as a way to drive market change. There are savings generated each year within the labs for specific projects, which function as point-in-time interventions. However, the broader goal is for the students to learn from these specific instances and technologies and for those impacts to ripple throughout their firms, careers, and communities as shown in Figure 3.

A mission statement of one of the IDL's captures this purpose well: "The IDL is dedicated to the development of high performance energy efficient buildings in the Pacific Northwest. This is approached through research, education and outreach efforts with students, owners, and professional design and construction teams to transform practice and keep pace with the milestones of the 2030 Challenge. Those who utilize the resources available through the IDL will design and construct buildings that are more comfortable for people, require less energy to maintain and operate, and enhance the health and productivity of inhabitants."

A 2012 ACEEE paper documented the direct energy savings and energy efficiency market transformation impacts on the Pacific Northwest. The energy savings estimates for the first ten years of the lab network were based on 722 buildings in which the IDL network had direct involvement. The population of buildings studied included over 51 million square feet of building area. Baseline energy consumption was established through Newsham and Scolfield's energy savings Intensity weighting methods so that the impact of the Integrated Design (ID) process could be quantified (Newsham et al. 2009) (Scofield 2009). The ID score refers to whether the following aspects were incorporated into the design process:

1) The design team established building performance goals (quantitative or qualitative) and compared the building's performance (during design) to these goals.
2) The design team worked outside of normal disciplines to identify and exploit synergies between climate, use, building and site design, and system selection and design.
3) Energy efficiency related analyses were completed to inform design decisions.
4) The design team considered climate as a resource.
5) The design team considered occupancy schedules and comfort criteria as malleable.
6) The design team designed the building to create small loads.
7) The design team matched the system design to actual loads.
(Van Den Wymelenberg, Loveland, and Brown 2012).

When examining the first 10-year program budget and impact of the lab network on new buildings, the direct energy savings of buildings was estimated to be 45.3 aMW of electric-only savings and over 265 million therms of gas-only savings. A conservative estimate of the Lab Network cost per kWh saved was $0.0092 (in 2012 dollars). This was three times lower than the national rate of the cheapest generation source at the time, coal, which had a generation cost of $0.032 per kWh (in 2012 dollars) (Greenstone and Looney 2011). These figures were judged to be conservative since no credit was given to either the non-electric savings or that these design process influences may have impacted buildings beyond a 12-year measure life for new construction (Van Den Wymelenberg, Loveland, and Brown 2012). These energy efficiency measures included methods to improve the building's envelope, lighting, and HVAC performance through both strategic design and equipment selection.

While the direct savings measured from 2000 to 2010 is significant, the indirect savings from educating professionals and students may have had an even greater impact over the ensuing years. Each lab has its own set of continuing education offerings, research programs, and student research internships that have, over the last two decades, facilitated the adoption of integrated design processes throughout the Northwest. The labs represent a unique bridge between higher education, research, and professional practice as noted by a current and former lab director in a co-authored book: "[the IDLs are] a fusion of academic research, professional practice, and teaching… In the university context, most of our work is characterized as applied research and project-based educational outreach. In the eyes of the design professionals, our work is characterized as building-science research and technical design assistance. This type of engagement has built a bridge between the design professions and the academy and helped develop a body of knowledge in building science." (Meek and Van Den Wymelenberg 2012) The students that these labs have mentored and supported have gone on to careers in the building design industry, taking with them the integrated design approach and the technical skills to employ it effectively.

Lab Activities

The lab network has a central focus on energy use in the built environment. They act as trusted third parties, partnering with industry, design firms, and local utilities. They are united in being tied to the architecture program at their respective universities and the directors meet each year to discuss market trends and intelligence. Each lab has its own research programs and areas of expertise. Students graduating from these programs develop skills and expertise in building energy modeling and efficient design.

University of Oregon Integrated Design Lab. The oldest of the Integrated Design Labs, University of Oregon's Energy Studies in Buildings Laboratory (ESBL) has been educating the design and construction workforce, performing applied research, and consulting on green building design and building energy efficiency for over 40 years, encompassing over 20 million square feet of building projects, including net zero energy projects. ESBL research is focused on developing new materials, components, assemblies, whole buildings and communities with improved energy and carbon performance; developing design tools that enable professionals to design more efficient buildings and communities; and understanding how buildings and related transportation and land use systems determine energy resource use. Today, the ESBL is one of three core labs within the Institute for Health in the Built Environment (IHBE) that also includes Baker Lighting Lab and the Biology and the Built Environment Center. IHBE expands the Integrated Design Lab's research capacity to include a focus on lighting energy efficiency and human health, acoustics, indoor environmental quality, and building resilience. IHBE has facilities and staff in Portland and Eugene, benefiting from closeness to both academic and professional communities, and more efficient logistical support of projects across a larger geographic area.

University of Washington Integrated Design Lab. The UW-IDL has influenced over 70 million square feet of new construction and major building renovation in the last 10 years. The UW-IDL has several areas of focus including working with the design profession to elevate design thinking in sustainable, high-performance buildings. This includes building energy efficiency, decarbonization, daylighting and lighting, human health in the built environment, and integrated building systems and operations. This work is grounded in work such as Building Performance Standards and energy efficiency in existing buildings, holistic approaches to decarbonization, workforce development in building assessment, maintaining energy at the forefront of building design, and tools and resources for implementation and measurement of energy efficient, low-carbon design. The lab works with many building typologies including high load/high functioning buildings such as hospitals. Translating research into real-world architectural practice grounds the lab's work in the intersection between research and design application. Trusted relationships with the design community enables influence on the region's design processes and products and creates a conduit to market-specific insights in the region. The UW-IDL also serves as a Dept. of Energy Building Training and Assessment Center (BTAC) for workforce training in building energy assessment, a collaboration with the UW's Industrial Assessment Center, South Seattle College's Sustainable Building Science Technology Program, and Northwest Indian College.

Washington State University Integrated Design + Construction Laboratory. The WSU-ID+CL focuses on advancing high-performance buildings through research that centers on the human experience of the built environment. Reflecting its expanded scope within the Integrated Design Lab network, the WSU lab incorporates "construction" in its name and maintains strong relationships with regional Energy Service Companies (ESCOs) while engaging students from across the disciplines of the WSU School of Design and Construction. The lab's work emphasizes the intersection of energy efficiency, occupant health and well-being, and construction workforce transformation. Through interdisciplinary research and industry partnerships, the ID+CL develops practical strategies that help design, construction, and

operations professionals implement energy-efficient, low-carbon, and occupant-responsive buildings.

A core area of expertise is occupant-centric energy efficiency, examining how human behavior, building interfaces, and environmental controls influence building performance. The lab conducts research on tenant engagement, user interaction with building systems such as thermostats and lighting controls, and behavioral strategies that reduce energy use while improving comfort. These insights are applied through initiatives such as the Energy and Comfort program at WSU, which combines plug-load interventions, technical improvements, occupant education, and decision-making tools. The lab also investigates the relationship between indoor environmental quality and human health, exploring how factors such as thermal comfort, daylight, air quality, and environmental control systems influence well-being and quality of life in the built environment. Recent work includes qualitative studies examining housing design for individuals living with neurodegenerative diseases, highlighting the importance of adaptable layouts, sensory-responsive environments, and smart-home technologies that support autonomy and caregiving. In parallel, the lab studies emerging design and construction methods and their implications for workforce development.

Through collaborations with national research organizations and industry partners, ID+CL researchers examine how industrialized and modular construction, locally sourced mass timber, and advanced manufacturing practices are reshaping labor needs, safety considerations, and project delivery practices. Across these areas, the ID+CL employs many methods of research, including case studies, surveys, interviews, and field engagement to translate academic research into practical knowledge for the architecture, engineering, construction, and operations community. By working directly with industry partners, operational facilities teams, and building occupants, the lab connects research with real-world implementation, helping accelerate the adoption of human-centered, energy-efficient building practices across the region.

Montana State University Integrated Design Lab. MSU-IDL's current research focuses on improving environmental performance and the design-decision making process. One major research effort currently underway is part of the ASHRAE RP-1929 for the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), which evaluates the gaps and limitations in existing LCA software used by building professionals. The lab is also currently supporting interdisciplinary research on evaluating the performance of evaporative cooling systems in the cold, dry climate of Montana.

In addition to research, the lab is actively engaged in outreach and professional service. This includes daylight analysis support for Montana architects and organizing seminars and workshops for architects, engineers, and builders across the state to promote climate-responsive design strategies for cold climates. A recent example includes a presentation on Heat Recovery Ventilators at the Building Codes Conference, which will be held in Missoula in April 2026.

University of Idaho Integrated Design Lab. The UI-IDL has established a long-term partnership with the local utility, Idaho Power. UI-IDL's contract with Idaho Power includes a technical assistance program whereby the UI-IDL can serve as a third-party educational resource during the design phase of new projects. This includes teaching specific individuals at firms how to use energy modeling software and sharing resources and case studies on emerging energy efficiency technologies. The UI-IDL also hosts an Energy Resource Library (ERL) for Idaho Power customers, where energy auditors and facility managers can rent energy monitoring

equipment, such as flow meters and infrared cameras to improve energy efficiency. Research at the UI-IDL has included exploring modular 3D printing of homes using bio-based materials, which has become an NSF project (PrinTimber). The lab has also partnered with industry through a state department of commerce program to research and test the effectiveness and optimal mix of materials for bio-based insulation materials (Hempitecture).

Lab flexibility. The lab activities are able to dynamically adjust to the needs of the market and the expertise each director brings to the lab. For example, at the UI-IDL, from 2006 – 2015, the primary focus was on daylight harvesting and occupant performance under different lighting conditions, from 2015 – 2019, the new director brought her expertise and background in Indoor Environmental Quality, while the director from 2019 - 2021 led efforts on energy code education and 3D printing structures using bio-based materials.

Lab Network

By being tied to state universities, and having a 25-year history, the design labs are able to serve as a trusted third-party resource to architecture firms, building owners, and utilities through individual contracts. Each of the labs conducts some form of professional education. For example, the UI-IDL has an annual Lunch and Learn program, sponsored by Idaho Power, where lab faculty and staff present energy efficiency techniques and technologies to architecture and engineering firms, a program that has provided over 1,093 contact hours with design professionals over the last five years. The UI-IDL also hosts a Building Simulation User's Group blog and lecture series, which is offered free of charge through Idaho Power's support. The BSUG lecture series has provided over 954 continuing education contact hours over the last five years. The UW-IDL provides professional education through codes and standards webinars in the Puget Sound Region and have led the development of national curriculum for the American Institute of Architects including "Getting to Zero," "Materials Matter" and additional content for members on the AIA's online resources.

Northwest Energy Efficiency Alliance BetterBricks program. The labs share some outreach programs through their work with NEEA's BetterBricks program to provide the design community with a connection to energy efficient technologies and practices. The labs share information on case studies and through their interaction with professional firms, collect market intelligence on the barriers to adoption. This includes supporting NEEA's Whole Building Program and providing structure and insights for the BetterBricks Building Upgrade Guide to help building owners approach energy efficiency upgrades. Additionally, the labs provide Luminaire Level Lighting Controls (LLLC) education and market intelligence. The labs also work with NEEA's Advanced Performance Dedicated Outdoor System program (APDOAS) including educational outreach, development of case studies, and market intelligence to ground the program in the design community's practices. The UI-IDL has LLLCs installed in their office where they offer tours to design professionals and facility managers who can actively engage with the technology and learn how to set up a lighting network and control system. The UO-IDL, WSU-ID+CL, and UW-IDL offer similar LLLC and efficient technology educational tours.

Energy efficiency tours. Several of the labs provide outreach to both students and design professionals through specialized facility tours. For over a decade, the UW-IDL has provided tours to over 5,000 annual visitors of the Seattle Bullitt Center. The Bullitt Center is a six-story

net-zero commercial building, which was one of the first to achieve the Living Building challenge certification, including net-zero energy (Crowe 2020). WSU's ID+CL offers a range of tours to expose students to real buildings and their inner workings. It is common for many students to graduate with a mechanical engineering or architectural degree without having been exposed to HVAC components like pumps, compressors, or rooftop units beyond a textbook diagram. Each of the design labs seeks to correct this through tours and sharing case studies that detail how mechanical and electrical systems are integrated into the structure of a building.

At the UI-IDL, student interns are regularly tasked with taking measurements of building systems using the lab's energy resource library. Students get hands-on experience performing energy audits and learning how to read equipment nameplates and specifications. These hands-on tours and audits offer tangible ways for students to better comprehend how to design for these systems - how they are laid out and how much room they may require. The UO-IDL designed and constructed a "climate chamber" in which design professionals and their clients can experience expanded thermal comfort models using passive design strategies for energy efficiency. The WSU ID+CL is currently testing a pilot undergraduate "introduction to built environment research" independent study with 5 freshmen to give students a view into the efficiency side of design/construction considerations they otherwise might not be exposed to. Ideally, this course structure could become available to any organization that uses Canvas for offerings in future semesters. Courses such as these, help give students a firmer background in building science so they are capable lab assistants when they are further in their majors.

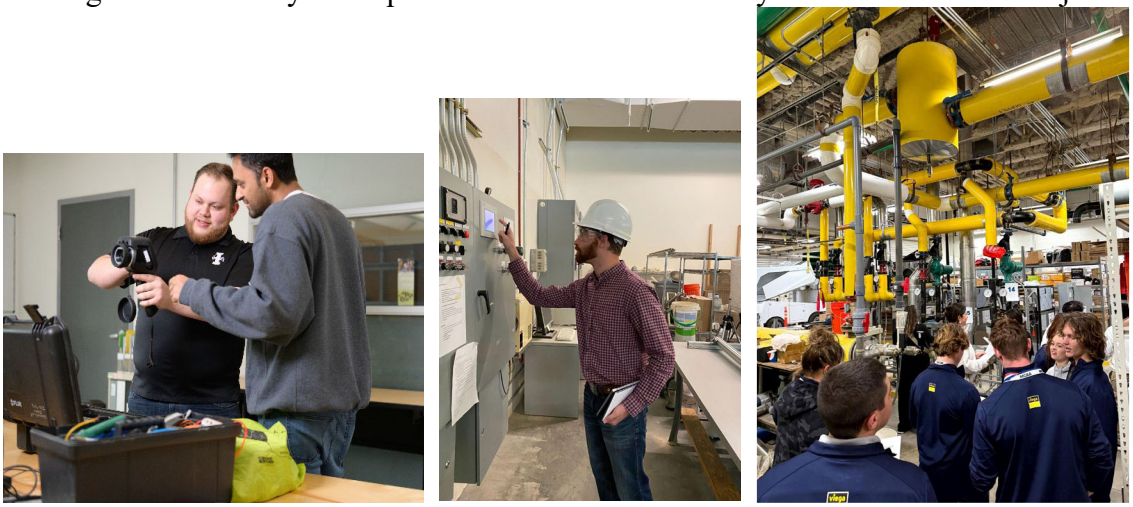

Figure 2: Left and center: students at the UI-IDL using tools to assess building performance. Right: students from the WSU ID+CL on a building tour.

Higher Education

Each of the lab directors is engaged in teaching at some level. In addition to the freshman pilot program, the leaders of the WSU-ID+CL teach building science students in Construction Management and Architecture, a course in Mechanical Electrical and Plumbing systems, two graphic design/visual communication courses, and courses in integrated design. This range of courses captures students from a variety of majors and backgrounds. The UI-IDL has taught courses in daylighting, net-zero design, building simulation, and environmental building performance. The directors of UW-IDL and MSU-IDL both teach building science courses and lead studio courses. The UO-IDL teaches courses on building enclosure design, lighting,

environmental control systems, building simulation, and design studios. Each of the labs are tied in with the regular architecture curriculum at their school, where students learn about building performance, ventilation, daylighting, and integrated design approaches that connect technical systems with architectural design and their impact on energy use.

Educational timescales. Educational energy efficiency impacts are not as readily quantifiable as they might be for a specific technological intervention at a single project. This intersects with NEEA's initiative lifecycle process in a number of ways. The IDL's support fundamental research on emerging products and perform lab testing similar to a scanning and concept advancement phase. The IDLs also support field studies and occupant satisfaction surveys to track case study performance. They help develop training, during NEEA's program development phase, and then execute the training and other support functions during the market development phase. Alumni are putting their training and learnings to use with real-world applications. The labs can and do provide specific efficiency recommendations on individual projects, many of which will generate energy savings for the next five years, if not the lifespan of the building. However, with education, a better model might be that of ripples in a pond as illustrated in Figure 3, where impacts swell and spread outward to affect far more than a single project at one point in time.

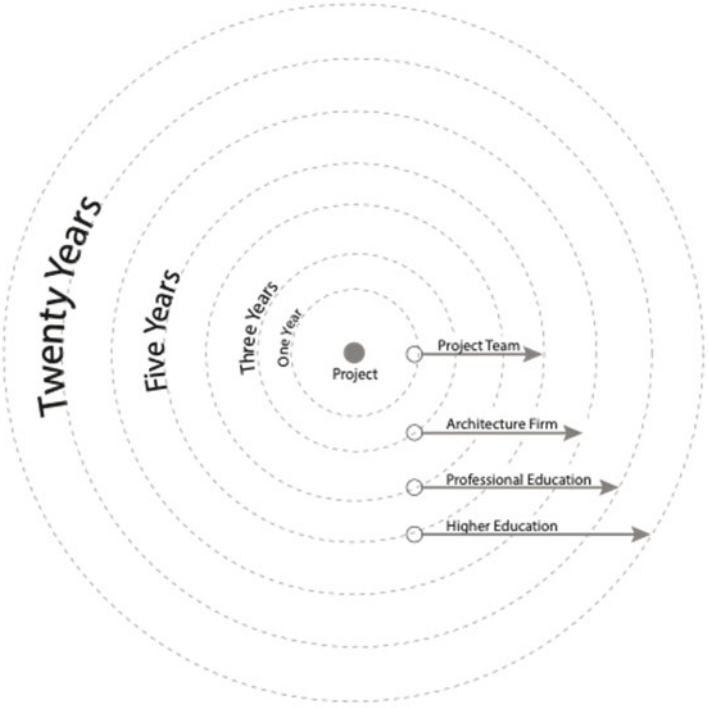

Figure 3. The variation in impacts and reaches from different forms of energy efficiency training. *Source:* University of Washington Integrated Design Lab

This education can occur at different scales and different intensities. For example, IDL faculty and staff might work with a design firm's team on a particular project and provide insight on different early design decisions - giving that team a methodology or approach that they can apply independently on future projects. At the next educational scale, the IDLs provide firm-specific training; as an example, the UI-IDL taught several individuals at a firm in 2024 to use daylighting analysis software that they could integrate into their normal design workflow. The

intention is that this new workflow will apply to most of their new commercial projects and save on electric lighting energy.

The IDLs also offer professional education courses that are open to any interested firms in the area - often these are sponsored by a utility or through NEEA's Better Bricks' program so that they are free of charge to attendees. These seminars or lunch lectures given to the public or to industry groups like the American Institute of Architects (AIA), Building Owners and Managers Association (BOMA), and the American Society of Heating Refrigeration and Air conditioning Engineers (ASHRAE). These outreach lectures give context to energy efficiency technologies and trends in the Northwest. The broadest and most lasting impact occurs at the higher educational level where students will carry the principles and skills taught with them throughout their careers over the following decades.

IDL Internship programs. The most intensive higher educational impact the labs have is through their internship programs. Each of the labs support students as research assistants over the course of a semester or for the entirety of their graduate program. The most common arrangement seen at the labs is to hire Masters of Architecture students as research assistants during their final two years of schooling. In some instances the students receive credit for their research, are offered stipends, and/or tuition waivers. These internships and students vary widely by location and situation. Some students are undergraduates pursuing a bachelors in mechanical engineering, or are majoring in interior design. As a conservative figure, the labs have mentored over 280 students, for which there are specific graduate records. While this is a small fraction of the total number of architecture students passing through these programs, these 280 students were deeply engaged in the work of the labs for at least a semester and many of them for multiple years.

Internship activities. The work of these research interns has included everything from building digital twins of buildings, constructing thermal testing devices, researching the energy impacts of covid mitigation strategies, embodied energy analysis, and much more. One of the founding principles of the lab network was that these students would go on to influence the wider community of architects, engineers, and building scientists to design and create environments that efficiently and effectively meet the needs of their occupants. The aim of the internship programs is to ingrain the practices of integrated design and to give interns a set of design skills, which they might carry with them into practice.

It would be extremely challenging to quantify in exact kWh or therms how much energy has been saved by these alumni. Such an effort would have to closely track every alumni project over decades and whether their time as an intern had a specific savings impact on each project. This would involve collecting data on tens of thousands of projects over the last 25 years. Rather, the authors wish to offer a cross-section of alumni responses from each lab to gauge whether their time as interns has affected their career path and their design decisions. The market transformation theory behind the internship program is to have narrow but deep impressions. That is, each lab only supports a few interns each year, but the aim is for these internships to be transformational in the development and careers of these individuals. In order to examine this inference, the directors reached out to their alumni networks to see what enduring impacts (ripples) the IDL internships continue to have in the Northwest after the alumni go out into the workforce.

Savings Beyond Measure

Alumni from the IDL network have settled throughout the four-state Northwest region. Where information was available, the graduates that had stayed in practice within the Northwest were compiled and can be seen in Figure 4.

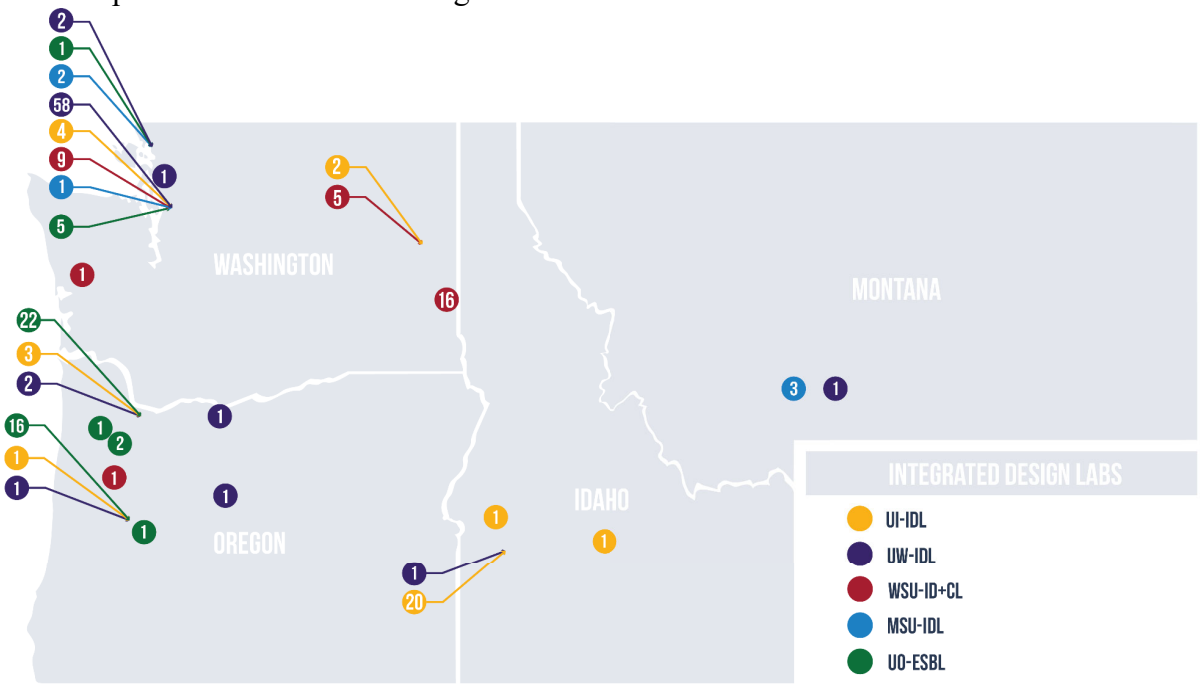

Figure 4. Geographic distribution of IDL alumni currently in practice in the Pacific Northwest.

Significant numbers of graduates have concentrated in the major cities in the Northwest including Seattle, Spokane, Boise, and Portland.

Alumni Interviews

At least three alumni from four of the IDLs, and two from the remaining IDL participated in 15-minute interviews to gather information on their career paths in the years since they graduated. The authors reached out directly to their alumni and attempted to capture a variety of graduates from different years at the labs and a spread of current employment. All interviews used the same set of 14 questions. The first seven questions focused on their careers after IDL. The second set of seven questions focused on whether their internship time at the IDL has affected their current practice. The questions were as follows:

1. What is your highest level of education?
2. What are your current qualifications, licenses, and certifications?
3. Where are you currently employed?
4. Where have you previously been employed (since graduation)?
5. What are you doing now (sector, project type, practice, or genre) ?
6. Are you out of the industry? Why?

7. What are one or two projects that you are working on right that you are the most excited about (if unable to share project data, please share sector, and any interesting design features/challenges)?
8. Can you share what you worked on during your time at the IDL?
9. Can you list some skills, in your own words, that you gained from working at the IDL?
10. Have any of those skills you learned at IDL resulted in energy savings for your professional projects? If so, how much?
11. How did your energy efficiency knowledge improve from your time at the IDL?
12. How has your work at the IDL helped you in your career? How has it informed your practice, sector, or area of focus?
13. Has your time at the IDL informed your mentorship of colleagues or research activities… how?
14. In your own words, please state how your experience in research and practice have benefited you as an individual?

Alumni feedback. Responses from 19 alumni were retrieved, with at least three graduates each from four of the five IDLs and two graduates from the remaining IDL. These alumni included a cross-section of graduates from as early as 2007 to as late as 2025. A majority of the respondents had come through the IDL internship programs as Masters of Architecture students, although some were Mechanical Engineering students, and one was a Construction Management Major. All but one respondent (a recent graduate) had additional qualifications including AIA, PE, LEED, and WELL, amongst others. All of the respondents are currently employed in the building industry either in architecture or engineering firms, handling LEED policy, or sustainability consulting. The projects these graduates are engaged in ranged from federal building retrofits to building decarbonization policies and mass timber design, to university stadiums, restaurants, and microscopy labs.

During their time at the IDLs, two of the respondents had focused work on tenant engagement. This involved learning how occupants interact with building systems, and teaching tenants about how to work with building systems. Seventeen of the respondents mentioned energy modeling as some part of their work at the IDL, which included daylight, operational energy, and/or embodied energy analysis. These experiences were reflected in the skills the respondents reported gaining during their time.

Skills gained. When asked to list what skills they gained from working at the IDL, 17 of the respondents mentioned that they had gained skills in energy modeling or daylighting design. Nine of the respondents discussed communication and client interaction skills gained from the professionally-facing nature of the IDL work and research. Ten specifically mentioned the software and programming skills they learned. Eight of the 19 stated that they had gained a solid understanding in daylighting analysis and design. Ten of the 19 indicated skills gained in "design thinking" and/or analysis during the design phase of a building. Two representative quotes from this question's response included: "I would say that the biggest skills I took away were energy modeling and the integrated design approach - being able to step back from a particular design aspect and see the big picture," and "I try to use the efficiency mindset on every project. I can run a quick model in EQuest or a shoebox model in EnergyPlus to look at the potential energy payback and make more informed design decisions based on that data."

Energy savings. When alumni were asked if those skills had resulted in energy savings for their professional projects, a majority (16) of the 19 alumni interviewed responded affirmatively that it has had direct impacts on the energy use of their projects moving forward. Three alumni stated that their time had directly impacted their workflow and approach for all projects. When asked if they were able to quantify the savings, many deferred on giving specific numbers. One respondent mentioned "I've done several energy studies on new construction, retrofit, and retro commissioning projects across the Western United States that resulted in significant and verified energy savings, resulting in millions of dollars' worth of utility incentives for [their engineering firm's] clients." Another respondent did provide a specific number: "Yes, my work is entirely focused on energy savings. It is hard to say the impact of my work supporting engineering work on buildings, but I did get a report on the estimated savings of my lighting retrofit projects thru[sic] SCL a few years ago, and it was 1,847,435 annual kWh saved for the projects completed between 2015 and 2020. Multiply that by a measure life of 12-15 years to get the total saved over life of measure."

Energy efficiency knowledge. Regarding whether their energy efficiency knowledge improved from their time at the IDL, 17 of the 19 responses indicated a major growth in their efficiency knowledge. Of the two who didn't, one reasoned because they were focused on side-projects with a higher focus on programming. The other mentioned that during their time at the IDL, their focus was daylighting design, and at the time, the connection between daylighting and energy consumption was still nascent. Other responses indicated that the labs offered a grounding in building science fundamentals: "a solid foundation to understand energy usage within the commercial buildings space" and "provided a good base knowledge and understanding of navigating energy code compliance." Still others indicated that the labs gave them a wider perspective on projects: "helped me with considering big picture daylighting and solar heat gain on most projects early in design." and "the IDL prepared me for in depth coordination and collaboration with MEP engineers. Energy codes, policies and goals." Another wrote: "I think I graduated with a level of building science expertise that was pretty uncommon for most [fellow] M.Arch students. I learned so much more about the real application of building systems in my work at the IDL than I did in any classroom."

Career assistance. There was universal agreement among the respondents that their time at an IDL helped them in their careers either through networking or providing them skills in high demand during a tough job market: "the biggest impact on my career now is from my time at IDL;" "My work at IDL really served as a launching pad for my interest in sustainable design;" "I attribute my experience at the lab as the reason I was hired into my current position;" "The IDL gave me a network and got my foot in the door with my first mentor at [architecture firm - name withheld]. That set the path to where I am now."

Mentorship and research. When asked to consider how their time at an IDL informed their mentorship or current research, two mentioned that it hadn't. One offered no further clarification, but the other stated it was because they were still new in a firm, but were planning a presentation on the benefits of using ClimateStudio to their colleagues and that they hoped to provide more mentorship in the future: "I just don't think I'm quite at the point in my position at the firm where we can fully capitalize on it yet." Fourteen other respondents stated that the mentorship they received at the IDLs is something they hope to pay forward: "the IDL set me up with

[architecture firm - name withheld] at the end of school, and that resulted in the first real mentorship I've had in my career. It's improved since then and now I mentor UW students." Another respondent noted: "working with an intimate team of faculty and students at the IDL at both a high level of output and targeted approach to impact has enabled me to manage a team of carbon and sustainability analysts over the last six years. It also contributed to the ability to mentor several students at the [name withheld] program as well as lecture students on lighting and decarbonization at [four universities listed - names withheld for anonymity]." Still another alumni stated: "I still use the training material I received at the lab to help train other colleagues today within the building energy modeling projects."

Benefit to individuals. The final question asked IDL alumni to, in their own words, state how their experience in research and practice has benefited them as an individual. Six responses were edited for length, but otherwise they are shared in full. Nineteen quotes are shared below, which include at least three responses from alumni at four of the five IDLs and two responses from the remaining IDL.

- "Working at the IDL during grad school gave me access to and knowledge of the tools and people that allow me to do the work I do today, as well as serving as an endorsement of my abilities and skills when I entered the workforce…. Having the skills and knowledge to do my work effectively as well as advocate for intelligent policies and practices is built on the foundation of my time at the lab."
- "Doing research opens up a wider world than what is available in practice. It requires you to get involved in a broader network, pay attention to what's going on outside of your sphere, and find ways to collaborate with others, either on the same project, or using previous projects to move the industry forward. That mindset has served me well, and it's what has kept me moving and excited within my career, even when I've found myself burning out from the architecture side."
- "Experience at the IDL directly improved my ability to collect, vet and apply research to practice which has been a differentiator and value multiplier for clients."
- "Being on the inside of the IDL can give you more confidence and faith in the fact that resources/research exists and is valuable and reliable and ACTIONABLE. It produces actionable recommendations!"
- "Working at the IDL helped me realize that my background [in biochemistry] and the way of thinking that comes with research not only had a place in my new career path in architecture, but that it was something that I could excel at. Applying a research/iterative approach to design is something that has greatly benefited my career in architecture!"
- "Across all industries I feel there is a bit of disconnect between academia (research) and practice (industry) but having experienced both domains I'm able to approach design challenges with a well-rounded perspective."
- "These days I'm advocating for good design, efficient design, and system innovation in how we build affordable housing."
- "I remain incredibly thankful for my experience working at the IDL, and I've continued to use my daylighting knowledge and experience throughout my career. I'm grateful for the amount of agency that I was given at the IDL, along with my colleagues, to work with local design firms, develop essential testing questions and criteria, and determine optimal solutions. In professional practice, this 'design-thinking' approach has helped me

tremendously and instilled confidence in my ability to find the overlaps between design 'form' and 'performance' and to communicate results effectively within design teams."

- "My time at the IDL has positively impacted my career. It offered me career direction and guidance and greatly improved my knowledge of efficiency and integrated design. I feel like it has made me a better design team member."
- "My experience at the Integrated Design Lab provided me with invaluable knowledge in building science, energy efficiency / modeling / analysis, and data processing techniques that I continue to use within my day-to-day workflow 5 years after graduation."
- "I feel like it just opened so many opportunities I didn't realize were even there in my undergrad. I felt empowered to take experiences from the lab and be able to scale them up to a practice level (at [architecture firm]) and now at [organization] - scaling up again to the policy and ecosystem level. I would have never understood there are bigger opportunities or had exposure to those opportunities without my internship time at IDL."
- "I think it gives me something to be really passionate about because it's both functional and widely applicable…. It's also universal in its impact. Thoughtful daylighting can improve energy efficiency, enhance human experience, and even support well-being and mental health. That's what makes it so compelling to me—it connects building performance with the quality of human life."
- "[A] holistic view of the industry is important – I now hold a much higher respect for designers than I think a lot of construction graduates hold… Yes their designs may be frilly and something I wouldn't choose, but the amount of time and effort and research that goes into those designs cannot be written off. [...] Overall, I tell those new kids to KEEP TRYING to create change, you are a part of the movement toward efficiency and sustainability, but the industry is like tectonic plates and takes time to fundamentally shift toward the better [...]– you need to have meaningful conversations on change, not shame people into thinking your ideas and your path forward is the right one"
- "I think my research and work at the IDL definitely helped reinforce my critical thinking skills and nomenclature in the profession… Being more critical and more intentional based on that foundational knowledge from IDL… It's been incredibly helpful to me and my career."
- "My experience at IDL was really beneficial because it gave me my initial interest in LEED, especially through work on daylight, views, LCA, and some energy analysis. That experience pushed me to pursue my LEED Green Associate accreditation and ultimately led me to positions where I could work on projects that allowed me to explore more of the architectural LEED credits. It's not just about the internal design team—it's also about working with clients. That collaborative, integrative approach has been one of the most valuable things I've taken from IDL into my career."
- "Having experience in research and practice taught me how to take responsibility and ownership of projects, and to have independent and critical thinking that it takes to rigorously think something through, whether we're talking about design, research, or how they come together. I think that's served me well so far in my career."
- "In many ways, … it has helped me view the world through a more compassionate lens. It makes me think twice more about my decisions. So, I would say it really influenced those lifestyle choices. I think from an analytical lens as well, if I'm making decisions about something big in my life, how do I make that decision? Do I just go with my gut

instinct, or do I try to kind of map out the inputs of information I have. I think there's a lot of things that kind of thinking has taught me."

- "Yeah, I mean, it is intrinsic to my role, and my job. I mean, my job in some ways is applied research, and whether that's around daylight or indoor environmental quality, or if it's around embodied carbon. I'd like to understand how to integrate it with design. How to look at options. How to analyze and how to present information. [T]o understand how to present information, lay in the metrics, be able to support design cases, and look at options. I mean, it's still what I do now, so I think it was tremendously influential. I think in terms of being a research assistant as a graduate student, I learned as much in the lab as I did in my architectural education. So, you know, spending 20 hours [each week] there, I had professors saying, "oh, your design work is going to suffer," and it probably did on some level, in terms of I didn't have that extra 20 hours to spend in the design studio. However, I think for where I wanted to go in terms of sustainable design, I have no regrets at all about that."
- "[My work at an IDL] felt to me as a celebration of human connection. I saw firsthand the consequences of uniformed automation (top-down decision making) on staff and faculty and the deeply human impact of person-to-person exchange of experience, anecdote, and opinion. In an era of increasing reliance on Artificial Intelligence, machine learning and LLM chatbots, I am now more than ever convinced of the importance of the people-centric work we have done and the work the IDL network continues to do."

Conclusion

Over the last 25 years the IDLs, through NEEA and the BetterBricks program, have provided education on market-transforming energy efficiency programs. These include integrated retrofit studies, advanced HVAC programs, and cutting-edge lighting designs and technologies. The IDLs provide market transformation at a variety of levels. For example, the labs conducted fundamental research on Luminaire Level Lighting Controls, which NEEA has used in their own programs to expand the available products and features on offer. The IDLs assisted with case studies and implementation of LLLCs. Now, IDLs educate students and train professionals on this technology and help increase its adoption. It may not be possible to strictly quantify in megawatt-hours the total energy savings of the IDL network as was attempted in 2012, but the responses do indicate that this research and education network has had perhaps an even more meaningful impact on hundreds of individuals and thousands of subsequent projects. One alumni estimated their work to have saved 1.8 million kWh between 2015- 2020. Another graduate mentioned millions in utility savings over the last five years. Many of these alumni have gone on to professional practice with a grounding in the principles of integrated design and some have adopted energy efficiency workflows into their daily work, which they then pass along to others in their firms. The interviews showed that the majority of graduates credit the IDL internships as affecting both their knowledge and approach to energy efficiency in practice. They continue to pass along skills in energy modeling and design thinking to others through work and mentorship. Still other alumni are actively engaged at the industry and policy level on sustainability initiatives or programs like LEED. Their responses indicate the lasting ripple effects of education and the value of a bridge between research, professional practice, and higher education.

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AI-assisted Tools: Disclosures and Responsibility

AI-assisted tools used: Microsoft Copilot.
Used for: Compiling interview responses from multiple word documents into a single table.
Extent: Copilot was used for this single task of moving text from 19 word documents into a single Excel sheet. Copilot was not used for editing, drafting, or summarizing any text.
Human review: The authors reviewed and verified all content (particularly the compiled interview responses), verified that the text was appropriately moved, and no AI was used for calculations or citations.