



Annual Report July 1, 2023 – June 30, 2024

Letter from the Director

Dear friends of the Clean Energy Institute,

Reflecting on the 2023–24 academic year, I'm proud of the trajectory we've set for CEI's second decade of operations. UW faculty and students from across campus are more eager than ever to get involved in clean energy research and training. And our programs and partnerships are bearing fruit in the form of tangible benefits to everyday people, from utility customers to EV drivers and elementary school students.

I was pleased to see many new faces join the CEI community this year, including 10 new Member Faculty who are already connecting across disciplines to drive transformative



research. CEI Collaborative Seed Grants catalyzed three new faculty research partnerships on campus, which also include Clark County and the Pacific Northwest National Lab. And with multidisciplinary work like this in mind, CEI faculty identified a need to formalize an interdisciplinary graduate curriculum in clean energy. I'm thankful for their efforts and those of CEI staff in launching the 15-credit Graduate Certificate in Clean Energy Science, Engineering, and Society: a transcriptable option for all UW graduate students who meet course requirements.

I'm proud that talented undergraduates are just as excited to work on clean energy: both the College of Arts & Sciences Dean's Medalist in the Natural Sciences, Rahoul Banerjee Ghosh (B.S. chemistry '24), and the College of Engineering Dean's Medalist for Academic Excellence, Aya Alayli (B.S. '24, current doctoral student in electrical & computer engineering), performed research in a CEI Member Faculty lab and participated in a CEI community engagement program.

And I am inspired by the response to the launch of the <u>CEI Innovation Fund</u>, which provides flexible funding for CEI priorities. We are grateful to donors like Janet Donelson and Stephen Dwoskin for their help establishing the fund, and for their ongoing support.

For our scholarship to impact the health and economy of our state, nation, and world, our partnerships with federal labs, businesses, utilities, civic organizations, and tribes are key. CEI is built on foundations of state, private, and federal support, but it's powered by a community with a common purpose.

So I invite you to join us at one of our CEI seminars on campus or climate tech networking events at the Washington Clean Energy Testbeds. And read on to learn more about how CEI supports Huskies working on clean energy solutions for everyone.

Thank you for your continued support,

Dan Adur

Daniel T. Schwartz

Director, UW Clean Energy Institute Boeing-Sutter Professor of Chemical Engineering

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Students collaborate across disciplines in CEI's Research Training Testbed.

REPORT HIGHLIGHTS

RESEARCH

- Welcomed 10 new Member Faculty across 7 departments
- Seeded new research collaborations in critical materials recycling, quantum computing hardware, and utility power grid management
- Advanced self-driving labs and autonomous experimentation for materials discovery
- Developed breakthrough 2D materials with novel electronic properties
- Piloted inkjet printing of quantum dots at the Testbeds



- COMMUNITY ENGAGEMENT 78 volunteer Clean Energy Ambassadors
- helped engage nearly 4,600 K-12 students, and reached another 6,600 students at UW **Engineering Discovery Days**
- Redeveloped SunDawg solar car kits for customizability and more sustainable materials
- Partnered with 2 returning and 2 new communities for year two of UW Engineering Community Capstones in Clean Energy, and held CEI's first Community Capstone Showcase at McKinstry

T EDUCATION

- Funded **31** CEI Graduate Fellows across 11 departments
- Launched interdisciplinary Graduate Certificate in Clean Energy Science, Engineering & Society with 33 UW students completing the broader impacts capstone course



- Booked over 60,000 hours worth of work at the Testbeds and welcomed 97 new users
- Planned and began construction on the new lab for pouch cell battery prototyping and training, opening Summer 2025
- Established Testbeds Undergraduate Research Awards thanks to a generous philanthropic gift, enabling 4 UW undergraduates to perform innovative research at the Testbeds
- Partnered with the CleanTech Alliance and VertueLab to support 5 early-stage companies in advancing their technologies to commercialization at the Testbeds
- Testbeds users Evoloh and Membrion raised \$20M and \$12.5M in funding, respectively
- Danish advanced manufacturing equipment company FOM Technologies opened its US office at the Testbeds

ABOUT CEI

MISSION

The <u>Clean Energy Institute (CEI)</u> at the University of Washington (UW) was founded in 2013 with funds from the state of Washington. Its mission is to accelerate the adoption of a scalable and equitable clean energy future that will improve the health and economy of our state, nation, and world. To accomplish this, CEI supports the advancement of next-generation solar energy and battery materials and devices, as well as their integration with power systems and the grid. CEI creates the ideas and educates the people needed to generate these innovations, while facilitating the pathways to bring them to market.

CEI supports students, faculty, and partners through education and workforce engagement programs, basic and translational research support, and access to world-class facilities. CEI is advised by a UW Trainee and Faculty Advisory Board (TFAB), including two Trainee Advisory Representatives and nine faculty; and an external Technical Advisory Council (TAC) of prominent members of the Pacific Northwest clean energy community.

FACULTY & TRAINEES

CEI's 46 <u>Member Faculty</u> are the core scholars who help define and implement the Institute's energy science and engineering research and educational programs. CEI also has 30 Affiliate Faculty who broaden and enrich the institute's programs.

Each year, CEI programs support approximately 100 UW graduate students as well as 20–30 undergraduate students from the UW and local two-year colleges. CEI programs are open to all UW students that meet the requirements specified in each program.



FACULTY RECOGNITION

Ting Cao (MSE): NSF Early CAREER Award

Corie Cobb (ME): Washington State Academy of Sciences

Brandi Cossairt (Chemistry): AAAS Fellow

Jun Liu (MSE, ChemE): NAI Fellow

Arka Majumdar (ECE, Physics): Optica Fellow

Igor Novosselov (ME): promoted to Research Professor

Doug Reed (Chemistry): Scialog Collaborative Innovation Award

Julie Rorrer (ChemE): American Institute of Chemical Engineers (AIChE) 35 Under 35

Alexandra Velian (Chemistry): promoted to Associate Professor with tenure, Sloan Fellow

Dianne Xiao (Chemistry): Camille Dreyfus Teacher-Scholar Award

Chaoyue Zhao (ISE): NSF CAREER Award

Guozhong Cao, David Cobden, Jun Liu, Di Xiao, Xiaodong Xu (CEI faculty); Sanfeng Wu (former CEI postdoc): <u>Web of Science Group Highly Cited Researchers</u>

NEW MEMBER FACULTY



Jungwon Choi Assistant Professor Electrical & Computer Engineering



<u>Matt Golder</u> Assistant Professor Chemistry



Sajjad Moazeni Assistant Professor Electrical & Computer Engineering



Douglas Reed Assistant Professor Chemistry



Zach Sherman Assistant Professor Chemical Engineering



Shijing Sun Assistant Professor Mechanical Engineering



Aniruddh Vashisth Assistant Professor Mechanical Engineering



Lingzi Wu Assistant Professor Construction Management



Di Xiao Campbell Chair Materials Science & Engineering



Jie Xiao Boeing Martin Professor Mechanical Engineering

CLEAN ENERGY STUDENT AWARDS

Each year, CEI recognizes a graduate student who has demonstrated extraordinary productivity in clean energy research and scholarship, as well as a graduate student who has demonstrated dedication and creativity when communicating STEM to a variety of audiences.

2024 Scientific Achievement Award



Maria Politi Chemical Engineering 2022-23 CEI Graduate Fellow



Maria Politi (center-right) with her advisor Lilo Pozzo (center-left), acting CEI chief scientist Cody Schlenker (left) and CEI director Dan Schwartz (right) at CEI's annual end-of-year celebration.

I'm thankful for all the support from the CEI community. It's been great to collaborate with UW scholars from different disciplines to develop our self-driving lab capabilities, and CEI opportunities were a big part of my grad school experience. As a CEI Graduate Fellow, I developed my skills in science communication and K-12 STEM education, and I really enjoyed mentoring Clean Energy Bridge to Research undergrads over the summers. CEI also supported my travel to a Materials Research Society conference that was pivotal to my doctoral research.

— Dr. Maria Politi, now a postdoctoral fellow in chemistry at the University of British Columbia

2024 Outreach & Service Awards



George Fennell

Materials Science & Engineering



Toni Vazquez Chemistry

2023-24 CEI Graduate Fellow

TRAINEE RECOGNITION

College of Arts & Sciences Dean's Medalist in the Natural Sciences <u>Rahoul Banerjee Ghosh</u> (Chemistry): researcher with David Ginger & Xiaosong Li, Clean Energy Ambassador

College of Engineering Dean's Medal

<u>Aya Alayli</u> (ECE): researcher with Daniel Kirschen, current Ph.D. student advised by June Lukuyu, <u>2023–24 Community Capstone: Beacon Hill</u>

Mary Gates Undergraduate Research Scholarship

Aya Alayli (ECE)

Kamaya Ronning (Chemistry): researcher with Dianne Xiao

Aaron Weaver (Chemistry): researcher with David Ginger

Husky 100

Jonathan Aalto (Chemistry): undergraduate researcher with Dianne Xiao

Nada Naser (ChemE): doctoral researcher with François Baneyx, CEI Graduate Fellow

National Science Foundation Graduate Research Fellowship

Jonathan Aalto (Chemistry): researcher with Dianne Xiao, starting Ph.D. in chemistry at Caltech

Audrey Hill (Chemistry): researcher with Dianne Xiao, starting Ph.D. in chemistry at UC Berkeley

Laura Reed (Chemistry): researcher with Matt Golder, starting Ph.D. in chemistry at Northwestern

At CEI's 2024 Community Capstone Showcase, ECE student Aya Alayli discusses her capstone project with Washington State Senator Joe Nguyen (LD 34), chair of the Senate Energy, Environment and Technology Committee. Alayli's team co-designed a clean energy microgrid to provide resiliency to Clallam County government headquarters, located on the Olympic Peninsula.



Renewable Energy Scholarship Foundation

Rahoul Banerjee Ghosh (Chemistry) Anthony Gironda (MSE): advised by Jerry Seidler, <u>CEI Graduate Fellow</u> Alexis Glaudin (Chemistry): advised by Cody Schlenker Seancarlos Gonzales (ChemE): advised by David Bergsman, <u>CEI Graduate Fellow</u> William Heins (ChemE): researcher with Devin MacKenzie & Hugh Hillhouse Ashlyn Kamin (Chemistry): advised by Dianne Xiao, <u>CEI Graduate Fellow</u> Eden Tzanetopoulos (Chemistry): advised by Daniel Gamelin, <u>CEI Graduate Fellow</u> Sophia Votava (ECE): <u>2022–23 Community Capstone: Fairchild Airport</u>

UW Chemistry Excellence in Graduate Research Award, Inorganic Chemistry

Hao Nguyen: advised by Brandi Cossairt, <u>CEI Graduate Fellow</u>

Kathleen Snook: advised by Dianne Xiao, CEI Graduate Fellow

UW Chemistry George H. Cady Prize for Best Thesis in Inorganic Chemistry

Ben Mitchell: advised by Alexandra Velian, <u>CEI Graduate Fellow</u>; now a Science, Technology, and Policy Fellow at the Building Technologies Office in the U.S. Department of Energy

Washington Research Foundation Research Fellowship

Jonathan Aalto (Chemistry)

Kelsey Zimmerman (Chemistry): researcher with Alexandra Velian

RESEARCH

CEI scientists and engineers are discovering new materials for more efficient, more easily-manufactured solar cells; designing new batteries that can safely power all forms of transportation or back up the electrical grid; and modernizing electrical grids with sophisticated information technology to accommodate new sources of power. Broadly, CEI research can be categorized within **solar energy, energy storage, systems integration**, and **advanced materials & measurements**.

As an interdisciplinary institute, CEI enables UW faculty in several departments to leverage a range of research expertise, educational programs, and open-access, low-cost user facilities to attract federal grant support. CEI also serves as an experimental platform for UW faculty to develop new educational methods and facilities that support CEI's goals in education and training. And through the Distinguished Postdoctoral Fellowship, CEI recruits recent Ph.D. graduates from leading U.S. research universities and national labs to advance CEI's mission in clean energy and community engagement.



RESEARCH CENTERS

In 2023–24, CEI faculty led research centers with a total of \$148.7 million in federal funding. These federally-funded research centers support a range of interdisciplinary activities under a major, cross-cutting research goal. These multi-institutional collaboratives typically include multiple universities, startups and major corporations, and national laboratories.



Center for Integration of Modern Optoelectronic Materials on Demand



IMOD is a National Science Foundation (NSF) Science and Technology Center (STC) led by the UW. IMOD research centers on new semiconductor materials and scalable manufacturing processes for new optoelectronic devices. Applications of IMOD research range from displays and sensors to a technological revolution, under development today, that is based on harnessing the principles of quantum mechanics. CEI Chief Scientist <u>David Ginger</u> is IMOD's director, and its membership also includes several CEI Member Faculty.



Molecular Engineering Materials Center

<u>UW MEM-C</u> is an NSF Materials Research Science and Engineering Center (MRSEC) that coordinates UW and PNNL materials research to address trans-disciplinary challenges. Interdisciplinary research groups explore engineering defects in nanostructures for information processing, sensing, energy, and research tools, and the quantum properties of atomically layered materials. MEM-C is led by CEI Member Faculty <u>Daniel</u> <u>Gamelin</u>, and includes several CEI researchers.



W

U.S. Manufacturing of Advanced Perovskites Consortium

The US-MAP Consortium aims to accelerate the domestic commercialization of perovskite technologies. As a founding organizer, the UW and the Testbeds serve on the US-MAP executive board and oversee delivery of projects.





University of Washington Clean Energy Institute



THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL





A miniature perovskite solar cell module fabricated at the Testbeds.



The Northwest Institute for Materials Physics, Chemistry, and Technology

NW IMPACT is a joint UW-PNNL initiative aiming to advance research within the Pacific Northwest region in the science of making materials, and to educate the next generation of chemists, physicists, and engineers in materials science. The Center for the Science of Synthesis Across Scales (CSSAS) is a DOE EFRC housed at the UW and co-led by PNNL via NW IMPACT. CSSAS researchers look to nature for inspiration as they create and analyze macromolecules that self-assemble into advanced functional materials. NW IMPACT is co-directed by CEI Chief Scientist David Ginger. CSSAS is co-led by CEI Member Faculty Dr. Jim De Yoreo, a PNNL Battelle Fellow who holds UW affiliate professorships in chemistry and MSE. NW IMPACT is in the process of re-envisioning its programs and leadership for its next phase of activities.



COLLABORATIVE SEED GRANTS

CEI Collaborative Seed Grants provide UW scholars with up to \$200,000 over two years for new collaborations in research and education to enable their pursuit of center-scale funding, especially in novel, high-risk/high-reward research topics.

Climate and equity considerations for community-based demand response strategies in the Pacific Northwest

Co-PIs June Lukuyu and Baosen Zhang (ECE) will study two important questions in designing demand response programs to manage AC loads: the first is quantifying the amount of air conditioners that are actually available to control; and the second is balancing system-level objectives with equity and fairness concerns. The co-PIs will conduct a study using five years of authentic data from Clark County Power & Utility District and longitudinal survey data from the American Housing Survey, using the 2021 heat wave as a "natural experiment" in climate-impacted demand for air conditioning.

Developing parafermion qubits for topological quantum computation

Building a useful quantum computer is extremely difficult — it is not even currently clear which materials are best for creating quantum bits (qubits). To address this grand challenge, project co-PIs <u>Matthew Yankowitz</u> (Physics, MSE), <u>Xiaodong Xu</u> (Physics, MSE), <u>Di Xiao</u> (MSE, Physics), and <u>Ting Cao</u> (MSE) propose an entirely new approach towards building topological qubits based upon atomically-thin "van der Waals" materials.

Optimization of RDA dynamic separations for recycling of critical clean energy materials

End-of-life processing and recycling of materials and components is critical to mitigating environmental contamination as well as U.S. dependence on foreign sources of materials for energy infrastructure. The joint UW-PNNL project led by Prof. <u>Lilo D. Pozzo</u> (ChemE) and PNNL's Dr. Elias Nakouzi will focus on developing a particular separation process for clean energy components: reaction-diffusion-advection (RDA). The UW team includes CEI faculty <u>David S. Bergsman</u> (ChemE), <u>Matt Golder</u> (Chemistry), and <u>Zach Sherman</u> (ChemE), while the PNNL team includes <u>Dr. Jim De Yoreo</u> (MSE).

RESEARCH HIGHLIGHTS

<u>Cells, microscopes and scientists: Chemical engineering</u> <u>professor's coloring book makes science accessible</u>



When Professor Julie Rorrer was a graduate student, she visited elementary schools with other members of her program to talk about science and give demonstrations. But explaining their work and research to the students was a challenge, which gave Rorrer the idea to use coloring pages. Rorrer founded <u>ColorMePhD</u>: a free, all-ages coloring book series that brings current doctorate-level research in science and engineering to a general audience. Each coloring page includes illustrations and descriptions of research papers and projects — all presented in a way that anyone can understand, on some level. As of this year, ColorMePhD has 30,000 downloads, and the pages are even being used as learning tools in K-12 classrooms.

Helping utilities deploy clean energy microgrids



CEI Distinguished Postdoctoral Fellow Dr. Zixiao Ma worked with ECE professor Baosen Zhang to develop machine learning-based, safety-critical controls for renewable energy-dominated microgrids. According to Zhang, Ma's "clever use of AI/ML techniques" makes him an expert in control algorithms that operate orders of magnitudes faster than conventional ones. He is a member of IEEE's Measurement & Verification Task Force for conservation voltage reduction, developing industry standards for utilities as they deploy advanced grid technologies to dynamically manage customers' demands for power and improve overall efficiencies.

Following the 2023–24 academic year, Dr. Ma accepted a position as an assistant professor of electrical & computer engineering at the State University of New York-Binghamton.

Inkjet printing quantum dots for future quantum information systems

With support from IMOD, Washington Clean Energy Testbeds researchers including CEI Graduate Fellow <u>Greg Guymon</u> and Testbeds technical director <u>Devin MacKenzie</u> demonstrated the first successful application of electrohydrodynamic inkjet printing for quantum dots. The technique involves using an electric charge to control the size of inkjetprinted droplets down to the attoliter scale — one quintillionth of a liter — which could enable sustainable, additive, and scalable nanomanufacturing for quantum photonics and computing hardware.

Recruiting robots for materials discovery

Professor <u>Lilo Pozzo</u> and her research group are using open-source tools to build modular robots that can run complex experiments in order to speed up the process of discovering and optimizing materials for clean energy applications and beyond.

With the push of a button, the "Jubilee" robot can use a motorized pipette to synthesize dozens of liquid combinations in a precise volume in a matter of seconds. The modular "open hardware" framework can accommodate additional functions, such as a camera system that photographs samples, and software that can interpret visual changes.



Chemical engineering students Brenden Pelkie (left) and Maria Politi (right) work with the Jubilee robot in the Pozzo lab.

In a *Nature* paper, a team led by CEI faculty <u>Matt Yankowitz</u>, <u>Di Xiao</u> and <u>Ting Cao</u>, including partners from Osaka University and the National Institute for Materials Science in Japan, demonstrates the breakthrough ability to imbue graphite — the 3D crystal made of bulk graphene, found in No. 2 pencils — with novel and unexpected properties. With a single layer of graphene placed with a one-degree moiré twist on top of a thin graphite crystal, electrons deep within the graphite behave like electrons at the graphene-graphite interface.



By stacking a sheet of graphene onto bulk graphite at a small twist angle (top), "exotic" properties present at the graphene-graphite interface (yellow) can bleed down into the graphite itself. (Ellis Thompson / UW Physics)

Essentially, the whole graphite crystal takes on the properties of graphene, pointing to a new approach to re-engineering the properties of conventional bulk materials using a single 2D interface.

Mixed-dimensional moiré systems of twisted graphitic thin films | Nature

Researchers make a quantum computing leap with a magnetic twist

In a series of articles published in *Nature* and *Science*, an international team led by CEI Member Faculty <u>Xiaodong Xu</u> (physics, MSE) and CEI Graduate Fellows <u>Heonjoon Park</u> and <u>Jiaqi Cai</u> describes fractional electronic charges in moiré-twisted 2D materials, observed for the first time without a strong magnetic field. The discovery of materials with stable partial charges represents a fundamental advancement in the development of quantum computing hardware. Xu, Park, Cai, and UW physics doctoral student Eric Anderson have applied for a patent based on this work.

The twisted material that splits the electron | *Nature News and Views* Physicists puzzle over emergence of strange electron aggregates | *Quanta Mag* Observation of fractionally quantized anomalous Hall effect | *Nature* Signatures of fractional quantum anomalous Hall states in twisted MoTe₂ | *Nature* Programming correlated magnetic states with gate-controlled moiré geometry | *Science*

EDUCATION

CEI supports the next generation of clean energy leaders and innovators through our unique education and training programs. We fund Ph.D. students exploring new directions in clean energy research, and our programs help students build professional skills that will serve them in any field, whether it's research, policy, or climate tech.

ENERGIZED FOR CHANGE

After seeing the devastation of hurricanes in Puerto Rico, CEI Graduate Fellow Miguel González-Montijo, who recently obtained his Ph.D. in civil & environmental engineering, decided to come to the UW for graduate school to build skills to make Puerto Rico more resilient. His intellectual curiosity led him to clean energy, and in the Clean Energy Institute, he found a community of people — in fields from electrical engineering and public policy to chemistry and physics — who shared his passion.

 Through CEI's Torrance Advanced Experience Program, González-Montijo helped inform state policy by contributing to a Washington State Academy of Sciences (WSAS) report about decarbonizing Washington's aerospace sector. He also got to hear from the CEO of electric-airplane company magniX and meet with a Washington state senator.
And for co-developing CEI's first Spanish-language learning resource, a bilingual climate science fact sheet for K-12 students, González-Montijo won a CEI Student Outreach & Service Award in 2022.

During his doctoral research, Dr. González-Montijo spent time as a graduate intern at the National Renewable Energy Laboratory, and since graduating from the UW, he has been working at NREL to further develop additive manufacturing for marine turbine blades.

"The UW has become a home away from home. I've had the freedom to explore the research I wanted to do and have stretched my curriculum far beyond my civil engineering roots. But the best part has been the people, who have been caring, compassionate, understanding and invested since day one."

 Dr. Miguel González-Montijo, National Renewable Energy Laboratory hydropower and water systems deployment researcher

CEI GRADUATE FELLOWSHIP

The CEI Graduate Fellowship funds two quarters of clean energy research for UW doctoral students each academic year, while providing interdisciplinary training via research seminars, science communication projects, K-12 engagement activities, climate tech networking events, industry field trips, and lab tours. CEI has awarded 275 Graduate Fellowships since 2013. After earning Ph.D.s at the UW, CEI Graduate Fellows have pursued careers in the climate tech industry, academia, think tanks and other nonprofits, and federally-funded research labs.

2023–24 CEI Graduate Fellows

CHEMICAL ENGINEERING

Spencer Cira Joelle Scott Mahdokht (Maddie) Soltani Zachery Wylie

CHEMISTRY

Connor Dalton Grant Dixon Jessica Kline Helen Larson Can Liao Robert Love Devin Rollins

CIVIL & ENVIRONMENTAL ENGINEERING

Rachel Pearson

COMPUTER SCIENCE & ENGINEERING

Vicente Arroyos Kyle Johnson Zhihan Zhang

ELECTRICAL & COMPUTER ENGINEERING Matthew Motoki

INDUSTRIAL & SYSTEMS ENGINEERING Xinyi Zhao

MATERIALS SCIENCE & ENGINEERING

Kuotian (Tim) Liao Meng-Yen Lin

Anthony Romero

Aaron Thomas

Yusen Ye

MECHANICAL ENGINEERING

Ethan Schwartz

MOLECULAR ENGINEERING

Abdul Moeez

PHYSICS

Jack Barlow Yeu (Helen) Chen Sarah Edwards Lingnan Shen

POLITICAL SCIENCE

Elizabeth Echavarria

<u>GRADUATE CERTIFICATE IN CLEAN ENERGY</u> <u>SCIENCE, ENGINEERING, & SOCIETY</u>

This 15-credit certificate, launched in fall 2023 and open to all UW graduate students, provides an interdisciplinary curriculum on the challenges and opportunities in clean energy and its adoption in society.

Through hands-on training and interactions with world-renowned energy leaders, students will:

- Increase and broaden their understanding of clean energy solutions
- · Develop skills to work across disciplinary boundaries
- Communicate the applications of their research
- Understand the social and economic issues related to a clean energy transformation

In 2023–24, 33 students participated in the Broader Impacts of Clean Energy Research Capstone course (MOLENG 599).

INTERDISCIPLINARY ENERGY LAB COURSE

CEI Member Faculty created an interdisciplinary energy lab, the Research Training Testbed located in the Nanoengineering & Sciences Building, and a hands-on course housed there called "Energy Materials, Devices & Systems" (EMDS). Upper-division undergraduates and graduate students get project-based training on materials for energy generation and storage, and the integration of renewables into energy systems.

EMDS currently welcomes 30 UW students from across the College of Arts & Sciences and the College of Engineering each year.



Students learn to collaborate across disciplines in the Research Training Testbed.

ADVANCED EXPERIENCE PROGRAM

The Advanced Experience Program in Clean Energy (AXP), created through the generous support of the Mark Torrance Foundation, provides opportunities for UW doctoral students in STEM to apply their knowledge to support decision makers in clean energy investing and science policy. AXP is designed to be a flexible, 20-hour time commitment to complement each student's Ph.D. training and longer-term professional development.

Torrance Tech Due Diligence analysts evaluate emerging climate technologies for the Seattle-area angel investing group E8; while Torrance Science Policy analysts prepare science and engineering briefs for policymakers alongside the Washington State Academy of Sciences.

AXP has supported 63 Tech Due Diligence trainees since the 2017–18 academic year, and 27 Science Policy Analysis trainees since 2020–21.





2023–24 Torrance Science Policy Analysts with WSAS executive director Donna Gerardi Riordan (center) and CEI associate director of operations Chapman Strong.

EDUCATION & TRAINING FELLOWSHIP

CEI Education & Training Fellows (ETFs) work closely with CEI's education staff for two to four academic quarters to develop outreach activities, displays, and curricula for K-12 classrooms. They also arrange logistics and recruit CEI student volunteers for classroom visits and other educational events.

TRAVEL GRANTS

2023–24 CEI Education & Training Fellows



Chaman Gupta

Materials Science & Engineering



Hareesh Iyer

Mechanical Engineering

CEI Graduate Fellow

CEI Travel Grants cover \$1,000 in expenses for UW students conducting research in CEIrelated areas to present their work at conferences — an ideal opportunity to apply science communication and networking skills. CEI provided 40 travel grants in 2023–24 with an approximate total of 270 travel grants in its history of operations.



Academy of

Sciences

SUMMER RESEARCH EXPERIENCES FOR UNDERGRADUATES & TEACHERS

In partnership with other UW units, industry partners, and nonprofit organizations, CEI provides students from universities, minority-serving institutions, and community or technical colleges with opportunities to perform hands-on research and learn from UW clean energy experts.

Clean Energy Bridge to Research

Each summer, the Clean Energy Bridge to Research (CEBR) program provides a select group of undergraduate students from two-year and tribal colleges with opportunities to perform clean energy research under the mentorship of UW faculty and students. CEBR students embark on a nine-week immersive research project in a UW clean energy research lab, produce an abstract and poster summarizing their work, and present at the UW summer undergraduate research symposium. Participants receive a stipend, housing, food allowances, and a travel allowance.

CEI supported seven research experiences for visiting undergraduates in summer 2023. Among 84 total participants since 2016, 43 came from two-year or community colleges (51.2%).

Outstanding Undergraduate Research Award

CEI's Outstanding Undergraduate Research (OUR) Award recognizes CEBR participants for exceptional undergraduate research and supports their continued journey in STEM fields. CEBR participants are nominated for this award by their graduate student mentors or their PIs. Awardees receive financial assistance of up to \$1,500 for a research conference of their choosing and the opportunity for another research experience in a UW CEI lab the following summer.

The 2023–24 Outstanding Undergraduate Researcher is **Deserée Lai**, who worked on metalorganic macrocycles in chemistry professor Dianne Xiao's lab in summer 2023. Lai transferred to the UW after graduating from <u>North Seattle College</u> with her Associate of Science degree in 2023. She is now a rising senior studying condensed matter physics, and in summer 2024, she is working towards the goal of creating a workshop for transfer students from two-year colleges.



Summer Research for UW Undergraduates

CEI provides summer research experiences for UW undergraduates in order to promote retention and academic excellence in STEM. The program supported three UW undergraduates in summer 2023 for a total of 28 students since 2015.

An enlightening opportunity: solar scalability

In summer 2023, UW mechanical engineering student **Sebastian Bustos-Nuno** worked with Washington Clean Energy Testbeds technical director J. Devin MacKenzie and CEI Graduate Fellow Ethan Schwartz to advance <u>perovskite photovoltaics for next-generation</u> <u>solar cells</u>. Bustos-Nuno's summer 2023 project was to design and fabricate a testing device called a continuous probe bar station, and he has continued to work in MacKenzie's group at the Testbeds to encapsulate perovskite PV modules. Encapsulation is key to their commercialization because of their tendency to degrade when exposed to the air.

"I first became interested in solar cells in the fifth grade during a field trip to a community college, so working at the Testbeds with Ethan and Devin was pretty awesome. All of it was a first-time experience it was my first time working with a professor and a Ph.D. student."

— 2023 summer researcher Sebastian Bustos-Nuno, a rising UW senior in mechanical engineering



At the Testbeds, undergraduate researcher Sebastian Bustos-Nuno and Ph.D. student mentor Ethan Schwartz, a CEI Graduate Fellow, power up and run a solar simulator to test the efficiency of a perovskite solar cell module.



Research Experience for Teachers

CEBR also includes a Research Experience for Teachers (RET) program for instructors at local gateway colleges who aim to integrate clean energy research into their curriculum. CEBR RET participants receive a stipend and spend six weeks in a CEI lab, where they learn a research technique and use it to develop a lesson for a gateway college with minimal equipment capability.

Summer 2023 RET Participants



Tommaso Vannelli (Whatcom Community College) collaborated with UW chemistry professor <u>Cody Schlenker</u>, mentoring former Research Experience for Undergraduates (REU) participant and Whatcom undergraduate Christopher Kleeves in developing an HPLC-based platform (High Performance Liquid Chromatography) for Course-Based Undergraduate Research Experience (CUREs) modules for Whatcom undergraduates.





Anna Waschke and Lisa Redsteer (Northwest Indian College — NWIC) collaborated with Washington Clean Energy Testbeds staff scientist <u>Dr.</u> <u>Bosong Li</u> to prepare for NWIC students to utilize power system simulation

technologies to assess the solar microgrid system that NWIC is developing in partnership with the Lummi Nation.



Jesse Schwartz (Green River College) worked with UW ECE professor <u>Baosen Zhang</u> to design and capture live action demonstration modules related to clean energy integration and utilization, which will be utilized by Jesse's environmental science students.







WASHINGTON CLEAN ENERGY TESTBEDS

CEI opened the Washington Clean Energy Testbeds in 2017 to provide academic and industry researchers with state-of-the-art capabilities for full-cycle development of climate technologies, including prototyping, testing, scaling, and validating new materials, devices, and software tools. The lab facility, which currently occupies about 16,000 square feet of leased space near the UW campus, is a unique public venue for innovation and demonstration that offers pay-as-you-go, open access to users without impacting their intellectual property.

Testbeds staff scientists and engineers provide customized, hands-on training on each instrument and can also perform contract-based remote work. The staff have experience in relevant sectors including power electronics, climate tech, clean energy, and mass production.



Testbeds Users by Industry Sector



FY24 User Highlights

EvolOH: Received \$20M Series A funding to manufacture electrolyzers for green hydrogen and industrial chemical production.

FOM Technologies: Developer of advanced manufacturing equipment, including the flagship roll-to-roll printer at the Testbeds. Opened their first US-based staffed location at the Testbeds. Partnering with Testbeds and multiple UW professors and partners to develop further advancements for tools used in energy device fabrication, including integrated machine learning platforms.

Membrion: Received \$12.5M Series B funding to produce membranes for industrial water desalination, after developing the technology and pivoting from flow battery applications at the Testbeds.

Membrion founder and CEO Greg Newbloom earned his Ph.D. in ChemE at the UW, advised by Lilo Pozzo. The company now offers UW Engineering industry capstones, and has hired UW alumni like CEI Graduate Fellow and Torrance Tech Due Diligence analyst Emily Rabe (chemistry Ph.D advised by Cody Schlenker), CEBR REU participant Eden Rivers (master's in MSE after graduating from North Seattle College), and Stephanie Candelaria (MSE Ph.D. advised by Guozhong Cao).

Verde Technologies: Developing a lightweight, flexible, perovskite solar panel with projected 28% efficiency, and 10 times lighter than traditional silicon panels. First winners of the DOE's Perovskite Startup Prize.









CleanTech Hardware Innovation Prototyping

The CleanTech Hardware Innovation Prototyping (CHIP) program was established in 2021 in partnership with the CleanTech Alliance, a non-profit climate tech trade association based in Seattle, and VertueLab, a climate tech accelerator with offices in Seattle and Portland. The CHIP program was created to increase access to advanced capabilities for scaled prototyping, testing, and demonstration of energy hardware technologies. CHIP provides early-stage companies with \$10k-\$25k worth of Testbeds access over six months, with an emphasis on supporting entrepreneurs and pre-B-round startups aiming to establish a foundation for more significant follow-on funding from grants or investors. CHIP supported five companies in 2023–24:





- Aionics: Developing an AI platform for materials development for energy applications
- **BioSensor Solutions:** soil health sensor platform to help growers visualize microbial activity in soil over time (DOE-relevant due to carbon sequestration in soil)
- **Cool Amps:** Electrochemical recycling to effectively manage and recover critical elements from end-of-life lithium batteries used in electronic hardware with a 95% materials recovery rate
- Homeostasis: CO₂ capture and processing of captured carbon into battery materials
- **Yonder:** Developing an AI platform for materials development for energy applications (formerly known as CombiMatrixAI)



Testbeds staff scientists like Joey Law perform experiments, train users, and maintain cutting-edge additive manufacturing equipment such as 3D printers.

Testbeds Undergraduate Research Awards

The Testbeds Undergraduate Research Award was established in 2023 thanks to a generous philanthropic gift. UW undergraduate students in their third academic year or higher are eligible to apply for a \$3,000 award over three academic quarters for new research in clean energy, advanced manufacturing, and related fields at the Testbeds. The first four projects supported by the Testbeds Undergraduate Research Award are:



Encapsulating large-scale perovskite solar cells

Sebastian Bustos-Nuno Mechanical Engineering Advisor: J. Devin MacKenzie



Prototyping 3D anode materials for fast charging

Lily Leaverton Chemical Engineering Advisor: <u>Corie Cobb</u>



Developing electrode materials for fluoride-ion batteries

Vyvyan Dao Chemical Engineering Advisor: <u>Vincent Holmberg</u>



Optimizing low-energyabsorbing molecules for solar and battery applications

Joy Lee Chemistry Advisor: <u>Cody Schlenker</u>

BATTERY FABRICATION EXPANSION

With new state funding to align with demand for people and ideas that fuel innovation in battery materials and manufacturing, the Testbeds planned a 1,600-square-foot lab focused on scaled battery prototyping. The expansion includes 900 square feet of dry room space, and features state-of-the-art pouch cell fabrication tools to demonstrate and deploy new materials and cell architectures in a standard industry format. The planning committee included stakeholders from the UW, PNNL, and industry. Capital purchases and construction began in spring 2024, with the new battery lab scheduled to open in summer 2025.



The dry room (-40°C dew point) will house a full suite of tools for mixing slurries, coating battery components, and the several-step process of assembling pouch cell batteries. (Chernoff Thompson Architects)

> The ambient room will house battery cyclers for forming solid-electrolyte interphases in assembled prototypes, a glove box for storing electrolytes, and other general equipment. (Chernoff Thompson Architects)

These new prototyping capabilities at the Testbeds are filling a critical need for battery innovation infrastructure in the U.S. As a Testbeds user, Group14 has already benefited from open-access innovation, and we've also recruited several UW PhDs with top-notch clean energy training. We're eager to explore new applications for our product at the Testbeds on our mission to electrify everything." — Rick Luebbe, CEO and co-founder of Group14 Technologies

EXPERTS IN RESIDENCE

Testbeds Experts-in-Residence advise entrepreneurs and early-stage climate tech startups at free, weekly office hours, and host workshops and events.

The **Testbeds Entrepreneur-in-Residence (EIR)** advises companies on team formation, product development, strategic marketing, fundraising, manufacturing strategy, and business development.



Volha Hrechka co-founded PolyDrop as a UW Chemical Engineering student with support from the UW Buerk Center for Entrepreneurship, and raised \$4M through angel investments, government support, and strategic partnerships. She is currently working towards an MBA at the UW Foster School of Business while also supporting Mighty Capital and Innovyze USA.



Dhileep Sivam joined the Testbeds from Breakthrough Energy, where he helped create Breakthrough Energy Sciences in order to achieve net zero emissions by 2050. He earned both his bachelor's degree and Ph.D. at the UW and has been working in Seattle in the energy industry since 2015. He is now CEO of Aquagga, a former Testbeds CHIP awardee.

The **Testbeds Investor-in-Residence (IIR)**, established in partnership with climate tech angel investment group E8, consults on funding proposals, investor pitches, financial strategy, fundraising, and strategic partnerships.



Jeff Canin is a board member at VertueLab and co-manager of the E8 Fund.

COMMUNITY ENGAGEMENT

CEI builds capacities for climate action in Washington communities by supporting K-12 and two-year college education, as well as community-led clean energy projects, research, and events.

CEI's K-14 programs seek to expand participation in STEM by making STEM study and STEM careers more attractive and more attainable for a broader cross-section of the US population. Expert education staff and graduate trainees work to integrate cutting-edge UW clean energy research with K-12 and undergraduate STEM concepts to create lesson plans and other learning resources.

Research and project support programs help Washington communities understand the clean energy transition and take advantage of state and federal funding for clean energy demonstration and deployment projects.

K-12 STUDENT ENGAGEMENT

CEI staff, students, and faculty have collaborated to develop a comprehensive library of K-12 clean energy lesson plans and hands-on activities in alignment with Next Generation Science Standards. CEI Education & Training Fellows lead their peers — student Clean Energy Ambassadors — on classroom, museum, and public-facing visits across Washington state, wielding science communication skills and UW's excellence in scholarship to bridge the critical knowledge gap between the STEM concepts covered in a conventional K-12 curriculum and the cutting-edge research that is carving the path towards a clean energy future.

2023–24 K-12 Engagement by the numbers



CEI reached another **6,600 K-12 students** at UW Engineering Discovery Days, held for the first time since 2019.



CEI also hosted **6 workshops** in partnership with iUrbanTeen's STEM-o-WEEN, the UW Robinson Center Summer Camp, the UW Youth & Teen Program Summer Visit, and <u>Adventure Camp:</u> <u>Social Skills Learning through Science Exploration.</u>

Clean Energy Ambassadors

Clean Energy Ambassadors are UW graduate and undergraduate students in STEM fields who lead students in hands-on activities at K-12 schools around Washington state and present at public events. The program is led by CEI Education & Training Fellows and is open to any UW student aiming to give back to Washington state, hone their skills at communicating science to the public, or gain first-hand experience as a STEM educator.

Ambassador activities include solar car races, "Meet a Clean Energy Scientist" presentations, and hands-on workshops with mini solar panels. Through these activities, CEI seeks to inspire a new generation of diverse students to take up STEM careers to support the global transition to a clean energy economy.

New SunDawg Solar Cars!

CEI staff redeveloped CEI's SunDawg kits to feature customizable solar cars made of more sustainable materials. Students can build the car themselves and modify components so they can create and test their own hypotheses about solar energy!



COMMUNITY RESEARCH & PROJECT SUPPORT

Federal and state funding mandate investments in clean energy projects that benefit underserved and overburdened communities. To advance the equitable deployment of clean energy, CEI partners with communities to analyze and design energy systems that align with community values and achieve specific goals, such as:

- · Reducing energy cost burden or generating income
- · Lowering emissions and improving local air quality
- · Keeping the lights on during power outages
- Sustaining critical energy services during extraordinary power interruptions
- Estimating costs, benefits, and impacts of clean energy options

CEI has established three pathways for communities to partner with UW faculty, students, and staff to co-develop clean energy strategies and tailored outcomes to meet community needs.

- 1. Open-ended exploration and analysis via UW Engineering capstone projects
- 2. Microgrid technical analysis
- 3. Deep-dive research collaboration

With support from the UW Office of the Attorney General, the Testbeds user agreement provides sovereign nations and civic organizations with the same IP and data privacy rights as user companies.

Community Capstones in Clean Energy

In the 2022–23 academic year, CEI established the Community Capstones in Clean Energy, in which UW engineering seniors fulfill graduation requirements by partnering with local communities and tribes to explore and co-develop clean energy solutions. UW students serve Washington's communities and gain critical experience working with diverse clients while leveraging technical resources and staff expertise at the Washington Clean Energy Testbeds. Community Capstones enable partner communities to access specific engineering talent while building up their own capacities for climate action by participating in the co-design process.

In June 2024, CEI hosted its first Community Capstone Showcase at McKinstry's offices, south of downtown Seattle. UW engineering student teams presented project posters alongside CEI-funded researchers who are working on community engagement and equitable deployment of clean energy solutions.



CEI Director Dan Schwartz, McKinstry President & Chief Market Officer Ash Awad, Beacon Hill Clean Energy and Community Resiliency Task Force chair Maria Batayola, State Senator Joe Nguyen, UW ECE student Aya Alayli '24, Jamestown S'Klallam Tribe Environmental Planning Manager & Climate Resilience Lead Robert Knapp, and Washington State Department of Commerce State Energy Office Deputy Assistant Director Cheryl Chan Hardee spoke at CEI's inaugural Community Capstone Showcase.



UW Engineering senior Chris Le discusses the Suquamish Tribal Museum capstone project with McKinstry President and Chief Market Officer Ash Awad.

Clean Energy Options for the Suquamish Tribal Museum and House of Awakened Culture

Project team: Christopher Le, Tuan Huynh, & Vinh Pham

Community liaison: Hannah Ljunggren, Suquamish Tribe Climate Resilience Program Manager

Partner organization: Suquamish Tribe

For the Suquamish Tribal Museum, the team estimated that 100 kW of solar with a 90 kWh battery would save over \$50,000 in net present value, while requiring about 90% of the capital grant-financed by or direct-pay credit for break-even in a decade. Relative to the existing diesel backup generator that provides about 80 hours of resilient power, solar+storage could roughly double the Museum's ability to operate through a grid outage.

For the House of Awakened Culture, assuming replacement of the propane boiler with a heat pump, the team estimated that a 100 kW solar array with 200 kWh of battery storage would generate over \$130,000 net present value savings, requiring at least 80% grant-financing of capital. The upgrade would eliminate about 42 tonnes of annual carbon pollution.

A Decarbonization Blueprint for Clallam County's Headquarters

Project team: Aya Alayli, Shawnie Peng, & Jonathan Wierzbicki

Community liaison: Diane Harvey, Chief Civil Deputy, Clallam County Sheriff's Office

Partner organizations: Clallam County Sheriff's Office, Port Angeles City Light

The team found that transitioning 20 light-duty vehicles to electric vehicle alternatives (32% of the county's fleet) reduces travel-based carbon emissions by 59% over 10 years, saving 1,700 metric tons of CO_2 and up to \$400,000 in transportation energy costs. Vehicle electrification is easily scheduled into the existing utility infrastructure, with capacity to allow for future EV expansion. Building upgrades and behind-the-meter generation improve the energy efficiency of the site and provide additional resiliency benefits. Capital investment in the courthouse boiler has an unsubsidized payback under 10 years, while the lighting plan, solar, and battery storage require grant subsidy to achieve 10-year payback.



THE SUQUAMISH TRIBE

Envisioning Beacon Hill Clean Energy & Climate Resilience

Project team: Francesca Abraham, Kevin Gamundi, Henri Lower, & Paww Yenbut

Community liaison: Maria Batayola, Beacon Hill Council Chair

Partner organizations: Beacon Hill Clean Energy and Community Resilience Task Force — Beacon Hill Council Seattle, Filipino Community of Seattle, El Centro de la Raza



<u>h Dian</u>

This project sought to enhance community resilience and reduce the impact of climate change in Seattle's Beacon Hill neighborhood. The Beacon Hill Task Force was referred to CEI by UW environmental & occupational health sciences professor Edmund Seto and the UW Center for Environmental Health Equity, which partnered with the Beacon Hill Task Force to study public health impacts of transportation and fossil energy use. CEHE research identified a heat island, air quality, and noise pollution as burdens on the health of Beacon Hill residents.

Project co-design goals include decarbonization of buildings, lowering energy burdens through utility bill savings, and providing energy resilience to support vulnerable populations. The ultimate goal is to create a network of 12 cooling centers with diverse language support in existing community centers throughout the neighborhood, meeting residents where they are already comfortable going in case of emergency. The capstone project provided a thorough understanding of how each site operates in regards to energy used and potential savings in cost and emissions, and built Beacon Hill's capacity to apply for clean energy and climate resilience grants.



UW Engineering seniors Henri Lower (third from left), Paww Yenbut (fourth from left), Francesca Abraham (third from right), and Kevin Gamundi (far right) with Filipino Community of Seattle executive director Agnes Navarro (far left), Beacon Hill Council chair and project liaison Maria Batayola (second from left), and FCS board member Gemma Mechure (second from right) at CEI's Community Capstone Showcase in June 2024.

Improving Power Quality at 7 Cedars Casino

Project team: Logan Mar, Charlie Reyerson, Jonathan Schaller, & Dylan Trivelli

Community liaison: Robert Knapp, Environmental Planning Manager & Climate Resilience Lead, Jamestown S'Klallam Tribe

Partner organization: Jamestown S'Klallam Tribe



The Jamestown S'Klallam Tribe (JST) is the second-largest employer in Clallam County, located on the Olympic Peninsula. JST and liaison Robert Knapp returned as Community Capstone partners from 2023.

Gaming is a significant source of revenue for the JST, and electronic games are susceptible to damage from poor power quality. This project aimed to future-proof growth in gaming loads by identifying strategies to monitor and mitigate power quality issues. The UW team conducted a site visit with JST electrical staff in March 2024, which included a walkthrough and review of power hardware and the consequences of power quality issues. The team identified harmonics that could increase current in the system and provided resiliency and mitigation options to minimize damage, created a balancing plan using real load data, and provided guidance on proposed system improvements such as transformer upgrades and branch circuit monitoring.



From left: UW Engineering seniors Jonathan Schaller, Charlie Reyerson, Dylan Trivelli, and Logan Mar show their Husky spirit at CEI's 2024 Community Capstone Showcase.

EXPENDITURES

	FY22	FY23	FY24
Faculty Support	\$835,951.25	\$441,902.37	\$539,050.70
Student & Trainee Support	\$469,458.90	\$1,858,968.22	\$1,615,696.34
Administrative Staff & Operations	\$681,416.76	\$450,543.04	\$656,338.49
Education & Workforce Engagement	\$1,034,617.41	\$467,056.91	\$398,002.57
Research, Facilities, & Infrastructure	\$2,874,920.38	\$2,737,275.97	\$3,215,339,30
Community Events & Sponsorships		\$67,897.03	\$31,246.45
Total CEI	\$5,896,364.70	\$6,023,643.54	\$6,455,733.85

APPENDIX1 CEI ORGANIZATIONAL CHART



APPENDIX 2

Trainee & Faculty Advisory Board



Brandi Cossairt Professor of Chemistry



Daniel Gamelin Professor of Chemistry



David Ginger TFAB Chair Professor of Chemistry



Xuetao Ma CEI Graduate Fellow, PhD candidate in Physics



J. Devin MacKenzie Professor of Materials Science & Engineering and Mechanical Engineering



Lilo Pozzo Professor of Chemical Engineering



Cody Schlenker Professor of Chemistry



Ethan Schwartz CEI Graduate Fellow, PhD candidate in Mechanical Engineering



Jerry Seidler Professor of Physics



Xiaodong Xu Professor of Physics and Materials Science & Engineering



Baosen Zhang Professor of Electrical & Computer Engineering



Zhihan Zhang CEI Graduate Fellow, PhD Candidate in Computer Science & Engineering

APPENDIX 3

CEI Tech Advisory Council

David Benson, Co-Founder and Managing Director, Bia Energy Capital Susan Betcher*, Partner and Firmwide Co-Chair of Clean Technology Practice, Perkins Coie LLP **Katy Briggs**, Global Service Area Leader, Renewables Advisory, DNV GL – Energy Jeff Canin, Testbeds Investor-in-Residence, Board Member VertueLab; Co-manager E8 Fund Byron Crawford, Power Business Development Lead, HDR, Inc. Dave Curry, Chairman, CarbonQuest and NextWatts Renee Gastineau*, Cleantech Advisor **Craig Husa**, Director, Lockheed Martin Energy Jun Liu, WRF Innovation Chair in Clean Energy and Campbell Chair Professor, Materials Science & Engineering and Chemical Engineering, UW Rick Luebbe, CEO & Co-Founder, Group14 Technologies Daniel Malarkey, Senior Fellow, Sightline Institute Uzma Siddigi, Technology Principal Engineer, Seattle City Light Patty Solberg, Senior Advisor, Solutions Innovation, ENGIE North America Ben Straughan, Partner, Emerging Companies & Venture Capital, Perkins Coie LLP Lawrence Tsang, Senior Vice President, Corporate Development, Convergent Energy + Power Malcolm Witter, Director, Dean Witter Foundation

* = CEI TAC co-chair

APPENDIX 4

Deans Committee



<u>Mari Ostendorf</u> *Committee Chair* UW Vice Provost for Research



Dianne Harris Dean of the College of Arts and Sciences



Dan Pollack Divisional Dean of Natural Sciences, College of Arts and Sciences



Nancy Allbritton Dean of the College of Engineering



Maya Tolstoy Dean of the College of the Environment



Jihui Yang Vice Dean of the College of Engineering