

IMPACT

2022-2023 ANNUAL REPORT

CMU researchers and
collaborators kick off
INDABA Partnership

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CMU Energy Week returns
in-person to tackle
industrial decarbonization

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The journey of post-doc
Renuka Hyderkhan in
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DIRECTORS' LETTER



Valerie Karplus
*Acting Director and Associate Director,
Wilton E. Scott Institute
for Energy Innovation
Professor, Engineering
and Public Policy*

When the United States Secretary of Energy Jennifer Granholm announced that the first-ever Global Clean Energy Action Forum would be held in Pittsburgh, it wasn't hard for her to explain why. "Over the last three decades, the Steel City has remade itself from a traditional coal-powered industrial base into a hub for groundbreaking technological innovation," she said. For the past decade, the Scott Institute for Energy Innovation has been a critical spoke in that hub. In this year's IMPACT report, you'll get a glimpse of the progress we've made in the past 12 months.

Industrial decarbonization has been a particularly active area of focus for the Institute over the past year. In March 2023, we focused the dialogue at our flagship event, CMU Energy Week, on the challenges and opportunities in decarbonizing the industrial sector (p 16-19). Over 300 attendees heard from 30 speakers about their insights on technologies, systems, policy, financing and workforce and community impacts of industrial decarbonization. A few months later, we kicked off a new international collaboration called the Industrial Decarbonization Analysis, Benchmarking and Action (INDABA) partnership, supported by the U.S. National Science Foundation, at a convening in Heidelberg, Germany (p 8-9), with an early focus on decarbonizing iron and steelmaking. We look forward to growing our engagement and impact in the area of industrial decarbonization in the years ahead.

In parallel, the Institute is growing its ability to support transformative energy research across disciplines. We are convening a diverse and expanding group of faculty from across the campus working on decarbonization technology, policy, workforce and community engagement to discover shared interests and pursue ambitious projects. Our seed grant program continues to fund new clean energy research projects that show potential to grow into bigger efforts. This year we awarded more than \$230,000 to three faculty-led projects (p 10-11). We also followed up with a former seed grant awardee from 2021 to explore how the funding led to an air quality innovation in which low-cost air quality monitoring can be achieved using cell phone cameras (p 12-13).

And speaking of innovations, we've catalyzed lots of exciting activities in innovation and entrepreneurship. We share the story of one of our postdoctoral researchers and their journey from the lab to clean energy entrepreneurship (p 30-31), as well as the story of another CMU spinoff, Ecotone Renewables, which aims to build a world without food waste (p 32-33). The Global Clean Energy Action Forum in September 2022 (p 20-24), our faculty and cleantech startups showed up to demonstrate how the Scott Institute is catalyzing clean energy innovation and accelerating the transition toward a more sustainable, deeply decarbonized future. We look forward to growing this impact in the coming decades.

Valerie J. Karplus *Dan Tkacik*



Daniel Tkacik
*Executive Director,
Wilton E. Scott Institute
for Energy Innovation*

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HIGHLIGHTS TIMELINE

SEPTEMBER 2022

Carnegie Mellon partners with Department of Energy to co-host the 2022 **Global Clean Energy Action Forum** in Pittsburgh, PA.

NOVEMBER 2022

Scott Institute Energy Fellows participate in the **COP27** climate change summit in Sharm el Sheikh, Egypt.

FEBRUARY 2023

Scott Institute hosts Department of Energy's **EnergyTech University Prize** Mid-Atlantic Region Explore Event.

INDABA partnership launches with \$1.5 million from National Science Foundation to create an international network of researchers focused on industrial decarbonization.

MARCH 2023

CMU Energy Week draws over 300 participants to discuss challenges and opportunities in decarbonizing the industrial sector.

APRIL 2023

Scott Institute faculty research showcased at DOE **ARPA-E Energy Innovation Summit**.

Scott Institute hosts inaugural **CMU Electric Vehicle Show**.

JUNE 2023

Scott Institute **Seed Grants** for Energy Research program received 22 proposals and over \$230K was awarded to three Carnegie Mellon University faculty projects.

AUGUST 2023

Costa Samaras named next Director and **Valerie Karplus** named Associate Director of Scott Institute.

ENABLING A SUSTAINABLE LOW-CARBON FUTURE

We address the world's most important energy-related challenges by enabling **collaborative research, strategic partnerships, policy outreach, entrepreneurship and education.**

We support transformative work that strives to optimize energy resources and reduce the environmental impacts associated with energy production and use with social equity. We also seek to encourage the development of breakthrough technologies that will accelerate the transition to a **sustainable, low-carbon energy future.**

TECHNOLOGY

Energy Technologies: Current and Future

- High-Performance Renewables
- Transportation Energy, EVs, Infrastructure and Electrification
- Energy Storage, Batteries, Fuel Cells and Internet of Things (IoT)
- Decarbonization, Carbon Capture, Sequestration and Utilization

EFFICIENCY

Resource Efficiency, Policy and Analysis

- Efficiency of Traditional Fuels and Resource Recovery
- Environmental Monitoring, Sensing and Treatment
- Energy Policy, Economics and Community
- Enhanced Water Resources

COMPUTATION

High-tech Energy and Computational Solutions

- Grid Modernization, Energy Planning, System Reliability and Resiliency
- Building Performance, Urban Planning, Design and Analytics
- Machine Learning, AI, Autonomous Vehicles and Robotics for Energy Systems
- High-Performance Computing and Data Centers

RESEARCH HIGHLIGHTS



Destenie Nock* along with **Corey Harper**, **Greg Lowry** and **Jeremy Michalek** were part of a study investigating the impacts of online grocery delivery on energy use, emissions and traffic congestion. The work created a new tool to aid policy-making and planning sustainable, equitable transportation systems.



Grigorios Panagakos (ChemE) and his research group explored ways to reduce emissions from power plants using 3D-printed stacked columns that capture post-combustion carbon via absorption.



Ana Inés Torres (ChemE) spent two years creating a framework that evaluates green-hydrogen production. Insights about the performance and operating costs of electrolyzer systems — key to green-hydrogen production — have been gained from using the framework to create different simulations.



Amir Barati Farimani's (MechE) research identified ionic liquid molecules that are ideal for CO₂ storage. There are high numbers of combinatorial possibilities for ILs, which is why machine learning is more efficient than conventional experiments.



Research led by **Mohammad J. Islam** (MSE) produces durable, lightweight and cost-effective carbon nanotubes. This manufacturing innovation improves efficiency and reduces the cost for solar cells, batteries and fuel cells.



Jay Whitacre (EPP) and **Venkat Viswanathan*** (MechE) were part of a team using robotics and artificial intelligence (AI) to optimize electrolytes for better functionality in lithium-ion batteries.



David Rounce (CEE) led international research using shared socioeconomic pathways to predict possible mass loss of the world's glaciers. This research presents various scenarios of changing emissions and how they will impact our climate.



Greg Lowry (CEE) created nanoparticles that can remain active within a plant for at least 15 days. This research is significant for agriculturists looking for ways to protect their crops from extreme heat due to climate change.



Destenie Nock* (EPP) conducted research revealing that inefficiencies in delivering electricity from suppliers to customers can cause unnecessary air pollution and require additional electricity generation. Proposing the use of smart meters and more, Nock's team anticipates certain changes could make investments in renewable energy more cost-effective.



Jeremy Michalek (EPP) and **Kate Whitefoot*** (EPP) used survey data to glimpse into the future of EV adoption. They found that consumers' preferences haven't changed, but are more willing to adopt EVs as technology improves.



Michael McHenry (MSE) worked with a team of researchers to evaluate power losses in high power-density motors and proposed using rare earth-free magnets to have lower losses.



Lining Yao (HCII) and team developed a low-tech device to help make sure that seeds dropped by drones germinate into saplings. These seed carriers with curved tails aim to help regrow vegetation on hard-to-reach mountainsides destroyed by wildfires.



Albert Presto (MechE) with a group of scientists at Carnegie Mellon and Texas A&M universities researched the Norfolk Southern train derailment site and found that concentrations of acrolein near the derailment site were up to six times higher than normal. According to the new study, low levels of exposure to acrolein are associated with slow breathing and burning in the nose and the throat.



Presto also collaborated with **Paulina Jaramillo*** (EPP) on project AfriqAir, a Carnegie Mellon Africa-affiliated group focused on improving air quality in Africa.



Robert Heard (MSE), along with the musical instrument manufacturer Marimba One, has received a patent for a synthetic material that replicates the quality sound of endangered tone woods commonly used for instrument making, contributing to their sustainable practices.



Ramteen Sioshansi (EPP) and a team of researchers identified challenges faced in current modeling systems for electricity-system planning, as well as opportunities to explore further improvements to these models.



Valerie Karplus* (EPP) and **Chris Pistorius** (MSE) were awarded \$3.1 million by the Department of Energy to support their project, "Scaling Hydrogen-Direct Reduced Iron Pathways to Decarbonize Iron and Steelmaking." Steelmakers Nucor and United States Steel Corp. will serve as industry partners on the project.

* Energy Fellow

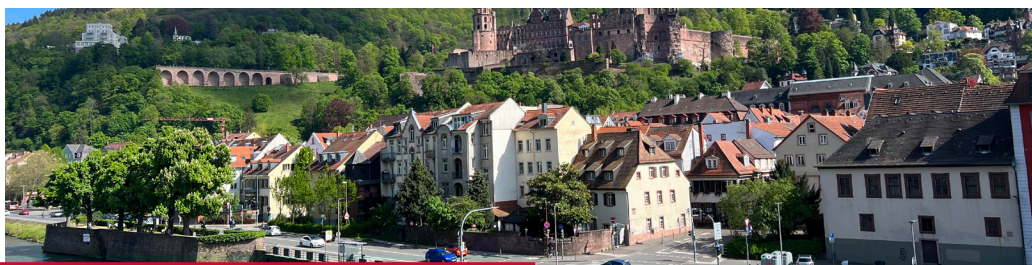
CMU RESEARCHERS & COLLABORATORS KICK OFF INDABA PARTNERSHIP

Scott Institute Energy Fellows **Valerie Karplus** and **Paulina Jaramillo**, along with Faculty Affiliates **Chris Pistorius** and **Edson Severini**, joined international collaborators in Heidelberg, Germany in May 2023 to kick off a research partnership focused on industrial decarbonization.

Awarded a \$1.5 million National Science Foundation Partnerships for International Research and Education grant, Karplus and her team established the Industrial Decarbonization Analysis, Benchmarking and Action (INDABA) partnership in January of 2023. "INDABA" comes from the Zulu and Xhosa languages of South Africa, and it refers to a discussion of an important matter within or between different communities.

Following the project's namesake, CMU researchers will collaborate with a diverse group of international partners. These partners include researchers from the University of Cape Town (South Africa), Tsinghua University (China), University of Mannheim (Germany) and the Technical University of Dortmund (Germany), along with a variety of industry leaders from the United States and Europe.

"Building a common understanding of the challenges that regions around the world face when decarbonizing industry is a first step to recognizing opportunities to collaborate on innovative research, demonstrations and policy design," said Karplus, the project's principal investigator. "Through data development, analysis and international exchange, the INDABA network will take that first step."



From May 3-5, 2023, members of the INDABA partnership met in Heidelberg, Germany, for their inaugural symposium, which focused on approaches to reduce greenhouse gas emissions from iron- and steel-making processes. Participants shared their prior research on technology, infrastructure, policy and community and workforce impacts of these processes and proposed future research topics for the group.

"Prior to the start of the partnership, the academic collaborators and industry partners had been working in parallel towards the shared goal of finding viable decarbonization pathways," said Karplus. "The meeting was filled with 'aha!' moments as we explored common interests and new research opportunities."

Iron- and steel-making contribute 7-9% of annual global greenhouse gas emissions. The project's primary aim is to characterize greenhouse gas emissions from steel-making facilities globally and consider the role of potential decarbonization pathways in different world regions. Researchers will also examine and compare potential regional impacts, including implications for workforces and communities, of decarbonization investments.

The INDABA partnership is preparing a new generation to tackle our planet's industrial decarbonization challenges. CMU students and faculty mentors involved in the project could spend up to three months working abroad alongside the partnership's international collaborators. Additionally, students at CMU can learn about GHG reduction pathways for the steel industry in project-based learning courses, in which they work with industrial partners to explore the commercial viability of low-

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carbon pathways. CMU participants in the INDABA partnership will develop and pilot a simulation game for high school students in the Pittsburgh region to teach them about decarbonization and its effects.

Moving forward from the May symposium, the team plans to more closely connect existing research projects, engage in faculty and student exchange and work together on outreach activities. INDABA's mission is to develop a common knowledge foundation to accelerate industrial decarbonization through international collaborative research and multi-sector, multi-stakeholder partnerships. The efforts set forth by INDABA can serve as an example for the globally-connected efforts needed to advance solutions to achieve greenhouse gas emission targets in the coming years.

2023 SEED GRANTS

Scott Institute Seed Grant Funding to Advance Three CMU Energy Projects

The projects, which were led by Carnegie Mellon University faculty from five different departments across campus, focus on energy modeling and risk assessment, material design for carbon capture and effects of hydrogen fuels on material properties.

The annual funding program, now in its eleventh year, supports the development of new research in areas such as energy sources, production, efficiency, environmental impacts and energy equity. Additionally, researchers can request awards to perform vital equipment repairs. This year, 22 proposals were submitted with requests totaling \$1.42 million as part of this highly competitive process. The Institute awarded \$230,000 to five faculty-led projects.

THE 2023 SEED FUNDING WINNERS:



Assistant Professor of Materials Science and Engineering **Mohadeseh Taheri-Mousavi** (MSE), working alongside **P. Chris Pistorius** (MSE) and **Marc De Graef** (MSE) will study H-embrittlement of high-strength structural alloys. The research should enhance our understanding of localized plasticity in pure alloys.

“THIS YEAR WE WERE PARTICULARLY INTERESTED IN SOLICITING IDEAS FOR PROJECTS EXPLORING DECARBONIZATION AND HYDROGEN TECHNOLOGIES. . .

... THESE THREE PROJECTS SHOW THE MOST POTENTIAL TO GROW INTO LARGER PROJECTS AND DRIVE REAL IMPACT ON THE TRANSITION TOWARDS DECARBONIZATION.”

DANIEL TKACIK, EXECUTIVE DIRECTOR OF THE SCOTT INSTITUTE



Russell V. Trader Career Development Associate Professor of Mechanical Engineering **Rahul Panat** (MechE) will work alongside **Burak Ozdoganlar** (MechE) and **Grigorios Panagakos** (ChemE) on the project “Scalable fabrication of porous MOF scaffolds via freeze casting for efficient and low-cost carbon capture.” This project aims to demonstrate scalable and low-cost manufacture of porous metal-oxide-frameworks (MOFs) for CO₂ capture and obtain the preliminary data to establish CO₂ capture from the MOFs.

Arthur Hamerschlag Career Development Professor of Engineering and Public Policy **Paulina Jaramillo*** (EPP) was awarded seed grant funds for her project “Climate risk assessment for electricity transmission assets in the U.S.” The project seeks to evaluate the climate risks to transmission and transformer infrastructure in the U.S. up to 2050 under different climate scenarios. Co-PIs on the project include: **Hamish Gordon** (ChemE), **David Rounce** (CEE) and **Peter Adams** (EPP).



* Energy Fellow

SEED GRANT LEADS TO AIR QUALITY INNOVATION

Air quality is a significant global challenge that affects people worldwide. Globally, air pollution contributed to just over 1 in 10 deaths in the latest year. Fortunately, the field of air quality research has seen progress in recent decades, thanks to innovative technology and the collaborative efforts of experts worldwide.

One such expert is **Albert Presto**, a research professor in the Mechanical Engineering Department whose research is supported by the Scott Institute's seed funding program. The 2021 seed funding led to an air quality innovation in which low-cost air quality monitoring can be achieved using cell phone cameras. The project was recently published in the journal *Environmental Science: Atmospheres*.

Presto's research project focuses on the intersection of two areas of interest for his research group at CMU: low-cost air pollutant sensing and work in the Global South, particularly in Africa. While his research group has done extensive work on low-cost air pollutant sensing in the United States, they aimed to expand their research to other



regions worldwide where air quality information is scarce. To achieve this, they leveraged consistent air quality data that was publicly available from U.S. embassies in the Global South. The data was limited to a small number of pollutants measured using filter tape — a common technique of measuring air pollution by blowing a known quantity of air onto a tape-like surface over a known period of time and then calculating the concentration of black carbon, an airbased pollutant, on the tape. Presto and his team seized this opportunity and developed a low-cost method to analyze filter tape images using cell phone cameras. This enabled them to monitor a wider range of pollutants and create spatially rich maps of air quality.

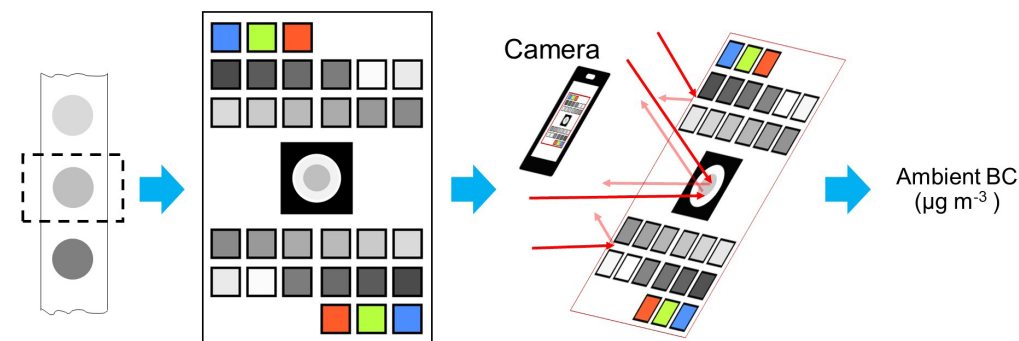


Figure: The method measures atmospheric Black Carbon concentrations by analyzing photos of particle deposits on glass-fiber filters. Post-analysis of beta attenuation monitor (BAM) tapes collected worldwide can be a valuable source for hourly BC data, particularly for countries in the Global South.

"Collaboration played a significant role in the success of this project," said Presto, who worked closely with Professor SP Kompalli and Eniola Ajiboye (Former Master's candidate) from CMU Africa along with Abhishek Anand (Ph.D. candidate) at CMU Pittsburgh.

Together, they developed a low-cost method for air quality monitoring that could be used anywhere in the world.

The relevance of Presto's paper is global, particularly in the context of energy transitions. Air quality and climate are closely linked, with many of the biggest anthropogenic emissions of air pollutants coming from combustion, which is also a major source of greenhouse gasses. This makes energy transitions a crucial area of study, particularly in developing countries where people are trying to industrialize and improve their standard of living.

The Scott Institute played a significant role in supporting Presto's research. The institute provides seed grants for research projects, which have been available for more than ten years. Presto was awarded funding in 2021 in the ninth round of seed grants. "The proposal process is

pretty easy!" said Presto while talking about the application, which involves submitting a two-page proposal and providing faculty members with enough advance notice to prepare their applications. "The timeline is convenient and aligns well with graduate student recruitment," he said.

Presto has applied for follow-on funding for his research, and the next steps involve obtaining tapes from embassies and exploring additional analyses. "There are also additional analyses we can do with the filter Tapes", says Presto. These involve using filters to understand the full composition of the particulate matter and its sources. Currently, they are supported by grants from the Dowd Fellowship and the National Science Foundation.

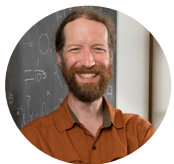
Presto's research serves as an example of the importance of collaborative efforts and innovative technology in addressing global issues such as air quality. Researchers can leverage the support of institutions such as the Scott Institute to continue developing low-cost methods for air quality monitoring and contributing to the global conversation on energy transitions.

FEATURED AWARDS & HONORS



Grigorios Panogakos (ChemE) received funding from the Lawrence Livermore National Laboratory's (LLNL) Laboratory Directed

Research and Development Program (LDRD). The three-year project will work with other researchers at CMU to model designs to scale-up the carbon absorption process.



Neil Donahue (Chemistry) was named the American Association for Aerosol Research's 2022 David Sinclair award recipient to commend his contributions

to aerosol research and atmospheric science.



With over 72 invention disclosures and more than 60 issued patents, **Howie Choset** (Robotics) was named Pittsburgh Intellectual Property Law

Association Inventor of the Year. Choset's research group has been at the cutting edge of innovation of robotics. Choset showcased robotic technologies for inspecting and repairing pipelines recently at the ARPA-E summit in March.



Akshitha Sriraman was among 15 award winners chosen for the 2023 Intel Rising Star Faculty Award. Her work on systematically designing data center

hardware has improved the efficiency of real-world data centers, reducing the global carbon footprint.



Nicholas Muller (Tepper) supported sustainability research and experiential learning opportunities for students as part of a recent BNY Mellon Foundation of

Southwestern Pennsylvania grant. This award will support the intersection of sustainability and business in Tepper School of Business, including continued research related to Muller's ESG Index.



Reeya Jayan* (MechE) was elected to the Board of International Microwave Power Institute, the leading scientific organization dedicated to the international

microwave energy community. Jayan's group uses microwaves for materials manufacturing and industrial decarbonization. Jayan will also chair their 58th Annual Microwave Power Symposium (IMPI 58) in Washington, DC in the spring.



Mario Bergés (CEE) was named an Amazon Scholar. Through the academia-industry collaboration, he will use his expertise to help

shape the scientific roadmap for energy and sustainability solutions developed by the company.



Gabriel Gomes (Chemistry) was named to Chemical and Engineering News' Talented 12 rising stars in chemistry.



Executive Director **Daniel Tkacik** is listed on the City & State PA's 2023 Energy & Environment Power 100 list of people making a difference in the energy sector.



Ramteen Sioshansi (EPP) and Open Energy Outlook's **Joseph DeCarolis** received the IEEE Power & Energy Society (PES) Prize Paper Award for "Energy-Storage Modeling: State-of-the-Art and Future Research Directions."



Burcu Akinci (CEE) and **Jeanne VanBriesen** were elected fellows of the American Association for the Advancement of Science. They have been recognized for their extensive work and contributions to the scientific community ranging from infrastructure management, smart habitats and water system sustainability.



Scott Institute Board Member **Katie McGinty**, vice president and chief sustainability and external relations officer at Johnson Controls, was named to Constellation Research 2023 ESG50 global list of top sustainability executives.

* Energy Fellow



CMU ENERGY WEEK RETURNS IN-PERSON TO TACKLE DECARBONIZING THE INDUSTRIAL SECTOR

The Wilton E. Scott Institute for Energy Innovation hosted its seventh annual Carnegie Mellon University (CMU) Energy Week from March 21-24, 2023. Returning in-person for the first time since 2019, this year's conference facilitated dialogue on the challenges and opportunities in decarbonizing the industrial sector.

"Nationally, the industrial sector accounts for roughly one-third of all greenhouse gas emissions. The challenge of decarbonizing while also minimizing its impact on jobs, communities — our livelihoods — that is what we're going to be discussing all day today. It's an important conversation to have, especially in this region, and we're honored to have representatives from industry, government, nonprofits and other critical organizations here today to take part in this conversation," Scott Institute Executive Director Daniel Tkacik said during his welcoming address.

The week's schedule included over 30 different speakers who shared their insights on technologies, systems, policy, financing

and workforce and community impacts of decarbonizing the industrial sector.

Day 1

CMU Energy Week 2023 kicked off with a day tailored to employers and students in the energy sector, including the annual Energy Industry Career Fair as well as a student networking event.



Day 2

The morning began with a welcome by Scott Institute Executive Director Daniel Tkacik and Engineering Dean Bill Sanders. Joylette Portlock, Executive Director of Sustainable Pittsburgh, set the stage for the rest of the day with her morning keynote discussing the opportunities that lie ahead and lessons we can learn while on the path towards decarbonization.

Later in the day the audience heard from regional leaders Brian Anderson, Director of the National Energy Technology Laboratory (NETL) of the Department of Energy (DOE), Rich Fitzgerald, County Executive, Allegheny County, and Jake Pawlak, Deputy Mayor, City of Pittsburgh, as they shared their perspectives on the future of energy.

Wednesday's Industrial Decarbonization Deep Dive also featured three panels about technologies and systems, policy decisions and building public support.



The first panel, *Technologies & Systems: How hard is it to decarbonize the industrial sector, really?*, featured Brenda J. Pretrilena (US Steel), Sarah Rilling-Hall (Shell USA), Grigorios Panagakos (CMU), Brian Guzek (Duquesne Light Company), Sandeep Nijhawan (Electra) and was moderated by Valerie Karplus (CMU). The panel discussed the most powerful technological levers to address Greenhouse gas emissions from industrial sources.



The second panel, *Policy Decisions: What policies do we need to support industrial decarbonization?*, discussed policies, financing and institutional design to encourage action in deploying decarbonizing solutions. Panelists included Samuel Taylor (WVU Energy Institute), Destenie Nock (CMU), Stephan Feilhauer (S2G Clean Energy Fund), Abby Smith (Team Pennsylvania), Ashleigh Ross (Carbon America) and was moderated by Tim McNulty (CMU).



The third panel of the day, *Building public support: How can we be sure a low carbon transition creates opportunities for workers and communities?*, discussed the challenges and opportunities around building a broad base of support to decarbonize industry. The panel offered their expertise on the future they think people want to see and how that connects with a low-carbon transition. Panelists included Elizabeth "Betsy" McIntyre (TEAM Consortium), Pam Snyder (former PA House of Representative), Christy Veeder (Office of Energy Jobs, U.S. Department of Energy), Darrin Kelly (Allegheny/Fayette Central Labor Council) and was moderated by Rick Stafford (CMU).



Day 3

CMU Energy Week continued Thursday with the Investor Forum. Dawn James, Managing Director, Sustainability Strategy & Transformation at Deloitte Consulting LLP, kicked off the morning with a keynote discussing how investors are thinking about energy tech investments and how to deal with the unprecedented amount of money coming out of the U.S. government to address the biggest technological and societal transformation in history



Her keynote led into the *Investor Panel: The Climate for ClimateTech Investment* where she joined a panel of investors representing specialist energy funds, generalist investment funds active in the energy space and corporate investors. The panel discussed the climate for energy and climate tech investments, what is unique about their approach to investment and what implications they see for the future as the new federal programs in the sector start to be rolled out. Dawn James was joined by Ian Adams (Evergreen Climate Innovations), Alicia Lenis (Chrysalix Venture Capital), Thurston Cromwell (Emerson), Matt Harbaugh (Mountain State Capital) and moderator Reed McManigle (CMU).



The panel was followed by an afternoon of startup pitches from 10 surrounding states. 18 startups presented their technologies in 4-minute pitches to a public audience that included judges and investors. The entrepreneurs also had the opportunity to meet one-on-one with nearly 20 investors from across the nation. The day ended with a Networking Reception at the Swartz Center for Entrepreneurship.



Day 4

The final day of CMU Energy Week 2023 kicked off with a morning keynote on the future of the energy transition from Paul Browning (CIT B.S. Met. '90), CEO of Continuum Renewables. During his keynote, he announced his plan to launch an energy transition startup incubator.

The morning continued with the second Tepper Cleantech Case Competition (TC3), included five finalists selected by TC3 organizers. Hosted by the Tepper School of Business and the Tepper Energy & Cleantech Club (ECTC), Ian Gray, the club's president, kicked off the event. The competition asked teams to act as consultants tasked with identifying the next cleantech investment opportunity and each finalist pitched 15-minute presentations to judges from the events sponsor, Emerson Ventures, as well as other venture capital firms.

A special thanks to this year's sponsors: Westinghouse, Duquesne Light Company, Trane Technologies, People's, Rose Rock Bridge, Energea, Wells Fargo Innovation Incubator (IN2), DOE American-Made Solar Prize, Emerson, United States Steel and Shell.



THE WILTON E. SCOTT INSTITUTE FOR ENERGY INNOVATION FEATURED EVENTS

DISTINGUISHED LECTURE WITH SALLY BENSON

The Scott Institute hosted a lecture on September 20, 2022 featuring **Sally Benson** (Deputy Director for Energy and Chief Strategist for the Energy Transition at OSTP). Benson discussed the provisions and scale of these actions that will launch a transformational decade of climate action and will make this future a reality.



NOVEMBER 15, 2022

Distinguished Lecture: Joseph DeCarolis
Distinguished Alumni **Joseph DeCarolis** (Administrator of the U.S. Energy Information Administration) joined the Scott Institute for a Distinguished Lecture discussing priorities and ongoing activities at EIA and the many lessons he learned as a graduate student in Engineering and Public Policy at Carnegie Mellon (EPP '04). This event was co-hosted the department of Engineering & Public Policy (EPP).

FEBRUARY 6, 2023

EnergyTech UP Mid-Atlantic Regional Explore Event

The Scott Institute has partnered with the Department of Energy's Office of Technology Transitions for the **EnergyTech University Prize (UP)** to serve as a Regional Convener for the Mid-Atlantic region.

APRIL 22, 2023

CMU Electric Vehicle Show

In celebration of Earth Day 2023, the Scott Institute hosted CMU's first ever Electric Vehicle (EV) Show, held in the Morewood Gardens parking lot. Several CMU faculty and staff brought their EVs, showed attendees what they looked like under the hood and talked about their experiences owning an EV.

SEPTEMBER 7, 2023

Non-Traditional Career Paths: How Students Can Join or Launch Startups

Reed McManigle, CMU's 'startup guru' shed light on resources available across campus for supporting the creation of startups around research results, and how to tap into the dynamic startup ecosystem in Pittsburgh as an alternative to a traditional academic or large company career path.

SEPTEMBER 14, 2023

Distinguished Lecture: Olivia Dippo

Olivia Dippo discussed her career path, from earning her undergraduate at Carnegie Mellon in the Materials Science & Engineering department, through today as the Co-founder and CEO of Limelight Steel.

Watch events online at cmu.edu/energy

OCTOBER 24, 2022

Scott Institute Hosts Norwegian Energy Officials during GCAEF

The Scott Institute hosted Per Arne Karlsen, Special Advisor on Resource Industries and the Environment Research Council of Norway, and David Barratt-Due, Advisor in The Norwegian Ministry of Petroleum and Energy, Climate, Industry and Technology Department (KIT), Research and Technology Section (FOT), from Norway during their visit to Pittsburgh for the Global Clean Energy Action Forum in September 2022.

OCTOBER 27, 2022

Distinguished Lecture: Mary Beth Green

Mary Beth Green (Chief Innovation Officer, Sheetz) shared historical context for how innovation has developed at Sheetz, best practices for consistent commercialization, a sneak peak of the future of innovation at Sheetz and key takeaways for those who want to power innovation in their business planning, studies, jobs or companies.



GUIDING THE CLEAN ENERGY TRANSITION

Azadeh Sawyer, center, assistant professor in building technology, gives a virtual reality tour at Mill 19 for green energy construction with the help of School of Architecture graduate students Mohammad Reza Takallouie, right, and Gavin Hurley, left.

There was notable excitement around the opening of the Global Clean Energy Action Forum (GCEAF) Wednesday evening, Sept. 21. The three-day event drew members of the global energy community to Pittsburgh to share their ideas on how to move toward a clean and sustainable future. Carnegie Mellon University was a co-sponsor with the Department of Energy (DOE) in hosting GCEAF.

Carnegie Mellon University President Farnam Jahanian welcomed hundreds of local and global top energy officials, CEOs and innovators to Pittsburgh at a reception held at the Heinz History Center. He recognized his fellow co-chairs on the Pittsburgh-based host committee that worked with the DOE to organize the event: Allegheny County Executive Rich Fitzgerald, Pittsburgh Mayor Ed Gainey and Allegheny Conference CEO Stefani Pashman.

"The imperative facing us could not be more urgent, and I would argue that, at this pivotal moment, there is no more fitting or inspiring place to hold these conversations than Pittsburgh," Jahanian said. "Over the past three decades, this region has reinvented itself as the center of a new economy — and a model for the power of innovation."

This first-ever event featured a high-level plenary, topical roundtables with energy and science ministers from 31 countries, CEOs and experts, expert panel discussions, technology demonstrations and pitches and other activities, all focused on how to deploy clean energy technologies.

Before the public program kicked off Thursday afternoon, GCEAF attendees visited Mill 19, a former steel mill that now serves as a state-of-the-art research facility shaping the future of advanced manufacturing and sustainable practices.

As part of the tour co-hosted by the Scott Institute, guests attended several demonstrations related to manufacturing and sustainable practices:

Faculty Affiliate **Azadeh Sawyer**, assistant professor in building technology in CMU's School of Architecture, showed how she's using virtual reality to promote green building practices, allowing clients to explore how different design elements impact the user experience and energy efficiency.

Sandra DeVincent Wolf, executive director of CMU's Manufacturing Futures Institute (MFI), showcased a robotic wire arc additive manufacturing process that uses less energy and reduces waste

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and costs compared to traditional manufacturing methods.

The **Advanced Robotics for Manufacturing (ARM)** team showed participants how a robotic arm can quickly and efficiently inspect complex turbine blades for defects.

Below: Executive Director Daniel Tkacik and Sandra DeVincent Wolf, executive director of the Manufacturing Futures Institute speaking to GCEAF attendees outside of Mill 19 during a tour.



A panel of experts and venture investors heard from Pittsburgh-based energy and climate technology startups pitching their innovative technologies. Hosted by the DOE's Office of Technology Transitions, many of the entities taking part were spun out of CMU and/or led by CMU graduates or faculty. They included:

- **CorePower Magnetics**, a company using advanced materials and manufacturing to create finished power electronics components (inductors and transformers) to operate with increased temperature stability.
- **Farm to Flame Energy**, a biomass solution that allows for the burning of several agricultural wastes in a smokeless and odorless manner.
- **LumiShield**, co-founded by Hunaid Nulwala, who at the time was an assistant research professor of chemistry at CMU, which has developed a process to stop corrosion without relying on toxic solvents.
- **Integrated Silicon Technologies**, a company that has developed an innovative continuous process to reduce the cost of silicon-based solar electricity by a factor of two.

Several CMU faculty members, alumni, students and administrators took part in panels during both days of GCEAF.

CMU Professor of Engineering and Public Policy (EPP) and Co-Director of the Green Design Institute **Paulina Jaramillo*** led a panel discussion on the recently launched Open Energy Outlook (OEO), an initiative that aims to examine U.S. energy futures to inform energy and climate policy efforts by applying the gold standards of policy-focused academic modeling, maximizing transparency and building a networked community. Katie Jordan, a Ph.D. student in EPP, presented the team's methodology and findings. The OEO is an initiative of the Scott Institute for Energy Innovation at CMU in partnership with North Carolina State University and receives funding from the Sloan Foundation.

Valerie Karplus*, a CMU professor in EPP, took part in a session entitled *A High Road Energy Transition: Ensuring Fairness for U.S. Workers and Communities*. The conversation included labor and nongovernmental organization leaders, all recognizing that different parts of the world are dealing with their clean energy transitions on different timelines. Karplus referenced the work of the Roosevelt Project, a research effort that included

examining the challenges facing the Southwestern Pennsylvania region in making the transition to a future with net-zero greenhouse gas emissions as an effort to examine community impacts of decarbonization policies.

Destenie Nock*, assistant professor in EPP and Civil and



From left, Valerie Karplus* and Paulina Jaramillo*; U.S. Secretary of Energy Jennifer Granholm; and CMU President Farnam Jahanian during the opening reception for the Global Clean Energy Action Forum on Wednesday Sept. 21, 2022, at the Senator John Heinz History Museum.



Destenie Nock, left, speaks during a panel titled "Systems Thinking for a Rapid and Just Net-Zero Transition."

Environmental Engineering, participated in an expert panel discussion on what is necessary to reach net-zero emissions and the ways systems methods can enable a rapid and equitable energy transition for all. Nock encouraged the panel to consider ways to create an equitable, sustainable and low-cost energy future all at once, and not leave consideration on how to make energy equitable until the very end of the modeling process.

M. Granger Morgan, Hamerschlag University Professor of Engineering, joined two of his former Ph.D. students, Sunhee Baik and Luke Lavin, and one current Ph.D. student, Angelena Bohman, at a side presentation to discuss power system resilience in the face of extreme events like terrorist attacks, or events occurring in nature as the result of climate change. Baik, now with the Lawrence Berkeley National Laboratory, talked about the problem of estimating the economic and societal costs of large outages of long duration, while Lavin, now with the National Renewable Energy Laboratory, presented his research conducted at CMU on resource adequacy implications of temperature-dependent electric generator availability. Bohman, who will defend her thesis in December, shared her

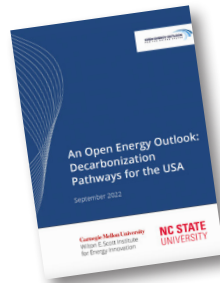
research on strategies for and efficacy of enhancing the resilience of power systems.

On the final morning of GCEAF, President Jahanian hosted a fireside chat with U.S. Sen. Joe Manchin (D-W.Va.), that focused on how to protect workers at the center of the transition to a clean and sustainable energy future and the prospects for enacting permitting reform as a means to narrow the timeframe of developing new energy technologies and helping America better compete on the global stage. Jahanian concluded, "Ultimately, the energy transition has to be centered around people, which means bringing meaningful opportunities to our communities — including good-paying jobs, affordable energy and a better quality of life — especially for those who have been most impacted by environmental harm from legacy industries."



M. Granger Morgan speaks on a panel titled "Enhancing Electric Power Resilience in the Face of Extreme Events."

POLICY OUTREACH



The Open Energy Outlook launched its first report detailing the team's efforts to research and simulate the future of the U.S. energy system under different decarbonization pathways. The report outlines four potential decarbonization scenarios for the U.S. energy system over the next 30 years.



Peter Adams (EPP) is working with the EPA on the Science Advisory Board's BenMAP and Benefits Methods Panel. The panel will provide independent advice and analysis of the evidence used to quantify and monetize air pollution-related effects and how the BenMAP tool comes to these conclusions.



In a white paper, **Laboratory for Energy and Organizations (LEO)** reviewed existing tools to evaluate corporate actions to reduce GHG emissions specifically in China due to its central role in global supply chains, the high carbon intensity of its electricity system and its unique policy and institutional complexities.



Paul Fischbeck (EPP) and colleagues proposed policy changes to support the new EPA emissions rules and use of carbon capture and storage, critical to preserve low-cost grid reliability while creating options for a future hydrogen economy.



Destenie Nock* (EPP) collaborated on research to inform government agencies and philanthropic institutions on how to enable an equitable energy transition to an inclusive approach to clean energy.



As a committee of the National Academies of Sciences, Engineering and Medicine member, **Jeremy Michalek** (MechE/ EPP) co-

authored a report on life cycle assessment (LCA) methods in order to develop a reliable and coherent approach to applying LCA to low carbon fuel standards.



Former Board of Advisors member **Jim Skea** was elected Chair of the Intergovernmental Panel on Climate Change (IPCC). With nearly forty years of climate science experience and expertise, Jim Skea will lead the IPCC through its seventh assessment cycle. Skea served on the Scott Institute Advisory Board from 2012-2023.



Karen Clay* (Heinz) and **Edson Severnini** (Heinz) co-authored a National Bureau of Economic Research working paper, *The Historical Impact of Coal on Cities*. The study, which examined the effects of differences in local coal availability, concluded that policymakers need to take into account the current and future payoffs when designing environmental regulation.



* Energy Fellow

KARPLUS PUBLISHES REVIEW ON THE POLITICS OF ENVIRONMENTAL POLICY

Political obstacles can be as formidable as technical challenges when addressing environmental issues. In a review of climate politics scholarship in *Nature Sustainability*, **Valerie Karplus** writes that politics should "not only be seen as a constraint but be recognized as a target of intervention to advance environmental solutions."

Specifically, Karplus, associate director of the Scott Institute and associate professor of engineering and public policy, and her co-author, Jonas Meckling from the University of California, Berkeley, encourage more focus on developing effective political strategies. In their review, they outline three shortcomings ("gaps") in current efforts to address climate change and explore how to surmount these barriers in future policy.

The **ambition gap** is the gap between national policy targets and scientific consensus goals. Groups that produce emissions often politically oppose scientific goals because they face the highest costs from policy change.

One way to bridge this gap is to craft policy that concentrates benefits while diffusing costs across a broad range of stakeholders, utilizing subsidies, tax rebates and deployment performance standards. For example, the Inflation Reduction Act rewards developers of low carbon technologies and promises to reduce clean energy cost over time. Alternatively, we can seek policy that compensates those paying the costs and rewards those championing the benefits. In addition, linking global environmental issues such as climate change with salient local issues like human health can also bolster political support.

The **implementation gap** occurs when a government fails to meet the adopted policy goals or ends up repealing the policy. This often happens when policy is not effectively enforced. For example, even with subsidies to support capital investment, incentivizing the continuous use of some low carbon technologies may be challenging if the costs prove too high.

Karplus and Meckling note several ways of bridging this gap. First, when interest groups have already invested in a policy, they're more likely to protect it. Second, policies can provide targeted benefits to key political groups to create positive feedback. And third, policies that provide strong initial benefits can be used as a stepping stone to policies in the future.

Finally, the **international action gap** describes the difficulty in developing cooperation among nations, industries and subnational actors when domestic issues take precedent over international ones.

The authors note opportunities for both deepening and widening international coordination efforts on environmental issues. They acknowledge progress toward deeper action by small groups of countries known as "clubs" and by certain sectors through industry agreements. In particular, policy actions in large markets or from climate leaders can affect other countries that look to these actors for guidance.

Through this review, the authors call for more climate politics scholarship that focuses on politically-effective strategies to tackle climate change. They aim for politics to become a lever of change alongside technology.



AT THE INTERSECTION OF ENERGY POLICY AND GLOBAL DEVELOPMENT

The Bipartisan Infrastructure Law (BIL) and the Inflation Reduction Act (IRA) represent two of the most significant climate-focused pieces of legislation in the history of the United States. Over one trillion dollars are set to bolster clean energy, revolutionize infrastructure and slash healthcare costs. It's not just about money; it's about saving our world and shaping a sustainable future for generations to come.

How could this actually impact the global community and climate change? That is precisely what EPP Projects Senior Capstone Class sought to answer in the spring semester of 2023.

Dr. Destenie Nock's class provided 28 students with an opportunity to delve into the ever-evolving landscape of climate-friendly policies and renewable energy. Through interviews with Nock and the teaching assistants, our team at the Scott Institute uncovered the critical details of the class, highlighting its impact on students' learning experiences.

Realizing the relevance of sustainable growth

Students came from several departments including Civil & Environmental Engineering, Mechanical Engineering, Electrical & Computer Engineering and Public Policy & Management. They were eager to learn from the class to better prepare for a more sustainability-focused workforce. Their motivation stemmed from a shared interest in understanding and harnessing the potential of these legislative developments.

Throughout the semester, these students engaged in extensive readings, discussions and analyses of the latest developments in the U.S. energy and climate landscape. The class emphasized the impact of the new bills on different industries, with each team focusing on a specific area of interest. Projects covered topics such as the impact of the legislation on heating, manufacturing and the cost of raw materials. The main focus was to analyze the bills' impact on industry growth and its equitable distribution across communities.

Mimicking real-world scenarios

To enhance collaboration and communication skills, Nock introduced a game that simulated electricity markets. The class was divided into two teams, with one representing power generation and the other representing power distribution companies. The game facilitated teamwork and negotiation, as teams struck power supply deals with each other. This interactive exercise aimed to improve communication and decision-making skills, providing valuable experience for future engineers working in collaborative environments. Nock stated, "A lot of people get frustrated because they want to do the perfect thing, but the goal is to do better than what you're doing. This is how decision-making can be improved in the energy space." The game fostered teamwork and instilled a sense of continuous improvement in students' approach to decision-making.

Making a continued impact in Pittsburgh and beyond

At the end of the course, each team presented their semester-long projects to a panel of ten advisors, including experts from the Scott Institute, the National Renewable Energy Lab and Pittsburgh Regional Transit. These projects showcased the impact of the legislation on various industries, highlighting growth, equity and policy analysis. Reflecting on the projects, Nock expressed, "The panel was super impressed with the quality of work showcased. It was a consulting style of assessing a problem,

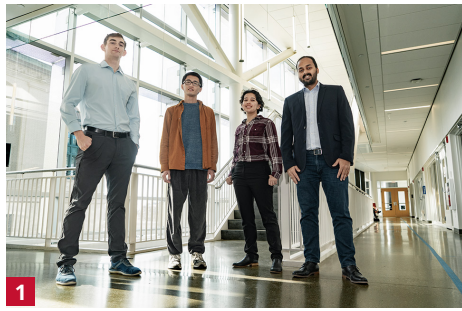
which helped students learn and grow in spaces such as data analysis and understanding uncertainty." The class not only deepened Carnegie Mellon University's collaboration with the National Renewable Energy Lab but also equipped students with essential skills for their future careers.

Students gained a range of soft and hard skills through "real-life" experience of how government policies and decision-making processes work in the energy sector. Expert lectures during the semester proved to be valuable learning experiences, expanding students' knowledge and perspectives. The feedback given by the students after the semester included, "The three expert lectures during the semester were very helpful in gaining a deeper understanding of the industry." Another student stated that their "writing and presentation skills were particularly improved," which will be invaluable for future endeavors.

Continuing the Journey in Climate and Energy Studies

Nock encourages students to take more courses about energy, technology and climate studies to further educate themselves on the important topic. She also encourages students to take humanities courses to contribute to a well-rounded understanding of the social aspects intertwined with climate challenges. With guidance from professors like Dr. Nock, Carnegie Mellon University can equip students with essential skills and knowledge to shape a sustainable, equitable future.

STUDENT NEWS



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1 **Abhishek Anand**, a Ph.D. candidate working with **Albert Presto**, was chosen for a Dowd Engineering Seed Fund for Graduate Student Fellowship for his work on the development and application of low-cost techniques to determine speciated $PM_{2.5}$ concentrations in Sub-Saharan Africa.

2 The eighth annual CMU Student Energy Research Poster Competition featured 19 posters presented by CMU students from across the university during this year's CMU Energy Week. First Place went to the poster titled "Electric Vehicle Battery Replacement Costs Under Realistic Fast Charging Behaviors" by EPP and MSE student **Hannah Morin**.

3 **Jinding Xing**, a CEE Ph.D. candidate working with Faculty Affiliate **Pingbo Tang**, was awarded the Robert E. Uhrig Graduate Scholarship. Xing aims to develop context-aware augmented reality glasses for nuclear field workers.

4 Former Scott Institute intern **Prathit Dave** along with 3 other Energy Science, Technology and Policy (EST&P) students placed 3rd in the North Carolina State Use Case Division for the U.S. Department of Energy (DOE) Solar District Cup by the National Renewable Energy Laboratory.

5 **Lauren Janicke**, a CEE undergrad who worked with Energy Fellow **Destenie Nock** and other researchers, helped develop a new model to accurately predict air pollution levels in cities. This research led to her winning the 2023 Judith A. Resnick award which is given to recognize and encourage an exceptional, senior woman graduating with an undergraduate technical course of study.

6 **Andrew Jones** (MS, 2019), was one of the prize winners at the Steinbrenner Institute for Environmental Education and Research's Annual Sustainability Symposium for research on the climate impacts of residential cooling demand and its implications on energy burden in Phoenix, Arizona.



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7 **Marissa Webber**, a current CEE Ph.D. student advised by Faculty Affiliates **David Rounce** and **Costa Samaras**, has been selected as a 2023 Freeman Fellowship recipient for her work in mitigating stormwater flooding in urban areas, especially in cities like Pittsburgh.

8 EPP students **Anna Cobb**, **Jon Gordon**, **Jaih Hunter-Hill** and **Sean Wu**, along with HCI student **Dorothy Li** students won Best Presentation at NASA's Gateways to Blue Skies: Clean Aviation Energy Competition. Their project "A Pathway to the Fuel of the Future: Hydrogen's Role in Aviation Decarbonization" was presented this June at the 2023 Blue Skies Forum in Cleveland, OH.

9 CMU Architecture Urban Design Students worked with **Edith Abeyta**, a local professional artist, through a case study to consider issues in the Mon Valley in order to conceive a decarbonized future led by community input and ideas.

10 CMU Ph.D. candidate **William Strahl** was chosen to conduct research at the National Energy Technology Laboratory (NETL) as a part of the U.S. Department of Energy Office of Science Graduate Student Research Program (SCGSR). Faculty Affiliate **Chrysanthos E. Gounaris** is Strahl's advisor.

11 Ph.D. candidate **Alex Wadell** from Energy Fellow **Venkat Viswanathan's** research group was selected for the Meta Research P.h.D. Fellowship program. He will be working to apply Scientific Machine Learning to develop battery models to address the challenges of AR/AV devices.

12 Ph.D. candidate **Sofia Martinez** has been awarded the prestigious Dwight David Eisenhower Transportation Graduate Fellowship by the U.S. Department of Transportation, Federal Highway Administration. Co-advised by Faculty Affiliates **Costa Samaras** and **Corey Harper**, she is focused on the electrification of the U.S. public transportation sector to reduce carbon emissions.

BRIDGING ACADEMIA AND ENTREPRENEURSHIP:

The Journey of Renuka Hyderkhan in Clean Energy Innovation

In the ever-evolving landscape of sustainable technology, individuals who navigate the realms of academia and entrepreneurship are a source of inspiration. **Renuka Hyderkhan**, a postdoc who is spearheading the research and development for a clean energy startup emerging from Carnegie Mellon University, stands as a prime example of such an individual. More recently, Renuka was one of five Ph.D. students/postdocs chosen to participate in the CMU Innovation Commercialization Fellowship program (ICF) in Carnegie Mellon's Swartz Center for Entrepreneurship, an accelerator that nurtures select entrepreneurs at CMU.

A Voyage of Exploration and Discovery

Hailing from India, Hyderkhan began her journey with a Ph.D. in electronics and electrical engineering at the Birla Institute of Technology, Pilani. Her research on renewable energy directed her towards the captivating realm of photovoltaics based on ferroelectric materials. With a record of publishing numerous papers and registering one Indian patent, her journey took a new direction during her Postdoctoral role. She shifted her research trajectory to explore the field of 2D materials, driven by the rapid growth of this industry.

Her journey towards an entrepreneurial role took a significant turn when her team at CMU made a groundbreaking discovery. They found that their material

coatings had a remarkable impact on lithium-ion batteries, significantly improving critical parameters such as battery cycle life and stability by an astonishing 17-fold. This patented invention was one of only two technologies selected to receive funding from the National Renewable Energy Laboratories (NREL)/Chevron Studio Cohort 2 program in 2023 from a list of over 300 submissions from U.S. national labs and universities. This program provided funds and matched the CMU team with an entrepreneur to investigate pathways towards commercializing this innovation, which has the potential to revolutionize the battery industry and greatly enhance the performance of lithium-ion batteries.

Cleantech Entrepreneurship: A Passion Transformed into Reality

Hyderkhan's driving force is her commitment to sustainability and the environment. Her motivation lies in creating tangible solutions that align with her values. The process of commercialization for her endeavor is intricately tied to the ICF program, an experience designed to cultivate entrepreneurship. It is within this program that she has the opportunity to engage with CEOs of various companies for customer discovery and scale-up, refine her product pitches and gain valuable mentorship for the commercialization. It's within this program that Renuka found support that shaped her entrepreneurial vision.

From Postdoc to Startup: Navigating Dual Roles

Balancing the responsibilities of a postdoc



at CMU with the leadership role of a burgeoning startup is no small feat. Renuka acknowledges that the transition from academia to entrepreneurship was a learning curve, but with her academic advisor's (**Reeja Jayan**, Associate Professor, Department of Mechanical Engineering) guidance and support, she navigated this uncharted territory. Networking, previously an academic afterthought, now forms an essential part of her responsibilities.

Nurturing Future Cleantech Innovators

"Young aspirants must dive through various challenges in this journey and always keep the end goal in mind," Renuka said. She added that aspirants have various resources such as GIST catalyst programs for women entrepreneurs, Cleantech Open startup accelerator and many more to test the waters. It is also important to have significant industry collaboration and partnerships for growth and sustainability in this space.

Looking Ahead: A Vision for Clean Energy

As Hyderkhan propels her commercialization effort toward success, there's a clear vision

for the future. With a focus on addressing battery-related challenges, her team is investigating and organizing efforts for scaling up their material. Despite the hurdles that come with any entrepreneurial journey, Hyderkhan, along with her team, are determined to secure additional funding through the Small Business Innovation Research (SBIR) type grants, further solidifying the startup's place within the clean energy landscape. As the R&D head, she envisions a team that includes a diverse and multidisciplinary team of materials and battery subject matter experts, all working collaboratively to amplify their impact.

Hyderkhan's journey from academia to cleantech entrepreneurship is a testament to the possibilities that emerge when passion, innovation and determination converge. Her role, born out of Carnegie Mellon's Swartz Center for Entrepreneurship, serves as an inspiring example for those aspiring to bridge the gap between research and real-world impact. With a commitment to sustainable solutions and an unyielding drive to make a difference, Hyderkhan's story illuminates a path toward a greener future.

ECOTONE RENEWABLES

CEO and Co-Founder Dylan Lew

Building a World Without Food Waste

According to the United States Department of Agriculture, people in the United States waste about 30-40% of the food supply. Since the founding of Ecotone Renewables in 2019, the Pittsburgh-based startup has converted 180,000 pounds of food waste into organic fertilizer and renewable energy.

Ecotone Renewables, co-founded by CMU alum **Dylan Lew** ('21) along with Kyle Wyche and Elliott Bennett, aims to eliminate food waste by transforming wasted food into energy and helping communities to develop sustainable food practices.

The innovation takes food that would normally end up in the garbage and breaks it down through anaerobic digestion. The waste turns into liquid fertilizer, which Ecotone calls "Soil Sauce," and methane gas. Producing over 2600 gallons of Soil Sauce annually,

Ecotone Renewables can divert 90 pounds of carbon dioxide emissions with each gallon of this carbon-negative organic fertilizer. Further, in a landfill, methane gas is released into the atmosphere and contributes to greenhouse gas emissions. For Ecotone, this gas is contained and converted to renewable energy to power the technology.

In June 2023, Pittsburgh International Airport announced a partnership with Ecotone Renewables to convert uneaten food to fertilizer and energy through the composting system, nicknamed ZEUS. The Zero Emissions Upcycling System can be seen at the airport's landside terminal if you look for an 8-foot x 20-foot green shipping container. ZEUS produces enough biogas to power its operations and the fertilizer that is produced can be sold to local farmers or used around the airport grounds.

Beyond the airport, developments to reduce food waste are in line with Pittsburgh's Climate Action Plan, and Ecotone's partnership with the City of Pittsburgh runs deep. Two co-founders are alumni of Pittsburgh universities, and the startup also participated in the eighth cohort of PGH Lab, a program that connects government officials and local startups.

Communities around Pittsburgh have benefitted from these anaerobic digestion systems over the past few years. East Liberty and Swissvale locations each process roughly 10 tons of food waste each year, taking food from organizations like the Greater Pittsburgh Community Food Bank, 412 Food Rescue and local neighborhood compost bins. They have 5 operating ZEUS digesters throughout the city and will launch 3 more in February 2024.

Ecotone Renewables has won multiple innovation and entrepreneurship competitions in the area. In September 2023, the company won the Pitt Sustainability Challenge, a \$300,000 prize to advance carbon neutrality in the University of Pittsburgh community. ZEUS composters will be placed on or near the University of Pittsburgh's campus to convert the campus's wasted food to Soil Sauce that can fertilize the campus's green spaces and gardens—increasing garden yields by over 30%.

Currently, the company is looking to expand its technology to cities around the United States, ultimately aiming to bring greater sustainability to our energy systems and reducing food waste.

Read more about CMU's energy startups at cmu.edu/energy/research-innovation/energy-innovations/startups.html



INNOVATION NEWS



Farm to Flame, which utilizes plant-based feedstocks for smokeless and odorless electricity generation, won \$150k in the UpPrize Sustainability category, funded by the BNY Mellon Foundation. Farm to Flame also won the Runner-Up prize for Climate Impact and Regeneration and received \$50,000 in August 2022 during the Cisco Global Problem Solver Challenge.



Ansys received \$10 million in funding from NASA to pursue research with its simulation technology to develop zero-carbon jet engines using liquid ammonia as fuel.



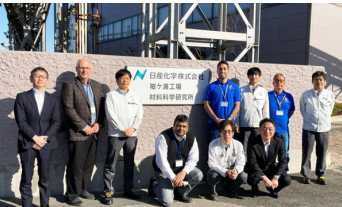
Stratus Materials announced progress toward establishing a pilot manufacturing plant in Pittsburgh that would produce a cobalt-free cathode to be used in the lithium-ion battery industry. Co-founder Jay Whitacre, former Director of the Scott Institute, indicated the company has taken the next step toward commercialization after completing a \$12 million Series A financing round last year that included Bill Gates' Breakthrough Energy Ventures.



CorePower Magnetics was selected by the Advanced Research Projects Agency-Energy (ARPA-E) Seeding Critical Advances for Leading Energy Technologies (SCALEUP) program. With this funding, CorePower Magnetics will scale its magnetic solutions for electric vehicles (EVs), EV charging and the grid using various components like inductors, transformers and electric motors. Using their soft magnetics technology, the power electronics components they produce operate with increased temperature stability and are smaller and lighter.



Conservation Labs was selected as one of nine startups to participate in the accelerator to tackle infrastructure-related sustainability challenges. Each of the nine startups will be participate in a five-week program that includes technical training, mentorship and networking. Conservation Labs has developed technology that monitors water usage to reduce costs, carbon emissions and risk for customers.



Arieca worked with Nissan to manufacture its liquid metal-based thermal interface materials (TIMs) at a high volume and supply them to the Asian market. Manufacturing at Nissan's Sodegaura plant will help reach carbon neutrality targets in the semiconductor industry.

OVER 160 FACULTY AFFILIATES ACROSS 30 CMU CENTERS AND DEPARTMENTS

14 ENERGY FELLOWS FROM VARIOUS DISCIPLINES

294 GRADUATES OF ENERGY SCIENCE, TECHNOLOGY AND POLICY MASTER'S DEGREE PROGRAM SINCE 2011

73 SEED GRANT PROJECTS SUPPORTED SINCE 2013

AWARDED \$3.3 MILLION RESULTING IN

NEARLY \$20 MILLION

IN FOLLOW-ON FUNDING

NEARLY 200

ENERGY RELATED COURSES AT CMU

OVER 400 PHD THESES WITH AN ENERGY FOCUS SINCE 2012

ATTENDEES AT 20 EVENTS OVER 1,800



AMERICAN-MADE SOLAR PRIZE ROUND 5 WINNERS MENTORED BY SCOTT INSTITUTE

The Scott Institute serves as one of the U.S. Department of Energy's National Renewable Energy Laboratory (NREL) American-Made Challenges' Power Connectors. The American-Made Challenges have awarded over \$250 million in prize awards to over 650 teams over the five years that the program has been running.

During Round 5 (June 2021-September 2022) of the American-Made Solar Prize, the Scott Institute served as one of two Power Connectors mentoring Hardware Track teams. Both of the winning Round 5 Hardware Track teams were mentored by the Scott Institute, and the teams received \$500,000 each for their hardware prototypes. Both prototypes will make the solar energy industry more efficient and accessible.

Further DOE Prize Partnerships

Serving for a second year as the Mid-Atlantic Regional Convener, the Scott Institute hosted the U.S. Department of Energy Office of Technology Transitions' American-Made EnergyTech University Prize (EnergyTech UP) 2023 Explore Showcase. EnergyTech UP is a competition where student teams compete for more than \$400,000 in cash prizes for identifying an energy technology, assessing its market potential and creating a business plan for commercialization. The Mid-Atlantic Explore event showcased 12 student teams from across the region presenting their business plans for exciting cleantech innovations.

The Scott Institute and the Swartz Center for Entrepreneurship co-hosted the **2023 Cleantech Open Pittsburgh Kickoff** which led to three CMU startups, People Energy Analytics, Power 3D and Silisium Tech, participating in the 2023 Cleantech Open Northeast cleantech accelerator cohort. Power 3D was selected to pitch at the Cleantech Open Global Forum after pitching at the northeast semi-finals pitch event.

Learn more about becoming a partner at cmu.edu/energy/get-involved/partner



U.S. DEPARTMENT OF ENERGY'S ARPA-E ENERGY INNOVATION SUMMIT

The Scott Institute was well represented at the **U.S. Department of Energy's Advanced Research Projects Agency - Energy (ARPA-E) 2023 Energy Innovation Summit**. During the event, recent CMU ARPA-E awardees were highlighted in a research showcase.

Shawn Litster* received \$3.2 M from ARPA-E for his research group to develop novel electrochemical interfaces based on functionalized mixed conductors (FMCs) that produce transformative improvements in polymer electrolyte membrane fuel cell (PEMFC) technology by eliminating the ionomer from the electrode.

Anthony Rollett leads a team that received a \$2.4 million grant from ARPA-E as one of 18 high-temperature materials projects. Rollett also showcased work being done with Prabhu Energy on an NETL-funded project creating prototypes of an Oxiperator device for methane mitigation.

As part of the ARPA-E's Rapid Encapsulation of Pipelines Avoiding Intensive Replacement (REPAIR) Program, **Howie Choset** and Project Scientist Lu Li are creating innovative robotic technologies for inspecting and repairing America's crumbling critical infrastructure.

Venkat Viswanathan* presented with Shashank Sripad about their SCALEUP project with 24M Technologies on lithium metal batteries for electric aviation. Aionics, Inc. co-founder, Austin Sendek presented with Viswanathan about their efforts on machine-learning guided battery materials optimization. CMU startup Chement co-founder "Breakthrough Energy Fellow"

Gregory Houchins presented about their progress on zero-carbon cement.

CMU startup CorePower Magnetics was selected by the Advanced Research Projects Agency-Energy (ARPA-E) Seeding Critical Advances for Leading Energy Technologies (SCALEUP) program and presented at the showcase.



The Scott Institute served as a Wells Fargo Innovation Incubator (IN2) Channel Partner in 2023. IN2 is a partnership between the Wells Fargo Foundation and the National Renewable Energy Laboratory (NREL) with the goal of de-risking innovations and bringing clean technologies to commercial markets. The CMU Energy Week 2023 Investor Forum was selected for an IN2 Channel Partner Connector Award which supports events that offer networking opportunities within the cleantech innovation space.

Executive Director **Daniel Tkacik** attended the IN2 Channel Partner meeting as well as the NREL Industry Growth Forum in May 2023 in Denver, CO. Daniel gave a presentation about the 2022 Channel Partner Strategic Award received by CMU faculty members **Corey Harper** and **Destenie Nock***. He shared findings and next steps relating to their research which includes creating a national map displaying potential inequities in electric vehicle (EV) charging infrastructure development.

* Energy Fellow

FACULTY IN THE MEDIA

Lifewire

The  INDEPENDENT

CGTN
AMERICA

The Verge

Bloomberg

u p r



Ding Zhao was quoted on the potential impact of self-driving cars, delivery robots and drones on reducing greenhouse gas emissions by *Lifewire*.



Reeya Jayan* shared with *UPR's So Undisciplined* her chapter in the book "Women in Mechanical Engineering" about nonlinear career paths.



Costa Samaras spoke with *The Verge* on crypto mining and its effect on energy emissions.



Granger Morgan spoke with *Bloomberg News* on possible effective grid reforms following the attack on two North Carolina electrical substations.



Venkat Viswanathan* was quoted on artificial intelligence in batteries to improve efficiency in *The Independent*.



Valerie Karplus* took part in a panel on climate change with *CGTN America*.



Erica Cochran Hameen highlighted the importance of equity in energy efficiency during a panel discussion around promoting sustainability and green buildings on *Washington Post Live*.

TECH EXPLORIST

CNET

Vox

Pittsburgh
Post-Gazette®

90.5
WESA
Pittsburgh's NPR News Station


NBC NEWS

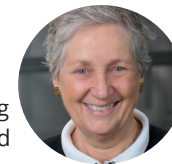

built in



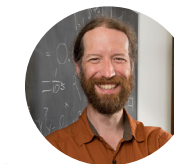
Nicholas Muller spoke with the *Pittsburgh Post-Gazette* on corporate climate requirements.



Amir Barati Farimani was mentioned in *Tech Explorist* as a contributor for new research on self-charging power sources for space applications.



Vivian Loftness* spoke with *CNET* about so-called "energy vampires," devices that use electricity even when not being used as long as they're plugged in. To defeat some of these vampires, Loftness said, you might just need a smart power strip.



Neil Donahue interviewed by *Healthline* on health risks of increased particulate matter in the atmosphere due to air pollution. He also discussed emissions from wildfires in a *Vox* piece on the increasing severity and frequency of air pollution crises.

* Energy Fellow

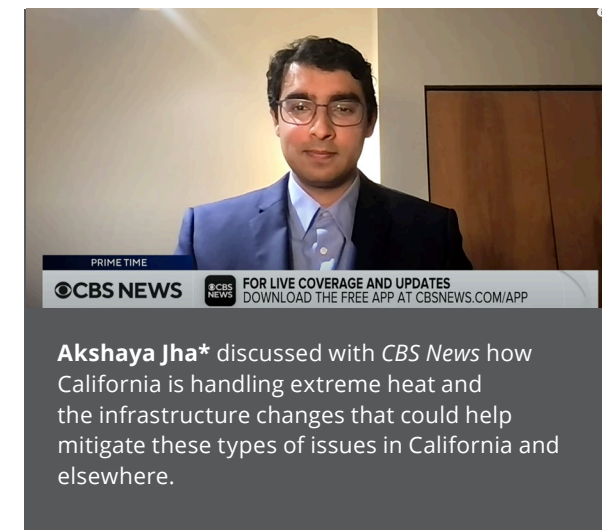
Paulina Jaramillo* commented on the strategy of transitioning local and state government fleets to EVs in a recent 90.5 WESA piece.



Michael Mchenry explained how superconductors work in a *Built In* article on their impact in medicine, power transmission and more.



Baruch Fischhoff discussed how climate-fueled events are stretching safety systems beyond their limits with *NBC News*.



Akshaya Jha* discussed with *CBS News* how California is handling extreme heat and the infrastructure changes that could help mitigate these types of issues in California and elsewhere.

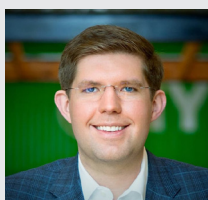
ALUMNI NEWS



Joseph DeCarolis (EPP 2004) was confirmed Administrator of the U.S. Energy Information Administration (EIA). He will oversee a wide range of statistical, analytical and dissemination activities and will serve as a primary spokesperson for the agency.



Andrew Jones (MS, 2019) was one of the prize winners at the Steinbrenner Institute for Environmental Education and Research's Annual Sustainability Symposium for research on the climate impacts of residential cooling demand and its implications on energy burden in Phoenix, Arizona. Jones was advised by Energy Fellow **Destenie Nock** and **Costa Samaras**.



Thomas Healy (MechE and EPP 2014) was elected to CMU's Board of Trustees. He is the CEO of Hylion, a company he started while at CMU which aims "to be the leading provider of electrified powertrain solutions for the commercial transportation industry."

ALUMNI FEATURED IN FORBES 30 UNDER 30



Former Scott Institute intern **Raafe Khan's** (EST&P '16) work with Pine Gate Renewables helped build one of the largest pipelines in the country, furthered domestically manufactured non-Lithium solutions and patented a novel approach toward designing renewable power plants.



Olivia Dipppo's (MSE '15) work uses laser furnace technology to heat iron ore with zero emissions. Dipppo's company LimeLight raised \$3.25M in pre-seed funding to work towards eliminating fossil fuels from the steelmaking industry.



Former Scott Institute Ph.D. student **Shashank Sripad** (ENG '22) researched electric mobility and co-founded And Battery Aero to build electric aircraft batteries supported by \$11.9 million from ARPA-E.

ENERGY FELLOWS

The Scott Institute Energy Fellows Program incentivizes, promotes and rewards Carnegie Mellon University's most dedicated tenure track energy faculty. Each fellow receives funding, resources and membership in the Scott Institute Fellow Council. We are grateful for their contributions to the energy field.

SENIOR FELLOWS

Karen Clay
Professor of Economics
and Public Policy, Heinz College
Tepper School of Business
(Courtesy),
Department of Engineering
and Public Policy (Courtesy)

Vivian Loftness
University Professor,
School of Architecture

Larry Pileggi
Coraluppi Head and Tanoto
Professor, Electrical and
Computer Engineering

FELLOWS

Stefan Bernhard
Professor of Chemistry
Director, Bernhard
Research Group

Paulina Jaramillo
Arthur Hamerschlag Career
Development Professor of
Engineering and Public Policy
Co-Director,
Green Design Institute
(Engineering 2004, 2007)

B. Reeja Jayan
Associate Professor of
Mechanical Engineering,
Chemical Engineering
(Courtesy), Electrical and
Computer Engineering
(Courtesy) and Materials Science
and Engineering (Courtesy)
Principal Investigator, JLAB

Akshaya Jha
Associate Professor of
Economics and Public Policy,
Heinz College

Soumya Kar
Professor of
Electrical and Computer
Engineering
(Engineering 2010)

Valerie Karplus
Associate Professor of
Engineering and Public Policy

Shawn Litster
Professor of Mechanical
Engineering, Materials Science
and Engineering (Courtesy)

Nicholas Muller
Lester and Judith Lave Associate
Professor of Economics,
Engineering and Public Policy in
the Department of Engineering
and Public Policy and Tepper
School of Business
Co-Director, Green
Design Institute

Destenie Nock
Assistant Professor of Civil and
Environmental Engineering and
Engineering and Public Policy
Director, Energy, Equity and
Sustainability (EES) Group

Venkat Viswanathan
Associate Professor of
Mechanical Engineering,
Physics (Courtesy),
Materials Science and
Engineering (Courtesy) and
Chemical Engineering (Courtesy)

Katie Whitefoot
Associate Professor of
Mechanical Engineering,
Engineering & Public Policy,
Heinz College (courtesy)



LEADERSHIP & STAFF

LEADERSHIP & STAFF

Valerie Karplus

Associate Director
Professor, Engineering and
Public Policy, Heinz (Courtesy)

Andrew Gellman

Co-Director
Lord Professor of Chemical
Engineering, Chemistry
(Courtesy), Materials Science
and Engineering (Courtesy)

Daniel Tkacik

Executive Director
(Engineering 2012)

Reed McManigle

Senior Manager, Business
Development and Licensing
Mentor-in-Residence, CMU's
Center for Technology Transfer
and Enterprise Creation

Virginia Delaney

Senior Administrative
Coordinator

Eliza McCarthy

Project Coordinator

Katelyn Haas-Conrad

Assistant Director for
Partnerships

Kristen Whitlinger

Digital Communications
Manager

Teddy Mermigas

Events Manager

A special thanks to our interns
Cody Januszko, Jai Shekhar,
Swaraj Degaonkar, Anthony
Wallace and Juliann Mathis.

FACULTY ADVISORY COMMITTEE

The Scott Institute's internal
faculty advisory committee
offers general strategic advice
and guidance to the Institute.
Committee members serve
terms of one to three years
and are chosen to provide
disciplinary diversity and
representation of faculty
members across the university.
The Institute is grateful
to the following members:

Yuvraj Agarwal

School of Computer Science,
Institute for Software Research

Stefan Bernhard

Mellon College of Science,
Chemistry

Christopher Bettinger

College of Engineering,
Materials Science and
Engineering,
Biomedical Engineering

Karen Clay

Heinz College of Information
Systems and Public Policy
Tepper School of Business
College of Engineering,
Engineering and Public Policy

Erica Cochran Hameen

College of Fine Arts,
School of Architecture
(Fine Arts 2014)

Baruch Fischhoff

College of Engineering,
Engineering and Public Policy,
Institute for Politics and Strategy

Shawn Litster

College of Engineering,
Mechanical Engineering,
Materials Science and
Engineering

Nikolaos Sahinidis

College of Engineering,
Chemical Engineering
(Engineering 1990)

Nicola Secomandi

Tepper School of Business,
Operations Management

Venkat Viswanathan

College of Engineering,
Mechanical Engineering,
Materials Science and
Engineering,
Chemical Engineering

BOARD OF ADVISORS

The Scott Institute Board of Advisors offers general
strategic advice, connections and guidance. The Institute
is thankful for the following members' continued support.

Aristides S. Candris

(Ret.), President and CEO, Westinghouse Electric Co.
Trustee, Carnegie Mellon University
(Engineering 1974, 1978)

Jared L. Cohon

President Emeritus and University Professor
of Civil and Environmental Engineering and
Engineering and Public Policy,
Carnegie Mellon University
Director Emeritus,
Wilton E. Scott Institute for Energy Innovation

Joseph "Joe" S. Hezir

Principal, Energy Futures Initiative
(Engineering 1972, Heinz 1974)

Michael W. Howard

President and Chief Executive Officer,
Electric Power Research Institute

Kathryn Jackson

Director, Energy & Technology Consulting,
KeySource, Inc.
(Engineering 1990)

Raymond J. Lane

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Partner Emeritus, Kleiner Perkins Caufield & Byers
Trustee, Carnegie Mellon University

Kathleen A. McGinty

Vice President, Global Government Relations,
Johnson Controls

J. Michael McQuade

Board of Advisors Member Emeritus
Vice President for Research,
Carnegie Mellon University
(Mellon College of Science 1977, 1978, 1983)

Oliver Morton

Briefings Editor, The Economist

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Sherman A. Scott

President, Delmar Systems, Inc.
(Engineering 1966)

James Skea

Strategy Fellow, Research Councils
UK Energy Programme

Daniel S. Swanson

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Lockheed Martin Corporation
(Engineering 1985)

Susan Tierney

Managing Principal, Analysis Group

Carol A. Williams

(Ret.), Executive Vice President,
Dow Chemical Company
Trustee, Carnegie Mellon University
(Engineering 1980)



SHAPING A SUSTAINABLE FUTURE: LULING HUANG'S QUEST FOR ENERGY EQUITY AND BEHAVIOR CHANGE

Luling Huang, a postdoctoral scholar working with Carnegie Mellon University Libraries and the Scott Institute for Energy Innovation, is immersing himself in the world of energy research with a particular emphasis on disparities in household energy usage and the need for behavior change. In our discussion, he recounted his academic journey, shared valuable insights and underscored the significance of addressing energy equity.

The Journey into Energy Research

Luling's journey into the realm of energy research is a distinctive one, closely tied to his background in communication studies and a strong inclination toward quantitative methods. When he embarked on his postdoctoral pursuit, he was presented with a range of research avenues in energy for social science. Nevertheless, his compass pointed towards energy access and energy poverty, driven by the desire for tangible, real-world impact. "My fascination with human behavior and change further propelled me in this direction," said Luling, making it a perfect fit.

He attributed a significant part of his success to his mentor, Energy Fellow **Destenie Nock**, who provided unwavering support and guidance throughout his postdoctoral odyssey.

Furthermore, this research is part of a shared role with the University Libraries and

the Scott Institute. It is integrated with a larger program that was created with the objective of assisting Ph.D. and postdoctoral students in exploring career options beyond conventional research and teaching (something Luling felt inclined toward).

The Research Focus: Energy Equity and Behavior Change

Luling's postdoctoral research primarily revolves around two core dimensions: energy equity and behavior change. He strongly advocates that access to energy for heating and cooling should be recognized as a fundamental human right. His current work is centered on indoor temperatures, offering insights into the relationship between energy consumption and income.

Understanding energy-limiting behavior is a topic that Luling's work specifically focuses on. It is a growth limiter where a household is unable to or not willing to consume a sufficient amount of energy due to financial constraints. Luling's article found energy-limiting behavior and concludes that the traditional energy burden measure may neglect certain vulnerable households, and there is a pressing need to further support energy home assistance programs to bridge the existing equity gap. These programs are present at the federal and state levels across the country. Assistance is provided through both cash and subsidies on household energy bills. Luling's work creates a case for a more widespread implementation of these programs.

He mentioned that he regularly seeks advice and insights from within Dr. Nock's research group known as the "Society, Policy, Infrastructure, Climate, and Energy (SPICE) Group." This group comprises diverse researchers, led by experts in decision-making, exploring a range of energy consumption facets, including transportation and disparities. An aspect of Luling's role within this group is to assess how effectively researchers manage and share data, a pivotal element in closing the chasm between academic research and practical solutions, as well as advancing open scholarship.

What Lies Ahead?

In the foreseeable future, Luling's research will continue to concentrate on how policymakers can effectively tackle the challenge of energy poverty under the context of energy transition. This will be focused on behavior and belief change through sustained funding to the energy assistance programs and also to encourage the utility providers to identify energy-limiting populations. One of his ongoing projects focuses on how the public values energy-limiting behavior.

Luling is also set to transition into the role of an assistant professor in Media and Communication at Missouri Western State University in January 2024, a move that will further empower him to bridge the gap between research findings and their communication to the general public.

The Role of the Scott Institute for Energy Innovation

The Scott Institute has played a pivotal role in Luling's postdoctoral journey. Besides providing financial support for his research endeavors, the institute displayed openness towards his choice of research topics, enabling him to align his work with his academic background and interests. The serendipitous connection between Dr. Destenie Nock, Luling's mentor, and the Scott Institute led to fruitful collaborations.

Luling was first introduced to Dr. Nock's research lab through his involvement as a judge in a student poster competition hosted by the Scott Institute in March 2021. This exposure ignited his interest and commitment to making energy research accessible and comprehensible to a broader audience.



Additionally, Luling has made valuable contributions to the institute, including designing the "energy expert finder," a tool that assists individuals in locating researchers working on specific energy-related topics within the institute. He also created a dashboard that aids in understanding the impact of climate change on hydropower in the global south, underlining his dedication to making research findings more tangible and accessible.

Luling Huang's academic journey within the domain of energy research is not merely an account of scholarly pursuit but a testament to the significance of addressing energy equity and behavior change. His work underscores the importance of bridging the gap between academic research and its real-world implications, while his collaboration with the Scott Institute emphasizes the critical role institutions play in supporting innovative research and initiatives. In a world grappling with energy-related challenges, Luling's dedication to comprehending and influencing behavior in energy consumption is a significant stride towards a more sustainable and equitable future.

Luling's fellowship is made possible in partnership with the Council on Library and Information Resources (CLIR), with the generous support of the Alfred P. Sloan Foundation.

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Thank you to our generous supporters.

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EnergyTech University Prize

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Wells Fargo Innovation Incubator
(IN2), co-administered by the National
Renewable Energy Laboratory (NREL)

Westinghouse



Sherman and Joyce Bowie Scott

The legacy of Wilton E. Scott, oil and gas geologist and energy industry leader, lives on through the Wilton E. Scott Institute for Energy Innovation. His son Sherman (Engineering 1966) and wife Joyce Bowie Scott (Fine Arts 1965) — pictured at left — established the Institute in 2012, providing support along with the Richard King Mellon Foundation to house it in the Sherman and Joyce Bowie Scott Hall.




Carnegie Mellon University

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