

IMPACT

2018 - 2019 ANNUAL REPORT

Researchers assess
the future of proton
exchange membrane
fuel cells

PAGE 8

Department of Energy
funds CMU project
using machine learning
to power renewables

PAGE 10

CMU VentureWell
Energy Hackathon
launches during CMU
Energy Week 2019

PAGE 12

DIRECTORS' LETTER



Jay F. Whitacre

Director, Wilton E. Scott Institute for Energy Innovation

Trustee Professor in Energy, Materials Science & Engineering and Engineering & Public Policy

With the passing of another year, the global energy and environment outlook continues to challenge us all. There have been some bright spots: the adoption of renewable energy technologies continues to grow everywhere, there is evidence of state, local and corporate entities taking on responsibilities that are not federally mandated and energy and environmental topics are frequently featured in political discourse. However, this past year, the Intergovernmental Panel on Climate Change released its landmark report on the near- and long- term consequences of climate change. We know now more than ever that we must respond in full force as soon as possible if we are serious about responding to these grave threats.

At the Scott Institute, our goal is to commit not only to accelerating the transition to a sustainable, low carbon future, but to also educate others on why our collective effort is imperative.

In 2018-2019, our distinguished lecture series, seminars and CMU Energy Week (page 12) provided opportunities for students, faculty, industry leaders and government/nonprofit partners to engage with experts on a variety of national and local issues, and forge strong collaborations.

While Carnegie Mellon University is but one player in a much larger network striving to make a difference, our research and technologies have the potential to make a positive, global impact. Just this year, one of our Senior Energy Fellows, Edward S. Rubin, was recognized as the world's most prolific and highly cited author of carbon capture and storage-related academic publications (page 7), and we are empowering our students so that they can become the next generation of critical thinkers and problem-solvers tackling the challenges we see today and those we will face tomorrow (page 20).

As Andrew Carnegie famously said, "My heart is in the work," we hope that this impact report reflects this. We are eager to collaborate with you in making the world a better place. We thank you for your attention and please, don't hesitate to contact us.

Best Regards,



Anna J. Siefken

Executive Director, Wilton E. Scott Institute for Energy Innovation
Adjunct Faculty Member, Heinz College of Information Systems and Public Policy

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Powering Electric Vehicles

Fuel cell electric vehicles could significantly reduce fossil fuel consumption and tailpipe carbon emissions.

PAGE 11
Improving the Energy Efficiency of Mobility



Awards from DOE support CMU scientists' work analyzing drone and vehicle delivery.

PAGE 12
CMU Energy Week 2019 Explores What's Next in Energy Innovation

More than 900 registrants and 85+ speakers engaged in dialogue to advance energy technologies.

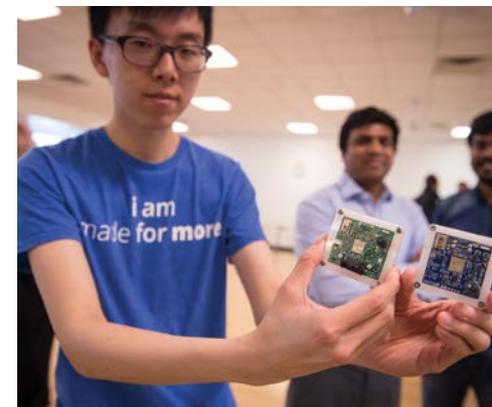


PAGE 20
Sustainability, Energy and the Environment

Energy Fellow Nicholas Muller (EPP/Tepper) teaches at the intersection of economics and environmental policy.

PAGE 28
Bringing New Innovations to Market

Scott Institute and the National Renewable Energy Laboratory are catalyzing cleantech technologies.



PAGE 35
Leading in Climate Change Mitigation

From CMU EPP researcher to international scholar, Jim Skea now serves on the Institute's Advisory Board.

HIGHLIGHTS TIMELINE

JULY 2018

Scott Institute hosts workshop on “**Real-Time Decision-Making for the Subsurface**” with NETL

NOVEMBER 2018

Neil Donahue, Krzysztof Matyjaszewski and Greg Lowry named among the **world’s most highly cited researchers** according to Clarivate Analytics

Scott Institute Executive Director Anna J. Siefken is part of City of Pittsburgh delegation focused on **global energy solutions** for sustainability in Denmark

MARCH 2019

Students teams compete in the Scott Institute’s inaugural **CMUVentureWell Energy Hackathon** during CMU Energy Week 2019

Wells Fargo Innovation Incubator (IN²) awards Scott Institute prestigious Channel Partner Award to drive cleantech innovation

Faculty affiliate Michael McHenry and research team win **Carnegie Science Award** for Advanced Manufacturing and Materials for their work on permeability engineering through strain annealing

JULY 2019

Senior Energy Fellow Edward Rubin recognized by international journal as **world’s most prolific and highly cited author** of carbon capture and storage-related academic publications

Scott Institute Co-Director Andrew Gellman selected to hold **International Guest Chair** as part of the Energy and Environment Solutions Initiative in France

SEPTEMBER 2018

U.S. Department of Energy awards CMU **\$2.5 million** to improve energy efficiency of mobility through two projects

Scott Institute named as one of five “Power Connectors” and receives funding to support the national DOE **American-Made Solar Prize**

DECEMBER 2018

Engineering and Public Policy Postdoctoral Research Associate Michael Whiston presents research on energy storage and participates on a panel with energy experts at **COP24 in Katowice, Poland**

FEBRUARY 2019

Scott Institute Seed Grants for Energy Research program receives 25 proposal submissions with approximately \$1.7 million in requested funding from CMU faculty

MAY 2019

Faculty Affiliate Krzysztof Matyjaszewski elected to the **National Academy of Sciences**

JUNE 2019

The Rockefeller Foundation awards Carnegie Mellon University, Columbia University and the Colorado School of Mines **\$3.8 million** to launch the Electricity Growth and Use In Developing Economies Initiative, an effort to apply data science to electricity demand prediction in energy-poor emerging economies

Civil and Environmental Engineering Ph.D. candidate Kelly Good recognized as a **Siebel Scholar**

The Wilton E. Scott Institute for Energy Innovation at Carnegie Mellon University addresses the world’s most important energy-related challenges by enabling **collaborative research, strategic partnerships, public policy outreach, entrepreneurship and education.**

As one of CMU’s only university-wide institutes, we seek to optimize energy resources, reduce the environmental impacts of energy production and use, and develop breakthrough technologies and solutions that will have meaningful global impact and to accelerate the transition to a **sustainable, low carbon energy future.**

RESEARCH FOCUS AREAS



1. 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



2. 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

3. 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



NEARLY **150** FACULTY AFFILIATES ACROSS 26 CMU CENTERS AND DEPARTMENTS

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

CMU ENERGY WEEK 2019:
 261 ORGANIZATIONS FROM 23 STATES AND 3 COUNTRIES
87 SPEAKERS
11 PANELS
8 KEYNOTES
2.2 MILLION ONLINE NEWS VIEWS

2.5K ATTENDEES AT 35 EVENTS



NSF FACULTY EARLY CAREER AWARD RECIPIENTS



SEED GRANT PROJECTS SUPPORTED SINCE 2013

AWARDED \$2.6 MILLION LEADING TO \$14.4 MILLION IN FOLLOW-ON FUNDING



KRZYSZTOF MATYJASZEWSKI
NATIONAL ACADEMY OF SCIENCES

RESEARCH HIGHLIGHTS



Krzysztof Matyjaszewski, J.C. Warner University Professor of Natural Sciences in

the Department of Chemistry, and Scott Institute Director and Trustee Professor in Energy **Jay Whitacre**, with their research team, developed a semi-liquid lithium metal-based anode that represents a new paradigm in battery design. Lithium batteries made using this new electrode type could have a higher capacity and be much safer than typical lithium metal-based batteries that use lithium foil as anode. Their research was published in *Joule*.



In a 2019 paper, *Examining Different Recycling Processes for Lithium-ion Batteries*, **Whitacre** (Engineering and

Public Policy/Materials Science and Engineering) and Princeton University Postdoctoral Fellow **Rebecca Ciez** (Engineering 2018) laid out a path for battery makers and policymakers to ensure that an influx of lithium-ion batteries doesn't undo the good work of electric vehicles.



Engineering and Public Policy (EPP) and Mechanical Engineering (MechE) Assistant Professor **Kate Whitefoot** co-authored a study

published in the journal *Science* that challenges the EPA's 2018 Fuel

and Emissions Proposal citing that the economic assumptions made in the report resulted in a flawed analysis that will likely increase the amount of greenhouse gas emitted, traffic fatalities and congestion.

In *Quantifying the Economic Case for Electric Semi-Trucks* published in *ACS Energy Letters*, MechE Associate



Professor **Venkat Viswanathan*** and Ph.D. student **Shashank Sripad** compared the cost of traditional diesel semi-trucks to electrically powered ones. They found that switching to electric would reduce the transportation sector's greenhouse gas emissions in about three years or less.



Research by **Nicholas Muller***, Lester and Judith Lave Associate Professor of Economics,

Engineering and Public Policy, demonstrates that the environmental benefits of electric vehicles are often outweighed by the damages caused by increased emissions from power plants. His team's work is published in a National Bureau of Economic Research working paper, *Distributional Effects of Air Pollution from Electric Vehicle Adoption*.



In the paper *Assessing Carbon Pollution Standards: Electric Power Generation Pathways and Their*

Water Impacts published in *Energy Policy*, EPP Professors **Haibo Zhai** and **Ed Rubin*** and their colleagues from Singapore Management University, determined governmental mandates to decrease CO2 emissions could also reduce water use in the power industry.

In a 2018 paper published in *Environmental Research Letters*, a team of EPP researchers, led



by EPP alum **Lynn Kaack**, explored strategies for decarbonizing freight transportation and policies to encourage a "modal shift." The team included Inês Azevedo (Engineering 2009), **Parth Vaishnav** (Engineering 2015) and **M. Granger Morgan*** (pictured above).



Duquesne Light Company Professor of Civil and Environmental Engineering and EPP **Jeanne VanBriesen*** and Ph.D. student

Kelly Good completed a national study of whether coal-fired power plants are unintentionally affecting drinking water treatment plants. They answered the question of where will it be most impactful to control bromide discharges. The results can help the EPA decide

how to regulate power plant discharges (under review in 2019).



Ryan Sullivan, associate professor of MechE and Chemistry, was the first

in North America to use optical tweezers, a 2018 Nobel Prize-winning technique in Physics. This helps him and his team better understand secondary organic aerosols. In a study using this technique, Sullivan discovered that the secondary organic aerosol droplet would phase separate and create a protective shell around the particle's reactive, aqueous core. The optical tweezers allow students to determine key properties of particles that are not possible using other techniques.



Energy executive and Scott Institute Board of Advisors Member

Emeritus **J. Michael McQuade** (Mellon College of Science 1977, 1978, 1983) joined CMU in 2019 as its vice president for Research. Reporting to the university president, McQuade works to strengthen and support research, creativity and entrepreneurship at CMU. He was previously Senior Vice President for Science and Technology at United Technologies Corporation.

THE FUTURE OF FUEL CELLS

Enabling An Electric Vehicle That Could Significantly Reduce Fossil Fuel Consumption

In the quest for the perfect alternative to gas-powered vehicles, there have been many contenders over the years. When it comes to public perception, battery electric vehicles (BEVs) are some of the most widely known. But among experts in the field, another alternative could show even greater promise for future vehicle electrification: fuel cells. In particular, proton exchange membrane fuel cells (PEMFCs). However, despite decades of development, PEMFCs still lack wide market acceptance in vehicles.

To understand what is affecting this acceptance and where the market is going in the future, CMU researchers conducted an expert elicitation assessment of the current and expected future cost and performance of automotive PEMFCs. Their paper was published in the Proceedings of the National Academy of Sciences.



Scott Institute Director **Jay Whitacre** with College of Engineering Professors **Inês Azevedo** (Engineering 2009), **Shawn Litster**, **Kate Whitefoot** and **Constantine Samaras** (Engineering 2008), and Engineering and Public Policy Postdoctoral Research Associate **Michael Whiston** spoke with fuel cells experts to understand their assessments of PEMFC costs, durability and power density under a hypothetical, large-scale production scenario.

“Expert elicitation draws on the knowledge and experience of individuals who have worked extensively with the technology,” Whitacre said, “and thus can inform the technology’s status and future trajectory. In the absence

of published data or conclusive evidence, assessments from expert elicitation could be used to develop technology roadmaps, inform policymaking, guide business decisions and develop analytical models.”

The researchers also asked the experts to quantitatively assess what it will take to meet cost and performance goals. Most respondents anticipate that the Department of Energy’s cost goal would be met by 2050. This goal of \$30 per kilowatt would greatly increase the likelihood of widespread adoption by the general public.

More than 45 percent of respondents expect the DOE’s targets for stack durability to be met by 2050, and many anticipate that the target median stack power density could be achieved by 2035. Once these targets are hit, and PEMFCs reach more mainstream adoption, this could spell big things for the auto industry — bigger than battery electric vehicles and even other types of fuel cells.

“The benefits of PEMFCs over batteries include faster refueling times and longer ranges,” Whiston said. “Fuel cell electric vehicles refuel within five minutes and operate at ranges exceeding 300 miles. Battery electric vehicles tend to be more limited in range, depending on the battery’s size and cost, and can take hours to recharge.”

Because fuel cell electric vehicles operate efficiently on carbon-free hydrogen, they could significantly reduce fossil fuel consumption and tailpipe carbon emissions in vehicles. Hydrogen fuel can be produced by a range of low-carbon electricity sources, including natural gas, so fuel cell electric vehicles could substantially reduce the net amount of greenhouse gas emissions from passenger cars. Additionally, these fuel cells emit none of the harmful tailpipe criteria pollutants, such as nitrogen oxides, particulate matter and carbon monoxide, making them much safer for human health. ■

FEATURED AWARDS & HONORS



Assistant Professor of Chemical Engineering **Zachary Ulissi** is leading a \$3.5 million DOE-funded project at CMU to develop

machine learning software that will accelerate molecular simulations. The simulations will focus on electrocatalysis, a process that performs chemical reactions using electricity as a driving force. These chemical reactions are important because they power renewable energy sources, like fuel cells and waste carbon dioxide utilization for fuels. Project partners include Brown University, Georgia Tech and MIT.



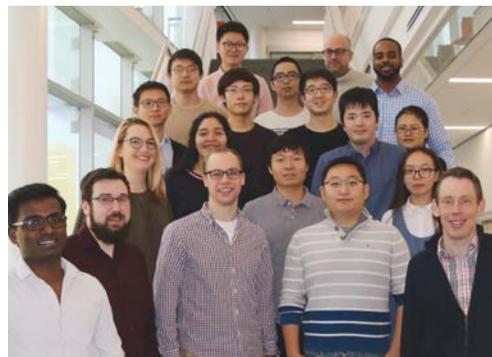
Mechanical Engineering (MechE) Assistant Professor **B. Reeja Jayan** was awarded a 2018 National Science Foundation Faculty Early Career Development

Program (CAREER) Award to study the potential of 3D printed ceramics. The award, including \$500,000 in research funding, is given to a faculty member in the early stages of their career with a proven potential to be a leader in their field and to integrate their research into novel educational opportunities. 3D printing ceramics could potentially achieve the same quality of results as current manufacturing methods — at a fraction of the energy cost.



Two Electrical and Computer Engineering Professors won 2018 Siebel Energy

Institute Seed Grants totaling \$100,000. **Pulkit Grover** received a grant for his project, *Coded Blockchain Architectures for Secure Cyber-Physical Systems (CPS) Based on Physical Proof-of-Work*. **Gauri Joshi** was selected for her project, *Privacy-Preserving Data Analytics in Cloud-Based Cyber-Physical Systems*.



The DOE recognized Mechanical Engineering Professor **Shawn Litster** with a 2019 Fuel Cell R&D Merit Award for outstanding leadership in conducting the project, *Advanced PGM-Free Cathode Engineering for High Power Density and Durability*. Litster is leading a team of scientists from CMU's College of Engineering, State University of New York Buffalo, Giner and 3M. The project's success is due to the team's strength in catalyst development, membrane electrode assembly fabrication and characterization and to the well-organized collaboration of industry, academic and national laboratory partners led by Litster.



From 2018-2019, Scott Institute Executive Director and Heinz College adjunct faculty member **Anna J. Siefken** was recognized multiple times for her

dedication to promoting energy efficiency, green initiatives, environmental practices, education and innovation. In 2018, the National Renewable Energy Laboratory selected Siefken as a member of its national Energy Executives Leadership Academy cohort. She then received a 2019 Women of Influence Award from the Pittsburgh Business Times.

School of Architecture Ph.D. candidates **Zhiang Zhang** and **Chenlu Zhang**, and Professor **Khee Poh Lam**, received an Outstanding Paper Award at the International Building Physics Conference for their paper titled, *A Deep Reinforcement Learning Method for Model-based Optimal Control of HVAC Systems*. Theirs was one of only six papers to receive an award out of nearly 200 peer-reviewed accepted papers at the conference that took place Sep. 23-26, 2018 in Syracuse, New York. Professor **Vivian Loftness*** delivered a presentation on *Intelligent Buildings for Resiliency, Health and Productivity*.



Faculty Affiliate **James H. Garrett Jr.** (Engineering 1982, 1983, 1986), a leading figure in computing in civil engineering, was honored by the American Society of Civil Engineers with inclusion in its 2018 class of Distinguished Members for pioneering work in bringing advanced computing technologies into civil engineering and for continued academic and professional leadership in engineering and education. Garrett was also named CMU's provost and chief academic officer on Jan. 1, 2019.

In 2018, The Andrew W. Mellon Foundation granted CMU \$225,000 for a prestigious 2019-2020 Sawyer Seminar on *Bread and Water: Access, Belonging and Environmental Justice in the City*.



The seminar brought together international scholars and Pittsburgh-area practitioners to explore policies and practices that promote access to urban food and water systems based on equity, inclusion and resiliency. *Bread and Water* is the brainchild of History Professors **Abigail Owen** and **John Soluri**. Scott faculty affiliate **Joel A. Tarr** (pictured) was instrumental to the project.



In 2018, the Department of Energy awarded two CMU projects \$2.5 million to improve the energy efficiency of mobility.

The team working on the project, *Understanding and Improving Energy Efficiency of Regional Mobility Systems Leveraging System-level Data*, includes **Sean Qian**, **Chris Hendrickson**, **Jeremy Michalek** (Engineering 1999), **H. Scott Matthews** and **Constantine Samaras*** (Engineering 2008). The second project *Drones, Delivery Robots, Driverless Cars, and Intelligent Curbs for Increasing Energy Productivity of First/Last Mile Goods Movement* is comprised of **Sebastian Scherer** (Computer Science 2004, 2007, 2011), **Qian**, Alexandre Jacquillat, **Michalek** and **Samaras** (lead PI).



Behavioral and Workpla
To ask questions, open [slido.com](https://www.slido.com)
Then, type event code: #cmuenergy

#CMUEnergy
@CMUEnergy
cmuenergyweek.org



The "Energizing Pittsburgh — Creating a Resilient Future" forum featured distinguished female leaders in the City of Pittsburgh's mobility and infrastructure planning sectors, and explored opportunities to create a resilient future for Pittsburgh. Panelists included Mary Conturo (Sports & Exhibition Authority of Pittsburgh and Allegheny County), Katharine Eagan Kelleman (Port Authority of Allegheny County), Karina Ricks (Department of Mobility and Infrastructure) and Arletta Scott-Williams (ALCOSAN).

CMU ENERGY WEEK 2019 EXPLORES **WHAT'S NEXT** IN ENERGY INNOVATION

Hosted by the Scott Institute, the fourth annual CMU Energy Week brought together thought leaders from energy and cleantech sectors to engage and collaborate. From the inaugural CMU VentureWell Energy Hackathon to mainstays, such as the CMU Energy + Cleantech Investor Forum and the Student Research Poster Competition, CMU Energy Week was a success. CMU Energy Week 2019 drew over 900 registrants for a facilitated dialogue on how to advance energy technologies and innovations around the world.

DAY 1

The CMU VentureWell Energy Hackathon welcomed over 80 participating students and five organizations including Chevron, Honda, the Pittsburgh Parking Authority, NextEra Energy Resources and the Port Authority of Allegheny County. Team Bottlerockets (Joshua Pope, **Lilan Huang** and **Kwaku Jymafi**) placed first and took home \$2,000 for their innovative solution to Chevron's challenge. Cash prizes were also given for second and third places as well as People's Choice. Later in the afternoon, over 150 students met with energy companies at the Energy Industry Career Fair.

DAY 2

CMU Energy Week 2019 officially kicked off with a welcome by CMU leadership and City of Pittsburgh officials including Mayor William Peduto, Chief Resilience Officer Grant Ervin, County Executive **Rich Fitzgerald** (Engineering 1981) and Councilman Corey O'Connor. Keynote speakers included Thomas Siebel, chief executive officer of C3.ai, who discussed the digital transformation and the company's analytics work across the smart grid. The day consisted of four panels and concluded with a forum of Pittsburgh's distinguished female leaders in the mobility and infrastructure planning sectors.

Continued from page 13

Mary Conturo, executive director of the Sports & Exhibition Authority of Pittsburgh and Allegheny County; Katharine Eagan Kelleman, chief executive officer of the Port Authority of Allegheny County; Karina Ricks, director of the City of Pittsburgh's Department of Mobility and Infrastructure; and Arletta Scott-Williams, executive director of the Allegheny County Sanitary Authority (ALCOSAN) discussed how to create a resilient future.

Later that afternoon, CMU students presented over 30 posters showcasing their innovative research. In first place, **Lola Ben-Alon**, a CMU School of Architecture Ph.D. candidate, won \$1,000 for her poster on *Integrating Earthen Building Materials and Methods Into Mainstream Construction*. Cash prizes were also awarded to second and third place teams as well as to People's Choice and Best In-Person Presentation winners.

DAY 3

CMU Energy Week 2019 activities continued Wednesday with a networking breakfast and several panels. First, a panel of recent CMU alumni reflected on their first years in the energy sector.

Energy Fellow **Constantine Samaras** (Engineering 2008) led a panel of experts from Tesla, Ford Smart Mobility, NREL, the City of Pittsburgh and Duquesne Light Company in a discussion about e-mobility. Afterward, NextEra Energy Resources Senior VP of Development Michael O'Sullivan presented an inspiring keynote aimed at the current landscape of utility-scale wind and solar power, with a look ahead at storage.

Later in the day, Barbara J. Burger, president of Chevron Technology Ventures, spoke about the relationship between corporations and the "innovation ecosystem."

Before an evening reception at the Tepper Quad, Matthew Nordan, managing director of PRIME Impact Fund, delivered a keynote speech about how a new strand of investors is mobilizing capital to fund high-risk, high-impact breakthroughs in cleantech.

DAY 4

The day began with a keynote by Cleantech Open Executive Director Ken Hayes. Panelists from Chevron Technology Ventures, Clean Energy Trust, Babst Calland, Energy Foundry and Mountain State Capital SBIC, LP then spoke about energy and cleantech innovation, commercialization and emerging cleantech trends in data analytics and AI.

The CMU Energy + Cleantech Investor Forum and Startup Pitch Showcase followed where 21 startups presented their technologies to a public audience, judges and investors. Prizes were given for the best pitch, which went to the CMU spin-out **Rapid Flow Technologies**. The entrepreneurs met one-on-one with nearly 20 investors from across the nation.

Energy Week concluded with sustainability tours at CMU's Sherman and Joyce Bowie Scott Hall and Phipps Conservatory and Botanical Gardens' Living Campus. ■

**SAVE THE DATE FOR
CMU ENERGY WEEK 2020:
MARCH 23-27**

Interested in partnering with us?
Contact Anna Siefken at asiefken@andrew.cmu.edu. Learn more and sign up for registration and programming updates at cmuenergyweek.org.

Watch videos and view photos from CMU Energy Week 2019 at cmuenergyweek.org.



CMU Mechanical Engineering Ph.D. student Mohamed Abdelrahman presents his team's final pitch at the inaugural CMU VentureWell Energy Hackathon.



Greenlots CTO Harmeet Singh (Engineering 2010) delivers the keynote address at CMU Energy Week 2019.



Carnegie Mellon leadership including Vice President for Research J. Michael McQuade and the Scott Institute's Executive Director Anna J. Siefken and Director Jay Whitacre stand with CMU Energy Week 2019 keynote speaker and C3.ai Chairman and CEO Thomas Siebel.

Featured Speakers

Thomas Siebel
Chairman and Chief Executive Officer, C3.ai

Barbara J. Burger
President, Chevron Technology Ventures

Denise Brinley
Executive Director, PA Governor's Office of Energy

Brian Anderson
Director, DOE National Energy Technology Laboratory

Michael O'Sullivan
Senior Vice President of Development, NextEra Energy Resources

Harmeet Singh
Chief Technology Officer, Greenlots (Engineering 2010)

Ken Hayes
Executive Director, Cleantech Open

Katharine Eagan Kelleman
Chief Executive Officer, Port Authority of Allegheny County

By the Numbers

261 organizations from **23** states and **3** countries

87 speakers

11 panels and **8** keynotes

4 networking sessions

20 event sponsors

2.2 million online news views

SEED GRANTS

Eight CMU Scientists Receive Seed Funding to Spur Energy Research

The seventh round of the Scott Institute's Seed Grants for Energy Research provided funding to eight projects that explore key energy topics ranging from emerging information technology to advances in high-performance materials to natural gas solutions.

The program supports faculty research in areas, such as energy sources, production, efficiency and environmental impacts. CMU professors can receive up to \$75,000 toward their research. In 2019, the Institute awarded \$372,095 with an additional \$126,695 from the EQT foundation for a total of \$498,790 for eight proposals.

"We have had strong faculty participation throughout the entire program. In 2019, the Scott Institute received 25 proposal submissions with approximately \$1.7 million in requested funding," said Executive Director **Anna J. Siefken**. "With approximately 150 faculty affiliates working on energy challenges from different perspectives, we're excited to see a blend of projects focused on technological innovations with those concentrated on policy recommendations."

SEED GRANT FUNDING RECIPIENTS



James Bain (Electrical and Computer Engineering) for "Establishing a New Collaborative Research Thrust in Energy-Efficient Computing"



Alan McGaughey (Mechanical Engineering) for "Thermally-Stable Halide Perovskites for Photovoltaic Energy Conversion"



Ignacio Grossmann (Chemical Engineering) for "Optimization under Uncertainty for Design of Shale Gas Infrastructures and Water Management"



Gauri Joshi (Electrical and Computer Engineering) for "Small-Data Machine Learning Techniques for Natural Gas Exploration"



M. Granger Morgan (Engineering and Public Policy) for "Analysis of U.S. Civilian Nuclear Power"



Matteo Pozzi (Civil and Environmental Engineering) for "Forecasting Induced Seismicity by Integrating Physics-Based Models with Machine Learning"



Venkat Viswanathan (Mechanical Engineering) for "Electrochemical Testing Infrastructure to Enable 'Big Data' for Batteries"



Kate Whitefoot (Mechanical Engineering and Engineering and Public Policy) for "Global Vehicle Emissions Regulations, Product Platforms, and Adoption of Fuel-Saving Technologies"



The Scott Institute Educates and Engages the Public with Solutions to International-Level Energy Challenges

On June 5, the U.S. Department of Energy and the National Rural Electric Cooperative Association hosted the Rural Cooperative Cybersecurity Capabilities (RC3) Summit at CMU. Among the presenters were Electrical and Computer Engineering Professors **Anthony Rowe** (Engineering 2003, 2010) and **Vyas Sekar** (Computer Science 2010) and Systems Scientist **Javad Mohammadi** (Engineering 2016). They spoke to electric utilities and co-operatives about CMU's work related to the Internet of Things, cybersecurity and specifically, Rowe's microgrid design pilot project in Haiti.

The Human Centric Lighting Roundtable held on December 14 in Chicago discussed the power of daylight, the role of smart technology and the increasing use of full-spectrum color and white tuning. Among the panelists, School of Architecture University Professor **Vivian Loftness*** spoke about the benefits of human-centric lighting to health, well-being and productivity.

Ed Rubin* (pictured above), CMU Alumni Chair Professor of Environmental Engineering and Science, Engineering and Public Policy and Mechanical Engineering, keynoted the Interdisciplinary Sustainable Architecture LAB Workshop June 10-15. The conference, hosted by the Polytechnic University of Valencia in Valencia, Spain, brought together an international audience of graduate students and faculty from universities in Europe and North America and focused on sustainable design of

urban areas. Rubin's keynote addressed sustainability challenges and opportunities posed by climate change.

On July 17-18, the Scott Institute, in partnership with the DOE's National Energy Technology Laboratory (NETL), hosted a workshop focused on real-time decision-making for the Earth's subsurface. Aimed at identifying the technology and data required to rapidly analyze subsurface data, the workshop began with opening remarks from NETL and CMU leadership including **Andrew Gellman**, co-director of the Scott Institute.

Tepper School of Business professors **Nicola Secomandi** and **Duane Seppi** were part of the organizing committee for the Commodity and Energy Markets Association Annual Meeting from June 21-22. The conference gathered nearly 100 researchers and practitioners engaged in the study or application of economics, finance, mathematics, operations and risk management in commodity and energy markets.

The 2019 POWER Conference, which brings together scholars and practitioners from around the world to exchange ideas on topics related to energy markets and regulation, featured Heinz College's **Karen Clay*** who discussed *Spatial Externalities in Groundwater Extraction: Evidence from Electricity Usage in California Agriculture and Decompositions and Policy Consequences of an Extraordinary Decline in Air Pollution from Electricity Generation*. ■

* Energy Fellow

POLICY OUTREACH



Scott Institute Executive Director Anna Siefken traveled to Denmark with the University of Pittsburgh to represent the City of Pittsburgh in discussions about global energy solutions for sustainability at the local level with the Danish Energy Agency and City of Arhaus.

2018

Engineering and Public Policy (EPP) Professor **Paulina Jaramillo*** (Engineering 2007) was named lead author for Chapter 10 of the Intergovernmental Panel on Climate Change's (IPCC) Sixth Climate Assessment Report, which focuses on Transport. Jaramillo's contributions are part of the IPCC's Working Group III. The IPCC's assessments on climate change draw on the work of hundreds of scientists from around the world. The reports enable policymakers to make sound, evidence-based decisions.



Scott Institute Professor of the Practice **Joe S. Hezir** (Engineering 1972; Heinz 1974) shared Scott Institute research on *Manufacturing &*

Energy Efficiency Policy Innovations to Advance Industry 4.0 at the Congressional Clean Energy Expo and Policy Forum in Washington, D.C. The event on Capitol Hill, hosted by the Environmental and Energy Study Institute and the Sustainable Energy Coalition, brought together businesses, academia and government agencies to discuss and showcase renewable energy efficiency policy

and technology, and called for more federal support for the renewable energy industry.

Constantine Samaras* (Engineering 2008) presented his research on the energy, safety and sustainability impacts of autonomous vehicles to several U.S. representatives and members of the Alliance to Save Energy's 50x50 Commission at CMU's National Robotics Engineering Center. The Alliance uses energy more wisely for a stronger economy, a cleaner environment and greater energy security, affordability and reliability. The 50x50 Commission brings together business, government and civil society leaders who are working to cut the U.S. transportation sector's energy use in half by 2050.

Scott Institute Director Emeritus **M. Granger Morgan*** and investigators in CMU's EPP Department led an international workshop on *Evaluating Strategies to Restore U.S. Leadership in the International Nuclear Market and Control Regimes* in Washington, D.C. Participants, including the Scott Institute's **Joe Hezir**, developed, assessed and evaluated strategies that could be adopted to begin to restore U.S. global leadership in civilian nuclear power.



2019

For the fifth year in a row, CREATE Labs' **Illah Nourbakhsh** (pictured above) presented EarthTime, a CMU visualization tool, at the World Economic Forum in Davos, Switzerland. EarthTime tells the narrative of the planet's most important stories, looking specifically at climate patterns and energy trends. The CMU team highlighted the fate of our oceans and the warming of the planet, among other topics.

EPP Ph.D. student **Brian Sergi** along with EPP Professors Inês Azevedo (Engineering 2008) and **Alex Davis** (Dietrich College 2009, 2012), and Peking University's Tian Xia and Jianhua Xu, conducted a comprehensive study on whether the public would support reducing China's air pollution and assessed how respondents prioritized factors like energy source, cost and reduction of emissions related to climate change or air pollution. The team found that respondents showed support for reducing emissions related to climate change and air pollution, and on average were willing to pay more for emissions reductions that addressed both issues simultaneously, compared to reductions that only addressed climate or health separately.

Energy Fellow **Constantine Samaras** (pictured below) moderated a panel of fuel cell experts at a policy briefing attended by Congressman Conor Lamb (PA-17). CMU research by Inês Azevedo, **Michael Whiston** and **Jay Whitacre** on fuel cell's impact on vehicles, buildings and utilities was also presented at the briefing on Capitol Hill (page 8). Their work is supported by the Alfred P. Sloan Foundation.



* Energy Fellow

ENERGY EDUCATION

“What I enjoy most about teaching is demonstrating to students how economic reasoning helps in both the design and evaluation of public policies.”

– NICHOLAS MULLER



Muller Blends Economics and Environmental Policy in the Classroom

Nicholas Muller,* the Lester and Judith Lave Associate Professor of Economics, Engineering and Public Policy, joined CMU in 2017. Deeply committed to interdisciplinary research, he fuses his Ph.D. in Environmental and Natural Resource Economics from Yale University with his bachelor of science degree in Public Policy, Planning and Management from the University of Oregon to solve problems at the intersection of environmental policy and economics.

He leads the Tepper School Sustainability Initiative, which offers students an opportunity to pursue scholarship, coursework and career opportunities in sustainability studies. The initiative encompasses a wide range of topics, including energy, natural resources and the environment; health and social well-being; engineering and architecture.

For instance, Muller teaches the undergraduate course “Sustainability, Energy and the Environment” at Tepper. One aspect of the course focuses on climate change.

“I want a student to emerge from this class with the ability to set aside their emotional priors and to approach these problems using empirical evidence and the tools of economics,” said Muller.

Muller also teaches master’s students in the Energy Science, Technology and Policy (EST&P) program where he became a core faculty member in 2018. In “Energy Policy & Economics,” he provides a refresher on basic microeconomics tools and concepts, then dives into energy topics, such as markets for fossil fuels, renewables, environmental externalities and policy design issues.



Tepper Energy Course Solves Real-World Market Challenges

In spring 2019, Tepper offered a new course taught by the Scott Institute’s **Panayiotis Moutis**. “Management in Electric Power Systems and Electricity Markets” exposed graduate students to the challenges of the modern electricity market as well as topics like market deregulation, streams of profit and savings and stakeholder relationships.

The course culminated in a final project where students tackled one of six real-world problems posed by industry experts and academics in the field and presented to their classmates and a panel where they faced challenging questions about their work. **Poorna Mujumdar**, an EST&P graduate student in the class, said talking about the course helped her crack internship interviews. **Nicholas Alexander**, a graduate student in Tepper, explained that Moutis’ course “is one of those rare classes that intertwines business management principles with the technical operations to deliver a multidisciplinary study of the subject.”

Moutis said the students’ stellar performance has raised the bar for future offerings of the course, which he plans to revamp to be even more interactive and stimulate deeper discussion. The course is being offered again with Moutis in fall 2019 with the title “Optimization Applications in Power Systems.”

* Energy Fellow

Continued from page 21



Assistant Professor of Engineering and Public Policy and Mechanical Engineering Kate Whitefoot sheds light on the hidden world of cost analysis and market competitiveness.

Engineering by the Numbers

Kate Whitefoot, assistant professor of Engineering and Public Policy and Mechanical Engineering, is working to shed light on the hidden world of cost analysis and market competitiveness with her course “Quantitative Entrepreneurship: Analysis for New Technology Commercialization.” The graduate-level course focuses on quantitative modeling skills that will help inform students’ entrepreneurial decisions and gives students the opportunity to work with sponsors interested in commercializing new technologies.

This year’s projects included a 3D-printed bike frame, an improved process for creating silicon wafers for solar panels and an electrostatic clutch for use in virtual reality systems. In some instances, students have been asked to continue working with sponsors or were hired due to their performance during the course. Many use their projects as a demonstration of the skills they’ve learned and as major talking points with prospective employers. ■

FEATURED EVENTS



JANUARY 24, 2019

Creating a More Efficient and Secure Energy System

Tony Markel

National Renewable Energy Laboratory

FEBRUARY 19, 2019

Fueling America’s Energy Generation

Brian Anderson

National Energy Technology Laboratory

APRIL 16, 2019

U.S. Energy Efficiency: Progress, Opportunities and Challenges

Kathleen Hogan

U.S. DOE

MAY 15, 2019

Achieving Drawdown: Building the Case for Climate Optimism with the Tools We Already Have

Jonathan Foley

Project Drawdown

JUNE 19

Taking the Lead: Exploring Two Pathways to Pennsylvania’s Energy Future

Andrew Place

PA Public Utility Commission (Heinz 2008)

Denise Brinley

and **Adam Walters**
PA Governor’s Office of Energy

Katrina Kelly-Pitou

SmithGroup

Ryan Unger

Team PA

JANUARY 17, 2019

Advancing a Clean Environment and Clean Energy: Lessons Learned from the Trenches and a Look Ahead

Karl Hausker

World Resources Institute Energy and Climate Programs; Kleinman Center for Energy Policy, University of Pennsylvania

Katie McGinty

Johnson Controls;
Scott Institute Board of Advisors

OCTOBER 8, 2018

Feedback, Fast and Slow — A Field Study on Activity-Specific Feedback on Energy Consumption

Verena Tiefenbeck

Bits to Energy Lab, ETH Zurich

OCTOBER 22, 2018

The Past as Prologue: Learning from the Climate Changes in Past Centuries

Michael Manning

Earth System Science Center,
Pennsylvania State University

WATCH EVENTS ONLINE
at cmu.edu/energy

STUDENT NEWS



The Scott Institute proudly supports students who travel the globe to compete in case competitions, present their research and volunteer their time.



Three **CMU Engineering and Public Policy (EPP) Ph.D. students Aniruddh Mohan, Ashley Orr and Tamara Savage** designed a financing solution for a manufacturing company's rooftop solar program, placed second in Columbia University's Energy Case Competition and took home a \$1,500 cash prize. The annual competition gives graduate students from around the world the opportunity to develop solutions to energy and environmental-related challenges and present those solutions to a panel of judges.

Founded by Heinz College alum **Tiffany Taulton**, CMU in Puerto Rico seeks to understand how communities in Puerto Rico responded to hurricanes Irma and Maria to rebuild and improve their climate resilience for the future in the absence of government. The alternative spring break relief program allowed students to participate in projects related to engineering, energy, climate resiliency, sustainability and community uplift programs.

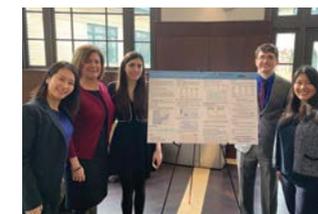


Graduate students in the **Energy, Science, Technology and Policy (EST&P) master's program and Civil and Environmental Engineering (CEE) Department** presented solutions for real-life energy problems at MIT EnergyHack. The EST&P team consisting of **Vibhor Kumar, Akshay Thyagarajan, Rahul Kamath, Shefali Rai, Samanvitha Murty and Ed Liu** took on a challenge by Cimetrics while the second EST&P team, which consisted of **Aditya Belapurkar, Ansh Nasta, Athanasios Terzakis, Daksha Bopanna, Kai-Wei Yu and Poorna Mujumdar**, chose WiTricity's challenge. The CEE team consisting of **Rahim Ali, David DeSmet, Aradhana Gahlaut, Parth Nabar, Akash Pushkar and Kandasamy Sivasubramanian** worked on the CustomerFirst Renewables challenge and proposed a solution that would enable MIT to power its campus using only renewable energy while accounting for hourly load matching. One EST&P team placed in the semi-final round.

CMU graduate students **Madalsa Singh** (EST&P) and EPP students **Vanya Britto** and **Erin Mayfield** presented their research at the 2018 C3E Women in Clean Energy Symposium. Singh presented her work titled *Micro-Hybrid Electricity System for Energy Access, Livelihoods and Empowerment* and Britto and Mayfield showcased their research on the life cycle greenhouse gases associated with the eucalyptus to ethanol pathway in Brazil and the cumulative air, climate and employment impacts of natural gas systems.



CMU EPP students took home first place in the 2018 United States Association for Energy Economics Competition, which focuses on contemporary energy themes and provides a forum for informed collegial discussion about emerging energy realities and how they will impact stakeholders. Ph.D. student **Liza Reed** was awarded Best Poster for her work *Under What Conditions is Conversion of Existing HVAC Corridors to HVDC a Cost-Effective Way to Increase Transmission Capacity?*



A team of four **Heinz College graduate students** including **Clarissa Paz, Krista Mobley, Atsumi Kainosho and Natasha Gonzalez** worked with Scott Institute Executive Director and Adjunct Professor **Anna J. Siefken** to understand the needs and implications of widespread grid-scale solar deployment in southwestern Pennsylvania. In collaboration with the PA Department of Environmental Protection (DEP) and commercial developers and utilities, the team identified 675 financially and environmentally feasible sites for the deployment of grid-scale solar in the Pittsburgh metro area. Based on the acreage of these sites, the potential capacity for the sites is the equivalent of 11 GW of electricity. The students presented their findings in a report to the DEP.

CMU Engineering, Technology and Innovation Management master's student and GEM fellow, **Denise Owusu**, worked at the Idaho National Laboratory (INL) in 2018. The National GEM Consortium increases the involvement of underrepresented groups pursuing a master's degree or a doctorate in science and engineering. INL provides students hands-on experience at a leading research institution.



Mercedes Hesselroth, a CMU student pursuing a combined degree in Global Studies and Drama, submitted a Commitment to Action to the prestigious Clinton Global Initiative University program, which aims to reduce the waste associated with theatrical productions at CMU's renowned School of Drama. Hesselroth said she hopes to implement practices such as recycling lighting gels after performances, using rechargeable batteries in sound packs and ensuring that the lights are off after rehearsal. ■

INNOVATION NEWS



1. CMU's Highmark Distinguished Career Professor of Chemical Engineering **Alan Russell** received the 2018 Innovator Award from the Pittsburgh Business Times for his work as CEO of startup BioHybrid Solutions. Russell co-founded the company with **Krzysztof Matyjaszewski**, the J.C. Warner University Professor of Natural Sciences in the Department of Chemistry, and **Tonia Simakova**, a postdoctoral researcher in the Matyjaszewski Polymer Group. BioHybrid was created in 2016 to produce protein-based products for a range of different industrial applications. Their process uses atom transfer radical polymerization. He and Russell collaborated and developed their technique for commercialization.

2. **Hyllion**, a startup founded by CMU Engineering and Public Policy and Mechanical Engineering alum **Thomas Healy**, won the 2018 Jim Winsor Memorial Technical Achievement Award for its powered auxiliary axle for road tractors and trucks. Called 6x4HE, the fuel-saving electric drive-axle system was selected at the Technology and Maintenance Council's Annual Meeting and Transportation Exhibition in Atlanta, Georgia. Healy is a founding board member of the Allegheny Cleantech University Prize Collegiate Competition, hosted by the Scott Institute.

3. CMU's RoadBotics, a Robotics Institute spinoff that uses smartphone and artificial intelligence technology to monitor the condition of concrete and asphalt surfaces, received the Overall Greatest Impact Award in the American Society of Civil Engineers Annual Innovation Contest. The company received citations including Most Feasible, Most Innovative and Best Value in the Internet of Things category, and Most Feasible in the Sustainable Engineering category. **Christoph Mertz**, Robotics Institute principal project scientist, has spent years developing the smartphone-enabled road inspection tool. He co-founded RoadBotics in 2016, along with **Mark DeSantis**, Benjamin Schmidt and Courtney Ehrlichman, to bring the technology to market.

4. CMU spinoffs, **Grid Fruit** and **ARIECA**, won awards for their innovations at the 2018 TransTech Energy Business Development Conference's Pitch Competition. Grid Fruit, co-founded by **Jesse Thornburg** (Engineering 2018) and ECE Professor **Javad Mohammadi**, won first place for their AI-based learning platform using existing food retail data to reduce energy and maintenance costs. The Technology Assistance Award went to ARIECA for its rubber composites that have unique electrical and thermal properties.



5. A team from **CMU's Robotics Institute** delivered a 270-pound robot called RadPiper to the DOE's former uranium enrichment plant in Piketon, Ohio, where it was successfully used to identify uranium deposits on pipe walls.

6. On Sept. 6, 2018, a team of CMU researchers led by Mechanical Engineering Associate Professor **Venkat Viswanathan**, in collaboration with Ather Energy, was a finalist in the MOVE: Global Mobility Summit's Hackathon. The team, which was one of 30 from around the world, presented its solution for efficient electric vehicle charging infrastructure design in New Delhi, India.

A team comprised of faculty from the University of Colorado Boulder and CMU's Electrical and Computer Engineering Department, including **Soumya Kar** (Engineering 2010) and **Javad Mohammadi** (Engineering 2016), was one of 10 university teams selected to receive funding to participate in the ARPA-E Grid Optimization Competition. Each team received up to \$250,000 to compete to find optimization algorithms, which allow the electrical grid to be operated in an efficient and resilient way. ■



American-Made Solar Prize Round 1 Finalists

Partnering to Advance Energy and Cleantech Innovation



In 2019, the Scott Institute received a prestigious **Innovation Incubator (IN²) Channel Partner Award**. The technology incubator and platform funded by the Wells Fargo Foundation and co-administered by the National Renewable Energy Laboratory (NREL) recognized the Institute for advancing sustainable technology solutions that improve energy efficiency. The Institute, one of just 13 organizations nationally to receive the award, has been working with

partner universities, in collaboration with CMU's Center for Technology Transfer and Enterprise Creation (CTTEC) and the Swartz Center for Entrepreneurship, to understand the overarching needs for a successful cleantech ecosystem.

Support from IN² will be used to create a platform to align and share ideas, foster greater collaboration and develop a shared message for communicating activities and successes, which will attract new investment and nurture talent to the region.



“CMU IS UNIQUELY POSITIONED TO SUPPORT ENTREPRENEURS AND INNOVATORS. WE NEVER KNOW WHERE THE NEXT BREAKTHROUGH IN ENERGY WILL COME FROM, BUT THE SCOTT INSTITUTE HELPS US FIND IT.”

— REED MCMANIGLE, CTTEC MENTOR-IN-RESIDENCE AND SENIOR MANAGER OF LICENSING AND BUSINESS DEVELOPMENT



U.S. DEPARTMENT OF ENERGY

The Institute is working with NREL in another capacity through the **American-Made Solar Prize** — a \$3 million prize competition that incentivizes U.S. innovators and entrepreneurs to rapidly discover, research and deliver new solar solutions to market. In September 2018, the Scott Institute received \$100,000 and was one of five organizations selected by the U.S. Department of Energy's NREL to facilitate and grow the competition.

As one of the designated “Power Connectors” in the American-Made Network, the Scott Institute assists competitors by tapping into its faculty and staff expertise, external partnerships and Carnegie Mellon resources in engineering, technology and data analytics. Further, the Scott Institute has cultivated partnerships both nationally and within the Mid-Atlantic and Midwest regions. With these connections and resources, the Scott Institute and the CTTEC provide competitors with guidance and mentorship as they progress through the contest.

The Institute has supported Round 1 competitors from across the region including BREK Electronics Corp., Omnisole and Solar Guardian. BREK had the opportunity to pitch at the CMU Energy + Cleantech Investor Forum at CMU Energy Week 2019 where they placed third for best pitch. BREK, along with the other teams the Institute assisted, were named finalists in Round 1 of the competition — receiving \$100,000 — and will advance to the final phase for the chance to win an additional \$500,000.



CMU Chemical Engineering Professor **B. Erik Ydstie** also competed in the challenge. Ydstie's project is focused on a novel method to improve the process of making silicon wafers for solar cells based on the observation that solid silicon is less dense than its liquid phase.

With support from the Scott Institute, a team of student research assistants worked with Ydstie to analyze the competitive landscape from a technical, business and intellectual property perspective. They've also helped to develop a funding and partnering strategy for moving the technology toward commercialization.

This type of support for innovators is what the Scott Institute promises as a Connector within the American-Made Network. By combining expertise in technology development, marketplace analysis and pitching, Connectors are helping competitors through each of the three stages of the solar prize competition. ■

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

ALUMNI NEWS



Mitsubishi Hitachi Power Systems (MHPS) Americas and Magnum Development launched the Advanced Clean Energy Storage (ACES) project in Utah. The world's largest project of its kind, the ACES initiative will develop 1,000 megawatts of 100 percent clean energy storage. MHPS Americas is led by President and Chief Executive Officer **Paul Browning** (Engineering 1990) returned to Carnegie Mellon to speak at CMU Energy Week 2019.



In 2018, **Stratos Pistikopoulos** (Chemical Engineering 1988), professor at Texas A&M University, was named the director of the Texas A&M Energy Institute, which pursues energy research in a number of areas, including production, technology, materials, economics, law and policy. Pistikopoulos serves as the course director of the institute's Master of Science in Energy program.



The Annual CMU Alumni Awards celebrate alumni accomplishments and dedicated service to CMU. The 2018 honoree, **Njema Frazier** (Science 1992), is a pioneering nuclear scientist and an advocate for diversity in STEM fields. Frazier was the first African-American woman to graduate with a physics degree from CMU's Mellon College of Science and the first to receive a Ph.D. in nuclear physics from Michigan State.



Travis Carless (PhD, Engineering and Public Policy 2018) was awarded the President's Postdoctoral Fellowship, which is offered to scholars whose research, service and academic pursuits contribute to the university's diversity and equal opportunities. Carless is a Stanton Nuclear Security Fellow at the RAND Corporation. Working with EPP Professor **Paulina Jaramillo*** (Engineering 2007), his research focuses on risk, life-cycle assessments, and nuclear energy and policy.



Dan Amboyer (Drama 2006) is a director and actor. His recent project *Whirlwind*, is an eco-comedy about a clean energy wind developer whose turbines are situated in the migratory path of endangered birds.



Chanette Armstrong (Engineering 1981) was named principal deputy director of the Advanced Research Project Agency-Energy (ARPA-E). She previously served as ARPA-E acting director and director of the Department of Energy's Office of Technology Transitions. She returned to campus for CMU Energy Week 2019.

FACULTY AFFILIATES IN THE NEWS



CNN

Water and climate change

Energy Fellow and Engineering and Public Policy (EPP) Professor **Paulina Jaramillo** (Engineering 2007) spoke about the climate impacts of freshwater resources in a live interview for CNN en Español. She noted these impacts are already happening in Miami, Florida.



NBC

Germany's new hydrogen-powered trains point the way to sustainable rail travel

NBC quoted Mechanical Engineering's **Shawn Litster** (MechE) in an article about some of the first trains in the world to run on hydrogen in Germany. Litster said the trains can reach speeds up to 87 miles per hour and travel up to 600 miles without refueling — about equivalent to the range of diesel trains.



PUBLIC RADIO INTERNATIONAL

Fracking is on the rise in Pennsylvania. So are radon levels. Are they connected?

A research project from Johns Hopkins University found a correlation between the natural gas hydraulic fracturing boom and an increase in radon levels — but not everyone agrees with its conclusions. EPP's **Elizabeth Casman** and her research team took gas samples from pipelines and found that even in worst-case scenarios, risk levels were not too bad.



USA TODAY

Life after solving climate change: Not mud huts and gruel but clean air and warm homes

To observe Earth Day, USA Today imagined the world after climate change is solved. According to **Jay Apt**, director of the Carnegie Mellon Electricity Industry Center, the shift to a cleaner future is already underway.



WIRED

California says "Nope" to the EPA's car emissions rules

While the EPA works to roll back clean car regulations, California's Air Resources Board passed a series of measures to reduce vehicle emissions in the state. WIRED turned to MechE Professor **Jeremy Michalek** (Engineering 1999) who said revoking the waiver could significantly impact the electric vehicle market.

ENERGY FELLOWS

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

Ed Rubin

Alumni Chair Professor of Environmental
Engineering and Science, Engineering and
Public Policy, and Mechanical Engineering

Director, Integrated Environmental
Control Modeling (IECM) Group

Jeanne VanBriesen

Duquesne Light University Professor of
Civil and Environmental Engineering and
Engineering and Public Policy

Director, Center for Water Quality in Urban
Environmental Systems (Water QUEST)



FELLOWS

Stefan Bernhard

Professor of Chemistry

Director, Bernhard Research Group

Paulina Jaramillo

Professor of Engineering and Public Policy

Co-Director, Green Design Institute

(PhD, Engineering 2007)

B. Reeja Jayan

Assistant Professor of Mechanical Engineering,
Chemical Engineering (courtesy), Electrical and
Computer Engineering (courtesy) and Materials
Science and Engineering (courtesy)

Principal Investigator, JLAB

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

Constantine Samaras

Associate Professor of Civil and
Environmental Engineering and Engineering
and Public Policy (courtesy)

Director, Center for Engineering and
Resilience for Climate Adaptation

Co-Director, Carnegie Mellon

Power Sector Carbon Index

(PhD, Engineering 2008)

Zachary Ulissi

Assistant Professor of Chemical Engineering

Director, Ulissi Group

Venkat Viswanathan

Associate Professor of Mechanical Engineering,
Physics (courtesy), Materials Science and
Engineering (courtesy) and Chemical
Engineering (courtesy)

LEADERSHIP & STAFF

LEADERSHIP & STAFF

Jay Whitacre

Director

Trustee Professor in Energy,
Materials Science and
Engineering and Engineering
and Public Policy

Andrew Gellman

Co-Director

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

Anna J. Siefken

Executive Director

Adjunct Faculty Member,
Heinz College of Information
Systems and Public Policy

Reed McManigle

Senior Manager, Business
Development and Licensing;
Mentor-in-Residence

CMU's Center for
Technology Transfer and
Enterprise Creation

Joe S. Hezir

Professor of the Practice

(Engineering 1972,
Heinz College 1974)

Virginia Delaney

Senior Administrative
Coordinator

Amanda King

Communications Analyst

Aiswariya Raja

Research Associate

(Heinz College 2019)

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
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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
(PhD, Fine Arts 2014)

Baruch Fischhoff

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

Bruce Krogh

College of Engineering,
Electrical and Computer
Engineering

Shawn Litster

College of Engineering,
Mechanical Engineering,
Materials Science and
Engineering

Nikolaos Sahinidis

College of Engineering,
Chemical Engineering
(PhD, Engineering 1990)

Nicola Secomandi

Tepper School of Business,
Operations Management

Jeanne VanBriesen

College of Engineering,
Civil and Environmental
Engineering

Venkat Viswanathan

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

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



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(Engineering 1966)*

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*Strategy Fellow, Research
Councils UK Energy
Programme*

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*Software Systems Engineer,
Lockheed Martin Corporation
(Engineering 1985)*

Susan Tierney

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Vice President for Research,
Carnegie Mellon University
(Mellon College of Science
1977, 1978, 1983)*

Q&A INTERVIEW

Prominent climate change scientist, **Jim Skea**, led the Intergovernmental Panel on Climate Change's special report on the impacts of global warming of 1.5° C. A former research associate in CMU's Engineering and Public Policy (EPP) Department, Skea is a professor of Sustainable Energy at Imperial College London's Centre for Environmental Policy and has served on the Scott Institute's Board of Advisors since 2013.



What drives you to continue to serve on the Scott Institute Board of Advisors?

Having worked in CMU's EPP Department a long time ago, the Scott Institute Board of Advisors is a great way to stay in touch with colleagues and pick up on developments in Pennsylvania and the U.S. We recently carried out a project on the role of innovation in shale gas exploitation. It was great to have support from colleagues at CMU, the University of Pittsburgh, as well as from EPP contacts in the Pittsburgh area.

Why is the work of the Scott Institute important to the regional, national and global communities?

CMU's EPP Department is a trailblazer in establishing strong links between public policymaking and the engineering disciplines. The Scott Institute builds on that tradition and leverages CMU's additional strengths. Being in London, I mainly see the global impacts. It's wonderful to see CMU professors like Paulina Jaramillo (Engineering 2007) engaged in international activities, such as the Intergovernmental Panel on Climate Change (IPCC).

You've performed a number of roles within the IPCC, most recently co-chairing Working Group III. What are the findings' impact in the report released in 2018?

The special report on the impacts of global warming of 1.5°C has probably made the biggest impact in IPCC's history. Along with being part of the report leadership, I was lucky enough to be very involved in the subsequent outreach and communication. I wriggled my way into 1,700 print and digital items and 350 broadcast items globally. I was most pleased by a name check in a New York Times editorial. The report overall generated 8 million online views. More importantly, the report has left its mark on intentional negotiations following the Paris Agreement on climate change.

Are you working on any other projects, or planning future ones?

If only there were more days in the week! My calendar is full of IPCC commitments right through 2022. But, my U.K. colleagues and I have recently authored a paper on *Energy Innovation for the Twenty-First Century*. Published by Edward Elgar, it covers energy innovation arrangements and activities in Europe, East Asia and North America. Plus, we are on the lookout for spin-out publications arising from IPCC work. ■

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 American-Made Solar Prize
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 co-administered by the National
 Renewable Energy Laboratory (NREL)



Sherman and Joyce Bowie Scott at the grand opening of Scott Hall.

Wilton E. Scott was an oil and gas geologist and energy industry leader. His legacy lives on through the Wilton E. Scott Institute for Energy Innovation, established in 2012 by his son Sherman (Engineering 1966) and his wife Joyce Bowie Scott (Fine Arts 1965). Support for the Sherman and Joyce Bowie Scott Hall, home to the Institute, was provided by these Carnegie Mellon alumni and the Richard King Mellon Foundation.

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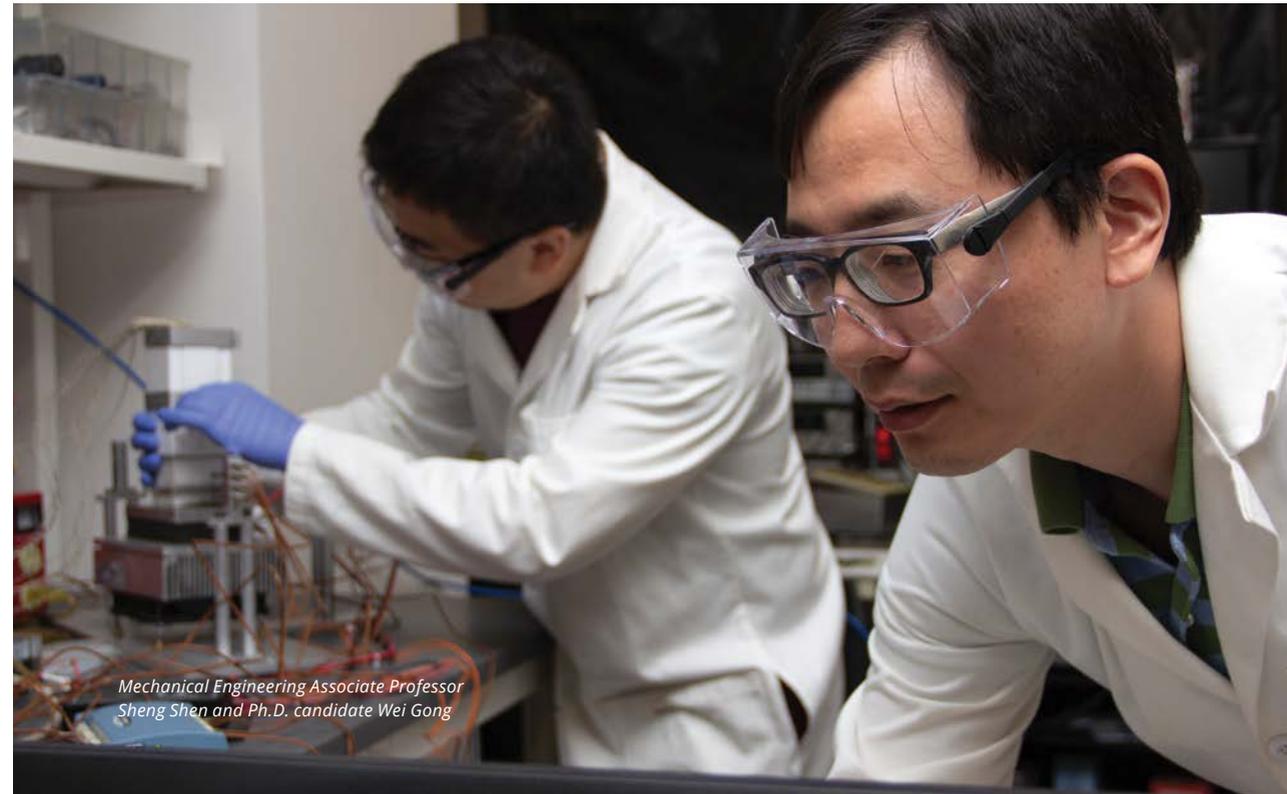
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 U.S. Department of Energy
 American-Made Solar Prize
 VentureWell
 Washington Clean Energy Testbeds
 Westinghouse
 WGL Energy



Students and mentors participate in the inaugural CMU VentureWell Energy Hackathon.



U.S. Representative Conor Lamb (PA-17) meets with Scott Institute affiliated faculty.



Mechanical Engineering Associate Professor Sheng Shen and Ph.D. candidate Wei Gong

Carnegie Mellon University

WILTON E. SCOTT INSTITUTE FOR ENERGY INNOVATION
5000 FORBES AVENUE
SCOTT HALL, 5127
PITTSBURGH PA 15213
T: 412-268-7434
E: scottinstitute@andrew.cmu.edu

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