

IMPACT

FALL 2018 ANNUAL REPORT

CMU Energy Week
2018 draws global
thought leadership
and 1,000 attendees

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The interdisciplinary
Energy Science,
Technology & Policy
master's program

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RoBotany transforms
agriculture with
automated robotics
and software analytics

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DIRECTOR'S LETTER



JAY WHITACRE
Director, Wilton E. Scott Institute for Energy Innovation, Trustee Professor in Energy, Materials Science & Engineering and Engineering & Public Policy at Carnegie Mellon University

By 2050, the projected annual global energy demand will be nearly twice that experienced now (BP Energy Outlook, 2017), and these needs will grow much faster in regions with developing economies. To meet these demands, we will be altering the environment at an alarming pace — often by any means necessary. It is critical to develop and implement new energy technology solutions, and there must be policies that encourage these new solutions and markets that grow around them.

At CMU, faculty, students, researchers and alumni who work in energy-related fields take these challenges to heart, and the Wilton E. Scott Institute for Energy Innovation strives to make the most of what Carnegie Mellon has to offer. We forge collaborative teams and create revolutionary solutions that are unexpected and groundbreaking. In our first annual report, we highlight the many energy-related CMU research projects, activities, events and innovations that have occurred in recent years.

In my first 18 months as director of the Scott Institute, I have interacted with our energy researchers, internal and external stakeholders, industry partners, world-class luminaries and policymakers. I have come to deeply appreciate the potential CMU holds as an institution to impact related energy fields, and I am galvanized by the determination and passion I see amongst my colleagues. They are inspiring and continue to attack the hardest problems with vigor and purpose.

Thank you for choosing to spend time on our Annual Report. We hope you learn something new about our people (like our new Executive Director Anna J. Siefken), our energy research, Carnegie Mellon and Pittsburgh. We look forward to hearing from you and we hope you'll engage with us on social media, attend one of our distinguished lectures or seminars and support the funding of our critical initiatives.

We are excited about our plans for the year ahead: enabling collaborative research, forming strategic partnerships and developing breakthrough technologies and solutions that will have meaningful global impact.

With deep appreciation,

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Mayors of San Juan and Pittsburgh discussed grid resilience in smarter cities at CMU Energy Week.

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EST&P master's program graduates first class of students receiving "Applied Studies" degrees.

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Tepper School of Business alumnus works to solve world hunger with efficient, indoor vertical farming.

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CMU, Itron and other leaders explored issues Pittsburgh faces when managing energy and water resources.

31. **Leadership Spotlight**

David Porges of EQT Corporation works on energy issues that matter.



HIGHLIGHTS TIMELINE

- JUNE 2012**

Scott Institute for Energy Innovation established with a lead gift from Sherman Scott (College of Engineering 1966) and Joyce Bowie Scott (College of Fine Arts 1965)
- JANUARY 2013**

The **Richard King Mellon Foundation** provides transformative gift
- 2015**

A third round of **Scott Institute Seed Grants for Energy Research** results in over \$500K in funding for eight projects (out of 35 submissions)
- APRIL 2016**

The Sherman and Joyce **Bowie Scott Hall opens**
- DECEMBER 2016**

Scott Institute selects its first **Faculty Advisory Committee**
- MARCH 2017**

Jay Whitacre becomes director of the Scott Institute

The Scott Institute launches the Carnegie Mellon Power Sector Carbon Index with support from **Mitsubishi Hitachi Power Systems**
- NOVEMBER 2017**

Scott Institute delegate Deborah Stine attends the **UN Climate Change Conference**
- AUGUST 2018**


Scott Institute appoints **Anna J. Siefken** as its inaugural executive director
- SEPTEMBER 2012**

Scott Institute launches with founding Director **M. Granger Morgan**
- MARCH 2014**

Jared Cohon appointed director of the Scott Institute
- MARCH 2016**

Scott Institute hosts inaugural **CMU Energy Week**; awards DOE-sponsored \$50K to startup Espresso Logic at the Allegheny Cleantech University Prize Collegiate Competition
- SEPTEMBER 2016**

Six CMU students are recognized as **Siebel Scholars**
- FEBRUARY 2017**

CMU Assistant Professor of Computer Science Zico Kolter presents **Applying Machine Learning to the Energy Sector** at ARPA-E Energy Innovation Summit
-  **OCTOBER 2017**

Scott Hall receives **LEED Gold** energy efficiency rating
- APRIL 2018**

The Institute inducts its inaugural class of Scott Institute Energy Fellows

Led by Executive Director Brock Glasgo, the **Center for Sustainable, Equitable, Efficient Energy Services** launches at CMU with support from the Scott Institute

Third-annual **CMU Energy Week** draws global thought leadership and includes inaugural CMU Energy + Cleantech Investor Forum

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.

RESEARCH

Scott Institute Seed Grants Fuel Energy Research

Funding from the Scott Institute has catalyzed new research initiatives ranging from helping people assess the climate risks of hydroelectric projects to finding a new way to produce semiconductors for electronic devices, including electric cars.

The Scott Institute's Seed Grants for Energy Research Program supports faculty research in areas such as energy sources, production, policy and more. CMU professors can receive up to \$75,000 for an 18-month seed project. The objective is to allow faculty members to collect initial data on a project for which they will subsequently apply for external funding.

Since 2013, the annual program has funded six rounds of applications and

44 research teams, yielding 45 projects from 179 proposals. The Scott Institute, the EQT Foundation and the Richard King Mellon Foundation have provided over \$2.3 million in funding. The EQT Foundation has contributed significantly to the program since 2015 to seed new research into natural gas-related issues.

"One impressive aspect of the responses we've received from the six calls for proposals is that they've spanned a wide range of topics, from developing advanced technologies, to human behavior and improving public policy," said Scott Institute Co-director Andrew Gellman, who manages the seed grant program. "Such broad interdisciplinary interest and strength is probably Carnegie Mellon's greatest strength in energy research and education."

As a result of the Scott Institute's seed grants, researchers have received \$13.9 million of external funding from federal agencies, corporations and nonprofits.

New to the 2018 round of funding was support for much-needed repairs and upgrades to research equipment. **The 2018 Instrumentation Repair Program** allows professors to have equipment replaced, repaired and in some cases moved to different locations to increase collaboration.

"Before we introduced the Instrumentation Repair Program, there was no existing maintenance mechanism for equipment that these researchers rely on," said Jay Whitacre. "This program allows our researchers to continue their pioneering work in energy research and education here at Carnegie Mellon." ■

Snapshot: 2018 Seed Grant Funding Recipients

- **Noa Marom**, assistant professor of Materials Science and Engineering (MSE), for *Data Driven Discovery of Singlet Fission Materials*. Marom and her collaborator will test how singlet fission (when a single photon generates a pair of excited states) can increase solar cell efficiency.
- **Lisa Porter**, MSE professor, *To Demonstrate the Growth of Gallium Oxide Crystal Layers*. Porter and her team will research why gallium oxide wide bandgap semiconductors should replace traditional silicon-based electronic energy powers. Porter also will illustrate how those semiconductors are more energy- and cost-efficient.
- **H. Scott Matthews**, professor in the departments of Civil and Environmental Engineering and Engineering and Public Policy, for *Reduced-Form Risk Models for Hydropower Projects Under Climate Change*. Matthews and his team will evaluate how climate change will affect running water as a renewable energy source based on scenario planning.
- **Bryan Webler**, assistant professor of MSE, for *Corrosion Behavior of Variable Composition Steel Thin Films for Sensor Application*. Webler and his research team will test iron-based sensors that can detect natural gas pipeline infrastructure corrosion.

SCOTT INSTITUTE FOCUS AREAS

1. Energy Technologies of the 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

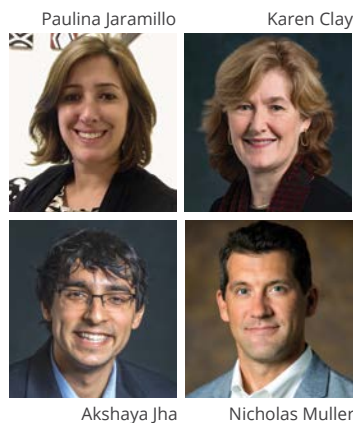
- Grid Modernization, Energy Planning, System Reliability and Resiliency
- Building Performance, Urban Planning, Design and Analytics
- Machine Learning, AI, Autonomous Vehicles and Robotics for Energy Systems
- High-Performance Computing and Data Centers


SCOTT INSTITUTE SEED FUNDING: SUPPORTED 45 PROJECTS AWARDED \$2.3 MILLION THAT LED TO \$13.9 MILLION IN FOLLOW-ON FUNDING FROM FEDERAL AGENCIES, CORPORATIONS AND NONPROFITS


RESEARCH HIGHLIGHTS


 In 2017, Environmental Research Letters editors selected an article by CMU researchers as one of the most significant breakthrough articles from the last 10 years. The article, *Life Cycle Greenhouse Gas Emissions of Marcellus Shale Gas*, was among the first studies of the life cycle environmental impacts of unconventional natural gas development. The authors include **Mohan Jiang, W. Michael Griffin, Chris Hendrickson, Paulina Jaramillo, Jeanne VanBriesen** and **Aranya Venkatesh**.


 A 2017 study by CMU and University of Pittsburgh researchers indicated that the policy debate surrounding crude oil transportation costs is overlooking a serious external cost — air pollution and greenhouse gas emissions. CMU's **Karen Clay, Akshaya Jha** and **Nicholas Muller** with Randall Walsh presented their findings in the working paper, *The External Costs of Transporting Petroleum Products by Pipelines and Rail: Evidence From Shipments of Crude Oil from North Dakota*, published by The National Bureau of Economic Research.



  According to a study co-authored by Engineering and Public Policy and Mechanical Engineering Assistant Professor **Kate Whitefoot**, regulations that set fuel-economy and greenhouse-gas emission goals for cars and trucks have lower costs and higher benefits than previous analyses report. The results were published in a paper titled, *Compliance by Design: Influence of Acceleration Tradeoffs on CO2 Emissions and Costs of Fuel Economy and Greenhouse Gas Regulations*, in Environmental Science & Technology in 2017.



 A 2018 study by Associate Professor of Civil and Environmental Engineering **Constantine Samaras** and co-authors from the Lawrence Livermore National Laboratory, University of Colorado Boulder, and SRI International found that small drones delivering commercial packages could be better for the environment than traditional delivery trucks. The team found that the amount of space needed to store packages for drones and how much energy drones use are important factors, as is the carbon footprint of the electricity used. The paper was published in Nature Communications and received wide media coverage.


 **Allen Robinson** and his research team found that newer gasoline vehicles emit less particulate matter, but vapors in the “cleaner” exhaust form particulate matter in the atmosphere long after exiting the tailpipe. These secondary particles can be just as harmful to human health. The findings were published in Proceedings of the National Academy of Sciences in 2017. Robinson is the Raymond J. Lane Distinguished Professor of Mechanical Engineering.

 **Brandon Lucia**, assistant professor of Electrical and Computer Engineering, Ph.D. student **Alexei Colin** and their research team created the first programming language designed to build reliable software for intermittent, energy-harvesting computers. The team’s paper, *An Energy-Interference-Free Hardware-Software Debugger for Intermittent Energy-Harvesting Systems*, was selected as one of IEEE Micro’s 12 top picks of all computer architecture papers published in 2016.

  Assistant Professor of Mechanical Engineering **Venkat Viswanathan** and Ph.D. student **Shashank Sripad** presented their research on electric semi-trucks in a paper titled, *Performance Metrics Required of Next-Generation Batteries to Make a Practical Electric Semi-Truck*, published in ACS Energy Letters. The paper was the publication’s most-read article of 2017 and Real Engineering featured their work in a YouTube video that has garnered

over two million views. Media outlets including WIRED, the New York Times and The Economist also highlighted their work.

  Duquesne Light Company Professor of Civil and Environmental Engineering and Engineering and Public Policy Professor **Jeanne VanBriesen** with Ph.D. student **Kelly Good** used different sources of bromide information to estimate the amount of bromide entering the Allegheny River basin in Pittsburgh from coal-fired power plants, as well as oil- and gas-produced water management activities. Their research was published in Environmental Science & Technology in 2017. Good and VanBriesen are now applying their methodology to the entire state of Pennsylvania, looking at all power plants and large, community-based drinking water treatment plants.

 In a 2018 paper titled, *An Intertemporal Decision Framework for Electrochemical Energy Storage Management*, published in Nature Energy, Carnegie Mellon and Tsinghua University researchers proposed a new framework that addresses the degradation of lithium-ion batteries — also known as electrochemical energy storage. They do this by deriving, implementing and optimizing new metrics. CMU researchers **Guannan He, Panayiotis Moutis, Soumya Kar** and **Jay Whitacre** collaborated with Qixin Chen from Tsinghua University.

Icons represent some of the Institute's focus areas.



Exploring the Energy-Water Nexus of Power Plants

Daniel Gingerich is a postdoctoral research associate in CMU's Department of Civil and Environmental Engineering (CEE). A 2017 graduate of the highly interdisciplinary doctoral program in Engineering and Public Policy (EPP) at CMU, Gingerich now works in the Water and Energy Efficiency for the Environment (WE3) Laboratory in the Sherman and Joyce Bowie Scott Hall with CEE/EPP Associate Professor Meagan Mauter.

"Daniel's work has focused on understanding air and water emissions trade-offs at coal-fired power plants," Mauter said. "This is an important factor when considering how and what type of environmental control technologies yield the greatest net benefits for human health, the environment and climate."

Gingerich came to CMU to study topics related to water and discovered that many of these topics were closely tied to energy.

"We knew that power plants were facing challenges when it came to water treatment," Gingerich said. "We had a technology that could be really

"DANIEL'S WORK HAS FOCUSED ON UNDERSTANDING AIR AND WATER EMISSIONS TRADE-OFFS."

– MEAGAN MAUTER

good for them, and that evolved into thinking about water management at power plants."

Much of his research involves the energy-water nexus, a term that refers to the interplay between water used for generating energy and energy used for moving, extracting or treating water.

Gingerich's current work focuses on the composition of flue gas desulfurization (FGD) wastewater. FGD is a process that fossil fuel power plants use to remove sulfur dioxide. The research group aims to understand the difference in wastewater between power plants using bituminous and subbituminous coal. Additionally, they are examining how air pollution control devices upstream of the flue gas desulfurization process impact wastewater composition.

Gingerich said he is happy to be a part of the energy ecosystem at CMU because the university's work in the energy field — and beyond — influences the conversations that decision-makers are having. In addition to collaborating with CMU faculty and students, Gingerich has worked with scientists at the National Energy Technology Laboratory and the Electric Power Research Institute. He cites the chance to influence policy as one of the most interesting facets of his time as both a student and a researcher at CMU.

"With regulations in flux right now, especially in the wastewater space, there are a lot of open questions," Gingerich said. "We're trying to see how we can help set an agenda for industry, academia and government to work together on mitigating pollution issues." ■

Learn more about WE3 research at we3lab.com.

FACULTY NEWS

Scott Institute Inducts Inaugural Class of Energy Fellows

To incentivize, promote and reward the Scott Institute's most dedicated energy faculty, it launched "The Scott Institute Energy Fellows Program" during CMU Energy Week 2018. Each fellow receives funding, resources and membership in the Scott Institute Fellow Council.

FELLOWS

Inês Azevedo

Professor of Engineering and Public Policy
Co-director, Center for Climate and Energy Decision Making
Co-director, Carnegie Mellon Power Sector Carbon Index
Principal Investigator, Center for Sustainable, Equitable, Efficient Energy Services

Stefan Bernhard

Professor of Chemistry
Director, Bernhard Research Group

Paulina Jaramillo

Associate Professor of Engineering and Public Policy
Co-director, Green Design Institute
Ph.D., College of Engineering, 2007

Meagan Mauter

Associate Professor of Civil and Environmental Engineering, Engineering and Public Policy, Chemical Engineering (courtesy) and Materials Science and Engineering (courtesy)
Principal Investigator, Water and Energy Efficiency for the Environment (WE3 Lab)

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

Costa Samaras

Associate Professor of Civil and Environmental Engineering, Engineering and Public Policy (courtesy)
Director, Center for Engineering and Resilience for Climate Adaptation
Co-director, Carnegie Mellon Power Sector Carbon Index
Ph.D., College of Engineering, 2008

Venkat Viswanathan

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

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 Paul Mellon Professor Andrew Mellon Professor School of Architecture

Edward 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)

FEATURED AWARDS

CMU's **Center for Air, Climate and Energy Solutions (CACES)**, funded by a \$10 million grant from the Environmental Protection Agency, launched in 2016. This multidisciplinary, multi-institutional research center represents an unprecedented approach to the integrated management of air quality, climate and energy. CACES includes CMU students and faculty from six departments as well as over a dozen faculty members from outside institutions.

In 2017, the Advanced Research Projects Agency-Energy awarded the George Westinghouse Professor of Electrical and Computer Engineering, **Raj Rajkumar**, and his General Motors research team \$4.2 million to develop innovative, predictive "InfoRich" vehicle dynamic and powertrain technologies. If successful, the project will enable at least an additional 20 percent decrease in energy consumption of future connected and automated vehicles.

The U.S. Department of Energy awarded Mechanical Engineering Professor **Shawn Litster** \$2 million as principal investigator of his multi-institution team's research project, *Advanced PGM-free Cathode Engineering for Higher Power Density and Durability*. Litster's work falls into the DOE's category of platinum group metal-free Catalyst and Electrode R&D, which aims to develop catalysts and electrodes from materials other than platinum group metals.

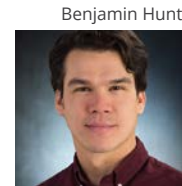
From 2016-2018, eight faculty affiliates have received *National Science Foundation Faculty Early Career Development (CAREER) Program Awards*. The CAREER Award is a notable five-year grant given to junior faculty members for research and education. **Tzahi Cohen-Karni**, **Meagan Mauter**, **Ryan Sullivan** and **Venkat Viswanathan** received awards in 2016; **Matteo Pozzi** and **Yisong Guo** received awards in 2017; and **B. Reeja Jayan** and **Sean Qian** received awards in 2018.

Jay Whitacre, director of the Scott Institute and Trustee Professor in Energy in the College of Engineering, was awarded the *2017 Leigh Ann Conn Prize for Renewable Energy* for creating the first mass-produced, low-cost, eco-friendly battery called the Aqueous Hybrid Ion (AHI™). In addition, Whitacre, along with **Venkat Viswanathan** and **Barnabás Póczos**, won a four-year, \$1.2 million grant from Toyota Research Institute to use an integrated machine learning/high throughput testing stand to select and optimize next-generation electrolytes and electrode materials for lithium-ion batteries.

In 2016, a team of researchers from CMU, the National Rural Electric Cooperative Association (NRECA) and Aquion Energy was awarded approximately \$1 million from the U.S. Department of Energy for its project, *Agent-Based Coordination Scheme for PV Integration*, which aims to develop and demonstrate a distributed, agent-based control system to integrate smart inverters, energy storage and commercial off-the-shelf home automation controllers and smart thermostats. The CMU researchers are: **Gabriela Hug**, **Soumya Kar**, **José Moura**, **Jay Whitacre**, **Javad Mohammadi**, **Panayiotis Moutis** and **Guannan He**.



Tzahi Cohen-Karni, assistant professor in the Departments of Biomedical Engineering and Materials Science and Engineering, and **B. Reeja Jayan**, assistant professor of Mechanical Engineering, received prestigious Young Investigator Awards. The Air Force Office of Scientific Research presented Jayan with the three-year grant for her proposal, *Far-from-Equilibrium Structures and Processes using Electromagnetic Fields: Non Thermal Effects*. The Office of Naval Research selected Cohen-Karni for his proposal,



Benjamin Hunt



Meagan Mauter



Vivian Loftness



Raj Rajkumar



Ignacio E. Grossmann



Burcu Akinci

Three-Dimensional-3D-Nanosensors Array for Measurement of the Electrical Activity of Microscale Human Brain Tissue.

Vivian Loftness, University Professor and the Paul Mellon Chair in the School of Architecture, received the *2018 Professional Leadership Award* from the Northeast Sustainable Energy Association. This award is given annually to those who demonstrate exemplary professional practice and exceptional humanity.

In 2017, **Benjamin Hunt**, assistant professor of physics, was awarded a five-year *DOE Early Career Research Award* in the area of basic energy sciences. Hunt studies the behavior of electrons in extremely cold temperatures and powerful magnetic fields where familiar physics fades away and particles are governed by a different set of laws. There, he said he hopes to discover new materials that could be building blocks for the quantum computers of the future.

In recognition of his outstanding achievements in Process Systems Engineering, **Ignacio E. Grossmann**, the Rudolph R. and Florence Dean University Professor of Chemical Engineering, was awarded the *2017 ETH Zurich Chemical Engineering Medal*. The Institute for Chemical and Bioengineering annually awards the medal to an outstanding individual for his or her exceptional contributions in the broad field of Chemical Engineering.

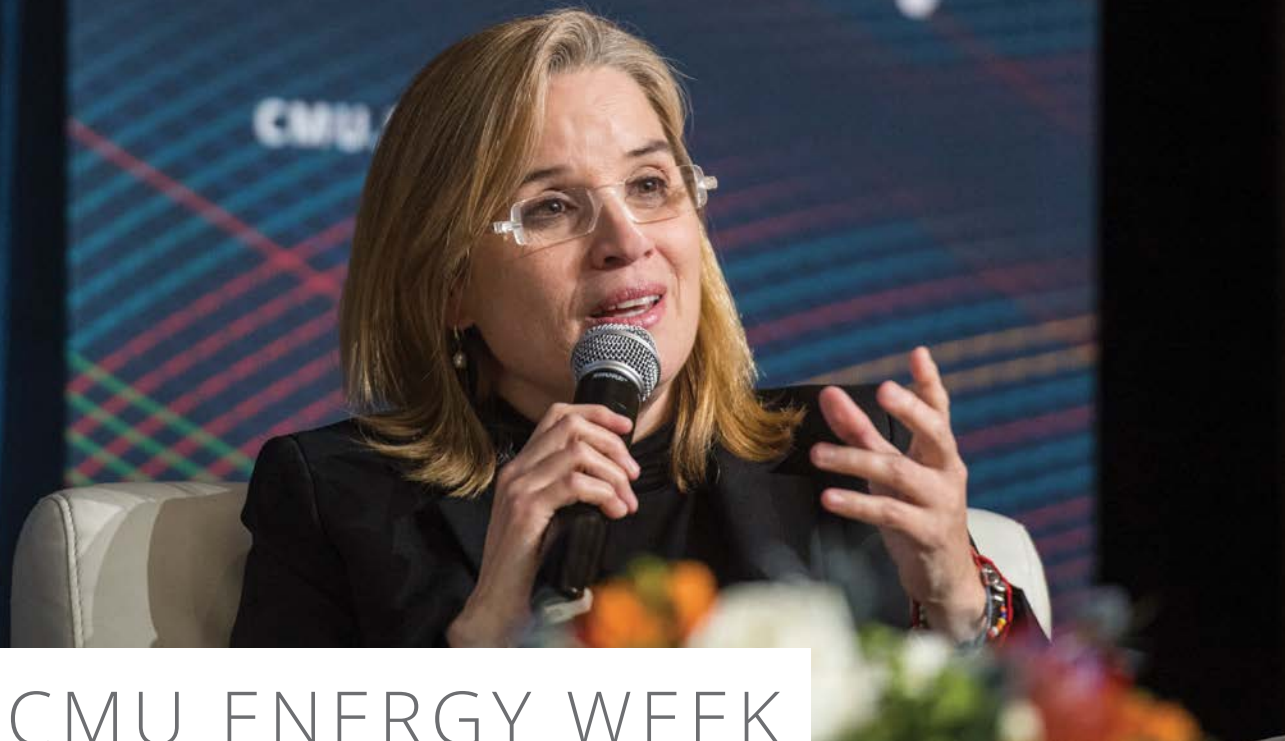
Scott Institute Director Emeritus **Jared L. Cohon** received the *Pennsylvania Environmental Council's 2018 Lifetime*

Achievement Award. Cohon, CMU president emeritus and University Professor of Civil and Environmental Engineering and Engineering and Public Policy, was recognized for his devotion to promoting innovative environmental efforts that enhance the quality of life in western Pennsylvania. Under his leadership, CMU built the first LEED-certified residence hall in the world.

In 2017, **Meagan Mauter**, associate professor of Civil and Environmental Engineering and Engineering and Public Policy, was awarded the *James J. Morgan Environmental Science & Technology Early Career Award Lectureship* by Environmental Science & Technology. This award recognizes researchers who have made creative and new contributions to the field consistent with Dr. Morgan's early contributions. Mauter's work focuses on seeking novel approaches to meet water supply requirements in a sustainable fashion in an energy-constrained world.

LeanFM Technologies Chief Innovation Officer **Burcu Akinci**, Ottomatika founder **Raj Rajkumar** and Rapid Flow Technologies Chief Executive Officer **Stephen Smith** received *The Pittsburgh Business Times inaugural 2017 Innovation Awards* in the fields of facility operations, technology and transportation. The Innovation Awards recognize companies that have made extraordinary advances in their respective fields, challenging conventional thinking.

Carnegie Mellon University



CMU ENERGY WEEK 2018 DRAWS GLOBAL THOUGHT LEADERSHIP

Pictured above: San Juan Mayor Carmen Yulín Cruz spoke with Pittsburgh Mayor William Peduto about the energy challenges and opportunities their cities face in a panel discussion during CMU Energy Week 2018.

The Scott Institute hosted its third annual Carnegie Mellon University Energy Week from April 4-6, 2018. Open to the public, the symposium brought together leaders from industry, government, academia and the nonprofit sector to engage and collaborate on energy research, trends, innovative technologies and opportunities to tackle pressing energy challenges.

Carnegie Mellon Energy Week 2018 was highly successful with approximately 1,000 attendees, over 90 speakers, 45 sessions including five keynotes and nine panels, 14 event sponsors, 280 companies and organizations represented and 25 local and national media placements.

Day 1

Exelon Utilities Senior Executive Vice President and Chief Executive Officer Anne Pramaggiore, who was president and chief executive officer of ComEd at the time of her talk, captivated the audience with her keynote address on ComEd's roadmap for the second electric revolution.

Five incredible panels followed, along with a keynote speech by Don Anderson, operating partner and chief sustainability officer of The Private Equity Group at The Blackstone Group. He discussed the evolution of energy efficiency and sustainability in the building and finance industries.

The day concluded with a Distinguished Mayor's Forum that featured San Juan Mayor and CMU alumna Carmen Yulín Cruz (Heinz 1986) and City of Pittsburgh Mayor William Peduto. Cruz and Peduto discussed resiliency, community and microgrids. Cruz, whose city was devastated by Hurricane Maria in 2017, spoke about the need for a "backup system of micro-grids" built on renewable energy sources, like solar and wind power.

"We must use the opportunity to look at that portfolio of options and to look at other cities that have already started considering these options," she said.

Cruz took the opportunity to thank Pittsburgh and CMU for their relief efforts for Puerto Rico.

"The City of Pittsburgh helped us, but above all Carnegie Mellon University rose to the occasion and showed

what Carnegie Mellon is all about. It's putting technology to work, but making sure that technology doesn't replace the heart of people. Lives were saved because of the people in this room," said Cruz.

"To have witnessed the mayor of Pittsburgh and the mayor of San Juan having such an intimate discussion about the importance of energy and grid resilience will have an impact on future initiatives and planning," said Scott Institute Executive Director and event organizer Anna Siefken.

Day 2

A Corporate and Industry Networking Breakfast was hosted by Mitsubishi Hitachi Power Systems President and Chief Executive Officer and CMU alumnus Paul Browning (Engineering 1990) who announced the release of the 2018 Carnegie Mellon Power Sector Carbon Index report (*read more on page 24*).

During his lunchtime keynote, David Danielson, managing director for Science at the Bill Gates-backed Breakthrough Energy Ventures (BEV), mentioned that his coalition of investors from across the world created a billion-dollar fund that will support BEV in its ventures to support cleantech investments. These projects will reduce at least half of a gigaton of greenhouse gases during every year of BEV's operation.

"CARNEGIE MELLON IS MAKING SURE THAT TECHNOLOGY DOESN'T REPLACE THE HEART OF PEOPLE. LIVES [OF PUERTO RICANS] WERE SAVED BECAUSE OF THE PEOPLE IN THIS ROOM."

– CARMEN YULÍN CRUZ

Day 2 also featured the CMU Scott Institute Faculty Seed Funding Showcase, the CMU Energy + Cleantech Investor Forum and Startup Fair, four panels, two speakers, an energy-themed monologue competition plus CMU Sustainability Weekend's opening showcase.

The day concluded with a special evening reception commemorating the Sherman and Joyce Bowie Scott Hall's LEED Gold certification from the U.S. Green Building Council. The Scott Institute also inducted its inaugural class of energy faculty fellows and director emeritus (*read more on page 9*).

Day 3

The final day of CMU Energy Week featured the Allegheny Cleantech University Prize Collegiate Competition where spotLess Materials LLC, a student team from Pennsylvania State University formerly named WasteLESS Tech, took home the DOE-sponsored \$50,000 grand prize for developing a coating to reduce water consumption. New to the 2018 competition was a \$35,000 prize from the U.S. Department of Defense that was awarded at nationals.

Afterward, the Scott Institute awarded \$2,500 in total prizes to CMU students in the annual CMU Energy Week Poster and Multimedia Competition.

Philips Lighting Chief Executive Officer Chris White spoke about the benefits of LED lighting innovations during his keynote, highlighting a smart light pole that his company installed in Huntington Beach, California. Smart poles like these each have 5G Wi-Fi and environmental antennas to cultivate a better community. White went on to speak about the IoT and future smart lighting applications.

One panel, an evening keynote, two field trips and two on-campus tours later — and CMU Energy Week 2018 officially concluded.

"The conversations and insights shared during CMU Energy Week 2018 were extraordinary," Siefken said. "We had thought leadership from around the world, and we could not be more pleased with the outcomes." ■

2018 CMU Energy Week Featured Speakers

Carmen Yulín Cruz
(Heinz 1986)
Mayor, San Juan

William Peduto
Mayor, City of Pittsburgh

David Danielson
Managing director for Science, Breakthrough Energy Ventures

Chanette Armstrong
(Engineering 1981)
Director, U.S. Department of Energy Office of Technology Transitions

Chris White
Chief executive officer, Philips Lighting

Anne Pramaggiore
Senior executive vice president and chief executive officer, Exelon Utilities

Alex Laskey
Founder and president, Opower

Don Anderson
Operating partner and chief sustainability officer, The Private Equity Group, The Blackstone Group

SAVE THE DATE

CMU Energy Week 2019 is March 25–28. Learn more and sign up for registration and programming updates at cmuenergyweek.org.



FEATURED LECTURES AND SEMINARS

2016

October 19, 2016
COP 21 and the Future of Fossil Energy

Christopher Smith
Former U.S. Department of Energy Assistant Secretary for Fossil Energy

November 9, 2016
Internet of Things: Unwrapping the Myth

Thomas M. Siebel
Siebel Energy Institute Chairman and C3 IoT CEO

2017

February 16, 2017
Energy and Water: Powering the Modern City

Philip Mezey
Itron President and Chief Executive Officer

March 7, 2017
Energy Insights and Career Reflections

Stacey Olson
Chevron Appalachia, LLC President

April 5, 2017
Designing the Utility of the Future

Val Jensen
Exelon Utilities Senior Vice President, Strategy and Policy

September 13, 2017
The Future of Sustainability, Efficiency and Transportation

Cindy Adams Dunn
PA Department of Conservation and Natural Resources Secretary

Leslie Richards
PA Department of Transportation Secretary

September 27, 2017
The Information Revolution and Sustainable Development

Jeffrey Sachs
Columbia University Center for Sustainable Development Director and University Professor

November 29, 2017
Navigating the Turbulence of the Global Energy System

Arun Majumdar
ARPA-E Founding Director and Stanford Precourt Institute for Energy Co-director

2018

January 29, 2018
Combining High Throughput Synthetic Methods and Computational Materials Science

Abraham Anapolsky
Toyota Research Institute Manager

April 5, 2018
The Academia-Industry-National Laboratory Partnership for Innovation

Randall Gentry
National Energy Technology Laboratory of the U.S. Department of Energy Deputy Director and Chief Research Officer

August 15, 2018
Advanced Manufacturing for Carbon Capture and Clean Energy Systems

Joshuah Stolaroff
(Engineering 2003, 2006) Lawrence Livermore National Laboratory Carbon Capture Program Environmental Scientist

POLICY OUTREACH HIGHLIGHTS

2016



Engineering and Public Policy Professor **Inês Azevedo** participated in a workshop held by the National Academies of Sciences' U.S. Global Change

Research Program's Board on Environmental Change and Society. The workshop explored ways to frame the fourth National Climate Assessment (NCA) and future NCAs in terms of climate-related hazards, risks and opportunities.



Carnegie Mellon and the University of Pittsburgh hosted former President Barack Obama during the White House Frontiers Conference in October.

The national conference brought together the world's leading innovators to discuss building U.S. capacity in science, technology and innovation, and the new technologies, challenges and goals that will shape the 21st century and beyond. These CMU energy experts participated in the conference: **Burcu Akinci, Inês Azevedo, Neil Donahue, David Dzombak, Vivian Loftness, Raj Rajkumar, Edward Rubin** (pictured above), **Costa Samaras, Deborah Stine** and **Jay Whitacre**, as well as alumna **Hahna Alexander**.

2017

Scott Institute Director and Trustee Professor in Energy **Jay Whitacre** and Engineering and Public Policy Professor **Erica Fuchs** served on an 18-month National Academies of Sciences panel that was charged with assessing the impact of the Advanced Research Projects Agency-Energy, a DOE organization conducting early-stage energy technology program work. There was significant publicity around the report launch.

At the World Economic Forum Annual Meeting in Davos-Klosters, Switzerland, **Illah Nourbakhsh**, professor of Robotics and director of the CREATE Lab at the Robotics Institute, and **Randy Sargent**, senior systems scientist and commercialization specialist, presented a continuation of their Earth Time-Lapse research with new data images focusing on urban fragility, nutritional deficiency forecasts due to climate change and other data sets. **Thomas Healy**, Carnegie Mellon alumnus and chief executive officer and founder of the CMU startup Hyliion, also participated in the meeting.



Former Scott Institute Director and CMU President Emeritus **Jared L. Cohon** became the new chair of the National Academies of Sciences, Engineering

and Medicine's Board on Energy and Environmental Systems, which oversees activities and committees to provide expert advice through prestigious, independent, impartial and influential studies on complex issues in science, technology and public policy. In March, Pittsburgh Mayor William Peduto appointed Cohon to the Pittsburgh Water and Sewer Authority (PWSA) Blue Ribbon Panel, which comprises local political, energy, academic and business professionals who are tasked with bringing improvement to the PWSA.



The Scott Institute hosted a policy briefing titled, "*Pipelines, Trucks, Buses and Automobiles: Where, When, Which?*" in Washington, D.C., in May 2017. CMU Professors **Karen Clay, Inês Azevedo, Jeremy Michalek** and former Postdoctoral Research Associate **Fan Tong** presented on several studies that provide guidance to policymakers for decisions they make related to energy and transportation.

Hamerschlag University Professor of Engineering **M. Granger Morgan** was elected to the American Academy of Arts and Sciences, joining the world's most accomplished scholars, scientists, writers, artists and civic leaders. In 2016, he received the Public Service Award from the Federation of American Scientists for his distinctive contribution to public policy. Morgan's research addresses problems in science, technology and public policy with a particular focus on energy, environmental systems, climate change and risk analysis.



Civil and Environmental Engineering Associate Professor **Costa Samaras** presented at a luncheon briefing titled *Connected & Autonomous Vehicles (AV): Incorporating AVs into Our Transportation Infrastructure* hosted by the Robotics Caucus Advisory Committee in conjunction with the Congressional Robotics Caucus in October. The featured panel of experts offered insight into how autonomous cars are expected to improve safety and solve transportation challenges, while discussing regulatory hurdles and how public policies can play a role in ensuring that these advanced technologies can unlock the economic value they promise.

2018



Baruch Fischhoff, a renowned expert in decision science and risk analysis, was inducted into the National Academy of Sciences (NAS) in April 2018.



CMU's **M. Granger Morgan** is another NAS member. Fischhoff, the Howard Heinz University Professor in the Department of Engineering and Public Policy and the Institute for Politics and Strategy is also an elected member of the National Academy of Medicine.

147
FACULTY
AFFILIATES
ACROSS 26 CMU CENTERS
AND DEPARTMENTS

34 ENERGY
STARTUPS

INVENTOR OF THE FIRST
MASS-PRODUCED

LOW-COST + ECO-FRIENDLY
BATTERY

JAY WHITACRE, 2015
LEMELSON-MIT
\$500,000 PRIZE WINNER

159

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

2018 SLOAN
RESEARCH FELLOW
VENKAT VISWANATHAN

SCOTT INSTITUTE
FACULTY FELLOWS

11 ENERGY
46 INNOVATIONS*

DOE CLEAN ENERGY
EDUCATION & EMPOWERMENT
2017 RESEARCH AWARD
WINNER INÊS AZEVEDO



NSF
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EARLY CAREER
AWARD RECIPIENTS



RESEARCH
CENTERS
LAUNCHED



NOBEL
LAUREATE
EDWARD S. RUBIN

ENERGY EDUCATION



40 YEARS AND COUNTING:
ENERGY COURSES AT CMU

Carnegie Mellon has offered educational energy programs for over 40 years. CMU prepares students to go into the world and make a significant impact on how humanity develops and uses energy resources.

The education and training of future generations is critical to this program's success. CMU has expanded its undergraduate and graduate curricula to include a greater breadth of energy-relevant, interdisciplinary activities including additional courses, expanded minors and new degree programs. Highlights include:

The CMU Dietrich College of Humanities and Social Sciences Grand Challenge Interdisciplinary Freshman Seminar on climate change.

- These seminar courses, which were created in 2017, are designed to create educational experiences that focus on tough societal problems. This particular course takes an interdisciplinary approach, and it's taught by Civil and Environmental Engineering and Engineering and Public Policy Professor **Peter Adams**, as well as Dietrich College Adjunct Instructor **Kasia Snyder** and Associate Professor of English **James Wynn**. The course, which returns fall 2018, engages

students with climate change using multiple angles, from scientific and technological to rhetorical and political.

A CMU case study on campus sustainability published in a 2018 report titled, *Sustainable Development: Educating with Purpose*, in collaboration with the International Sustainable Campus Network and the Global University Leaders Forum.

- CMU was one of 42 leading universities that contributed to the report, which was shared at the World Economic Forum. CMU's contributions focused on its commitment to ensuring that all of its students are stewards of the environment. Several examples included discussions of "Low-Carbon Energy" that addressed advancements in both renewable and conventional energies at the 2017 Energy Science, Technology and Policy Program Symposium, the university's second annual Sustainability Weekend and CMU Energy Week 2017 (hosted by the Scott Institute), which allowed leaders in the field to gather and exchange resources and information. ■

Learn more about CMU energy education at cmu.edu/energy.



CMU'S ENERGY SCIENCE, TECHNOLOGY & POLICY MASTER'S PROGRAM

AN INTERDISCIPLINARY PROGRAM SUITED FOR ENERGY'S MANY ANGLES

CMU's Energy Science, Technology and Policy (EST&P) program offers a distinctive Master of Science degree based in engineering, aligned with new discoveries in science, attuned to sustainability and the environment and informed by a broader perspective in economics and public policy. EST&P is an interdisciplinary engineering degree of the College of Engineering in association with the Wilton E. Scott Institute for Energy Innovation.

Launched in 2009, EST&P delivers a technical education centered upon a common core energy curriculum, anchored in one of six disciplinary concentrations and individualized with options of policy, business, engineering, science and applied studies electives. The program's strength is founded upon

the excellence of CMU faculty teaching energy-related courses and carrying out research projects, many of whom are affiliated with the Scott Institute.

The program has represented the Institute both on campus and nationally. In February 2017, nine EST&P students took second place in a case competition at Columbia University's Energy Week. At CMU, EST&P student (now alumnus) Ashwin Kumar Balaji won first place in the 2017 Solutions Challenge for Social Innovation with an idea involving constructing solar kiosks to provide the community with energy to power essential appliances. Balaji later successfully submitted this project to the 2017 Clinton Global Initiative University conference.

The program owes much of its success to its strong leadership. David Landis, the founding director of the EST&P program, guided and expanded the program over its first nine years, along with Associate Director Nora Siewiorek. Landis retired in June 2018 and Paul Salvador, professor of Materials Science and Engineering, took on the role of interim director. Salvador previously joined the core faculty of the EST&P program in fall 2017, teaching the core course "Energy Conversion and Supply."

"My goal as interim director is to continue the tradition of excellence in energy studies at Carnegie Mellon and to market the strengths of this program to intellectual leaders in energy from around the globe," Salvador said.

Salvador added that as the program matures and moves into its next decade, it's a good time to build on the program's strengths and success of its alumni.

"The most enjoyable aspect in my role as interim director has been meeting alumni and learning about the exciting energy-related careers they've embarked on," Salvador said.

The program has generated 159 alumni, and its first class of students receiving applied studies degrees graduated in December 2017 and May 2018. These alumni lead successful careers in industry, consulting, nonprofits/non-governmental organizations and at universities. They work everywhere from Pittsburgh, New York and Washington, D.C., to Shanghai, New Delhi and Geneva.

"AS THE PROGRAM MATURES AND MOVES INTO ITS NEXT DECADE, IT'S A GOOD TIME TO BUILD ON THE PROGRAM'S STRENGTHS AND THE SUCCESS OF OUR ALUMNI."
— PAUL SALVADOR

Learn more about the EST&P program at cmu.edu/engineering/estp.



Strengths of the EST&P Program:

- Distinctive and interdisciplinary Master of Science degrees in energy
- An interdisciplinary and customizable curriculum
- Disciplinary concentrations in six engineering departments
- Involvement with the Scott Institute for Energy Innovation
- Strong professional development and career preparation
- Energy project opportunities



Yihan Julia Ju, an EST&P alumna who graduated in 2012, is now the origination analyst for Renewables at CLP Holdings Limited in Hong Kong. Ju uses knowledge from

her EST&P program to analyze markets, evaluate competitors and assess the viability of renewable energy projects.

"I appreciate that the core courses gave me a solid foundation in energy policy and economics along with more technical expertise into the generation and transmission of electricity," said Ju.

Daniel Hochman graduated from the program in 2014. He's now the director of Sales and Technical Services at Sealed, a New York City-based company that aims to reduce energy waste and improve home comfort. While a student at CMU, his coursework focused on engineering and public policy and he helped to organize the program's Energy Careers Symposium.

"I loved the breadth of coursework," said Hochman. "I learned so much by being surrounded by people from different disciplines and I think a lot of the engineers learned from me as well. It was difficult, but worth it." ■



ROBOTANY

Transforming the Agriculture Industry with Automated Robotics and Software Analytics

RoBotany, a Carnegie Mellon University spin-off company founded in 2016, develops automated robotics and software analytics to make indoor agriculture more efficient and environmentally friendly. The company, co-founded by Carnegie Mellon Tepper School of Business alumni Austin Webb and Daniel Seim along with Austin Lawrence and Brac Webb, grows produce on floor-to-ceiling shelves in a climate-controlled warehouse — a former steel mill located in the South Side neighborhood of Pittsburgh, Pennsylvania.

RoBotany Co-founder and Chief Executive Officer Austin Webb inspects his company's produce that's grown in a climate-controlled warehouse.

RoBotany's smart, indoor vertical farms grow hyperlocal, pesticide-free produce year-round while using 95 percent less water and avoiding runoff pollution.

Its innovative technology allows for the first-ever human-free farm while also optimizing plant growth for both quality and yield.

"They are solving two big problems: one is world hunger. We have a growing population and more arid land to actually grow food,

so this is a more efficient way to grow food and even though it's starting small here at Carnegie Mellon in Pittsburgh, there is big potential," said David Mawhinney, who serves on RoBotany's Advisory Board and is executive director of CMU's Swartz Center for Entrepreneurship. "There is also a desire amongst communities to have food that is grown closer to them under organic conditions. Indoor vertical farming is better than organic, and RoBotany wants to create a category that is beyond organic on the premium food measurement scale."

With more than 80 percent of the U.S. population now living in urban areas, RoBotany's technology can provide a solution for growing smart cities.

The startup currently sells its produce from one of its prototype farms to Whole Foods and Giant Eagle Market District in Pittsburgh under its produce brand Pure Sky Farms.™

RoBotany recently expanded its office space and has grown the team fivefold. As of fall 2018, they are building the company's first full-scale farm.

RoBotany's innovative solution has caught the attention of media like NEXTPittsburgh, which named RoBotany one of 17 tech companies to watch in Pittsburgh. The company's work has been featured in various media outlets including U.S. News & World

Report, National Public Radio and the Tribune-Review.

While he was a student at CMU, Webb took advantage of multiple entrepreneurship resources on campus to launch RoBotany — from working on the company in his classes to participating in the National Science Foundation (NSF) I-Corps site program at CMU, which aims to accelerate commercialization of university research. In 2016, RoBotany was accepted into CMU's startup incubator, Project Olympus — the birthplace of RoBotany's first farm.

In 2017, the team went on to compete and place first in two on-campus competitions: the Swartz Center's McGinnis Venture Competition and the DOE-sponsored Allegheny Cleantech University Prize Collegiate Competition hosted by the Scott Institute. The company took home a combined \$75,000 in prizes.

"CMU helped me launch RoBotany because of the early pre-seed capital we received from these programs," Webb said. "In addition, we were able to benefit from the university's concentrated ecosystem of talent across many disciplines on campus." ■

For more information about CMU's energy startups and innovations, visit cmu.edu/energy.

PARTNERSHIPS



MHPS President and Chief Executive Officer Paul Browning (Engineering 1990) announces the launch of the Carnegie Mellon Power Sector Carbon Index at CMU Energy Week 2017.



Inês Azevedo



Costa Samaras

Carnegie Mellon Power Sector Carbon Index to Improve Climate Change Decision-Making

In partnership with Mitsubishi Hitachi Power Systems (MHPS), CMU launched the Carnegie Mellon Power Sector Carbon Index in 2017. This new tool measures carbon dioxide emissions from the U.S. electrical power generation sector. Co-directed by Scott Institute Energy Fellows **Inês Azevedo** and **Costa Samaras**, the index tracks the environmental performance of U.S. power producers and compares current emissions to historical data collected nationwide from more than two decades.

"We've found this index to provide significant insight into trends in power generation and emissions," said Samaras, associate professor of Civil and Environmental Engineering at CMU. "In particular, the data have shown that emissions intensity has fallen to the lowest level on record, as a combination of natural gas and renewable power have displaced more carbon-intensive coal-fired power generation."

These findings were recently published in an article, "Assessing the Evolution of Power Sector Carbon Intensity in the United States," in the peer-reviewed journal Environmental Research Letters. In it, Azevedo, Samaras and lead graduate student researcher Greg Schivley report that between 2001 and 2017, the average yearly carbon dioxide emissions intensity of electricity production in the U.S. decreased by 30 percent. They attribute this change to increased natural gas and wind generation and decreased coal-fired power generation.

The team of researchers also publishes a quarterly report of power sector carbon emissions performance trends and provides an online resource for a wide variety of power sector emissions data and forecasts. Policymakers, industry, academia, nongovernmental organizations, think tanks and the public can rely on the index to quickly understand up-to-date trends in carbon intensity of the U.S. electric power sector and uncover insight into the underlying drivers of these trends every three months. The index advances energy-related decisions and education not only for the U.S., but also globally. ■

Learn more at emissionsindex.org.

Partner Spotlight: Itron

On Feb. 16, 2017, the Scott Institute hosted over 400 faculty members, staff, students and members of the public at a panel discussion titled "Building a Resilient, Smart and Sustainable City: The Energy-Water Nexus" at Carnegie Mellon. Keynote speaker Dr. Michael E. Webber from the University of Texas at Austin set the stage by explaining the challenges and solutions that arise from the interdependent nature of energy and water.

Sponsors included the City of Pittsburgh, Duquesne Light Company, Itron, Peoples Natural Gas and the Scott Institute. The Institute worked closely with the Department of City Planning and Itron to plan the event.

"Having CMU host this signature event allowed our CEO a unique opportunity to interact with students at the university and also exposed Itron to the skills and capabilities of the world-class Scott Institute faculty. It brought together key thought leaders and inspired collaboration for next-generation innovation," said Itron Vice President of Smart Cities Business Development Bob Borzillo.



DISTINGUISHED PANELISTS:

Rich Fitzgerald
Allegheny County Executive

Philip Mezey
President and CEO of Itron

William Peduto
Mayor, City of Pittsburgh

Morgan O'Brien
President and CEO of Peoples Natural Gas

Richard Riazzi
President and CEO of Duquesne Light Company

Richard Stafford
Distinguished Service Professor at CMU's Heinz College and Founder of Metro21/MetroLab

Borzillo says Itron benefits from partnering with the Institute in a number of ways including collaborating with CMU faculty and students on internal and external engagements related to energy, water and the Internet of Things.

He adds that partnering with the Scott Institute has allowed Itron to strategically collaborate within the City of Pittsburgh and surrounding Allegheny County on events, such as its recent participation as a sponsor and speaker at CMU Energy Week 2018.

"Universities like CMU play a growing and central role in the energy and smart cities innovation ecosystem, driving regional and national economic growth," said Anna Siefken. "Partnerships, like the one we have with Itron, are integral to the work we do at the Scott Institute for Energy Innovation." ■

Moderated by the Scott Institute's Executive Director Anna J. Siefken and former Director Jared Cohon, a distinguished panel of government leaders, CEOs and academic experts discussed the role of the energy-water nexus across the country.

SUPPORTERS AND PARTNERS

Thank you to the generous donors and partners whose support helps to realize the vision of the Scott Institute.

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Philips Lighting

PSG Energy Group

Shell Oil Company

Southern Company

The Efficiency Network (TEN)

Uber Technologies Inc.

Wells Fargo

WGL Energy



THE SCOTT FAMILY

Carnegie Mellon alumni Sherman and Joyce Bowie Scott honored Sherman's father's legacy as an oil and gas geologist and energy industry leader by establishing the Wilton E. Scott Institute for Energy Innovation in his name. The Scott Institute and the Sherman and Joyce Bowie Scott Hall were made possible through the generosity of the Scott family and the Richard King Mellon Foundation.

STAFF AND FACULTY ADVISORY COUNCIL

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

Joe S. Hezir

Professor of the Practice

(Engineering 1972)
(Heinz College 1974)

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

Amanda King

Communications Analyst

FACULTY ADVISORY COMMITTEE

The Scott Institute works with an internal faculty advisory committee that offers general strategic advice and guidance to the Institute. Committee members serve terms of one to three years. They are chosen to provide disciplinary diversity and representation of faculty across the university. Thank you to our current members:

Yuvraj Agarwal

School of Computer Science,
Institute for Software Research

Inês Azevedo

Ph.D. (Engineering 2009)
College of Engineering,
Engineering and Public Policy

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

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

Meagan Mauter

College of Engineering,
Civil and Environmental
Engineering,
Engineering and Public Policy

Steven Ray

Silicon Valley Campus

Nikolaos Sahinidis

Ph.D. (Engineering 1990)
College of Engineering,
Chemical Engineering

Nicola Secomandi

Tepper School of Business,
Operations Management

Jeanne VanBriesen

College of Engineering,
Civil and Environmental
Engineering

Venkat Viswanathan

College of Engineering,
Mechanical Engineering

Meet Our Newest Staff Members:



Anna J. Siefken

Executive Director

Adjunct Professor, Heinz
College of Information
Systems and Public Policy

On August 1, 2018, Anna was named the inaugural executive director of the Scott Institute where she helps drive initiatives integral to the Institute's mission and vision. Previously, she served as the Scott Institute's associate director for Innovation and Strategic Partnerships, a role in which she deepened engagements and developed an innovative partnership strategy that promotes collaboration with industry, government, nongovernmental organizations, foundations, universities and several of Carnegie Mellon's energy-related centers. The strategy focused on research, commercializing technologies, education and outreach.

Prior to joining CMU in 2016, Anna was the Pittsburgh 2030 District director and vice president of Strategic Engagement for the Green Building Alliance, one of the largest regional chapters of the U.S. Green Building Council. Anna previously worked at ICF International and The Home Depot headquarters. She is a founding member of the international 2030 District Network's Board of Governors. Anna is one of six CMU-affiliated women who were honored with the Pittsburgh Business Times' 2016 Women in Energy Leadership Award. In 2018, she received the Cribbs for Kids' Women of Achievement Award. Most recently, the National Renewable Energy Laboratory selected Anna as a member of its national Executive Energy Leadership Academy cohort.



Joe S. Hezir

Professor of the Practice

Prior to joining the Scott Institute in 2017, Joe served as the U.S. Department of Energy's chief financial officer. Outside of the Institute, Joe jointly leads the new Energy Futures Initiative. Prior to these roles, he worked for major corporations and the EPA. Joe, who earned degrees in chemical engineering and public policy from CMU, assists the Scott Institute's leadership team in strategic planning, including developing objectives, strategies and implementation plans.



Virginia Delaney

Senior Administrative
Coordinator

GINNY began working at Carnegie Mellon in 1998 as the assistant to the dean of Student Affairs. She served as the dean's assistant for eight years until joining University Advancement, where she worked as the assistant to the vice president for University Advancement. In March 2016, Ginny joined the Scott Institute as its administrative assistant.



Amanda King

Communications Analyst

AMANDA manages the Scott Institute's marketing, communications and Internship Program. As a former multimedia journalist, she covered a wide range of environmental and energy topics for publications like PublicSource, the Bucks County Courier Times and the Beaver County Times. Amanda previously blogged and wrote copy for energy companies, such as BOSS Controls and H&M Land and Mineral. She has seven years of experience working in communications and marketing roles.

EXTERNAL ADVISORY BOARD

THE SCOTT INSTITUTE EXTERNAL ADVISORY BOARD

The Scott Institute works with an external advisory board that offers general strategic advice, connections and guidance.

Aris Candris

Senior Advisor, Westinghouse Electric Company LLC
Trustee,
Carnegie Mellon University

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

Steven Hamburg

Chief Scientist,
Environmental Defense Fund

Michael W. Howard

President and Chief Executive Officer, Electric Power Research Institute

Scott D. Izzo

Director, Richard King Mellon Foundation

Kathryn Jackson

Director, Energy & Technology Consulting, KeySource Inc.

Director, Portland General Electric Company

Director, Cameco Corporation

Alex Knaster

Chairman and Chief Executive Officer, Pamplona Capital Management LLP

Raymond J. Lane

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

Kathleen A. McGinty

Former Secretary,
Pennsylvania Department of Environmental Protection
Board Member,
Energy Futures Initiative
Board Member,
Committee of Seventy

J. Michael McQuade

Retired, Senior Vice President for Science and Technology, United Technologies Corporation
Trustee,
Carnegie Mellon University

Oliver Morton

Briefings Editor,
The Economist

David Porges

Interim President,
Chief Executive Officer and Chairman of the Board of Directors, EQT Corporation
Trustee,
Carnegie Mellon University

Sherman Scott

President, Delmar Systems Inc.

James Skea

Strategy Fellow, Research Councils UK Energy Programme

Daniel Swanson

Software Systems Engineer,
Lockheed Martin Corporation

Susan Tierney

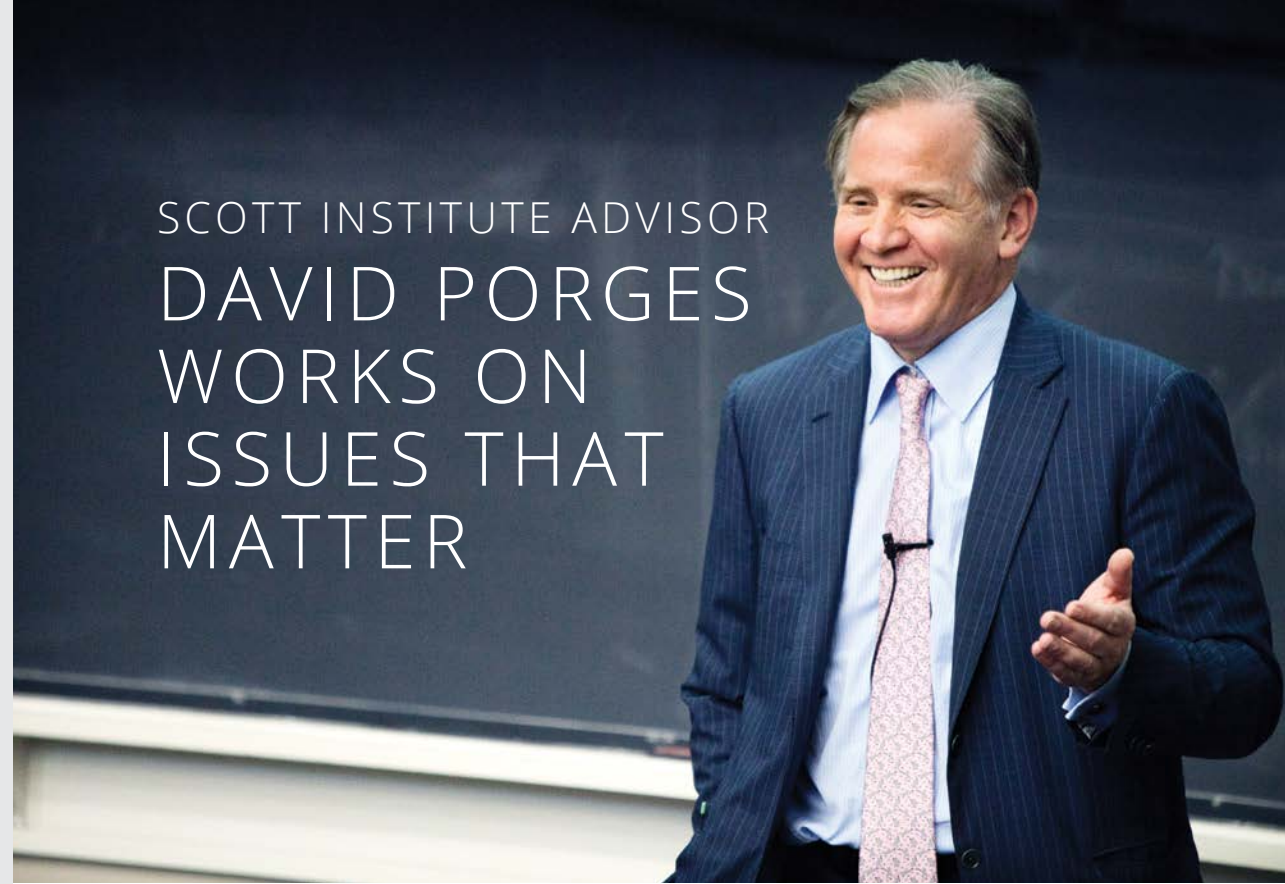
Managing Principal,
Analysis Group

Carol Williams

Retired, Executive Vice President of The Dow Chemical Company
Board Member,
Olin Corporation
Board Member, Owens Illinois
Trustee,
Carnegie Mellon University

Titles as of August 2018

SCOTT INSTITUTE ADVISOR DAVID PORGES WORKS ON ISSUES THAT MATTER



David Porges has served on the Scott Institute External Advisory Council since its inception in 2012 and has been a valuable asset to the board — lending his decades' worth of experience in the energy industry. Porges serves as interim president and chief executive officer of EQT Corporation (as of March 2018 and at the time of publication).

He transformed EQT from a local utility worth about \$1 billion in 1998 to the largest producer of natural gas in the U.S. — worth \$12-15 billion. Porges joined EQT in 1998 and has served in various senior management roles within the corporation including as president, CEO, CFO, chairman and executive chairman. Before that, Porges spent years in investment banking, primarily working with energy companies, while also directing areas such as mergers and acquisitions, structured finance and risk advisory.

Outside of EQT, Porges blends his passions of the humanities and sciences. He is a trustee of Carnegie Mellon University, RAND Corporation, the Carnegie Museums of Pittsburgh and Winchester Thurston School. Yet he remains engaged at the Scott Institute because its faculty and students are

exploring and innovating in broad areas of energy research.

"I continue to be interested in participating on the Scott Institute Advisory Council because there are a lot of smart people at the Institute working on issues and problems that matter," said Porges.

While he adds value with his knowledge of existing energy sources, Porges enjoys being able to learn about new pathways. He fondly recalls a conversation he had about carbon capture and storage with founding Scott Institute Director M. Granger Morgan at the Institute's 2012 groundbreaking. Porges was concerned if it would work.

"Granger said it has to work so that we can utilize natural gas and coal in a cleaner way," said Porges.

Porges continues to learn about innovations in energy from Morgan and the more than 140 other faculty affiliates at CMU who are working on energy issues.

"They are looking at this vast energy landscape and tend to focus on different aspects of it from varying perspectives — I just find that very interesting," said Porges. ■



KATE JACKSON: DISTINGUISHED ENERGY ALUMNA

"BECAUSE THE SCOTT INSTITUTE IS WELL RESPECTED AND OBJECTIVE, IT HAS AN OPPORTUNITY TO MORE GREATLY INFLUENCE THE ONGOING TRANSFORMATION OF OUR ENERGY SYSTEM."

– KATE JACKSON

Scott Institute External Advisory Council member Kate Jackson participated in the panel "Science and Engineering on Screen: Hollywood Loves Energy!" at CMU Energy Week 2017.



Kathryn "Kate" Jackson is one of the newest external advisory council members who joined the Scott Institute in March 2018. Jackson is an energy expert with over 30 years of experience in the industry. The Carnegie Mellon alumna who earned a master's and doctoral degree in engineering and public policy in 1990 has held leadership positions at a wide range of energy companies including RTI International Metals Inc., Westinghouse Electric Company and the Tennessee Valley Authority. Jackson also serves on the boards of Portland General Electric Company and Cameco Corporation, and previously served on the boards of Rice Energy Inc., Hydro One and ISO New England.

Because of her diverse background, she brings to the Institute a broad understanding and perspective of the energy industry, both nationally and globally. She's currently a corporate director and heads the energy and technology consulting practice for KeySource.

"I'm passionate about having an energy system that delivers clean, reliable and affordable energy while giving customers choice and power over their bills. This requires appropriate regulation, legislation and market design," Jackson said. "Making sustainable energy choices requires innovation and careful risk analysis while balancing our thirst for energy with the inevitable consequences of energy production and use."






The Scott Institute is already a leader in energy innovation, but Jackson wants to help the Institute raise its profile.

Jackson added, "Because the Scott Institute is well respected and objective, it has an opportunity to more greatly influence the ongoing transformation of our energy system. I look forward to contributing to this work." ■



Carnegie Mellon University

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