BOSTON UNIVERSITY INSTITUTE FOR SUSTAINABLE ENERGY

Annual Report | 2020

Boston University Institute for Sustainable Energy

BOSTON UNIVERSITY

Boston University
Institute for Sustainable Energy
Annual Report
2020

ISE research on water, Africa, & clean grid transition

8

University collaborations

12

NSF, *The Boston Globe* & more featured events

17

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INSIDE FRONT COVER: PHOTOS BY MRNOVEL/SHUTTERSTOCK.COM, DAVE GREEN PHOTOGRAPHY, ADVANCED ENERGY ECONOMY

FOLLOWING PAGE: PHOTO BY LIZ LINDER

LETTER FROM THE DIRECTOR

Dear Colleagues, Supporters, and Stakeholders:

The ISE is now entering its fifth full year of existence, and it has been wonderful to see it grow into a full-fledged member of the BU research community and a respected peer among academic energy research centers. During this extraordinarily difficult year, I am humbled to say that, despite many challenges, the ISE has been able to thrive and contribute.

Prior to the pandemic, we were steaming ahead with research in our core areas of the clean energy transition, city climate strategies, clean mobility, and water. As this report chronicles, we increased the number and reach of our live events, published a wider set of research papers than ever before, and added superb new members to the ranks of our affiliated faculty, senior fellows, and advisory board. We were also honored to coordinate a university-wide effort to create a proposal to expand the ISE into a broader organization focused more generally on sustainability.

When the pandemic arrived, the ISE, along with much of the rest of academia, went entirely virtual. At first, we thought that interest in our work would diminish greatly as everyone focused on immediate safety and a way forward through the crisis. To our surprise, the pandemic led to a broad and clearly palpable increase in interest in climate policy and environmental justice, leaving us busier than ever. The earth-shattering effect of a tiny, invisible threat, and the realization that effective governmental actions and policies are utterly essential for a solution, led many to see great parallels with the challenge of global climate change. We received more and better coverage in the media during the first quarter of the pandemic than ever before, and we also received the institute's largest single gift, an anonymous donation that will create a new program on sustainable finance jointly with BU's Susilo Institute.

We were also deeply disturbed by George Floyd's murder and the many other racially unjust killings that were so visible this year. These events have led us to redouble our commitment to climate justice, equitable access to clean energy, and equitable participation in the clean energy revolution. In response to these incidents as well as the pandemic, we launched significant new research on the intersection of resilience, climate policy, and climate justice. We believe this ongoing work will be increasingly important as the economic and environmental impacts of the pandemic accumulate.

We understand that the coming year will present many enormous challenges for our world, our country, our university, and our institute. We pledge to do as much as we can to help contribute solutions that accelerate sustainability in all its forms alongside racial justice.

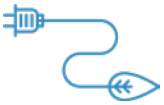
Sincerely Yours,
Dr. Peter Fox-Penner
Director, Boston University Institute for Sustainable Energy

Institute for Sustainable Energy: Accelerating Our Energy Future

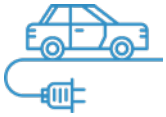
MISSION & CORE RESEARCH

THE BOSTON UNIVERSITY INSTITUTE FOR SUSTAINABLE ENERGY (ISE) translates sustainable energy research into urgent action. The ISE is a university-wide center dedicated to developing energy systems that will provide abundant, universally accessible, and sustainable energy sources for emerging and advanced economies. Our approach combines interdisciplinary research, policy analysis, and collaborative engagement with partners at every level—from individual energy and water utilities to cities, states, and countries.

SUSTAINABLE CITIES
As the world's population continues to grow and urbanize, the ISE is leading research to create vibrant, sustainable, and equitable urban environments with a high quality of life. This calls for new methods of urban planning and policymaking, clean energy to power the electric grid, new mobility options, and greater energy efficiency in our buildings and infrastructure.



UTILITY OF THE FUTURE
Energy production is the largest global source of greenhouse gas emissions, making transformation of the power grid—the backbone of our clean energy future—a research priority. Now that the transition to more distributed, carbon-free energy is underway, the ISE is delving into the future of the power industry. This includes microgrid development, demand management to support increased electrification, and investments in clean energy resources.



NEW MOBILITY
Advances in transportation have incredible potential to significantly reduce greenhouse gas emissions through automation, electrification, and ridesharing. The ISE's research anticipates and prepares for these massive changes in mobility, working to advance further implementation of electric vehicle infrastructure and autonomous vehicle electrification.

SUSTAINABLE WATER MANAGEMENT
As water and energy utilities have evolved, their challenges and requirements are becoming increasingly similar. The ISE identifies opportunities for utilities to integrate "One Water" strategies into water management, including new approaches to supply and demand management, strategies to ensure good water quality, and water ratemaking and financing.

EMERGING RESEARCH

BOSTON UNIVERSITY SUSTAINABILITY RESEARCH INITIATIVE (SRI)

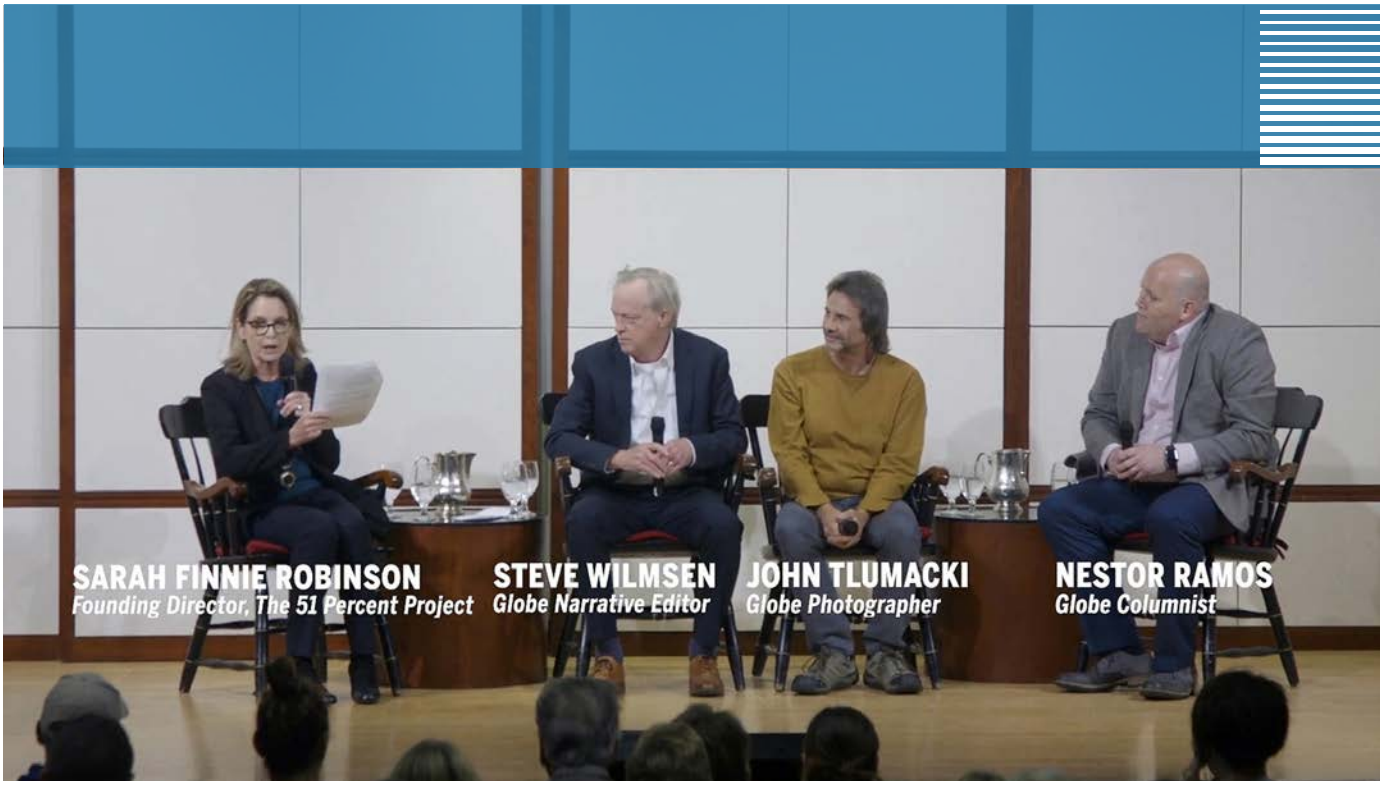
The Sustainability Research Initiative envisions a just and sustainable world where nature and people thrive. We cultivate an ecosystem where BU's diverse talents, as seen in our students, faculty, staff, alumni, and stakeholders, converge to tackle grand challenges through big ideas and applied solutions. Part research engine and part community catalyst, this effort engages with our communities to convert knowledge to action. Sustainability has no geographic bounds—we work locally, we work globally.

We seek solutions to grand sustainability challenges. We identify places where life on our planet is at paramount risk and co-create solutions that make a real impact on people's lives and livelihoods. We embrace the co-production of actionable solutions as both a responsibility and an opportunity.

ANTI-RACISM AND THE SRI

The Boston University community recognizes that a key feature of a sustainable society is equitable access to the social, economic, and natural resources that underpin important freedoms and capabilities, which in turn allow each person to achieve what will contribute to each person's own well-being. Decades of research on environmental justice in the United States unequivocally demonstrate that racism has forced Black Americans and other vulnerable populations into communities that are more polluted and less resilient to natural hazards, thus resulting in poorer health outcomes and diminished quality of life.

Anti-racism must permeate all of our work. We commit to expanding research and teaching that starts with the tenet that sustainability is unattainable when racism remains endemic. The SRI's focus on collaborative, interdisciplinary research enables research and communication that will improve social equity. As with other forms of injustice, we must respond with urgency and determination to identify, understand, and dismantle systemic racism, and replace it with the equality of opportunity that is a foundation of a sustainable world.



Climate communications: "At the Edge of a Warming World" panel hosted by the ISE featuring The Boston Globe*'s special report on climate change on Cape Cod.*

ENVIRONMENTAL, SOCIAL, AND GOVERNANCE (ESG) INVESTING

Responsible investing is gaining momentum. Since 2005, over 3,000 asset owners and managers accounting for more than $100 trillion in assets have signed on to the United Nations Principles for Responsible Investment. The ESG approach, categorizing a firm's impact on the environment and society, along with its governance practices, has significant potential to shift the global economy and finance climate and water sustainability. The ISE is exploring how to implement reliable, widely accepted ways of measuring responsible behavior.

CLIMATE COMMUNICATIONS

Greta Thunberg, *Time* magazine's Person of the Year for 2019, personifies the power of climate communications. Thunberg fueled a global youth climate movement through the simple act of talking about climate change and exerting her skyrocketing influence. The ISE's climate communications initiative, The 51 Percent Project led by Founder and Director Sarah Finnie Robinson, is at the forefront of putting the major principles of climate communications into practice through student curriculum, industry engagement, and major media and industry partnerships. This past year, The Project spearheaded Boston University's institutional partnership with Covering Climate Now, a new global journalism initiative of 400 news outlets with a combined audience of nearly two billion people.

This page: video still by The Boston Globe

HIGHLIGHTS OF FY2020

Power after Carbon

ISE Director and Questrom Professor of the Practice Peter Fox-Penner released his third book, *Power after Carbon*, on May 19, 2020. The book, which will also be published in China, quickly rose to #1 in Amazon's Oil and Energy section and led to many presentations to diverse audiences around the world. Former U.S. Energy Secretary and MIT Professor Ernie Moniz called the book "a serious exploration of the…drive for zero carbon emissions" while energy expert Amory Lovins called Fox-Penner "among the world's most admired and respected electricity experts." In the coming years the ISE expects to continue its research and publication on the future of the electricity grid.

New Senior Fellows

The ISE's Senior Fellow research community doubled in size this past year, expanding to include industry experts Panagiotis Andrianesis, Power System Economics Expert; Eugene J. Berardi, Visiting Fellow & Researcher; Ed Craig, Founder & Executive Director of ECCI; Lawrence Jones, Vice President, Edison Electric Institute; Olena Pechak, Clean Electricity Implementation Expert; Rebecca Pearl-Martinez, Doctoral Researcher, Department of Geography at Durham University; Johannes Pfeifenberger, Principal, The Brattle Group; Kurt Roth, Head, Building Energy Systems, Fraunhofer USA; Karen Wayland, Energy Strategy Consultant; and Yingxia Yang, Senior Technical Leader, Electric Power Research Institute.

External Grant Funding

The ISE supported a proposal submitted by Professor Michael Caramanis, which resulted in the award of $3 million in funding from the U.S. Department of Energy's Advanced Research Projects Agency-Energy (ARPA-E). Caramanis' team will develop a New Risk Assessment and Management Paradigm (NewRAMP) designed to overhaul Electricity Markets by efficiently addressing uncertainty in the forthcoming massive renewable generation and electrification of fossil fuel reliant energy uses. Numerous ISE affiliates are part of the team, including Professor Christos Cassandras, Research Associate Professor Pablo Ruiz, Postdoctoral Associate and ISE Senior Fellow Panagiotis Andrianesis, and Professor Nalin Kulatilaka. ■

INSTITUTE FOR SUSTAINABLE ENERGY AT A GLANCE

49
Affiliated Faculty Members

$500K
Largest Single Gift in ISE History

20
Senior Fellows

9
Published Reports

26
Archival Publications

46
Events Hosted or Speaker

6
Research Focal Areas

FEATURED RESEARCH PROJECTS

ONE WATER STRATEGIES IN URBAN WATER MANAGEMENT

ACROSS THE WORLD, the risk and complexity surrounding water management practices are mounting, with pressures from urban densification, water scarcity and flooding, aging infrastructure, and management systems that do not reflect the true cost of water. In recent years, water stakeholders have begun to consider fundamental changes to management practices that increase water use efficiency and enhance conservation of limited freshwater resources for people and the environment. Integrated urban water management approaches, such as One Water, emphasize the interconnectedness of water throughout the water cycle and focus on opportunities that arise from this holistic viewpoint.

This year marked the finale of the ISE's three-year research project funded by the Cynthia and George Mitchell Foundation that examined approaches to ensure a sustainable water supply in Texas, where urban populations are growing rapidly, water infrastructure is aging, and climate change is affecting supply. Starting with an overarching review of how integrated urban water management practices could be applied broadly, the team moved to considerations of how New Braunfels Utilities could implement such a framework. This included rigorous assessment of how overall water demand is dependent on population growth—this is a nonlinear relationship owing to population growth impacting residential and commercial/industrial demand in different ways, especially once efficiency measures are accounted for. A further study examined opportunities for conservation efforts to affect demand. Ultimately, this led to development of a water utility rate structure that balanced considerations of managing total demand with appropriate conservation measures, ensuring the utility's fiscal health, and maintaining equity for customers. The rate study was comprehensive, and the ISE team's rate proposal was accepted by NBU's Board in August 2019 and by the City of New Braunfels shortly thereafter; it was implemented in November 2019.

3-year research project published 5 reports.

Michael Grinshpun and Josef Benzaoui, key contributors on the ISE's water research team led by Jacqueline Ashmore, ISE Executive Director.

The consideration of equity in the local context led a student on the ISE water research team, Michael Grinshpun, to write his Honors thesis on the question of water affordability in the U.S. more generally. He noted that the United States is suffering a crisis of affordability, especially among low-income and marginalized communities. One portion of the affordability crisis that has received disproportionately little effort and attention is the cost of water and sanitation services. These costs have increased so rapidly in recent years and can soon notably threaten access to this essential service, in turn threatening public and individual health. The current solutions for these affordability issues are insufficient, as are the metrics to measure the scope of these problems. Grinshpun's thesis offers a more comprehensive set of metrics to measure the scope of the affordability problem in the United States, an affordability assessment tool for decisionmakers, and recommendations for how different stakeholders can take action to address affordability.

BRINGING POWER AND PROGRESS TO AFRICA IN A FINANCIALLY AND ENVIRONMENTALLY SUSTAINABLE MANNER

RESEARCH HIGHLIGHTS excerpted from the ISE webinar Bringing Power and Progress to Africa on April 16, 2020, with research authors Richard Stuebi, ISE Senior Fellow, and Edem Adukonu, ISE Research Assistant. The event was moderated by ISE Senior Fellow Lawrence Jones.

Economic advancement's dependence on electricity
Adukonu: I grew up one of the 700 million fortunate Africans with access to electricity. Even then, in Ghana, I have experienced my fair share of blackouts, which are not very uncommon. About 600 million Africans have no access to electricity services. Indeed, access to electricity is essential to achieving the economic prosperity that we all want. This is evidenced when you compare per capita GDP to electrification rates across the globe. Pure economic takeoff happens when you exceed about 95% electrification rates.

The gap in electricity infrastructure
Adukonu: The huge gap in electricity generation capacity across the African continent, and also between rural and urban areas, would require huge investments to bridge—in the order of about $30 to $50 billion dollars per year to achieve universal access to electricity by 2030 at minimum levels. To reach for higher tiers of universal access, you're looking at about $100 billion dollars per year and beyond. Since we currently barely hit the $20 billion mark, we need to start seeing a paradigm shift in infrastructure investments in the African energy industry.

Electricity infrastructure investment opportunity
Adukonu: Fortunately, a good share of projected additions to power generation is renewable, and natural gas makes up the larger chunk of new planned fossil fuel additions. This is on a backdrop of about 80% of the continental energy mix being fossil. So far, Africa has contributed only 3% of total global CO2 emissions. But should the historic 4% annual growth in emissions continue, we will definitely exceed the global carbon budget and have a bigger problem than we have on our hands currently. The good news is, Africa is heavily endowed with the renewable energy resources for carbon-free growth. The downside, however, is that the locations where these resources are richest do not always coincide with the locations of dense populations.

Increasing emphasis on distributed energy
Adukonu: What we are most likely to see happen over the next few years is the simultaneous development of grid and stand-alone solutions, which over the period would start getting interconnected as they grow into a grid of grids network. Distributed resources are modular and can be deployed in incremental doses with minimized risk profiles. This becomes very important when you consider that the perceived risk profiles of the various African nations in the eyes of international infrastructure investors vary vastly from country to country.

$1 trillion infrastructure investment required for reliable universal electrification.

An estimated 600 million people in Africa lack any access to electricity.

Industrialization as part of the trillion-dollar investment equation
Stuebi: There are three ways of thinking about the financing and the financeability of up to or more than a trillion dollars of capital investment in African electricity infrastructure. Industrialization is certainly one of the three pockets. There are definitely regions and operations across and through Africa that do require power and require more power and higher quality power than they're getting now. And they can not only serve as the anchor tenant for their own purposes, but will allow essentially cost-effective development improvement of electricity supply for the neighboring locations. But I don't think that captures the biggest untapped set of opportunities.

The rural parts of Africa where their purchasing power is admittedly quite low, and where grid extension and massive investments to do that are probably beyond the pale, the DER-based minigrids and microgrids are often based on a pay-as-you-go financing structure. And so, they are in many ways, even though small scale, more financially viable than attracting the capital for the big mega projects for the cities.

The bigger topic is the need to create economic growth as part and parcel of the investment and industry building activity. What you need to do is figure out ways to induce or create investment that in turn spawns economic health and activity in a region, which spawns more economic value creation and more electricity demand creation, which can, therefore, attract more investment. Then you get the virtuous cycle going.

One of the aspects of industry or economic development which can be fostered with electricity infrastructure investments is investing in infrastructure that not only solves electricity issues, but also water issues and telecommunications issues, and maybe even healthcare issues and water treatment issues. There are some common economies of scale, both in deployment of the capital as well as in operation and administration of it.

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POWER AFTER CARBON: BUILDING A CLEAN, RESILIENT GRID

"The new book *Power after Carbon* by @PeterFoxPenner is the best resource I've seen to understanding everything about how the grid needs to evolve to supply low-carbon, affordable and reliable power."—@JasonBordoff, Professor and Founding Director, Center on Global Energy Policy, Columbia University

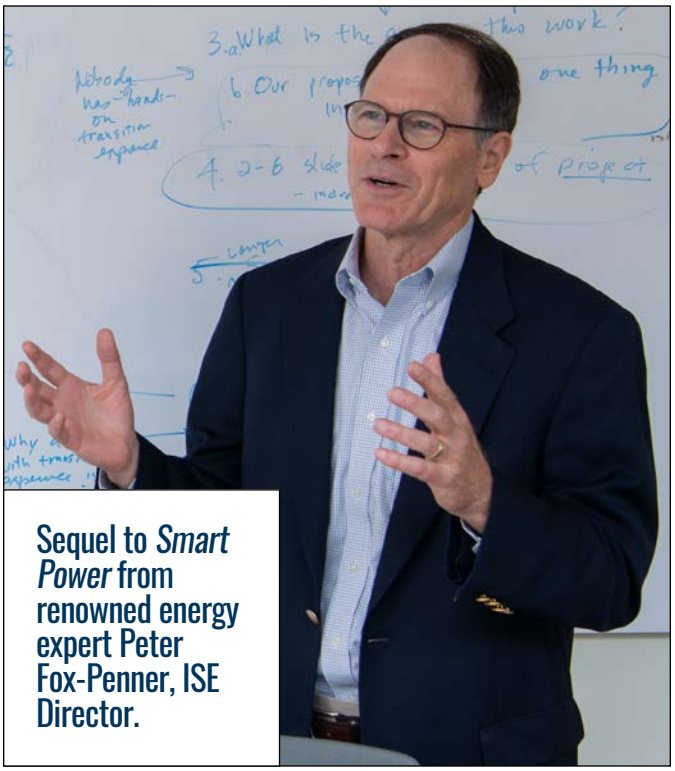
AS THE ELECTRIC POWER INDUSTRY faces the challenges of climate change, technological disruption, new market imperatives, and changing policies, Peter Fox-Penner offers a roadmap to the future of this essential sector in *Power after Carbon: Building a Clean, Resilient Grid* (Harvard University Press, 2020).

While the trendy solution is to think small with smart buildings, small-scale renewables, and other locally distributed green energy sources, these will not be enough to meet our increasing needs for clean power. *Power after Carbon* points to the indispensability of large power systems, battery storage, and scalable carbon-free power technologies, along with the expanded grids and markets that will integrate them into a single large system.

Power after Carbon was two years in the making, drawing on the support of seven Boston University students over time and core team member Olena Pechak, now one of the ISE's esteemed Senior Fellows. Pechak was a major contributor to book development for the duration. Asked for a behind-the-scenes look at the making of *Power after Carbon*, Pechak shared some of her experiences working alongside author Peter Fox-Penner, from start to finish.

First word that comes to your mind about your experience working on *Power after Carbon*?
Reading, reading, reading! Initially among my main responsibilities was finding the most recent and overarching material for certain topics. Before writing, Peter [Fox-Penner] wanted to be sure he had the whole picture of a given subject from the ocean of various publications. Meeting paywalls on the road highlighted how much of the material is not easily accessible. I would say that was a very important task since you become a filter for the information that reaches the author in the work; missed details would lead to wrong conclusions or interpretations.

Later I was reading the manuscript, editing, and checking for mistakes and references (the most boring but important part of the work).



Sequel to *Smart Power* from renowned energy expert Peter Fox-Penner, ISE Director.

What was the best part of the process? The most surprising?
I've learned a lot about the energy sector, especially about recent developments. I haven't been involved in such a thorough search for material since the beginning of my PhD. For instance, it was amazing to see how people use their imagination to address the issue of energy storage. It is much more than pumped hydro storage or Li-ion batteries.

Your favorite chapter from *Power after Carbon* to hook readers?
I would recommend "The Fragmented Future" chapter. It pushes us to see the wires—which we are so used to that often we don't see them at all—as a complex installation. Very often these poles seem to be strong and enduring. But the wires and grid are very fragile structures and can be damaged by numerous factors, from a hungry squirrel to a terrorist or a solar wind. ■

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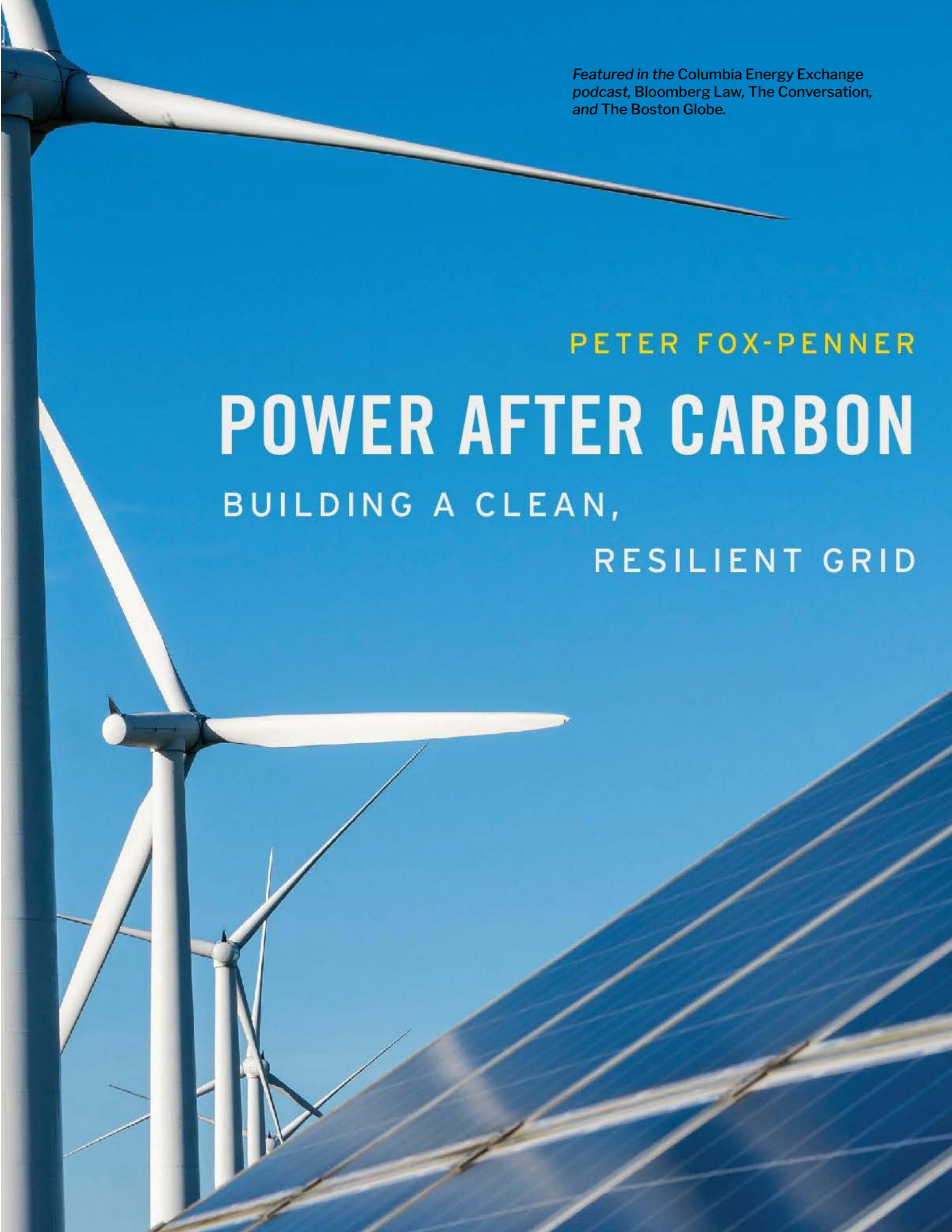
Featured in the Columbia Energy Exchange *podcast,* Bloomberg Law, The Conversation, *and* The Boston Globe.
PETER FOX-PENNER
POWER AFTER CARBON
BUILDING A CLEAN,
RESILIENT GRID

UNIVERSITY COLLABORATIONS

CENTER FOR INFORMATION & SYSTEMS ENGINEERING

The ISE collaborated with the Center for Information & Systems Engineering (CISE), a unit of Boston University's College of Engineering, on a workshop and paper examining new approaches to modeling the interaction of electric transport options and the power grid. The joint workshop brought together over 25 leading U.S. transport modeling experts along with many BU students and other observers. The workshop's paper, *Integrating Electric Mobility Systems*, serves as a roadmap for future research on this highly multidisciplinary and fast-evolving topic.

DEPARTMENT OF ENVIRONMENTAL HEALTH

The ISE collaborates with the Department of Environmental Health within the School of Public Health on questions around how combined sewer overflows and other water quality issues impact environmental justice communities who draw their drinking water from the Merrimack River. The Boston University research team is closely engaged with community groups, including the Merrimack River Watershed Council and the Merrimack River Planning Commission, to determine which analyses and studies are relevant and actionable for community stakeholders who aim to build a roadmap for establishing better watershed health and human health in the Merrimack Valley.

INITIATIVE ON CITIES

The ISE and the Initiative on Cities (and an external organization, Innovation Network for Communities) have recently partnered on research to provide community leaders, inside and outside of local government, with guidance about navigating climate-action priorities through the gauntlet of challenges created by the COVID-19 pandemic and the ensuing economic crisis. Topics that will be addressed are: why local climate action remains urgent, how the pandemic response creates opportunities and risks for local climate action and how socially vulnerable populations can benefit from purposeful responses to the pandemic and climate change, and finally which local climate actions should be a priority for federal funding.

GLOBAL DEVELOPMENT POLICY CENTER

Throughout the past year, the ISE collaborated on an ongoing basis with the Global Development Policy Center (GDP Center), a university-wide peer institute of the ISE. Among other topics, the GDP Center is known throughout the world for its expertise in multilateral development financing and China's offshore financing activities. The GDP Center's experts participated on the ISE team that worked with GEIDCO, an international organization created by the State Grid Corporation of China to promote sustainable energy, especially on the ISE's major paper on Africa's electric power sector, *Bringing Power and Progress to Africa*.

BU SUSTAINABILITY

The ISE and BU Sustainability continually partner on a range of activities that span research and campus emissions reduction efforts. This year, the ISE supported BU Sustainability in launching the Campus Climate Lab that aims to advance research and catalyze the Boston University community towards climate action. Together, the ISE and BU Sustainability are active in the Boston Green Ribbon Commission's Higher Education Working Group, which has a multi-strategy approach to support the effective and equitable implementation of the City of Boston's climate goals by sharing knowledge and lessons learned.

BU URBAN

The ISE is involved in the BU URBAN program. This year one of ISE's Senior Fellows, Sarah Finnie Robinson, taught URBAN program student trainees about climate change communications through an "Accelerating Climate Solutions" workshop, providing the trainees with skills to apply to their URBAN internships with municipalities, NGOs, or the private sector and in other future work. Students selected a notable report on climate change, and then learned about and applied the principles of climate change communication developed for the ISE's The 51 Percent Project to develop their own communications piece.

STUDENT ENGAGEMENT

University Collaborations *continued*

COLLEGE OF COMMUNICATION

The ISE works closely with faculty and students at the College of Communication (COM) through The 51 Percent Project led by Sarah Finnie Robinson, ISE Senior Fellow and adjunct clinical professor at COM. This past year, Robinson created numerous opportunities for COM students to work with *The Boston Globe* staff, in addition to teaming up on a PRLab campaign for The 51 Percent Project; a Hothouse Productions film, "Climate in the Media;" and student-produced climate action PSAs that aired nationwide on major TV networks—resulting in 596 airings that generated nearly 88 million impressions. Faculty research collaborations include an ongoing efficacy analysis of the PSAs, led by Dr. Arunima Krishna of the BU College of Communication Research Center (CRC), and a meta-analysis of Q4 climate coverage in the media with Dr. Lei Guo, BU CRC.

Edem Adukonu, ISE Research Assistant

This page: photo by Liz Linder

Nicole Mikkelson, ISE Management Intern (Questrom MBA, '20)
Nicole Mikkelson was a management intern and research analyst for the ISE this year, in parallel with completion of the second year of her Social Impact MBA in the Questrom School of Business. Mikkelson contributed to research on the utility of the future, including for Peter Fox-Penner's book *Power after Carbon*. She also played a notable role in researching peer universities' sustainability research initiatives for the Sustainability Research Institute plan. After graduating in May 2020, Mikkelson secured a job with Enel Green Power as a Lead Project Engineer for wind projects.

Edem Adukonu, ISE Research Assistant (Questrom MBA, '20)
Edem Adukonu was a research assistant at the ISE this academic year, and also in parallel completed the second year of his MBA from the Questrom School of Business. A key project that Adukonu supported was the development of a report on *Bringing Power and Progress to Africa in a Financially and Environmentally Sustainable Manner*, making recommendations to better inform and guide decision-making, action, and investment in electricity in Africa. A second project covered urban multi-modal travel to optimize efficient traffic management within sustainable cities. Following his graduation in May, he took a position as an energy consultant with PA Consulting.

Eugene Berardi, ISE Senior Fellow (Questrom MBA, '20)
Eugene Berardi's passion and entrepreneurial skills led him to quickly progress into a leadership role on the ISE's engagement with eastern European stakeholders in the coal and power industries. Berardi helped lead every part of the project, from the background research to stakeholder meetings in Europe to fundraising pitches. He graduated with his MBA this year and joined the ranks of ISE's highly regarded Senior Fellows.

Michael Grinshpun, Research Assistant (BA and MA, Economics, '20)
Michael Grinshpun worked with the ISE over a two-year period as part of the water research team while he completed his combined Bachelors and Masters of Arts in economics in the Kilachand Honors College at Boston University. Grinshpun worked on water conservation and ratemaking, focused especially on how a mid-sized and growing water utility in Texas could balance water demand, maintaining fiscal stability, and sustainable water management practices while serving customers equitably. His honors thesis examined water affordability metrics and measurements in cities across the U.S. Grinshpun is now working for National Grid as an Associate Analyst of Strategy Development.

Beth Haley, School of Public Health
Beth Haley is a second-year graduate student in the School of Public Health and is also enrolled in the BU URBAN program. Haley and Professor Wendy Heiger-Bernays are focused on public health questions relating to water quality in the Merrimack Valley, and they are collaborating with the ISE as well as with community organizations in the Merrimack Valley to develop research that goes beyond analyzing the public health impacts to assess potential water management solutions (e.g., green infrastructure). This partnership resulted in a successful application to the Initiative on Cities Early Stage Urban Research Award.

FACULTY ENGAGEMENT

Faculty and staff joined the Boston University Sustainability Curriculum Workshop on January 24, 2020 to discuss new collaborations, curricula, and a campus-wide knowledge network. Led by ISE Associate Directors Emily Ryan and Cutler Cleveland with affiliated faculty Neta Crawford, Professor and Chair, Dept. of Political Science.

Professor Christos Cassandras, Engineering and the Center for Information and Systems Engineering (CISE)
Professor Christos Cassandras in Engineering and the CISE collaborated with the ISE to put on a two-day workshop on Integrating Electric Mobility Systems with the Grid Infrastructure in November 2019 involving 25 experts from academia, industry, and government across the U.S. Supported by the Alfred P. Sloan Foundation, 20 talks examined the future of mobility and the ability of electric utilities to meet the needs of a highway transportation system powered primarily by electricity. The challenge at hand was to define plausible future structures of electric grids and mobility systems and anticipate the direct and indirect impacts of the changes involved. Recommendations for future research based on the workshop discussions included: exploring uncertainty through scenarios that include innovation in electric utilities and mobility; assessing data ownership and management models; considering the role of electric vehicles in ex-urban and rural areas; and addressing current complexity in financing and electric rates.

Professor Wendy Heiger-Bernays, School of Public Health
Professor Wendy Heiger-Bernays in the School of Public Health is collaborating with the ISE on water quality questions in the Merrimack Valley. The academic research is being shaped in parallel with community-led discussions involving Massachusetts and New Hampshire politicians, the Merrimack Valley Watershed Council, the Merrimack River Planning Commission, the Merrimack Valley District Commission, and community organizations such as Groundwork Lawrence. During the period when community engagement has been ramping up and the leadership of multiple community organizations has been in transition, Professor Heiger-Bernays served on the Merrimack River Technical Advisory Group—providing input to assess existing data and future needs relating to data and management, with the ultimate goal of informing effective watershed management. Challenges span the impact of combined sewer overflows and what industrial effluent is permitted, as well as developing a better understanding of how PFAS affect environmental and public health.

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PUBLISHED REPORTS

Research	Authors	Type	Research Area
More Urgency, Not Less: The COVID-19 Pandemic's Lessons for Local Climate Leadership	Peter Plastrik, John Cleveland (Innovation Network for Communities); Joyce Coffee (Climate Resilience Consulting); Jacqueline Ashmore, Ardeth Barnhart, Cutler J. Cleveland, Peter Fox-Penner (ISE)	Paper/Report	Sustainable Cities
Measuring and Addressing Water and Waste Water Affordability in the U.S.	Michael Grinshpun	Paper/Report	Water Management
One Water Demand Management: Rethinking Ratemaking	Michael Grinshpun, Josef Benzaoui, Jacqueline Ashmore	Paper/Report	Water Management
Multi-modal Travel	Edem Adukonu	Brief	New Mobility
Power After Carbon	Peter Fox-Penner	Book	Utility of the Future
Still Charging: Energy Storage Commercialization in Massachusetts	Victor Marttin	Paper/Report	Utility of the Future
Bringing Power and Progress to Africa in a Financially and Environmentally Sustainable Manner	Richard Stuebi, Edem Adukonu, Peishan Wang, Ted Zhang, Xin Yue, Justin Ren	Paper/Report	Utility of the Future
Final Report: Integrating Electric Mobility Systems with the Grid Infrastructure	Christos G. Cassandras, Peter Fox-Penner, Henry Kelly	Paper/Report	New Mobility
Water Utility of the Future: A Case Study of Conservation as a Service	Michael Grinshpun, Jacqueline Ashmore, Josef Benzaoui	Paper/Report	Water Management

ISE BLOG COMMENTARY

Thought leadership on ISE research and timely issues.

Title	Author
COVID-19 Lessons for Dealing with Uncertainty, to 2020 Graduates	Sarah Finnie Robinson
COVID-19 Teaches Us Lessons About Air Pollution, Environmental Justice, and Climate Change	Michael Grinshpun
Coal Region Economic Transformation in China	Yingxia Yang
Earth Day 2020: Honoring the 50th Anniversary	Featuring Philip Warburg
Earth Day 50th Environmental Victories	ISE
Will Shale Oil Survive a Restructured Oil Market?	Robert Kaufmann, Nalin Kulatilaka
World Water Day 2020: Deep Dive Into Water and Climate Change	Featuring Jacqueline Ashmore, Cutler Cleveland
The Decade Ahead: Energy, Transportation, and Climate Action	Peter Fox-Penner, Jacqueline Ashmore, Henry Kelly
Detecting Giant Methane Leaks	Robert Kleinberg
Encouraging Congress to Enact the Best Possible Environmental Regulations	Robert Kleinberg
UN Climate Week: China's Electricity Market Reform Is Underway	Peishan Wang
The U.S. Military's Key Role in Advancing Clean Energy Innovation: What I Would Have Said to Bill Gates	Dorothy Robyn
Hurricane Resistant Electric Systems? Building Resilient Microgrids	Richard Stuebi

FEATURED EVENTS

National Science Foundation Conference | Re-Envisioning Urban Infrastructure to Address Climate Change: A Comprehensive Regional Framework for Sustainability, August 5-6, 2019

The ISE collaborated with Boston University's Urban Climate Initiative, URBAN Program, and Initiative on Cities, as well as the Metropolitan Area Planning Council, to host a two-day conference on Re-Envisioning Urban Infrastructure funded by the NSF Sustainable Urban Systems program. The conference was designed to lay the groundwork for developing the new science, data, and methods needed to inform integrated urban sustainability outcomes across local-to-regional-to-national scales. It brought together a community of scholars; federal, state, regional, and local policymakers; and community groups to define a research agenda that explores integrated sustainability pathways and outcomes considering trade-offs and co-benefits.

***The Boston Globe* Events | At the Edge of a Warming World, October 22, 2019**

More than 350 people packed the Questrom School of Business auditorium for a behind-the-scenes look into *The Boston Globe*'s special report on climate change on Cape Cod, one of its most-read stories of 2019. Co-sponsored and hosted by the ISE, the event kicked off with an introduction to The 51 Percent Project, the ISE's climate communications initiative. Project Founder and ISE Senior Fellow Sarah Finnie Robinson moderated the panel that followed featuring *Globe* columnist Nestor Ramos, narrative editor Steve Wilmsen, and photographer John Tlumacki. Editor Brian McGrory made introductory remarks, saying the story also boasted the highest engagement rate for the year. For the second part of the evening, ISE Associate Director Cutler Cleveland joined a panel of climate experts and policymakers.

Advanced Energy Economy Executive Forum | Microgrids, Energy Storage, and Renewable Natural Gas: Capturing Value for Consumers, November 14, 2019

The ISE co-hosted AEE's invitation-only Executive Forum at Boston University, convening more than 30 top executives and policymakers from Veolia North America, ABB, Compass Energy Platform, Stem, Sidewalk Labs (an Alphabet company), Lockheed Martin, National Grid, Ultra Capital, Schneider Electric, M.J. Bradley & Associates, Mitsubishi Hitachi Power Systems, Massachusetts Department of Public Utilities, Hannon Armstrong, Enel X North America, ENGIE, Pinnacle West Capital Corp. / Arizona Public Service Co., Mintz, IMBY Energy, Landis + Gyr, and Tritium. The day's agenda included discussion of use cases for microgrids and energy storage; capturing the full value of energy storage and microgrids; the role of renewable natural gas in a low-carbon energy system, and the role of utilities vs. third-party ownership in modernizing the grid.

American Meteorological Society | 100th Annual Meeting, January 12-16, 2020

The ISE joined the momentous AMS Centennial Meeting, giving presentations on climate communications and power forecasts at the world's largest annual gathering for the weather, water, and climate community. In the session "Taking the Next Step: Continuing the Conversation off Camera, in Your Work and Personal Life," ISE Senior Fellow Sarah Finnie Robinson of The 51 Percent Project presented the key principles for efficacious climate conversation. ISE Associate Director Cutler Cleveland joined the panel "Power Forecasts: Using Daily Wind and Solar Energy Predictions" to discuss the current state of renewables and their trends in the U.S.

COVID-19 Impacts

A series of webinars wrestling with the far-reaching impacts of COVID-19 have featured ISE speakers on a range of topics related to energy markets and sustainability. Associate Director Cutler Cleveland weighed in with "Current Insights on the Clean Energy Transition & Investment Opportunities" for an event hosted by BU Alumni & Friends. Director Peter Fox-Penner and Senior Fellow Philip Warburg teamed up to discuss the "Environmental Impact of COVID-19: Sustainable Energy, Climate, and Societal Shifts," also with the BU Alumni network. Senior Fellow Sarah Finnie Robinson joined a panel hosted by the Out of Home Advertising Association of America (OAAA) for "Perspectives: Sustainability After COVID-19."

This page: photo by Dave Green Photography

ISE HOSTED EVENTS & SPEAKING ENGAGEMENTS

ISE experts discussed their research at events on campus and across the U.S., and through webinars that reached global audiences.

Date	Event	ISE Speaker/ Moderator	Sponsor/Host	Focus Areas
8/5/19	Re-Envisioning Urban Infrastructure to Address Climate Change: A Comprehensive Regional Framework for Sustainability	N/A	ISE, Initiative on Cities, Urban Climate Initiative, BU URBAN, Metropolitan Area Planning Council, National Science Foundation	Decarbonization
9/9/19	Annual WateReuse Symposium	Jacquie Ashmore	WateReuse Association	Water Management
9/12/19	BU Alumni Association Presentation	Peter Fox-Penner	BU Alumni Association	General ISE
9/18/19	Tackling Climate Change: The Case for Carbon Dividends	N/A	BU Global Development Policy Center, Pardee Center, ISE	Decarbonization
9/18/19	One Water Summit	Jacquie Ashmore	US Water Alliance	Water Management
9/19/19	BU Sustainability Festival with BU Energy Club	N/A	BU Sustainability, BU Energy Club, ISE	Other
9/20/19	Horizon 19: Future of Transportation	Jennie Hatch	Horizon19	New Mobility
9/23/19	Born Global Foundation's Competition for Innovation in Sustainability kick-off event	N/A	BU ENG, ISE	Decarbonization
9/23/19	United Nations Economic Commission for Europe Geneva Climate Conference	David Jermain	UNECE	Decarbonization
9/25/19	Rising Temperatures, Rising Costs: The Increasing Global Energy Needs that Come with a Changing Climate	N/A	BU Pardee Center, ISE	Decarbonization

ISE Hosted Events & Speaking Engagements *continued*

9/25/19	University Energy Institute Leadership Summit	Jacquie Ashmore	Wilton E. Scott Institute for Energy Innovation at Carnegie Mellon University, Colorado School of Mines' Payne Institute for Public Policy, Rice University's Baker Institute for Public Policy	Decarbonization
9/29/19	GEIDCO Climate Week	Peter Fox-Penner	GEIDCO, Bloomberg Philanthropies, ISE	Utility of the Future
10/22/19	At the Edge of a Warming World	Sarah Finnie Robinson	*The Boston Globe*, ISE, Pulitzer Center	Climate Communications
10/22/19	Annual US Water Treatment Conference	Josef Benzaoui	LMN Power	Water Management
10/25/19	Princeton Environmental Forum: Breaking the Logjam: The Way Forward	Sarah Finnie Robinson	Princeton Environmental Institute	Decarbonization
10/28/19	Cornell Seminar Presenter for Environmental Engineering Group: Carbon Capture Research	Emily Ryan	Cornell University	Decarbonization
11/6/19	Sloan Foundation: Integrating Electric Mobility Systems with the Grid Infrastructure	Peter Fox-Penner	ISE, BU Center for Information and Systems Engineering	New Mobility, Utility of the Future
11/14/19	Advanced Energy Economy Executive Forum: Microgrids, Energy Storage, & Renewable Natural Gas: Capturing Value for Consumers	Peter Fox-Penner	AEE, ISE	Utility of the Future, Decarbonization
11/14/19	Scialog: Advanced Energy Storage	Emily Ryan	Alfred P. Sloan Foundation, Research Corporation for Science Advancement	Decarbonization
11/19/19	Future of Food & Its Global Impact	N/A	BU Global Programs, ISE	Other
11/21/19	Q4 EV Infrastructure Luncheon Series: Maximizing EV Deployments and Boston's Commitment to Be Carbon Free by 2050	Peter Fox-Penner	Advanced Energy Group	New Mobility
12/2/19	COP25: Multilateral Responses to Climate Change from an Interdisciplinary Perspective	Peter Fox-Penner	ISE, Harvard University Center for the Environment, Environment and Natural Resources Program at the Harvard Kennedy School Belfer Center for Science and International Affairs, Real Colegio Complutense at Harvard	Decarbonization

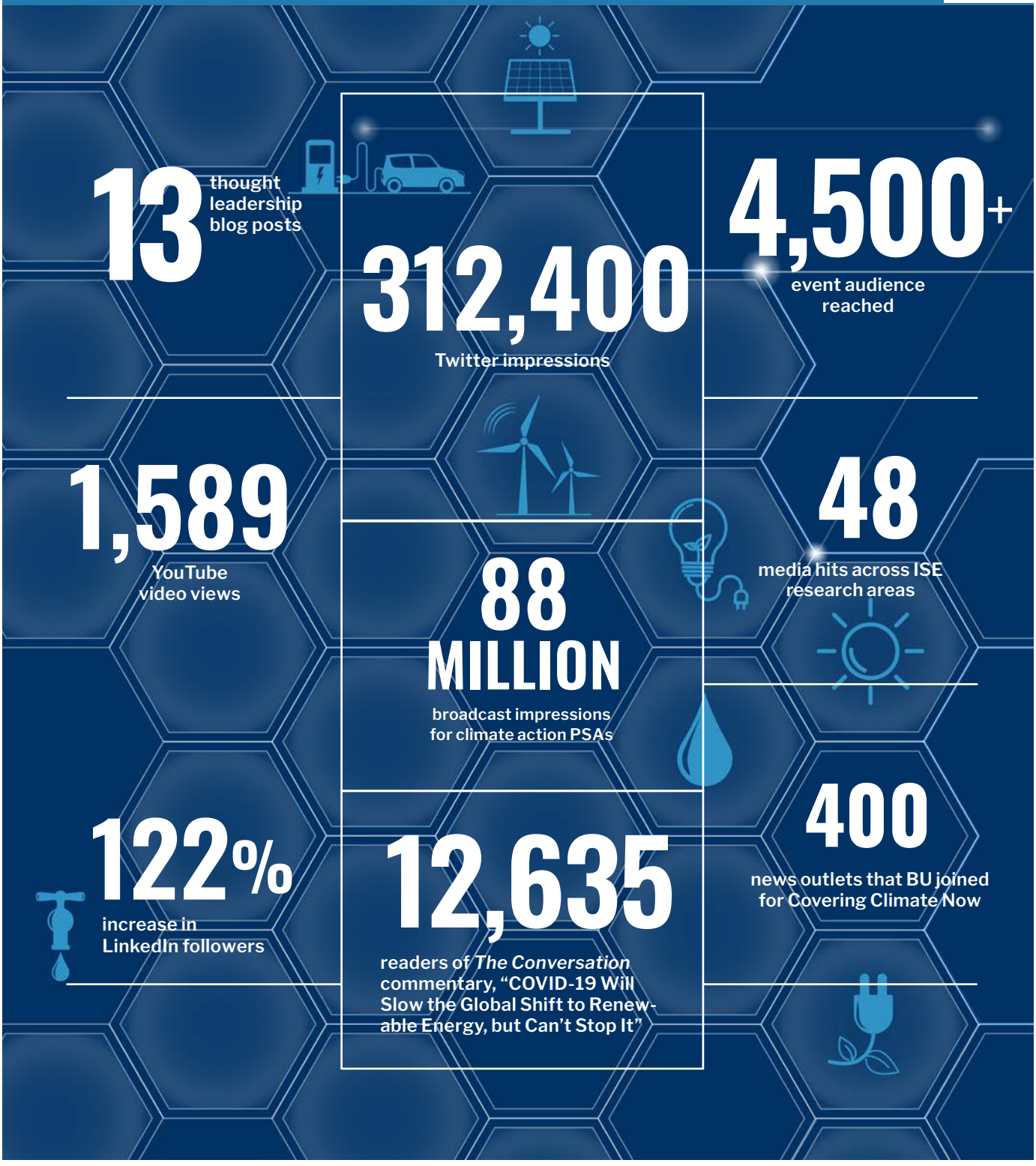
ISE Hosted Events & Speaking Engagements *continued*

12/4/19	Research on Tap: Accelerating the Energy Transition: Transformative Pathways to Decarbonization and Sustainability	Peter Fox-Penner, Robert Kleinberg, Jacquie Ashmore, Emily Ryan, David Jermain, Justin Ren, Lucy Hutyra, Cutler Cleveland, Michael Caramanis, Michael Gevelber, Jon Levy	BU Office of Research, ISE	New Mobility, Decarbonization Pathways, Sustainable Cities, Utility of the Future, Water Management
12/9/19	New England Women in Energy and the Environment Lunch Roundtable: Hybrid energy systems, solar photovoltaic (PV) facilities, microgrids	Jacquie Ashmore	BU, ISE, NEWIEE	Sustainable Cities, Utility of the Future
12/9/19	American Geophysical Union Fall Meeting	Robert Kleinberg	AGU	Decarbonization
12/18/19	Less Certain than Death: Using Tax Incentives to Drive Clean Energy Innovation	Dorothy Robyn	Information Technology and Innovation Foundation	Decarbonization
1/14/20	American Meterological Society Centennial Annual Meeting	Cutler Cleveland, Sarah Finnie Robinson	AMS, Lockheed Martin, Vaisala	Climate Communications, Decarbonization
1/22/20	Corporate Communications Workshop for Business Leaders	Sarah Finnie Robinson	AHC Group	Other
1/24/20	BU Sustainability Curriculum Workshop	Cutler Cleveland, Emily Ryan	ISE	Decarbonization
1/31/20	State of the Waters 2020	Jacquie Ashmore	Merrimack River Watershed Council	Water Management
2/15/20	IDEA Conference 2020: Leadership in Climate Action: Entrepreneurs, Universities, and Cities	Cutler Cleveland	Innovate@BU	Sustainable Cities, Utility of the Future
2/18/20	American Resilience Project: Current Revolution with Roger Sorkin	N/A	ISE	Utility of the Future
2/25/20	Increasing Electric Vehicle Adoption: The Intersection of Battery Technology, Charging Infrastructure, and Public Policy	Jennie Hatch, Henry Kelly	National Association for Business Economics	New Mobility

ISE Hosted Events & Speaking Engagements *continued*

3/5/20	2020 Renewable Energy Conference: How to Operate the Grid of the Future	Jacquie Ashmore	Northeast Energy and Commerce Association	Utility of the Future
3/6/20	Thermal Decarbonization with Jurgen Weiss and Dean Martin from Brattle Group	N/A	ISE	Decarbonization
4/16/20	Bringing Power and Progress to Africa in a Financially and Environmentally Sustainable Manner	Richard Stuebi, Edem Adukonu, Peter Fox-Penner, Lawrence Jones	ISE	Utility of the Future
4/22/20	Environmental Impact of COVID-19: Sustainable Energy, Climate, and Societal Shifts	Peter Fox-Penner, Phil Warburg	ISE, Alumni Relations	Utility of the Future, Decarbonization
5/6/20	Emerging Trends Series: New Business Models for Electrification	Peter Fox-Penner	Northeast Clean Energy Council (NECEC)	Utility of the Future
5/20/20	EVCx Forum: Past, Present and Future of Transportation Electrification: The World View—Melting the ICE	Peter Fox-Penner	CS Week Synergy Group	New Mobility
5/21/20	*Power after Carbon: Building a Clean, Resilient Grid*	Peter Fox-Penner	Edison Electric Institute (EEI)	Utility of the Future
5/26/20	Converge to Transform: Making Energy Sustainable	Cutler Cleveland	City University of New York (CUNY)	Sustainable Cities
6/2/20	Economics Group (Climate Change Mitigation and Adaption Group)	Peter Fox-Penner	Cosmos Club	Utility of the Future
6/3/20	GridWise Policy Council: *Power after Carbon*	Peter Fox-Penner	GridWise Policy Council	Utility of the Future
6/17/20	Current Insights on the Clean Energy Transition and Investment Opportunities	Cutler Cleveland	Boston University Development & Alumni Relations	Decarbonization
6/17/20	Lessons from DOD, Where Demonstrations Are Part of the Culture	Dorothy Robyn	American Energy Innovation Council	Other
6/23/20	Out of Home Advertising Association of America lunchtime webinar series: Sustainability During and After COVID-19	Sarah Finnie Robinson	OAAA/OOH	Decarbonization

COMMUNICATIONS BY THE NUMBERS



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LEADERSHIP & STAFF

Peter Fox-Penner
Director
Professor of Practice, Questrom School of Business
pfoxp@bu.edu

Jacqueline Ashmore
Executive Director
Research Associate Professor, Department of Mechanical Engineering
ashmore@bu.edu

Cutler Cleveland
Associate Director
Professor, Earth & Environment
cutler@bu.edu

Laura Hurley
Marketing & Communications Director
hurleyl@bu.edu

Robert Perry
Communications and Administrative Coordinator
rperry22@bu.edu

Will Edwards
Associate Director of Finance and Operations
willed@bu.edu

David Jermain
Associate Director
Adjunct Professor, Questrom School of Business

Emily Ryan
Associate Director
Associate Professor, Mechanical Engineering
ryanem@bu.edu

Naseme Hallum
Senior Administrative Assistant
nhallum@bu.edu

This page: Fox-Penner and Ashmore photos by Liz Linder

ADVISORY BOARD

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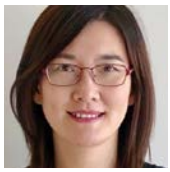

Yingxia Yang
Senior Technical Leader, Electric Power Research Institute

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Alan Feld, Professor of Law

SCHOOL OF PUBLIC HEALTH

Wendy Heiger-Bernays, Clinical Professor, Environmental Health
Patrick L. Kinney, Professor, Environmental Health, Kinney Lab
Jonathan I. Levy, Professor, Environmental Health

*Core ISE faculty. Core faculty participate in the day-to-day activities of the ISE by being a lead for or a member of a research team on a project for which the funding runs through the ISE. Affiliated faculty engage by participating in ISE research discussions and events throughout the academic year.

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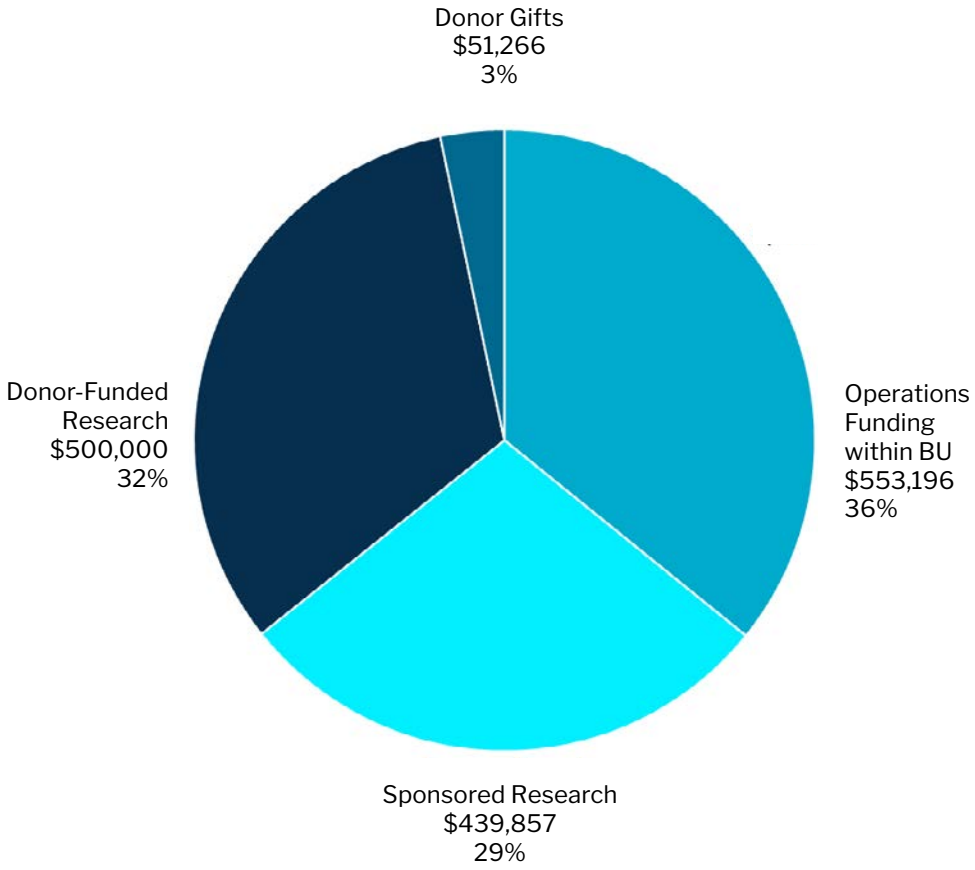

SPONSORED RESEARCH

Source	Duration	Amount
Bloomberg Philanthropies	10/01/17–03/31/20	$800,000
Hewlett Foundation	10/01/18–10/01/20	$200,000
Mitchell Foundation	04/01/19–05/31/20	$130,000
TOTAL SPONSORED FUNDING		**$1,130,000**
ESTIMATED PIPELINE		**$875,000**

▲ *Research on Tap featuring 10 ISE micro-talks, hosted by Gloria Waters, Vice President and Associate Provost for Research.*

▼ *Distinguished alum Charles Curtis (BU Law '65), former U.S. Deputy Secretary of Energy, shares insights from his career in energy, law, and public service with the BU Energy Club.*

STAY CONNECTED

Boston University Institute for Sustainable Energy
180E RIVERWAY, 2ND FLOOR
BOSTON, MA 02215

bu.edu/ise
EMAIL: iseinfo@bu.edu

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BOSTON, MA 02215

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Flashback to the ISE's first staff meeting of the 2019/2020 academic year.