FY18 Annual Report

Institute for Sustainable Energy

650 Beacon Street, 5th floor
Boston, MA 02215

617.358.6248 | www.bu.edu/ISE

Public version | September 2018

BOSTON UNIVERSITY

Letter from the Director

Dear Stakeholders and Colleagues:

The ISE is now just over two years old, and looking back on our trajectory the pace of growth is notable. In pausing to consider what we have accomplished to date as well as what we seek to accomplish in the coming years, I find myself reflecting on some notable success stories that ISE has already generated.

- ISE straddles audacious sustainability goals (making Boston carbon-neutral by 2050) with data-driven solution pathways.
- ISE works on all geographic scales – our most established projects encompass local (Carbon Free Boston), national (e.g., sustainable water management in Texas), and international (e.g., electric vehicle markets in China, Europe, and the US).
- ISE amplifies the work of multiple colleges and schools of BU: our energy storage work will support federal grant proposals to the NSF and other federal agencies; Carbon Free Boston has expanded the work on CAS faculty; work on electric vehicles and decarbonization more broadly builds on the interests of Questrom faculty. Other smaller projects support other faculty and student research interests, e.g. studies of microgrids in the northeastern US and in Haiti.

While we are proud of our results from the last two years, the ISE has much room in which to deepen our engagement with BU faculty, industry, and policy makers. We also look forward to communicating our work more broadly with the support of professional marketing and communications staff. We will build on our collaborations with Innovate@BU and Sustainability@BU to maximize our efforts to address the challenges of the present and the future.

We are grateful to our staff, our non-resident senior fellows, our advisory board members, and our many supporters – including stakeholders within BU and many others who generously give their time and advice to help advance ISE's work.

Sincerely,

Dr. Peter Fox-Penner
Director, Boston University Institute for Sustainable Energy
Professor of Practice, Questrom School of Business
595 Commonwealth Avenue
Boston, MA 02215

Contents

1. Project Overviews

Carbon Neutral Cities

- Quantitative assessment of alternative strategies to reduce Boston's GHG emissions from all sources to carbon-neutral by 2050
- Model the effects of policies on emissions from building, transportation, power, and waste sectors
- Incorporate feedback from technical advisory groups, with inclusion of equity discussions
- Provide model projections that facilitate decisions to be made by the City of Boston on which policies to pursue to achieve goal of carbon neutrality
- Building foundation for a BU Center for City Climate Modeling (C^3M) to help cities all over the world reduce their carbon footprints using ISE's open-source models.

This project is generously funded by over twelve Foundations and companies

BU/Columbia-Bloomberg GEIDCO Project

- An overview of potential energy transition roadmaps of China and US (2030, 2040, 2050), primarily including energy structure, technical economy, carbon emission situation and key policies.
- A comparative study of electric vehicle and charging infrastructure network development in China and US.
- Electrification in Africa and Latin America

Electric Vehicles

- In July, ISE published reviewed article in Energy Policy outlining the electric grid and greenhouse gas implications of electrifying transportation.
- Current ISE studies include:
  - Greenhouse gas implications of autonomous vehicles
  - Forecasts and implications for charging infrastructure
  - Low GHG transport and mobility policies in the City of Boston
- Case studies on the electric vehicle infrastructure of multiple cities in the US, China, and Europe are underway.

Sustainable Water Management

- Integrated water management practices can help Texan cities manage water resources in the face of rapid urban growth, climate change, and aging infrastructure.
- The ISE team is in year 2 of a 3-year project funded by the Cynthia & George Mitchell Foundation.
- The team has worked closely with San Antonio and developed a demand project model that accounts for different land use choices as a city grows. This is being utilized by San Antonio and can be use by other cities also.
- We are now working with New Braunfels, a smaller city outside Austin, that is looking to reduce consumption and ensure resilient supplies as they experience population growth.

- Jacquie Ashmore was on a panel about public private partnerships for stormwater management at the P3 Water Summit in March, presented the team's work at Texas Water in April, and is moderating a panel on water reuse in Texan cities at the WateReuse Symposium in September,

- We will also discuss this work with BU alumni at development events in the Austin and Houston areas in fall 2018.

ISE team members and New Braunfels partners

Energy access in Haiti

- In Haiti, the promotion of electric cooking appliances may help accelerate the sustainable provision of electricity to rural villages that currently lack access to energy by making microgrids more financially viable, while also providing multiple environmental, human health, and household economic benefits by transitioning away from charcoal-based cooking.

- The ISE and EarthSpark International engaged in a collaborative project evaluating alternative electric cooking appliances to determine which type is both most economically-beneficial and most likely to be broadly adopted and continuously used in Haiti given local cultural and social factors.

- The project involved the ISE team developing a report on Haiti's electricity sector and six students participating in an independent study course that included a one-week trip to Haiti for field studies.

- This work is part of a broader effort that aims to facilitate additional microgrid financing and development and increased adoption of electric cooking in Haiti.

This project was generously funded by a donor, Jay Cashman

Microgrids in the northeastern US

- Many of the most important impediments to microgrid adoption – including significant issues about business model, pricing, regulation and financing – arise once more than one customer is served by a microgrid.
- The ISE is working with NECEC to create a summary report of the obstacles that inhibit microgrid development, and make recommendations to reduce/eliminate the obstacles.
- The team is reviewing multi-user microgrids in New England and New York that are operational or under development (or made significant progress towards development before plans were abandoned).
- The findings will be presented at Horizon 18, a major clean energy economy conference, in Boston in October.

This project is generously funded by a donor, Steve Cowell

Energy storage in Massachusetts

- Massachusetts policymakers and energy industry leaders are interested in assessing how to further Massachusetts as a leader in energy storage development.
- ISE is collaborating with Greentown Labs and Innovate@BU to map the landscape of energy storage resources in Massachusetts for entrepreneurs and policy makers.
- This work includes:
  - Assessment of the major market needs for energy storage technology and business model innovation over the next 10 years (electronics, EV, and residential / utility scale storage applications).
  - research on the life cycle of energy storage startups and the major challenges presented across these major phases.
  - research, documentation and categorization of energy storage testing, research, business and commercialization resources in Massachusetts.
- This complements upcoming events and federal grant applications from BU engineering faculty engaged in storage research

2. ISE publications

- **Peer-reviewed**

  Helveston, Feit & Michalek, *Pooling Stated and revealed performance data in the presence of RP endogeneity,* Transportation Research Part B 109 (2018) 70- 79

  Fox-Penner, Gorman & Hatch, "Long-term Transportation Electricity Use Considering the Effect of Autonomous-vehicles: Estimates & Policy Observations," Journal of Energy Policy, to appear in July 2018

- **In preparation**

  Ashmore, Hendrick & Marttin, *Integrated urban water management in Texas: A review to inform a One Water approach for the future,* in preparation for submission to

  Hatch & Gorman, *Heaven or Hell: What are the GHG emission implications for light-duty vehicles of autonomy and ridehailing?* In preparation for submission to Nature Energy

- **White papers**

  Stuebi & Hatch, "Assessment of Haiti's Electricity Sector" (2018)

3. Engagement with faculty

ENGINEERING	
Peter Fox-Penner is collaborator on Nitin Joglekar's and Malay Mazunder's ARPA-E proposal	Funding pipeline
Partnered Christos Cassandras with CSE and were successful in RFQ with LADWP	Funding pipeline
Supported Michael Caramanis's Sloan Foundation grant	Funding
Pursued DoE regional innovation center prospect - originally planned to fund centers at $2MM/year: - Ashmore participated in MIT organized workshop with relevant DoE personnel presenting (Oct 2016) - Co-hosted two half day workshops at BU and in NY to establish initial ideas for a solid partner coalition approximately six weeks before anticipated RFP (mid-November 2016). All ISE affiliated faculty were invited to the BU workshop and several participated.	Funding pipeline
Contributed to Michael Gevelber's NSF NRT proposal	Funding pipeline
Supported Michael Gevelber's exploration of a new research area relating to wind energy: - provided ISE seed grant - found student to work on project - made introduction to Fraunhofer CSE to enable data access	Funding & partnership pipeline
Helped Uday Pal pursue external collaboration on EFRC pre-proposal	Funding & partnership pipeline
Shared NEEP research opportunities for students, encompassing engineering topics	Partnership pipeline & education
Featured multiple Engineering faculty at the ISE inaugural Annual Executive Briefing in Oct 2017	Funding & partnership pipeline
Established scholarship access for BU engineering students to the Peak Load Management Alliance conference	Education



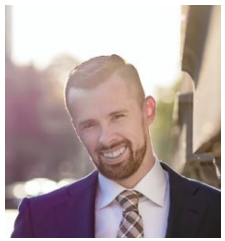



Engagement with faculty

QUESTROM	
Led creation of GEIDCO project that substantially funds Justin Ren and students	Funding
Engaged Kira Fabrizio on microgrid barrier assessment project in partnerwhip with NECEC, with $75k total budget	Funding & partnership
Supported Nalin Kulatilaka's pursuit of clean energy finance partnerships and funding with multiple introductions in the finance community	Funding & partnership pipeline
Supported Rob Metcalfe with two introductions to private sector partners	Funding & partnership pipeline
Created opportunity for Paul McManus to lead student course on microgrids in Haiti, including spring break trip to Haiti	Funding & partnership
CAS	
Provided considerable fundraising, partnership, and management support for Carbon Free Boston project, with Cutler Cleveland as PI	Funding & partnership
Made an introduction for a potential project for Pam Templar's UniverCity NRT program	Partnership
Worked with Sean Elliott to assess possible Nature Conservancy funding for a postdoc	Funding pipeline








Student engagement & teaching

- Peter Fox-Penner teaches a Questrom course on sustainable energy
- Guest lectures in six other BU courses
- Two executive education courses taught
- Five BU students participated in independent study course on viability of microgrids in Haiti, including one-week trip to Haiti to interview local people
- Collaboration with Innovate@BU events including ISE representation at Innovation Week events
- Over ten BU students have worked on research projects with ISE teams during the last year

4. Key ISE events in 2018

- **Meeting Crown Prince of Saudi Arabia, March 2018**: Peter Fox-Penner hosted a roundtable with representatives of the Crown Prince of Arabia and international business leaders

- **Hosting GEIDCO leadership team, April 2018:** ISE hosted the senior leadership of GEIDCO for a half day of discussions of their strategies to build renewable energy supplies and deployment

- **International Mayors Climate Summit, June 2018:** Cutler Cleveland spoke about the Carbon Free Boston project in a panel on sustainable energy, at the event which featured appearances by former secretary of state John Kerry and convened more than 20 mayors from across the globe to discuss approaches to combating climate change.

Annual Briefing, October 2017

- ISE hosted 40 business leaders and policy experts from across the US and China to present innovative BU research and discuss others' efforts relating to
  - carbon-free cities of the future
  - transportation
  - the electric grid
  - sustainable water management
  - energy finance

- Commissioner Cheryl LaFleur, Chairman of FERC, gave a keynote presentation

- This event led to the formation of ISE's Advisory Board and spun up research collaborations

Select recent ISE events

ISE convened members of the BU community, alumni, and partners at numerous events including:

- Screening of “Chasing Coral” with over 300 people attending (September 2017)
- Alumni events in
  - San Francisco (September 2017)
  - New York (December 2017)
  - Washington DC (February 2018)
- Water Utility of the Future workshop in Texas (April 2018)
- First ISE Advisory Board meeting (April 2018)
- Electrification in Haiti roundtable (May 2018)
- Regular seminars in the fall and spring semesters

Upcoming ISE events

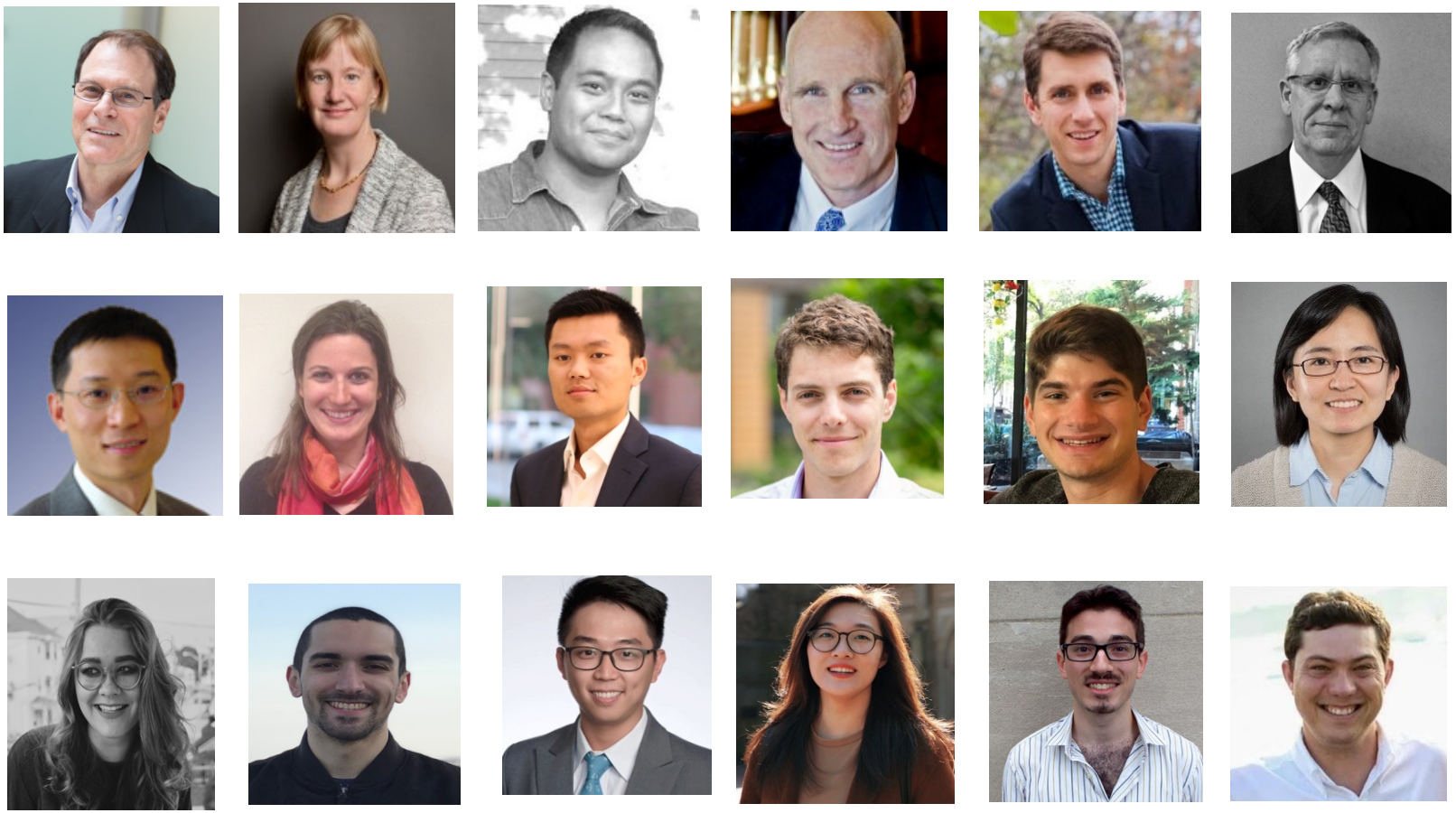
- ***September***
- ISE will participate in a UN Committee in Sustainable Energy conference in Geneva
- ISE will participate in the Global Climate Summit in San Francisco
- ISE will host the Veteran's Energy Seminar, supporting veterans in applying for clean energy jobs

- ***October***
- ISE's next Advisory Board meeting will be 10/3 – 10/4
- Cutler Cleveland will speak in a panel session at Horizon 18, an international clean economy conference in Boston
- ISE will be featured in Questrom alumni events in Houston and Austin
- ISE is co-sponsoring BU's Materials Day focused on energy storage

- ***November***
- ISE's annual faculty retreat will be on 11/4

5. The ISE team: core staff

The ISE now has 25 people contributing on a daily basis, spanning senior leadership and faculty members to mid-level and junior research fellows, to students. We are proud that two ISE postdocs have launched into a faculty position at University of Washington and a non-profit job with Fresh Energy.



ISE's Non-Resident Senior Fellows

Sarah Finnie Robinson
Sarah is an investor in large-scale climate solutions and a founding partner of WeSpire, a Boston tech form that powers sustainability programs at F500 corporations. She is active on the Climate Task Force for Boston Harbor Now.

Lawrence E. Goldenhersh, JD
Lawrence is the founder, president, and CEO of Enviance, a 13-year-old cloud-based environmental software company. He specializes in environmental compliance and risk management, greenhouse gas accounting and finance, cloud computing, and supply chain environmentalism.

Henry Kelly, PhD
Henry is an expert in technology policy and has worked extensively on energy, information, education technology, and nuclear weapons. He now serves as the chief scientist in the US Secretary of Energy's new Energy Policy and Systems Analysis organization.

Robert Kleinberg, PhD
Robert joins the ISE after a 37-year career at Schlumberger. His previous work was on geophysical measurements and the characterization of unconventional fossil fuel resources. He now focuses on energy technology, economics, and environmental issues associated with oil and gas development.

Dorothy Robyn, PhD
Dorothy is a public policy expert who writes and consults on policy issues related to energy, infrastructure, and telecommunications. She has 35 years of experience in government, academia, and consulting. She is currently doing foundation-funded research on how to make military bases more energy resilient.

denotes recently appointed

Brett Perlman, JD, MPA
Brett is the former Commissioner of the Public Utility Commission of Texas, appointed in 1999. More recently he founded Vector Advisors, a management consulting firm that serves telecommunications and energy clients.

Richard Stuebi
Richard is the founder and president of Future Energy Advisors, a management consulting practice advising corporate clients on innovative growth strategies relating to energy. Previously he served as the Vice President of US Strategy & Group Technology at National Grid.

Jonathan Schrag
Jonathan is currently the Deputy Administrator of the Rhode Island Public Utilities Commission. Previously he was Senior Director of the Clean Energy Idea Bank at the Environmental Defense Fund and a Senior Fellow at the Guarini Center on Environmental, Energy and Land Use Law at New York University.

Pauliina Schwartz, CFA, MBA
Pauliina Swartz leverages her background in finance and her passion for clean tech to expand financing for renewable energy and other distributed energy resources. She has expertise in structured finance, fixed income markets, global banking operations, and experience with clients ranging from small specialty lenders to largest institutional investors in the world.

Philip Warburg, JD
Philip is an author and lawyer specializing in renewable energy. He has worked with governments and citizens groups on environmental initiatives in several Middle East nations and across Eastern Europe.

ISE's Advisory Board

Sheldon Simon (Chair)
Adage Capital Management

Jill Anderson
Southern California Edison

Leah Bissonette
The Energy Bliss

Ned Bartlett
Veolia

R.F. Hemp Hill
AES Solar Energy

Farshid Mostowfi
Schlumber-Doll Research

John S. Skrinar
Noble Americas

Alumni Outreach

- Peter Fox-Penner and Jacquie Ashmore spent a week visiting alumni in four cities in California in September 2017
- Throughout the last year, ISE was featured in well attended alumni events in the Bay Area, New York, and Washington DC
- ISE works closely with BU's development team and with Sheldon Simon to develop more engagement with alumni in the Boston area
- ISE will be featured at two BU Questrom alumni events in Austin and Houston in October 2018

Core Managerial Support

Maria Anderson

Courtney Hudson

Montanna Freeman

Tom Elsey

Cyrus Roxas

Ryan Hopping

Robert Perry

6. Marketing and communications

- The ISE launched a new webpage in March 2018.
- We have also leveraged opportunities to be featured to partners' online platforms, e.g. Margaret Cherne-Hendrick and Jacquie Ashmore each had a blog post featured on the Cynthia and George Mitchell Foundation's website.
- ISE is recruiting a new marketing and communications staff member (half-time) in FY 19. This person will be tasked with supporting effective branding of ISE's thought leadership and applied research.
- We seek to reach a number of different audiences, including sustainability leaders and enthusiasts, policymakers, regulators, the private sector, NGOs and foundations, individual philanthropists, engineers and scientists, specialized and mainstream media, and Boston University faculty, staff, students, and alumni.
- This is an important addition to our team in ensuring that appropriate experts are aware of our contributions.

TEXAS SADDLES UP FOR THE "WATER UTILITY OF THE FUTURE"

Dr. Margaret Cherne-Hendrick | Senior Science Policy Associate | Boston University Institute for Sustainable Energy | April 25, 2018

In order to meet the water needs of urban and suburban populations across the United States, utilities are undertaking long-term planning that accounts for the risk and uncertainty of droughts and flooding, while ensuring that adequate reserves are maintained to refresh groundwater supplies and freshwater flows for the environment.

These planning exercises are especially critical to urban populations in the state of Texas.

Texans endured a historic drought in the 1950s as well as a notable drought in 2011. The state also faces periodic, sometimes catastrophic, flooding associated with tropical storms and hurricanes that approach from the Gulf of Mexico. Further, water managers strive to protect sensitive freshwater bays, estuaries, and aquifers while also procuring sufficient potable water supplies _to meet demand in Texas's rapidly growing metropolitan areas. The challenge is compounded by the aged state of water infrastructure systems and the increasing impact of climate change.

Water utilities must decide how to move beyond conventional business and financial models in order to address these challenges head-on. A utility's long-term water plan has as much to do with forecasting supply and demand as it does with envisioning the "Water Utility of the Future."

In Texas, as in many other parts of the world, water stakeholders view the adoption of integrated urban water management approaches, such as One Water, as a hallmark of the Water Utility of the Future. Notably, Austin Water and San Antonio Water System (SAWS) are both engaged in long-term planning processes that embrace aspects of the One Water philosophy in the cities of Austin (Water Forward) and San Antonio (2017 Water Management Plan), respectively.

On a more granular level, however, the Water Utility of the Future is defined by four key principles: 1. reflective of the "true cost of water", 2. sustainable, 3. resilient, and 4. integrated. These principles are integral to a One Water approach and, if woven into future business and financial