new beginnings

CUE'S SECOND DECADE

2021
ANNUAL
REPORT

Toronto Metropolitan University

Centre for Urban Energy
Faculty of Engineering
& Architectural Science

a message from our **academic director**

As we embark on our second decade of working towards an equitable and inclusive carbon-free energy future, we've set ambitious new energy goals, including several that address Canada's commitment to achieve net-zero emissions by 2050.

Here are just a few activities that align with our strategy:

- **Transform TO** – With our project partners and the university, we will support the city's plan to achieve net-zero emissions in Toronto by 2040, a full decade ahead of the national plan.
- **Canada's Hydrogen Strategy** and **Ontario's Hydrogen Strategy** – Hydrogen is included as one of our research focus areas to promote further greening in the energy sector.
- **The Power Up Program** – This new initiative is designed to help students and early-stage entrepreneurs develop a deeper understanding of global challenges and real-life issues facing the energy sectors.

Our efforts continue to gain international recognition and support and will be increasingly interdisciplinary as we look at problems from various angles and seek solutions that are engineering-based and informed by assessments of user-focused data, social impacts and equity implications.

As with all new beginnings, the past is prologue. I'm excited to see how, together with our partners, we build on the successes of our first decade and pursue our vision for CUE in the years ahead.

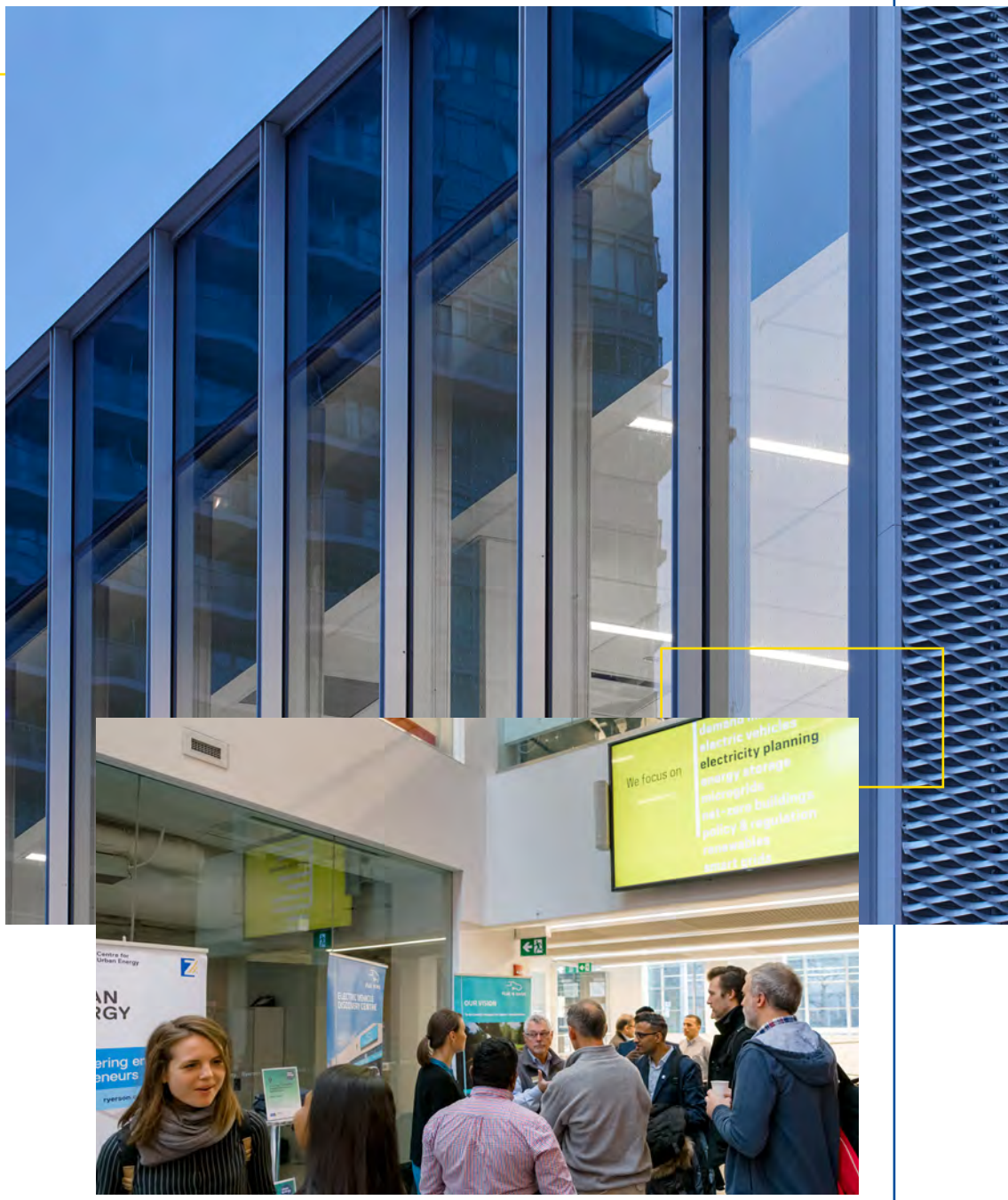
– Bala Venkatesh

our **vision**

CUE was created to be a world-class research and innovation centre dedicated to solving our most pressing urban energy challenges.

our **model**

CUE is an academic-industry partnership established to explore, develop and commercialize sustainable, innovative, cost-effective and practical clean-energy solutions and technologies.



our **three pillars**

CUE delivers products, services and supports in three categories:

research, testing and consulting

Projects and reports are often completed with the collaboration of — or sponsorship by — government and industry partners.

Testing of products or prototypes takes place at a world-class university, using state-of-the-art equipment.

Consulting projects draw on our capacity for multidisciplinary collaborations between industry professionals and academic researchers, as well as access to our unique lab spaces.

education

Professional development is offered through a formalized curriculum and an executive education seminar series.

innovation

Startups are incubated at the **Clean Energy Zone**, which is based within CUE and part of Toronto Metropolitan University's Zone Learning ecosystem.

CUE's **scholarly, research and creative activities**

CUE's work and culture are guided by Toronto Metropolitan University's scholarly, research and creative (SRC) objectives. Our key performance indicators are listed later in this report under SRC Excellence.

acknowledgments

founding **sponsors**

hydro one

ieso
Power to Ontario.
On Demand.

TORONTO HYDRO®

2021 **partners**

Celestica
Elocity
Hydro One
Mitacs
NSERC
Opus One
Tata Power
TCHC
Toronto Hydro

advisory **board**

Thomas Duever
Dean, Faculty of Engineering and Architectural Science, Toronto Metropolitan University (Chair)

Matthieu Bureau
Vice-President, Power Systems Canada, Schneider Electric

Tom Chapman
Senior Manager, Market Development and Strategy, Independent Electricity System Operator (IESO)

Martin Huang
Vice-President, System Operations, Hydro One

Steven Liss
Vice-President, Research and Innovation, Toronto Metropolitan University

Elias Lyberogiannis
Executive Vice-President, Planning and Chief Engineering and Modernization Officer, Toronto Hydro

Neetika Sathe
Vice-President, Green Energy & Technology (GRE&T) Centre, Alectra

Thomas Timmins
Leader, Energy Sector Group, Gowling WLG

Bala Venkatesh
Academic Director, Centre for Urban Energy

focus **areas**

climate change; microgrids; demand management; efficiency; electricity planning; hydrogen; conservation; electric vehicles; net-zero buildings; policy and regulation; renewables; smart grids; storage, transmission and distribution; transactive energy

activities

CUE combines the perspectives of engineering, science, environmental studies, business, social sciences, public policy, law and infrastructure management.

advantages

- World-class urban energy researchers, technologies and facilities
- Multidisciplinary collaborations under one roof
- Integration of research and commercialization
- Research and cost-effective testing for real-world applications
- Objective, academically driven innovation
- Evidence-driven approach to big-picture issues
- Committed to supporting incubation and entrepreneurship

addressing **your needs**

YOU

- Have a pressing energy problem to solve
- Need access to pioneering research and innovative development
- Have a grid-scale prototype or project to test under real-world conditions
- Want customized energy education for professional development
- Would like to sponsor research, mentor a student or support awards

CUE

- Has world-class researchers with urban-energy expertise
- Collaborates across disciplines and industries to develop energy solutions
- Merges research, innovation and commercialization
- Is nonpartisan, objective and evidence-based
- Generates and demonstrates real-world impact

our **stakeholders model**

utilities
benefit from access to cost-effective research, testing and innovation.

government
benefits from policy and technical implementation, white papers, reports and a vision for whole energy systems.

industry
benefits from a pool of highly qualified personnel.

students
benefit from working and/or training directly with industry partners.

society
benefits from efficient, accessible electricity and a cleaner environment.

resources

people

administration

6
employees

researchers

6
research fellows

3
honorary fellows

2
visiting researchers

8
principal investigators

facilities

6 labs

including the **Schneider Electric Smart Grid Lab**

736 m^2 (7,922 ft^2)

TEDS showcase

SRC **excellence**

commitments

- Increase in international students
- Continued student engagement
- Continued global connections
- Push towards equitable energy research using interdisciplinary approach

students

6 undergrad

3 MASc

10 PhD

4 research assistants

student **engagement**

8 projects

25 events

4 awards

partners

7 industry

2 government

projects

83 total

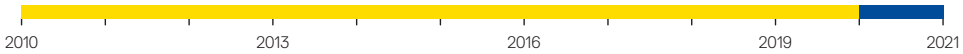
71 completed

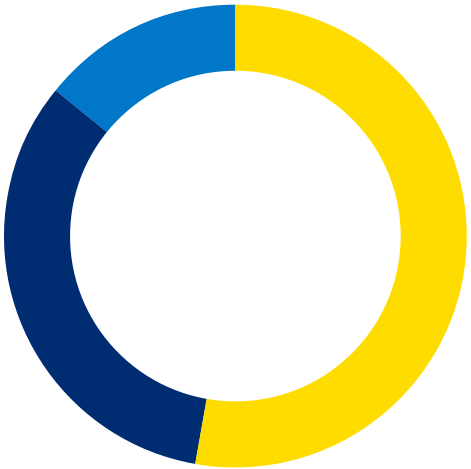
12 in progress

funding

$31.81M
total funding from 2010

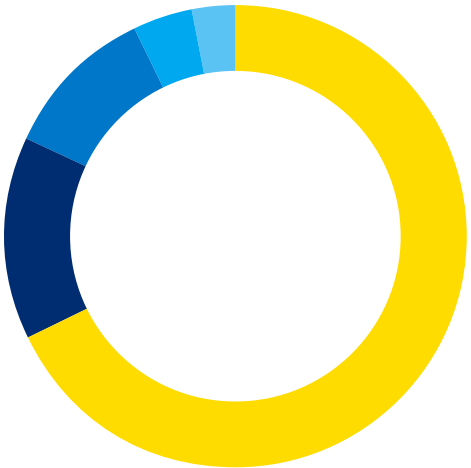
$1.64M
2021 funding





sources of funding

- 53% industry
- 33% government
- 14% university



funding distribution

- 68% research
- 14% operations
- 11% research fellows
- 4% student awards
- 3% Clean Energy Zone

impact

9 journal publications

86 journal publications from **2015**

33 technical reports from **2015**

3 conference publications

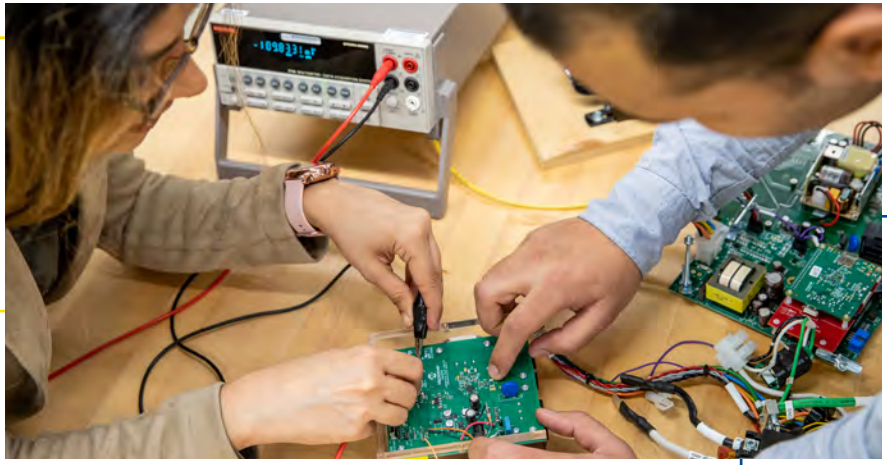
31 conference publications from **2015**

2 patents

global partnerships

1 USA	1 Scotland
2 Brazil	1 Singapore
3 England	1 India

featured **projects**



Celestica

CUE and Celestica will work together to develop a testing solution for use with a variety of EV chargers. The solution will help OEMs and manufacturers accelerate new product launch activities and gain performance insights into their designs to enable advanced continuous improvement.

Hydro One

CUE will develop tools and frameworks to support the seamless integration of distributed energy resources (DERs) into the Hydro One grid to improve reliability and electrification for customers.

NSERC Energy Storage Technology Network (NESTNet)

With a legacy of more than 365 published papers and technical reports, six patent applications, 95 events and 58 percent of its graduates moved to the energy sector, the highly successful pan-Canadian NESTNet led by CUE completed its six-year term in 2021.

Opus One Solutions

CUE will forecast growth of the electric vehicle (EV) and photovoltaic markets from 2021 to 2030 to determine the optimal proportional relationship between population and available EV chargers. CUE will also use Opus One's GridOS solution to analyze the impact of EV growth on a New Delhi utility distribution feeder and provide technology solutions such as energy storage to mitigate overloading.

In a second project, CUE will develop designs for utility pole-mounted energy storage for InnPower and Evergreen Brickworks in Ontario and Tata Power Delhi Distribution Limited in New Delhi, India.

Toronto Community Housing Corporation (TCHC)

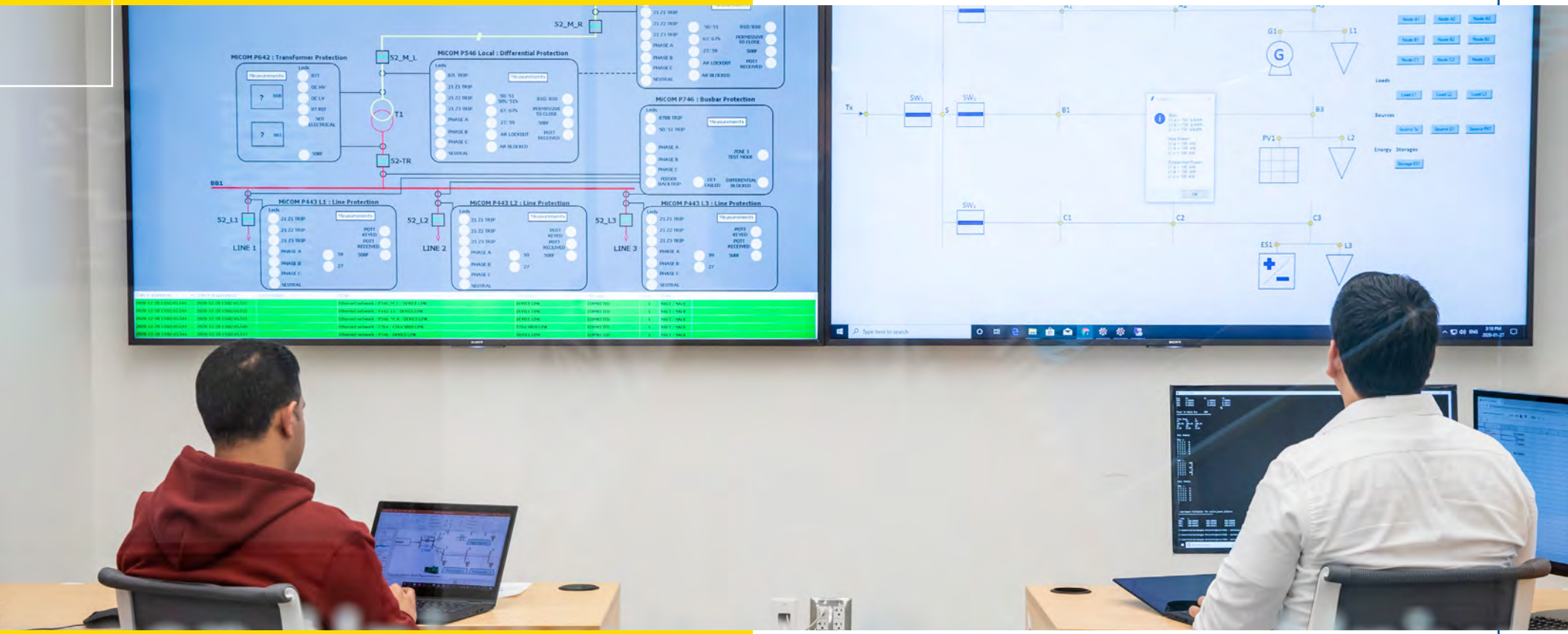
CUE will recommend ways to increase energy efficiency in residential buildings, find solutions to offset the financial impact of reducing greenhouse gases and power consumption and provide emergency power solutions for life safety where appropriate.

Toronto Hydro

CUE will study combinations of ownership, management and beneficiaries to identify planning and operational strategies to achieve the strongest economic outcome, optimal size of energy storage, and ideal charge and discharge schedules for the utility.

Transactive Energy Distribution System (TEDS) Lab

Connected to the Schneider Electric Smart Grid Lab, the revolutionary TEDS Lab models, tests and analyzes transactive energy distribution systems. Transactive systems enable the economic operations of energy distribution and create opportunities to trade energy and ancillary services within the distribution sector.



our **programs**

Professional Master's Diploma in Energy and Innovation

This part-time program aims to equip participants with the knowledge and skills required to function competently as operators, officers, administrators, managers, technicians, analysts, policy advisors and other key occupations in the fast-growing and rapidly changing Canadian energy sector.

Electrical Engineering 101

This seminar series introduces the fundamental concepts of electrical engineering to those without an engineering background looking to break into or advance their career.

Customized Executive Education Programs

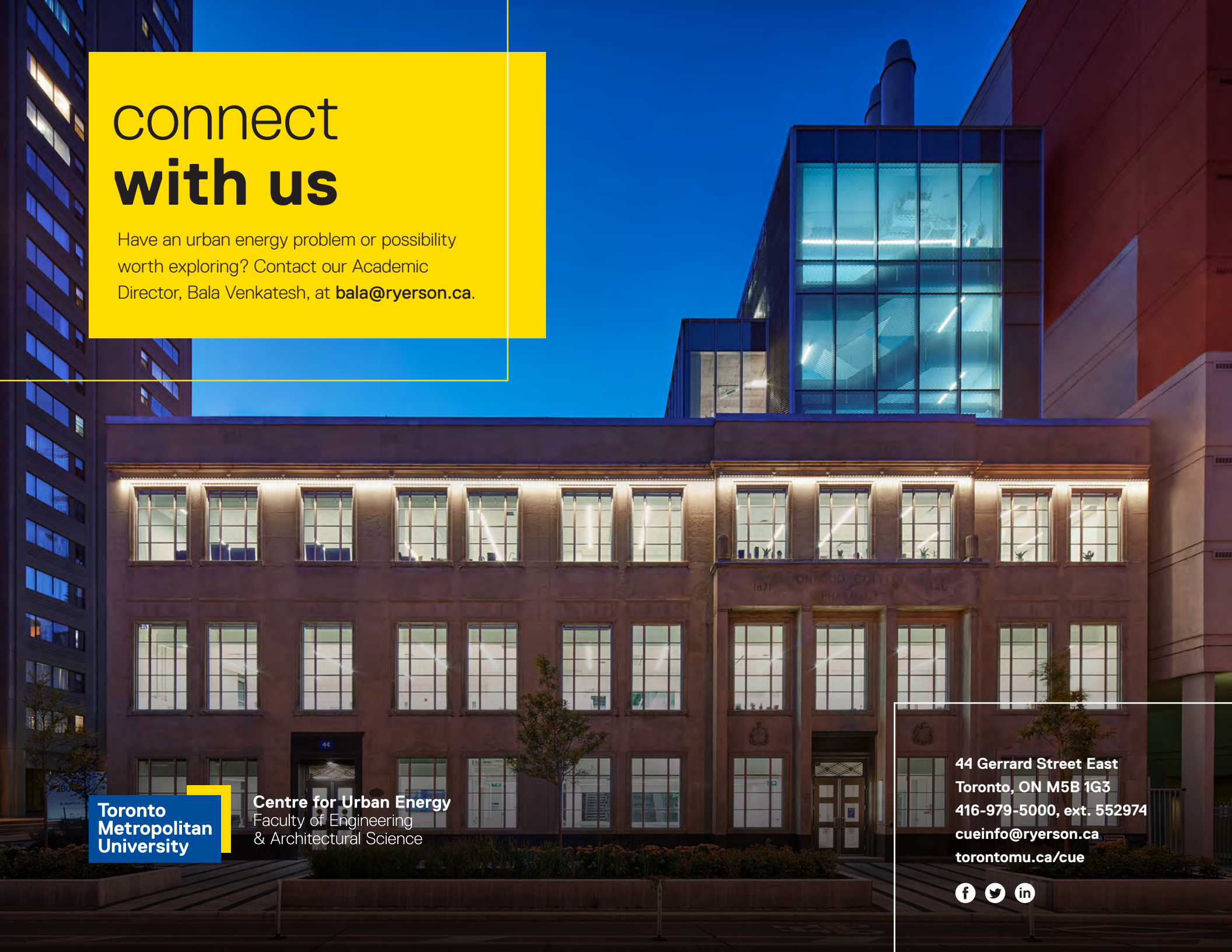
CUE delivers seminars and workshops developed for the unique needs of Canadian organizations and international groups. Optional daytime and evening networking events can also be added to give groups an exclusive opportunity to connect with Ontario's energy leaders and policymakers.

CLEAN ENERGY zone

Have an idea for an urban energy startup?

The Clean Energy Zone is an industry-leading, campus-based incubator located at the Centre for Urban Energy. Since its inception, 50 startups have passed through the Zone, including million-dollar companies such as Argentum Electronics, in the smart buildings space, and Elocity, which is focused on the electric vehicle charging ecosystem.

Learn more at torontomu.ca/cue/cez



connect **with us**

Have an urban energy problem or possibility worth exploring? Contact our Academic Director, Bala Venkatesh, at **bala@ryerson.ca**.

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44 Gerrard Street East
Toronto, ON M5B 1G3
416-979-5000, ext. 552974
cueinfo@ryerson.ca
torontomu.ca/cue