

# Electric Horizon

2024 Annual Report

**Toronto  
Metropolitan  
University**

**Centre for Urban Energy**  
Faculty of Engineering  
& Architectural Science

# Welcome message

At the forefront of clean energy research and innovation, the Centre for Urban Energy (CUE) at Toronto Metropolitan University proudly celebrates its progress in 2024. With over a decade of expertise, CUE continues to bridge the gap between research and industry solutions, enabling the shift to a sustainable energy future.



Mohamed Lachemi

Since its inception in 2010, CUE has successfully secured \$37 million in funding for 90 research projects. Highlights of this year include the new, collaborative Canada First Research Excellence Fund (CFREF) project with Concordia University, our ongoing research projects with Toronto Hydro, Hydro One, Tata Power-Delhi Distribution Limited (DDL), and Toronto Community Housing (TCHC), our support for emerging startups through the Clean Energy Zone and Power Up Program, and the continued growth of our international network.

The 2024 annual report celebrates another year of forward-thinking research, impactful partnerships, and an unwavering commitment to advancing sustainable energy solutions for a clean, more resilient future.

**Mohamed Lachemi**  
President and Vice-Chancellor



We're proud to continue working with CUE as we explore innovative ways to manage the energy transition. CUE's research addresses complex problems with practical solutions that are needed to meet Toronto's future electricity needs.

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





# Vision

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

# Mission

- Build academic, public and private sector partnerships
- Conduct research, development and demonstration, leading to commercialization
- Create the next generation of energy entrepreneurs
- Encourage multidisciplinary and collaborative approaches
- Provide scholarship and learning opportunities



# Activities

## Research, testing and consulting

- Sponsored projects and reports are executed in collaboration with government, industry and academic partners.
- Testing of products and prototypes is completed at world-class, state-of-the-art laboratories.
- Consulting projects draw on our capacity for multidisciplinary collaborations between industry professionals and academic researchers, as well as access to our unique laboratories.

## Education

Professional development is offered through a formalized curriculum.

## Innovation

As part of TMU’s Zone Learning ecosystem and housed in CUE, Clean Energy Zone (CEZ) is a startup incubator focused on fostering innovative ideas and businesses in the clean and sustainable energy sector.



# Focus areas

CUE’s focus areas are energy generation, transmission, distribution and use, with emphasis on:

- energy transition, deep electrification and transactive energy
- energy planning, policy and regulation
- demand management, efficiency and conservation
- renewables, smart grids, microgrids, storage hydrogen, electric vehicles and net-zero buildings

# Expertise

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

# Advantages

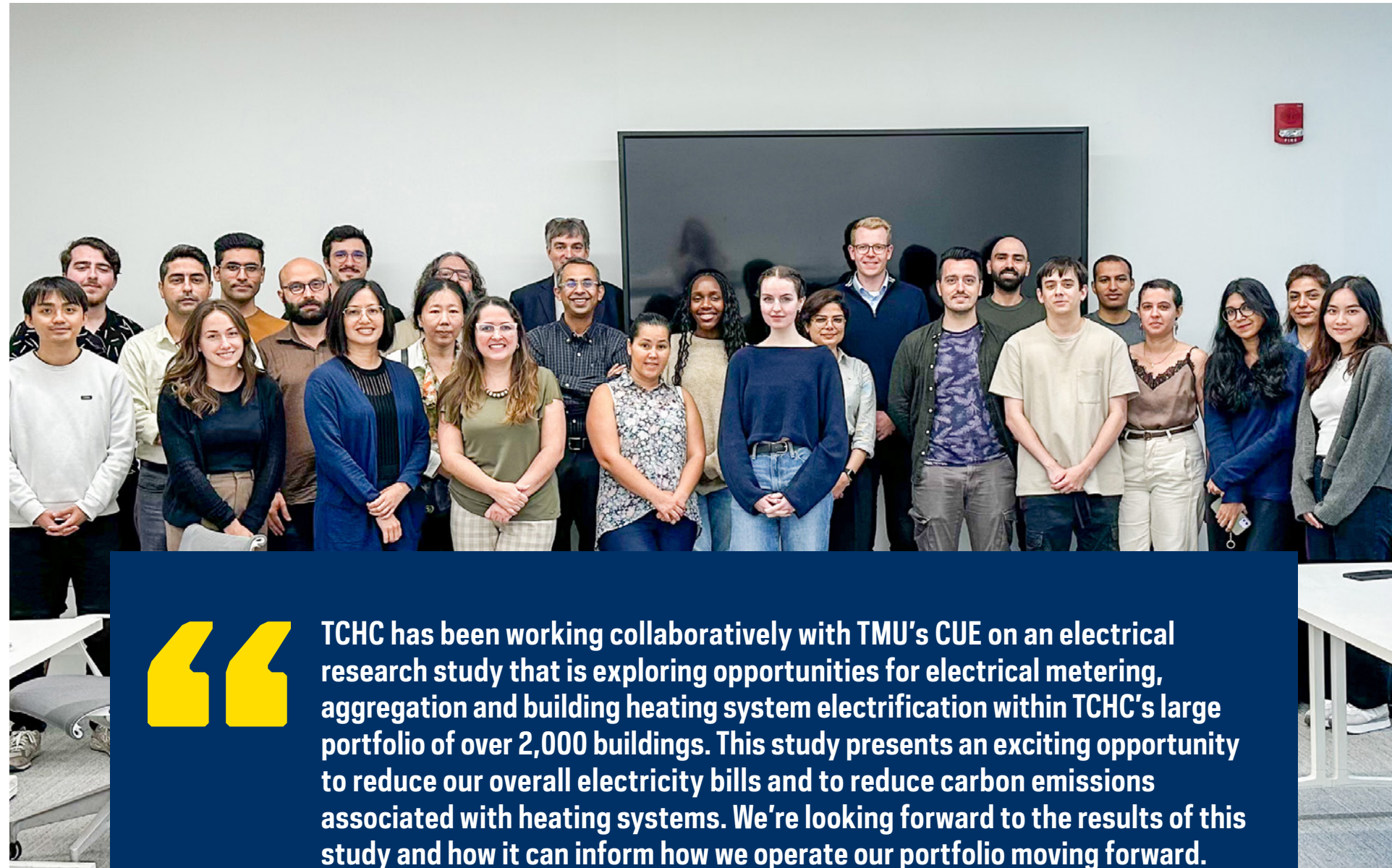
- World-class urban energy researchers, technologies and facilities
- Multidisciplinary collaborations under one roof
- Integration of research and commercialization
- Research and cost-effective testing for real-world applications
- Objective, academically driven innovation
- Evidence-driven approach to big-picture issues
- Sustained commitment 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
- Would like to sponsor research, mentor a student or support awards





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TCHC has been working collaboratively with TMU's CUE on an electrical research study that is exploring opportunities for electrical metering, aggregation and building heating system electrification within TCHC's large portfolio of over 2,000 buildings. This study presents an exciting opportunity to reduce our overall electricity bills and to reduce carbon emissions associated with heating systems. We're looking forward to the results of this study and how it can inform how we operate our portfolio moving forward.

**Vuk Skulic**

Design Program Manager, Electrical, TCHC

## Applying our model to different stakeholders



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

**Governments** benefit from policy and technical implementation, white papers, reports and a vision for whole energy systems.

**Industries** benefit 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.



# Acknowledgments

## Founding sponsors



## 2024 partners and sponsors

Celestica  
CFREF  
City of Toronto  
Enwave  
Halton Hills Hydro  
Hydro One

Mitacs  
NSERC  
Peak Power  
Tata Power  
TCHC  
Toronto Hydro



## 2024 advisory board

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

**Shitiz Agarwal**  
Vice-President, Power Systems, Sales and Operations, Schneider Electric

**Tom Chapman**  
Principal, The Brattle Group
- Martin Huang**  
Vice-President, System Operations, Hydro One

**Steven N. 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 and Technology (GRE&T), Alectra

**Katherine Sparkes**  
Vice-President, Grid Solutions, Enwave

**Thomas Timmins**  
Leader, Energy Sector Group, Gowling WLG

**Bala Venkatesh**  
Academic Director, Centre for Urban Energy

# Our resources

## People

### Administration



### Researchers



## Facilities

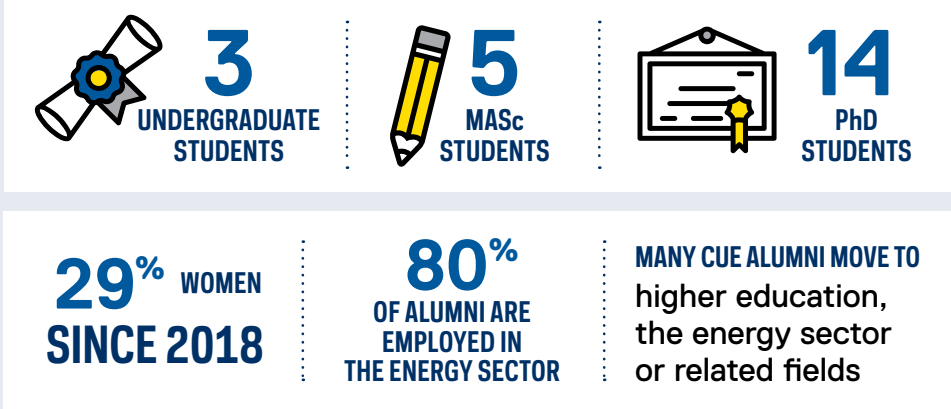




# Achievements and impact

CUE is actively delivering innovative solutions for the energy sector, encompassing workshops and cutting-edge software offerings.

## Highly qualified personnel



## Events



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Participating in projects aimed at developing a more sustainable future and engaging with outstanding researchers and students has been an enriching professional experience. The collaborative atmosphere encouraged cross-cultural exchange, and the available infrastructure made it easy for me to conduct my research using the latest tools and technologies. Additionally, the faculty and staff have always been very supportive.

**Fernanda Trindade**  
Associate Professor,  
University of Campinas, Brazil

## Partnerships



**Visiting researchers**  
In 2024, CUE welcomed four scholars and nine students from six institutions. These collaborations across borders continue to bring diverse perspectives and foster coordinated, unified approaches to solving some of the energy sector’s complex challenges.

## Partners



## Projects







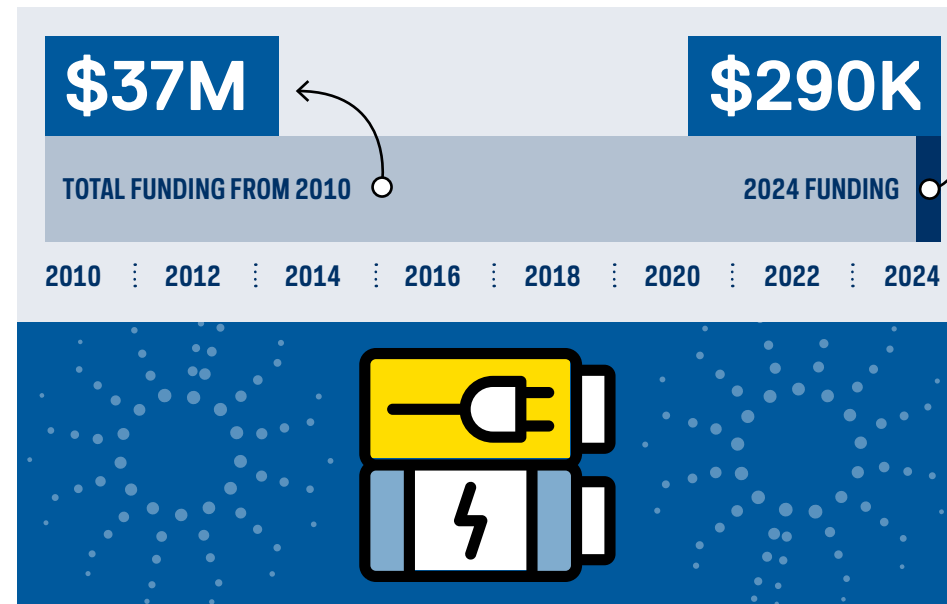
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The Centre for Urban Energy at Toronto Metropolitan University is at the cutting edge of creating sustainable and affordable energy systems to fuel healthy communities and economies of the future. CUE is a positive, dynamic and collaborative space in which I spent seven years as a research fellow and PhD student, and it was instrumental in accelerating my career development. I look forward to continuing to collaborate with CUE to create a just energy future for all.

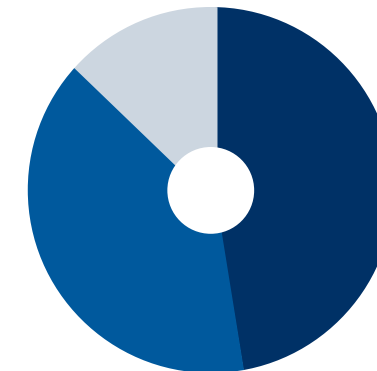
**Jessie Ma**

Assistant Professor and Ontario Research Chair in Sustainable Energy, University of Waterloo

## Funding

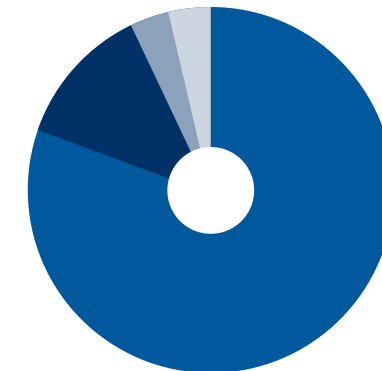


Sources



- 47.8% industry
- 38.7% government
- 13.5% university

Distribution



- 80.3% research
- 12.6% operations
- 3.1% student awards
- 4.0% Clean Energy Zone

## Outcomes

6  
JOURNAL  
PUBLICATIONS  
↓  
74  
JOURNAL  
PUBLICATIONS  
FROM 2018

2  
BOOKS/BOOK  
CHAPTERS  
FROM 2018  
↓  
55  
TECHNICAL  
REPORTS  
FROM 2018

12  
TECHNICAL  
REPORTS  
↓  
55  
TECHNICAL  
REPORTS  
FROM 2018

4  
CONFERENCE  
PUBLICATIONS  
↓  
25  
CONFERENCE  
PUBLICATIONS  
FROM 2018

3  
PATENTS  
↓  
3  
PATENTS  
FROM 2018

SINCE 2018,  
86%  
OF JOURNAL  
ARTICLES  
100%  
OF BOOKS AND  
BOOK CHAPTERS  
100%  
OF CONFERENCE  
PAPERS  
COMPLETED WITH HIGHLY QUALIFIED PERSONNEL



# Featured projects

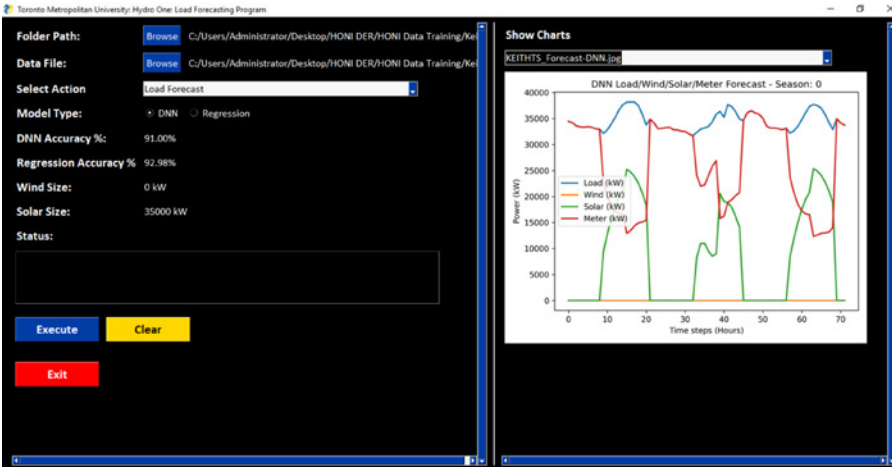
## Forecasting and Modeling of Distributed Energy Resources, and Models for Distributed System Operator Planning and Operation – Hydro One, Peak Power, Natural Sciences and Engineering Research Council (NSERC) and Mitacs

Integrating distributed energy resources (DERs) such as renewables, storage and smart loads into electric power distribution systems is essential for deep electrification and energy transition to a zero-carbon 2050 future. However, predicting, modelling and managing a distribution system connecting innumerable small, intermittent DERs is a challenging task.

To meet this challenge, CUE has developed aggregate DER models at the distribution feeder level for estimating, forecasting, and engineering studies (steady state and transient). In addition, distribution system operator (DSO) models are being developed. These efforts have resulted in the creation of 12 technical reports and four software modules to date. These tools are poised to enhance operational capabilities, improve grid resilience, and support the integration of DERs, making a measurable impact on the path to a sustainable energy future.

The project is supported by Hydro One and the joint NSERC Alliance and Mitacs Accelerate program.

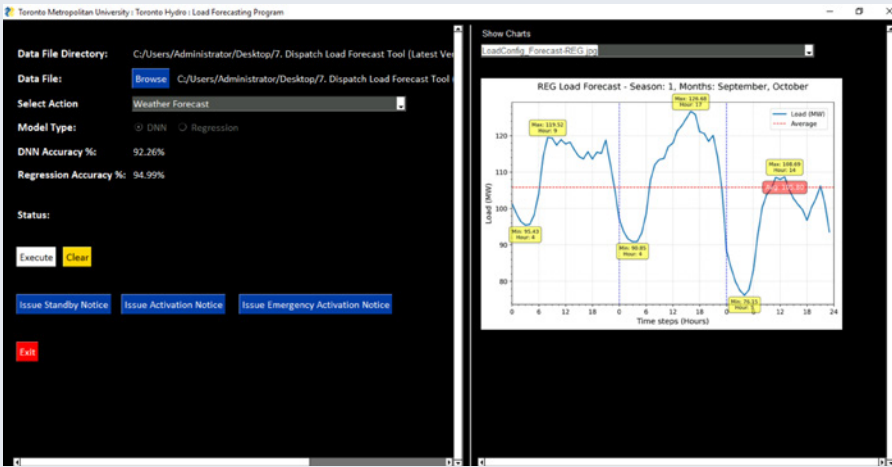
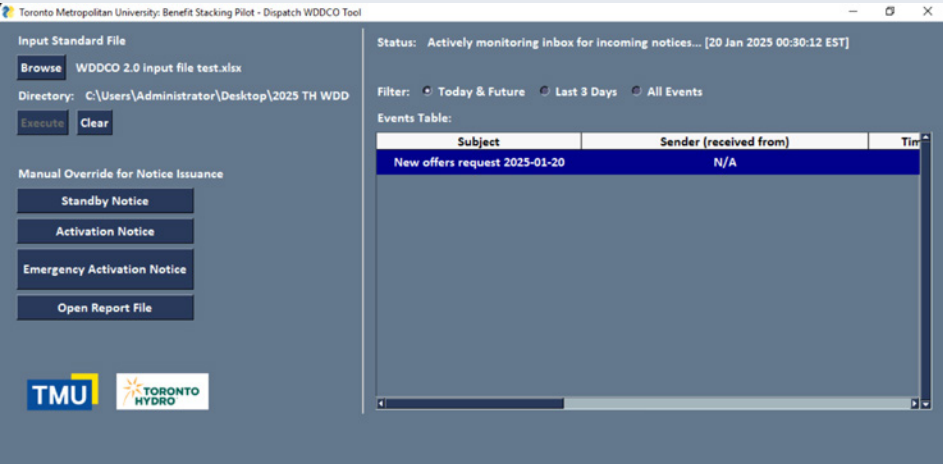
<b>2024 team</b>	2 postdoctoral fellows, 1 research associate, 7 PhD students, 1 MASc student
<b>Timeline</b>	2022-2027



## Dual Participation of Local Demand Response Resources – Independent Electricity System Operator (IESO), Toronto Hydro and Power Advisory LLC

CUE collaborated with Toronto Hydro and Power Advisory LLC, with support from the IESO Grid Innovation Fund and the Ontario Energy Board’s Innovation Sandbox, to identify solutions that will enable the utility to use the same demand response resources simultaneously to meet the capacity needs of both local and provincial grids. CUE developed nine tools and a virtual platform to implement a dual participation model, ensuring seamless coordination between the transmission/bulk system and Toronto Hydro. The overall goals of this program is to build resilient infrastructure, promote sustainability and foster innovation.

<b>2024 team</b>	1 postdoctoral fellow, 2 research associates, 1 undergraduate intern
<b>Timeline</b>	2023-2024





**Energy Storage Solutions for Zero Carbon 2050 Electric Distribution Systems – Toronto Hydro, Halton Hills Hydro, NSERC and Mitacs**

This project aims to address economic, regulatory, and technological barriers to the adoption of electricity storage technologies by utilities, supporting renewable integration, avoiding expensive utility asset upgrades, and advancing smart, intelligent, robust distribution systems.

CUE is currently investigating novel models for ancillary services, focusing on new methods to evaluate and compensate for electricity storage solutions in distribution networks. As part of this effort, work is being completed on microgrid services and their benefits to customers, DER vendors and the utility.

<b>2024 team</b>	2 postdoctoral fellows, 3 PhD students
<b>Timeline</b>	2022-2027

**Dynamic Reconfiguration and Feeder Power Management – Tata Power-DDL and Mitacs**

Climate change will drive the transition to deep electrification, leading to increased electric loads. This project develops methods and strategies for dynamic reconfiguration and feeder power management to address operational challenges that utilities such as Tata Power-DDL may encounter.

CUE is actively exploring methods to manage feeder load, including the development of a software tool that can optimally operate sectionalizing switches, enabling the utility to mitigate temporary overloading and enhance grid resilience.

The impact of this work extends beyond operational improvements, contributing to the broader goal of building a sustainable and electrified future, ensuring utilities are equipped to meet the demands of a rapidly changing energy landscape.

The project is supported by funds from the Mitacs Accelerate grant and Tata Power-DDL.



<b>2024 team</b>	2 postdoctoral fellows
<b>Timeline</b>	2023-2025



**Resilient Distribution System Microgrids – Concordia University, CFREF, Hydro One**

In Canada, many rural and semi-urban communities suffer from lower-than-expected electric power supply reliability, as strengthening the supply in these sparsely populated areas often fails the classic return-on-investment test. As a result, these communities turn to polluting, diesel-powered backup supply.

This project seeks to tackle this issue by developing standardized, utility-operated local microgrid solutions that provide reliable, low-carbon electricity during outages. The lack of standardized designs in existing microgrid implementations has been a key barrier to widespread adoption of microgrid solutions by utilities.

Through this initiative, a microgrid controller-in-a-box was developed and validated by CUE in the Schneider Electric Smart Grid Lab using commercial, off-the-shelf equipment. This will ensure readiness for real-world deployment and pave the way for large-scale pilot projects. This approach bridges the technology gap and advances the electrification and decarbonization of underserved communities.

<b>2024 team</b>	1 research assistant, 3 MASc students
<b>Timeline</b>	2024-2026





2024 CUE Clean Energy Expo

The 2024 CUE Clean Energy Expo was held in April with an attendance of 65 guests. The event included a panel session with Susanna Zagar, CEO of the Ontario Energy Board; Robby Sohi, COO and Vice-President, Markets and Reliability at IESO; John MacRitchie, Assistant Vice-President, Zone Learning and Strategic Initiatives at TMU; and Roberta Iannacito-Provenzano, Provost and Vice-President, Academic at TMU. In addition, posters were presented by researchers and CEZ startup companies exhibited.

Attendees	65
Research posters	7
CEZ startup posters	5



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During my time at CUE, I was fortunate to work in a dynamic and forward-thinking environment focused on addressing some of the most pressing energy challenges of our time. The collaborative culture at CUE fostered innovation and encouraged interdisciplinary approaches, allowing me to contribute meaningfully to impactful projects. I am deeply grateful for my time at the CUE and highly recommend it to anyone passionate about advancing the future of urban energy systems.

**Bhanu Opathella**  
Associate Director, Battery Storage Engineering, PureSky Energy



Energy Transition Workshops

Starting 2023, CUE hosted an energy transition workshop series to build a large international consortium of academic and energy sector specialists. The objective is to foster collaboration on innovative solutions for the future energy system. In 2024, the workshop speakers included Rachele Levin, Board Member, Smart Grid Innovation Network; John Penaranda, Grid Operations Manager, Hydro One; Katherine Sparkes, Vice-President, Grid Solutions, Enwave; and Joerg Wittenbrinck, Manager, Integrated Energy Policy and Research, Ontario Ministry of Energy and Electrification.

Recently completed project

Study of Metering and Aggregation, and Electrification of Buildings – TCHC

Committed to reducing energy consumption within their buildings, TCHC partnered with CUE on a study to explore opportunities for metering, aggregation and electrification of TCHC’s heating systems across its portfolio of buildings.

In 2024, this research project was successfully completed as planned.

2024 team	2 postdoctoral fellows
Timeline	2023-2024





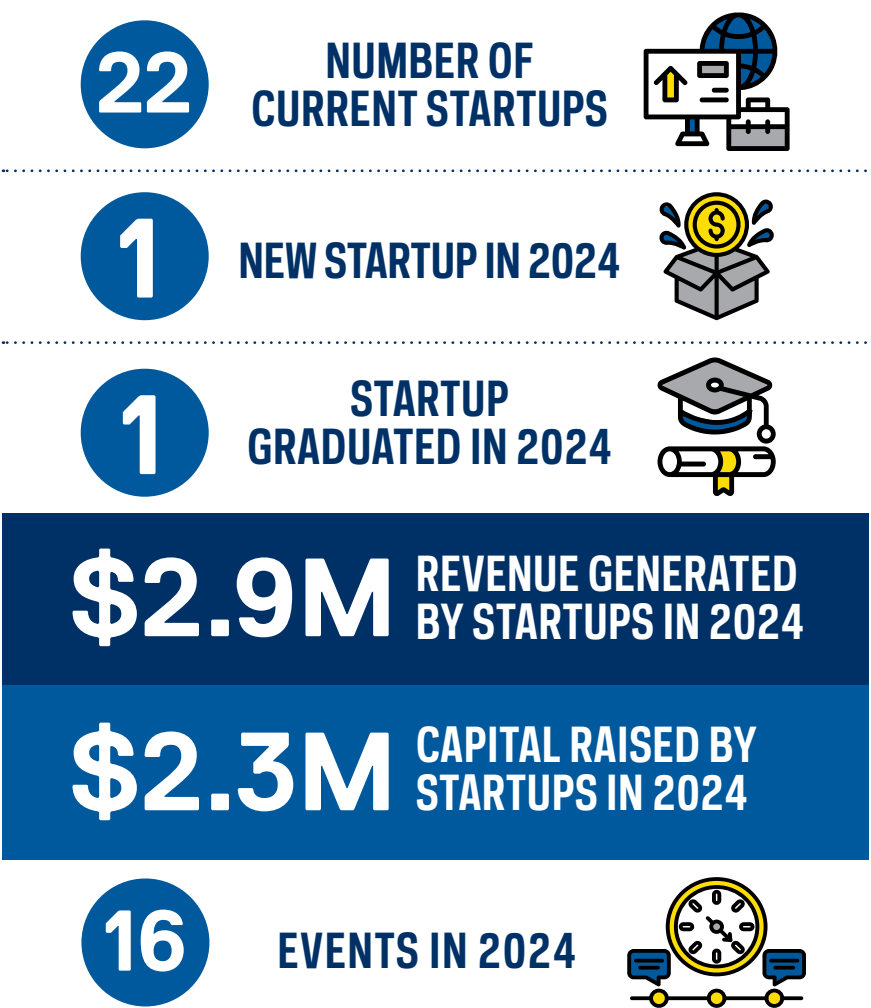
# Professional Master's Diploma in Energy and Innovation

The Professional Master's Diploma in Energy and Innovation program is designed to equip participants with the knowledge and skills required in the fast-growing, rapidly evolving, dynamic Canadian energy sector. Courses include smart grids, energy storage, demand management, electricity markets and a diploma project.



## CLEAN ENERGY zone

The Clean Energy Zone (CEZ) is an industry-leading, campus-based incubator located at CUE. 63 startups have passed through CEZ since 2012, including million-dollar companies such as Peak Power and SWTCH.

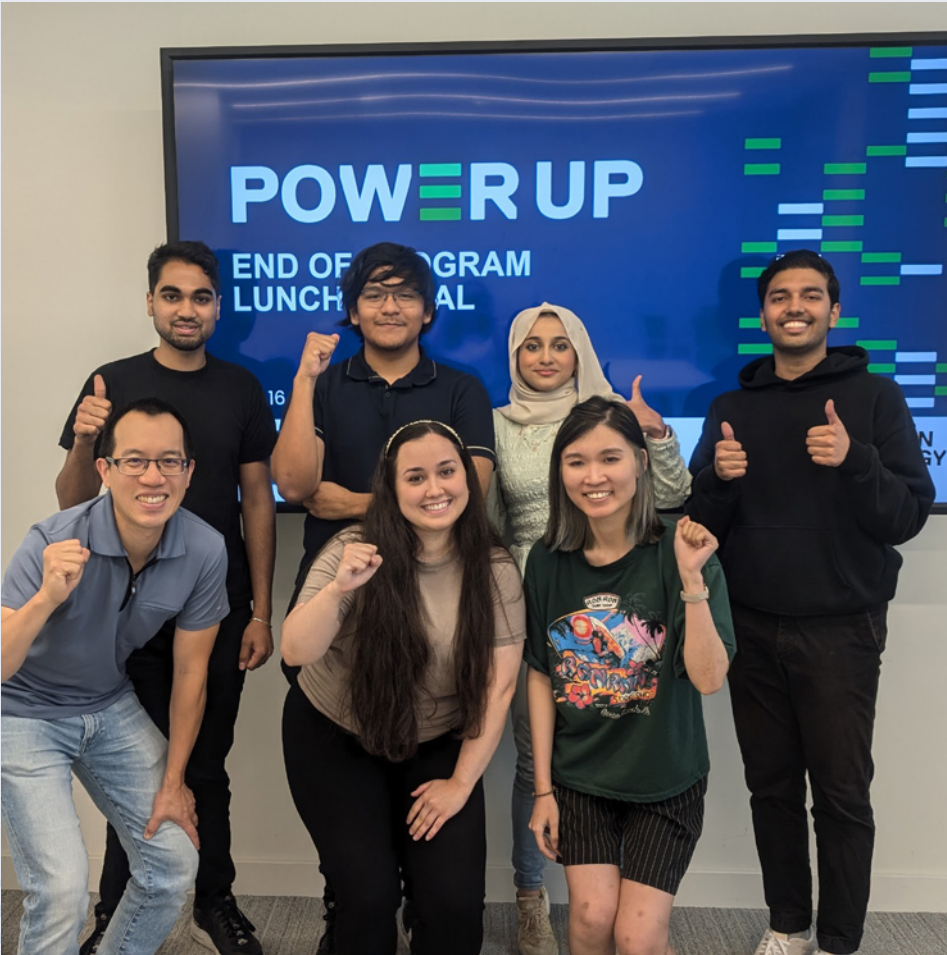


### Companies

- |                          |                        |
|--------------------------|------------------------|
| Cence Power              | Innowind               |
| BKR Energy               | Integrated ClimateTech |
| DisRAPTOR PAV            | Innovia GEO            |
| Niso Energy              | HEBÉ                   |
| RenMobi                  | InferModel             |
| Saturnu Solutions Corp   | Alphacor               |
| Electric Autonomy Canada | Kiwi Charge            |
| GREENBMG                 | Liquid Energy          |
| Can Grow Here            | Serenity Power         |
| Renergy Technologies     | CleanAir.ai            |
| Proton Fuels             | (graduated in 2024)    |
| Airgreening (Canada)     | Elocity                |
| 13278247 Canada Inc      | (graduated in 2024)    |

### Power Up Program

The CEZ's newest initiative, the Power Up Program, aims to tackle energy entrepreneurship inequity by providing financial support to high-potential student entrepreneurs with promising clean energy-based ideas, in the form of full-time, four-month internships. The Power Up Program provides student entrepreneurs with the tools necessary to build scalable enterprises and bring their clean energy ventures to life.





# Featured companies

## Proton Fuels

Proton Fuels is an energy infrastructure company focused on the design, manufacturing, and operation of hydrogen vehicle fueling systems. With a focus on modular, flexible, and rapidly scalable fuel systems, Proton Fuels seeks to revolutionize the future of renewable energy, most notably in the transportation sector. By eliminating the prohibiting challenges that have long held back the wide-scale adoption of hydrogen fuel transportation, Proton Fuels will build out a national hydrogen infrastructure network, thereby unlocking the massive untapped potential of the hydrogen atom.

## 2024 achievements

- Featured as an exhibitor at the 2024 DiscoveryX Conference
- Awarded SmartTO funding as part of the Smart Mobility Tech Accelerator
- Completed research project with Centennial College School of Engineering Technology and Applied Science
- Awarded Mitacs Accelerate Entrepreneur funding for a research project that will produce much-needed real-world data on the operation of hydrogen fueling stations
- Made continued advancements in full-scale prototyping



## Innovia GEO

Innovia GEO is unlocking clean geothermal energy with its innovative ultra-shallow geothermal systems, installed at depths of 15 to 100 feet. Using fast, low-cost and widely available shallow drilling methods, their systems can be installed up to 50% cheaper than conventional geothermal systems, while operating up to 25% more efficiently. By cutting the payback of a geothermal system in half, their goal is to enable cost-effective geothermal heating and cooling for new and existing low- to mid-rise buildings.

## 2024 achievements

- Filed first patent application
- Installed first paid pilot project
- Awarded a multi-year research grant from NSERC with TMU
- Awarded a multi-year research grant from NSERC with the University of Calgary
- Awarded funding to support up to three pilot projects in New York State beginning in 2025
- Selected to participate in Canada's Next Sustainable Changemaker Challenge



Have an idea for an urban energy startup?

Visit [torontomu.ca/cue/cez](https://torontomu.ca/cue/cez) today to find out how you can join the Clean Energy Zone.



# Connect with us

Have an urban energy problem or possibility worth exploring?

Contact us at [cueinfo@torontomu.ca](mailto:cueinfo@torontomu.ca).

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