



University of Toronto Research Expertise

Electrification/Critical Minerals



UNIVERSITY OF
TORONTO

Jun 2023

U of T Global Rankings

#1 in Canada | #18 worldwide

THE World University Rankings (2021-2022)

#1 in Canada | #34 worldwide

QS World University Rankings (2021-2022)

A POWERHOUSE FOR INNOVATION & ENTREPRENEURSHIP

600 Startups

More than **\$2.5B** in investment secured by **600+** startups over the past decade.

350+ Private Sector Partners

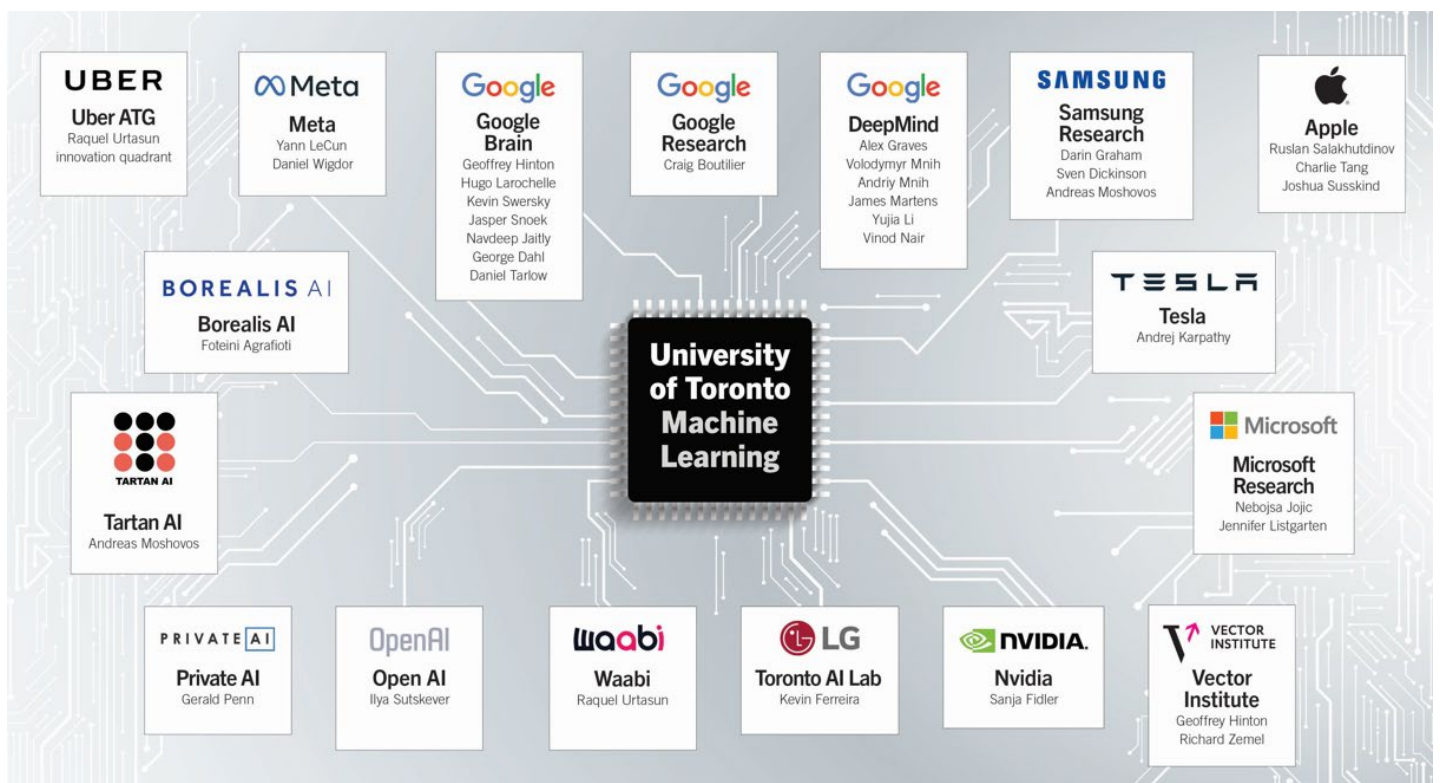
U of T's global reputation as a top research university and its vibrant innovation and entrepreneurship culture attracts industry partners from across Canada and worldwide.

1000+ Patent Applications

U of T is a leader among North American universities for research-based startups, inventions, licenses and options.

U of T EXPERTISE IS SOUGHT BY GLOBAL GIANTS

U of T Faculty and Alumni are hired by some of the most influential tech companies worldwide
(This graphic depicts engagements over the past several years, but may not reflect current status in all cases.)



Impact Stories



[To help meet global EV demand, researchers develop sustainable method of recycling older lithium-ion batteries](#)

Oct 3, 2022



[AI used to discover clean energy materials 'faster and more efficiently'](#)

Feb 7, 2023



[As demand for EVs grows, student researcher explores social and ecological risks of lithium 'gold rush'](#)

Sep 29, 2022



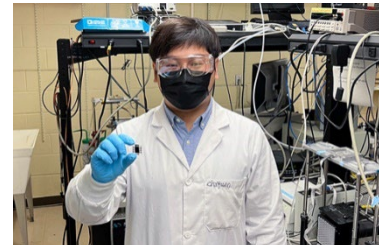
[Academic-industry partnership develops better way to manage sulfur compounds at mining sites](#)

Mar 4, 2022



[Electric vehicles can fight climate change, but they're not a silver bullet: U of T study](#)

Sep 29, 2020



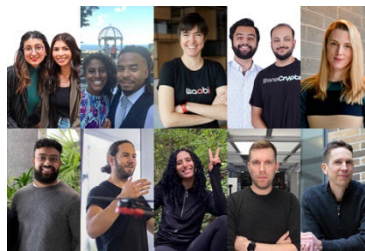
[Researchers enhance durability of low-cost solar cells made from nano-sized crystals](#)

Feb 23, 2021



[Bioinnovation partnership: U of T Engineering and Ford Canada introduce new, sustainable automotive material](#)

Jan 7, 2022



[U of T Entrepreneurship Week 2023: Top 10 startups to watch](#)

Mar 2, 2023



['An everybody problem': David Sinton on how U of T experts can help Canada – and the world – get to net-zero](#)

Dec 15, 2021

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INITIATIVES – KEY RESEARCH CENTRES AND INFRASTRUCTURE

With internationally recognized strengths across a wide breadth and depth of disciplines, the University of Toronto is one of the few global institutions able to implement innovative strategic initiatives that span fields and faculties.

Institutional Initiatives are large-scale, cross-divisional research centres supporting interdisciplinary teams of University of Toronto researchers and partners, addressing grand challenges and pursuing bold ideas that require true collaboration and the integration of various disciplinary research approaches.

These are just some of the collaborative initiatives we are supporting.

Schwartz-Reisman Institute for Technology and Society

<https://srinstitute.utoronto.ca/>

The Schwartz Reisman Institute draws on U of T's signature strengths in the sciences, humanities and social sciences to explore the benefits and challenges that AI, biotechnology and other technological advances present for our economy, our society and our day-to-day lives.

Acceleration Consortium

<https://acceleration.utoronto.ca>

The **Acceleration Consortium** is leading a paradigm shift in scientific discovery through the development of self-driving artificial intelligence-guided robotic labs that accelerate the discovery of advanced materials and small molecules, from decades to years. The consortium addresses fundamental topics, such as deep learning algorithms, materials modelling, and robotics and applied challenges, such as discovering materials for a wide range of commercial applications. The Acceleration Consortium supports a commercialization-focused ecosystem that aims to translate materials discoveries through start-ups and industry partnerships.

A3MD

<https://light.utoronto.ca/a3md/>

The **Alliance for AI-Accelerated Materials Discovery (A3MD)** seeks to leverage the power of artificial intelligence to design the next generation of high-performance materials. Uniting recent advances in machine learning and high-throughput experimentation, the team seeks to accelerate the discovery and commercialization of new, efficient catalysts and consumer electronic materials. A3MD brings together world-leading researchers from the University of Toronto, McMaster University and the National Research Council of Canada, as well as industrial partners LG and Total.

School of Cities

<https://www.schoolofcities.utoronto.ca/>

The **University of Toronto School of Cities** convenes urban-focused researchers, educators, students, practitioners and the general public to explore and address complex urban challenges. The interdisciplinary research is conducted with the aim of making cities and urban regions more sustainable, prosperous, inclusive and just.

University of Toronto Robotics Institute

<https://robotics.utoronto.ca>

The **University of Toronto Robotics Institute** is home to the largest and most diversified robotics research program in Canada. We unite, grow, and catalyze collaborations among the many exceptional robotics

research clusters at the University. Serving as the headquarters for robotics collaboration at U of T, we unite leading robotics experts from across the University around three research pillars: Autonomous Field Robotics; Healthcare Robotics; Advanced Manufacturing.

UTTRI

<https://uttri.utoronto.ca/>

Faculty members at the **University of Toronto Transportation Research Institute (UTTRI)** specialize in systems analysis and policy evaluation, and are leaders in building and applying cutting-edge computer simulation models to the analysis and design of complex transportation systems. U of T has an internationally recognized critical mass of researchers with extensive experience in the analysis, planning and design of urban transportation systems, covering roads, transit, freight and active transport modes (walk and bike) across a range of perspectives – travel behaviour, system performance, economics and environmental impacts. We have extensive experience with comprehensive, system-wide, evidence-based policy analysis and decision support, leading to successful transportation facilities implementation and operations.

School of the Environment

<https://environment.utoronto.ca/>

The **School of the Environment** serves as an interdisciplinary hub for education and scholarship on the environment and sustainability. We create new knowledge; train future leaders; engage and forge partnerships with the wider community; and contribute to positive environmental and social change from the local to the global scale.

University of Toronto Electric Vehicle Research Centre (UTEV)

<https://utev.utoronto.ca/>

The **University of Toronto Electric Vehicle (UTEV) Research Centre** is a game-changing university-industry partnership, focused on next generation of EV technologies. Research is focused in a state-of-the-art battery and power electronics lab, with multi-disciplinary collaborations alongside leading professors from Electrical and Computer Engineering, as well as from other engineering units. In partnership with Industry and Government partners, UTEV researchers study Energy Management and Storage, Advanced Power Modules, Next-generation powertrain, Ubiquitous Charging, and generally new opportunities for EVs.

University of Toronto Electrification Hub

<https://electrification.utoronto.ca/>

The **University of Toronto Electrification Hub** brings together Engineering, Public Health, Urban Planning, Cybersecurity, and Anthropology experts to contribute to the broader electrification revolution with multidisciplinary research and innovations on material discovery, batteries, chargers, and stationary energy storage, in collaboration with Canada's fast-growing e-mobility sector.

Climate Positive Energy


<https://cpe.utoronto.ca/>

The Climate Positive Energy Initiative reflects the University of Toronto's response to Canada's formal commitment to achieving Net-Zero Greenhouse Gas emissions by 2050. It currently includes more than 100 faculty members from a wide range of fields, from anthropology to electrical engineering to public policy, developing clean-energy solutions that are mindful of political, human, and societal considerations.

U of T RESEARCHERS

This is not intended as an exhaustive list of our faculty members in this field, but highlights some of our relevant researchers. Appearance on this list should not be interpreted as indicative of any individual's availability for a specific external engagement.


Cristina Amon

	University Affiliations: Mechanical & Industrial Engineering Chemical Engineering Electrification Hub Climate Positive Energy
	Website: Cristina Amon
	Keywords: CFD Thermofluids Sustainability Renewable Energy CleanTech Electrification

Cristina Amon pioneered the field of Computational Fluid Dynamics and the development of multidisciplinary multi-scale hierarchical modelling. Her current research includes nanoscale thermal transport, clean energy systems; thermal battery management in electric vehicles; and hemodynamics and transport in biomedical systems. This research has applications in electronics and electric vehicles, renewable energy, and biomedical devices.

Professor Amon is **Dean Emerita** of the **Faculty of Applied Science and Engineering**, She has recently been named a **Member of the Order of Canada** and the **Royal Society of Canada**. She is a fellow of all major professional societies in her field. Professor Amon was awarded the **2020 Engineers Canada Gold Medal**, the highest honour in the field.


Gisele Azimi

	University Affiliations: Chemical Engineering Materials Science & Engineering Electrification Hub Acceleration Consortium Climate Positive Energy
	Website: Gisele Azimi
	Keywords: Energy Sustainability Waste Reduction/Recycling CleanTech Electrification

Gisele Azimi's research lies at the intersection of Process Engineering, Electrochemistry, and Materials Science; it combines fundamental science and engineering principles to develop real-world solutions in her areas of interest. These areas include Urban Mining (advanced recycling of electrical/electronic waste materials); Carbon Management through development of green electrochemical technology for the iron/steel industry; Waste Valorization to reclaim rare earths, lithium, and cobalt, reducing industrial solid waste; and Energy Storage in the development of post-lithium rechargeable batteries.

Professor Azimi holds the **Canada Research Chair in Urban Mining Innovation**; she has also been recognized with the **Dean's Spark Professorship (2018)**, the **McCharles Prize for Early Career Research Distinction (2020)**, and the **Canadian Society for Chemical Engineers Innovation Award (2020)**.


Mansoor Barati

	University Affiliations: Materials Science & Engineering Sustainable Materials Processing Research Group Institute for Water Innovation Lassonde Institute of Mining
	Website: Mansoor Barati
	Keywords: Sustainability Green Energy

Mansoor Barati and his research group conduct research into industrial processes that are less energy-intensive and more environmentally sound. His team has been researching improvements in the refining of metals and alloys such as solar-grade silicon; more energy-efficient means of producing metals, with fewer emissions; and recovering value from industrial waste, reducing environmental impact in landfills

Professor Barati's work has been recognized with Best Paper awards from CMQ and JOM. He has received the TMS-EPD Technology Award, the Brimacombe award, and he has served as **President** of the **Metallurgical and Materials Society of Canada**.


Aimy Bazylak

	University Affiliations: Mechanical and Industrial Engineering Materials Science & Engineering Climate Positive Energy Electrification Hub Acceleration Consortium
	Website: Aimy Bazylak
	Keywords: Electrification Sustainability Renewable Energy CleanTech

Aimy Bazylak has focussed her research career on clean energy applications; thermofluids; polymer electrolyte membrane (PEM) fuel cells; PEM water electrolyzers; carbon dioxide electrolyzers; and solid-state batteries. Her advancement of these clean energy technologies includes the development of new materials, component architectures, and performance optimization for cost effective and high-performance energy conversion.

Professor Bazylak holds the **Canada Research Chair in Clean Energy** (Tier 1). She has been named an **Alexander Von Humboldt Fellow** (2015 – Germany) and a **Fellow** of the **American Society of Mechanical Engineers** (2019). In 2020, she was elected to the **Royal Society of Canada College of New Scholars, Artists and Scientists**, while in 2022 she was elected as a **Fellow of the Engineering Institute of Canada (EIC)** for excellence in engineering and services to the profession and to society. Professor Bazylak is also a **Helmholtz International Fellow**.

Greg Evans


	University Affiliations: Chemical Engineering Occupational & Environmental Health School of Cities School of the Environment SOCAAR ISTEP Centre for Global Change Science Electrification Hub Climate Positive Energy
	Website: Greg Evans
	Keywords: Pollution Environmental Health Sustainability

Greg Evans devotes much of his research to the study of particulate matter polluting urban air, and impacts on human health and the environment. He focuses on traffic related air pollution, identifying the sources of pollution, development of inexpensive sensors, creation of large datasets, and understanding how the sources and composition of particulate matters influences its potential to induce oxidative stress.

Professor Evans is also deeply engaged in studying how engineering students use their skills and competencies to the betterment of society, and how transdisciplinary skills can optimize their future success.

Professor Evans is the **Director** of **SOCAAR**, the Southern Ontario Centre for Atmospheric Aerosol Research, an interdisciplinary centre with medical, chemical, environmental, and public health expertise. In 2021, Professor Evans was awarded both NSERC's **Brockhouse Canada Prize**, and the **Environment Division Research and Development Dima Award** from the **Chemical Institute of Canada**.


Frank Gu

	University Affiliations: Chemical Engineering Biomedical Engineering Acceleration Consortium Data Sciences Institute Climate Positive Energy Transform HF
	Website: Frank Gu
	Keywords: Nanotechnology Chemistry Critical Minerals Sustainability Drug Delivery

Frank Gu has established a frontier research program in Nanotechnology Engineering, leading to important advances in fields as diverse as targeted drug delivery, pathogen detection, and passive water treatment. His work has also led to the creation of two Canadian start-ups, MyX Therapeutics (mucoadhesive nanoparticles for treatment of Dry Eye) and H2NanO, focusing on solar-powered sustainable water treatment technologies. His novel approaches to water treatment focus in part on the efficient removal and repurposing of Selenium and other critical minerals from tailings ponds and other waste streams in the oil industry, as well as in agriculture and power generating systems.

Professor Gu holds the **NSERC Senior Industrial Chair in Nanotechnology Engineering**. He is a Member of the **College of the Royal Society of Canada**, the **Canadian Society for Chemical Engineering**, and the **Association for Research in Vision and Ophthalmology**. In 2023, he was part of the team awarded the **NSERC Brockhouse Canada Prize for interdisciplinary Research in Science and Engineering**.


Marianne Hatzopoulou

	University Affiliations: Civil Engineering Transportation and Air Quality research group TRAQ Positive Zero Transport Futures Electrification Hub Climate Positive Energy
	Website: Marianne Hatzopoulou
	Keywords: Sustainability Transportation Planning Environmental Health Pollution

Marianne Hatzopoulou leads the Transportation and Air Quality Research Group (TRAQ), which studies the intersection of transportation methods, air quality, climate change, and public health. Her main expertise is in modelling road transport emissions and urban air quality, and the consequences for population exposure to air pollution; she investigates interactions between daily activities of urban dwellers and impacts of traffic emissions in these near-road urban environments.

Professor Hatzopoulou holds the **Canada Research Chair in Transport Decarbonization and Air Quality** (Tier I), and is the **Director of Positive Zero Transport Futures**. In 2021, she was part of the team awarded the **NSERC Brockhouse Canada Prize for Interdisciplinary Research in Science and Engineering**. She is **Associate Editor of Transportation Research Part D: Transport and Environment**, and is the current **Chair of the Transportation Research Board Standing Committee on “Air Quality and Greenhouse Gas Mitigation.”**


Reza Iravani

	University Affiliations: Electrical & Computer Eng'rg Energy Systems Group Centre for Applied Power Electronics
	Website: Reza Iravani
	Keywords: Energy Smart Grid Electric Vehicles Renewable Energy CleanTech

Reza Iravani has developed innovative solutions to several engineering problems associated with the applications of power electronics and emerging control and operational concepts in electrical energy systems, including utilization and grid-integration of renewable energy resources, efficient utilization of the legacy-grid asset, and modernization of the electric grid.

Professor Iravani is the former **editor-in-chief** of **IEEE Transactions on Power Delivery** and co-author of the reference book 'Voltage-sourced Converters'. He is a **Fellow** of both the **IEEE**, and the **Royal Society of Canada**.


Deepa Kundur

	University Affiliations: Electrical & Computer Eng'rg Communications Group Electrification Hub Climate Positive Energy
	Website: Deepa Kundur
	Keywords: Cybersecurity Signal processing Complex dynamical networks Computer communications Smart Grid Digital Forensics

Deepa Kundur's research interests lie at the interface of cybersecurity, signal processing and complex dynamical networks. She is a recognized authority on cybersecurity issues, especially in the automotive sector. These issues are also particularly relevant in securing Smart power grids. Her work also investigates steganalysis and authentication of digital video signals, as well as image fusion and blind image restoration.

Professor Kundur is currently the **Chair of the Edward S. Rogers Sr. Department of Electrical & Computer Engineering**. In 2015, she was elevated to **IEEE Fellow** for her contributions to signal processing techniques for multimedia and cyber security.


Peter Lehn

	University Affiliations: Electrical & Computer Engineering Energy Systems Laboratory for Advanced Power Conversion and Systems Analysis
	Website: Peter Lehn
	Keywords: Power Energy Power Storage Sustainability

Peter W Lehn and his team conduct research into analytical modeling of nonlinear and switched circuits. He also directs the **Laboratory for Advanced Power Conversion and Systems Analysis**, with a focus on new power converter topologies, analytical and simulation models, control schemes and experimental systems providing tools supporting the transition to more sustainable electrical power systems, expanding integration with renewable energy sources. Expertise extends to power systems, renewable energy storage systems, and electric vehicle drivetrain and charging infrastructure.

Professor Lehn is a **Senior Member** of the **IEEE**.


Keryn Lian

	University Affiliations: Materials Science & Engineering Climate Positive Energy
	Website: Keryn Lian
	Keywords: Nanotechnology Composite Materials Energy Storage Smart Devices Coatings Sustainability

Keryn Lian researches electrochemical energy storage materials, capable of high power and rapid delivery of energy. Her team investigates biomass carbon electrodes, nano and activated carbon electrodes, solid polymer electrolytes, and solid cell assemblies. Thin flexible polymer electrodes can combine with batteries or solar cells to form hybrid or self-powered energy devices – with implications for printed flexible/wearable electronic devices for sensors or IOT applications

Professor Lian is an editorial board member of **ACS Applied Energy Materials**, a member of the Education Committee of **the Electrochemical Society**, and a board member of the **International Academy of Electrochemical Energy Sciences**.

Eric Miller

	University Affiliations: Civil Engineering UTTRI School of Cities School of the Environment Electrification Hub Climate Positive Energy
	Website: Eric Miller
	Keywords: Transportation Systems Urban Infrastructure Smart Cities Public Transit


Eric Miller focuses his research investigations within the area of transportation modelling and sustainable urban design. He is a pioneer in the development and application of agent-based microsimulation model systems in large urban contexts. His research is centred in the implementation of integrated transportation-land use models that permit the analysis of the two-way interaction between transportation systems and urban form. His work serves to improve urban transportation best practices and policy decision-making and, thereby improves the quality of life in urban settings.

Professor Miller is also **Research Director** of the **Data Management Group (DMG)**, providing data to government agencies, private sector partners working for government, and university researchers in support of a wide variety of travel behaviour analyses and modelling activities. He is also **Founding Research Director**

of the **Travel Modelling Group (TMG)**, a research consortium that provides a forum and mechanism for inter-agency collaboration designed to improved travel modelling practice for all.

In 2018, Professor Miller received a **Lifetime Achievement Award** from the **International Association for Travel Behaviour Research (IATBR)**.

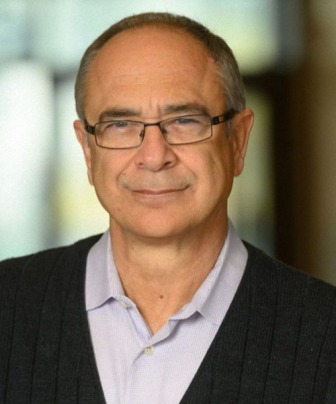
Alison Olechowski

	University Affiliations: Mechanical Engineering Electrification Hub Troost ILead
	Website: Alison Olechowski
	Keywords: Human factors CAD Electrification Design

Alison Olechowski leads research into product design and development, including design tools, methods, and processes. Her team also studies engineering collaboration and leadership, and project management; and the tools used by engineers as they design innovative new products in the aerospace, automotive, electronics, medical device, and fuel industries. She is currently leading a project on Thermal Management of Electrification Technologies.

Professor Olechowski is an academic lead at the Troost Institute for Leadership Education in Engineering (ILead).


Vladimiros Papangelakis

	University Affiliations: Chemical Engineering Institute for Water Innovation
	Website: Vlad Papangelakis
	Keywords: Environmental Engineering Sustainability Water chemistry Bioremediation

Vlad Papangelakis is an internationally respected researcher in industrial water chemistry and hydrometallurgy. His work currently investigates low-energy desalination technologies, and the recovery of base metals (including critical minerals) from mine tailings and metallurgical slags.

Professor Papangelakis holds the **Senior Industrial Research Chair in Water and Sustainable Extractive Metallurgy**. He is a recipient of the **Canadian Metal Chemistry Award**, a **Fellow** of the **Canadian Academy of Engineering**, and a **Fellow** of the **Canadian Institute of Mining, Metallurgy, and Petroleum**. He is the **Director** of the **Institute for Water Innovation**.


Mohini Sain

	University Affiliations: Daniels Forestry Mechanical & Industrial Engineering Chemical Engineering Low-Carbon Renewable Materials Centre Electrification Hub Climate Positive Energy
	Website: Mohini Sain
	Keywords: Sustainability Biocomposites CleanTech

Mohini Sain specializes in advanced nanocellulose technology, biocomposites and bio-nanocomposites. In particular, his work on Bio-inspired Advanced Materials and nanocellulose technology has been transformed from pure research into business opportunities, with the creation of several start-ups. His current research interests include fuzzy neuro-networks in next-generation transportation, bio-nano cellulose and carbon material for functional materials, low-carbon and carbon-negative technology development for the construction sector, and advanced portable electronic devices.

Professor Sain is a founding member of the **Canadian Natural Composites Council**, the **Ontario BioAuto Council**, and the **Ontario-Jianshu Nano-Innovation Centre** in Suzhou, China.


Olivier Trescases

	University Affiliations: Electrical & Computer Eng'rg Energy Systems Group UT EV Research Centre Electrification Hub Climate Positive Energy
	Website: Olivier Trescases
	Keywords: Renewable Energy Transportation Electric Vehicles Sustainability System Control Autonomous Vehicles

Olivier Trescases conducts research on high-efficiency switched-mode power converters for automotive, industrial, aerospace, solid-state lighting and renewable energy applications. He is one of the academic Leads on the UofT Electric Vehicle Research Centre, which focuses on power electronic converters for EV drivetrains; charging infrastructure; energy storage for EVs; and autonomous operation of EVs.

Professor Trescases hold the **Canada Research Chair in Power Electronic Converters**. He also serves on several **IEEE** committees.


Oleksandr Voznyy

	University Affiliations: Physical and Environmental Sciences Acceleration Consortium Climate Positive Energy A3MD
	Website: Oleksandr Voznyy
	Keywords: Sustainability Cleantech Renewable Energy Solar power

Oleksandr (Alex) Voznyy and his team focus on means of achieving the Paris climate agreement targets of net-negative global emissions of all greenhouse gases by 2070. They tackle this problem in addressing sustainability and cleantech issues by developing new materials for Li-ion batteries, hydrogen storage, carbon capture, and photovoltaics. The intermittent nature of some renewable power sources requires low-cost and scalable energy storage solutions. The team's tools include atomistic simulations, machine learning, automated high-throughput materials synthesis and characterization

Professor Voznyy was named a **Highly Cited Researcher** in 2020, 2021, and 2022 by Clarivate – recognition awarded to only 0.1% of the world's researchers each year.

Yu Zou

	University Affiliations: Materials Science & Engineering Acceleration Consortium
	Website: Yu Zou
	Keywords: Advanced Manufacturing Energy Storage Advanced Materials

Yu Zou leads the Laboratory for extreme Mechanics & Additive Manufacturing (LEMAM). He and his team use novel experimental, analytical and computational tools to explore materials with extreme properties, or under extreme conditions, especially metals. The work in “the 4 Ms” (Metals, Mechanics, Manufacturing, and Machine-Learning) has applications in such vital sectors as aerospace, biomedical, electronic, environment, and energy.

Professor Zou was the recipient of the **Dean's Spark Award**, recognizing excellence among early career researchers. He currently serves as the **Chair of Materials Technical Section** in the **Metallurgy and Materials Society of CIM (MetSoc)** for Canada. In 2022, he received an **Ontario Early Researcher Award**, as well as the **TMS Early Career Faculty Award**.

SELECT TECHNOLOGY OPPORTUNITIES

U of T has flexible IP terms available to sponsoring partners. U of T's interest in IP developed through this research is "Inventors' Choice" where the inventors have the option to manage IP themselves, or to transfer IP to the university for management/commercialization (via the Innovations & Partnerships Office).

For all U of T technologies currently available for licensing, visit <http://uoft.me/tech-ops>

Active shading devices for eco-efficient buildings

<https://research.utoronto.ca/technology-opportunities/db/active-shading-devices-eco-efficient-buildings>

More energy is spent conditioning our indoor climate (e.g., heating, cooling, lighting) than on any other human activity. No building facade technology is capable of dynamic optical reconfigurability for comprehensive climate control because of the constraints imposed by solid-state materials/systems. This platform technology is capable of dynamically and independently controlling the amount (intensity), spectrum (wavelength band), and direction (scattering distribution) of transmitted solar radiation, enabling significant improvements in building energy efficiency.

Traditional solid-state building materials cannot independently tune the intensity, spectrum, and dispersion of transmitted sunlight within a room, resulting in large heating/cooling/lighting energy inefficiencies. Our fluidic system is the first that can individually and dynamically tune these three parameters (intensity, spectrum, dispersion), enabling configurable optimization of the amount, wavelength, and position of transmitted sunlight over time. The level of general optical and thermal tunability that our fluidic system enables **annual modelled energy reductions of more than 43%** over state-of-the-art existing electrochromic technologies.

Nanostructured Solar Selective Catalytic Supports

<https://research.utoronto.ca/technology-opportunities/db/nanostructured-solar-selective-catalytic-supports>

The vast majority of energy consumed by the human population is derived from burning fossil fuels because of their abundance and remarkably high energy density. The new catalytic supports prepared by Dr. Ozin's lab offer a large improvement in yield of the gaseous process at ambient conditions, together with the discovery of both photochemical and photothermal activation in the system. This process resulted in a bold vision of a large scale photocatalytic energy plant, using sunlight to power the conversion of carbon dioxide and water to form natural gas and oxygen.

Multi-Port Converter Structure for DC/DC Power Conversion

<https://research.utoronto.ca/technology-opportunities/db/multi-port-converter-structure-dcdc-power-conversion>

The invention is for a new power electronic converter topology suitable for modularly configured solar photovoltaic or battery storage applications. Its highest value is seen within the space of battery storage applications where the topology offers unprecedented levels of electrical power process conversion efficiencies, with preliminary prototypes offering efficiencies on the order of 99%. Unlike competing technologies that typically address only a subset of system level and battery features, the proposed topology addresses all features that are viewed as critical for the formation of scalable energy storage systems. The topology also employs the lowest volume of magnetic components of any battery storage converters developed to date, save for switch capacitor circuits that suffer from drastically higher conversion losses. This makes the topology suitable not only for stationary battery storage applications, but also a premiere candidate for mobile applications, such as hybrid or electric vehicles.

SELECT COMPANIES IN THE UofT COMMUNITY

e-Zinc

<https://e-zinc.ca/>

Founded in 2012, e-Zinc is a Toronto-based corporation that has developed a breakthrough electrochemical technology for storing energy in zinc metal. This low-cost, flexible, and long-duration energy storage solution will provide the platform for the world's energy markets to be fully powered by renewable energy, enabling a zero-carbon energy future. e-Zinc uses commodity materials (e.g. zinc, nickel, copper, steel) in a patent-protected process to ensure low-cost energy storage to replace diesel generators for remote communities.

QD Solar

<https://qdsolarinc.com/>

QD Solar is a next-generation solar materials company developing advanced multilayered solar photovoltaics. By using highly tuned and complementary perovskite and quantum dot layers, we can harvest significantly larger amounts of solar radiation than conventional solar cells.

Reeddi

<https://www.reeddi.com/>

Reeddi innovatively provides clean energy and allied innovations at a price point that individuals and businesses operating in energy-poor regions of the world can afford. Reeddi's portable power packs were named one of TIME Magazine's "[Best Inventions of 2021](#)".