Skulematters

University of Toronto | Faculty of Applied Science & Engineering | 2011

Climate Change **Global Leadership** Air Water Future
Energy Conserving **New Possibilities** Creativity **Solutions**
Innovation **Collaboration** Invention **Livable Cities**

SUSTAIN ABILITY

HOW U OF T ENGINEERS ARE GLOBAL STEWARDS CREATING NEW WEALTH, IDEAS, INNOVATION

Wealth Creation **Protection** Partnership **Efficiency**
Meaningful **Green Information Technology** Economy **Spark**
Elegant **Scalable** Environment **Engineering** Research

UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

Table of Contents

On the cover: *A textual interpretation of the many facets of sustainability at the University of Toronto's Faculty of Applied Science & Engineering.*

Advisor:
Cristina Amon, *Dean*

Editor:
Madelyn Herschorn

Managing Editor:
Liz Do

Feature Writers:
Wayne MacPhail
Sharon Oosthoek

With Thanks to:
Vanessa Abaya
Stewart Aitchison
D. Grant Allen (ChemE 8T1, MASc 8T3)
Colin Anderson
Olenka Baron
Estina Boddie
Kate Brand
Dawn Britton
Sharon Brown
Sanjeev Chandra
Will Cluett
Joan DaCosta
Chris Damaren (EngSci 8T0, AeroE MASc 8T7, PhD 9T0)
Sonia De Buglio (ChemE 9T4, MASc 9T8)
Carolyn Farrell
Shilpa Gantotti
Deirdre Gomes
Raj Grainger
Susan Grant
Nina Haikara
Jennifer Hsu
Janet Hunter
Bryan Karney
Brenda McCabe (CivE 9T4)
Susan McCahan
Rob Milchard
Liam Mitchell
Sachiko Murakami
Megan Murphy
Farid Najm
Cynthia Nevins
Luke Ng (ChemE 0T7)
Jun Nogami (EngSci 8T0)
Shannon Osborne (IndE 0T6)
Elizabeth Raymer
Doug Reeve (ChemE MASc 6T9, PhD 7T1)
J. Paul Santerre
Takara Small
Geoff Wichert
David Zingg (EngSci 7T9, AeroE MASc 8T1, PhD 8T8)
Jean Zu

Photography:
Mark Balson
Dani Couture
Sean Moore

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Faculty of Applied Science & Engineering
University of Toronto
Galbraith Building
35 St. George Street, Room 116
Toronto, Ontario
Canada M5S 1A4

Tel: +1 416-978-0380
Fax: +1 416-946-3450

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SUSTAIN ABILITY

Welcome to this special issue of *Skulematters*.

The focus of this entire issue is sustainability, a subject that touches all our lives. Fortunately, engineers – and especially engineers at the University of Toronto – are working on innovative solutions and inventions that make industry, cities and technologies more sustainable.

In this issue, we will be looking at some of the world-leading sustainability research at the U of T that is taking place in many facets of the Faculty. Great opportunities reside here that set us apart from others in Canada and put us among the leaders in the world. Our engineers are at the forefront of research in clean and renewable energy, clean water, bioremediation, power systems, sustainable mining practice and urban infrastructure.

Sustainability is not about turning our back on technology. It is about creating efficiencies, applying creativity to challenging problems, providing new opportunities and shepherding our scarce and non-renewable resources. It is about invention, not rejection. And it is about doing that in a way that boosts the global knowledge economy and surfaces opportunities for future innovation.

Photo/Christopher Lawson Photography

At U of T Engineering, we thrive on that challenge and have risen to the occasion again and again. We make things happen and invent the future. And, with the new Centre for Sustainable Energy that is described in this issue, we will lead in the way we share our collective knowledge with each other and the world. In addition, we are exploring the establishment of several key centres that will support research in the areas of clean water, power systems and resilient infrastructure. Investment in these initiatives will enable us to develop a system approach towards sustainable growth and development that will re-imagine our built environments and protect our planet for the benefit of generations to come.

We will also nurture the entrepreneur inside the engineer. Our new Engineering Business minor, to start in fall 2011, will encourage engineering students to become more entrepreneurial and build our reputation as graduating engineers who are also strong in business. That way, U of T Engineering can sustain and grow our reputation as a global leader in creating new possibilities for everyone who values our world.

I hope you enjoy this *Skulematters* issue. I invite you to contact us with any feedback you may have, and accept my warm wishes on behalf of your alma mater.

Cristina

Cristina Amon
Dean

Living Cities

More than half the world's population now lives in urban areas, with more of us congregating in cities every year. But as they grow, these centres create waste that, if not properly managed, could be their undoing.

The key to a city's sustainability lies in understanding its "metabolism," says Civil Engineering Professor **Chris Kennedy**.

"If you look up the dictionary definition of metabolism of an organism, it's the sum of the chemical processes that result in energy production, growth and elimination of waste," he says. "Cities do the same thing. Cities grow. They bring in energy and produce waste."

Photo/John Hryniuk

Civil Engineering Professor Chris Kennedy

Kennedy is focused on a particular type of waste – greenhouse gases – and has created a system for calculating a given city's emissions. His inventory tallies emissions produced both inside the city (from car exhaust, for example) and outside (power plants that provide electricity to city homes and businesses).

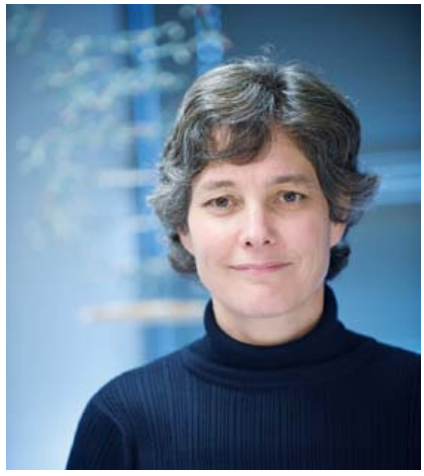
"It's about being carbon numerate," says Kennedy.

Kennedy compiled greenhouse gas inventories of 40 cities for the World Bank, which it uses to decide how to spend its development funds. The bank recently gave Thailand money for Bangkok, based on the inventory Kennedy assembled for that city and the plan Bangkok submitted to deal with it.

The healing power of real living organisms

Chemical Engineering Professor **Elizabeth Edwards** is focused on different kinds of waste, and using living organisms to detoxify them.

"We've discovered some micro-organisms have gotten used to chemicals we use a lot in cities, like gasoline and dry-cleaning solvents," says Edwards, who is also the Director of BioZone, a new centre for collaborative bioengineering research.



Photo/Michael Tenaglia

Chemical Engineering Professor Elizabeth Edwards, the Director of BioZone

Soils contaminated with cancer-causing dry-cleaning chemicals and industrial degreasers are especially hard to clean up. These chlorinated solvents are denser than water and sink deep into the ground where there is little oxygen to help them break down.

But a recently discovered class of micro-organisms living in these soils "breathe chlorinated solvents like we breathe oxygen," says Edwards. In doing so, they break down the solvents into harmless components.

But just as we can't function on oxygen alone, these micro-organisms can't decompose chlorinated contaminants

Engineers are thinking about towns and cities as living organisms. We show how engineering can make them happy and healthy ones.

unless they have something to eat. So Edwards has come up with processes for adding nutrients to soil so the organisms are fed and active.

She and her team recently sold the licence for the technology they created to feed and grow one of these micro-organisms to SiREM, a Guelph, Ont.-based company. SiREM now uses the technology to clean up contaminated sites.

Water, water everywhere, but is it fit to drink?

Civil Engineering Professor **Robert Andrews** is optimizing processes for the treatment of drinking water and inventing new ones in anticipation of future needs.

"Our research almost always precedes regulations. I have to take a guess and say 10 or 15 years from now, what will be needed?" says Andrews, Senior Natural Sciences and Engineering Research Council (NSERC) Chair in Drinking Water Research.

Drinking water in Ontario is extremely safe, says Andrews, but it can be another matter in places where fresh water is scarce and residents must address the presence of wastewater in their drinking supply.

And so Andrews is working with colleagues at other universities including the National University of Singapore to come up with reliable ways to remove pharmaceuticals that end up in wastewater every time someone on medication flushes the toilet.

He is also testing an artificial intelligence system that he and alumna **Kelly Griffiths** (CivE MASc 1T0) designed for a London, Ont. drinking water treatment plant to minimize small particles – the size of pathogens – from getting through treatment and into the water.

Taking a deep breath

Chemical Engineering Professor **Greg Evans** (ChemE 8T2, MASc 8T4, PhD 8T8) is gathering information that will allow us city dwellers to breathe easy – literally. He examines the source and composition of airborne particles, a key pollutant contributing to poor air quality.

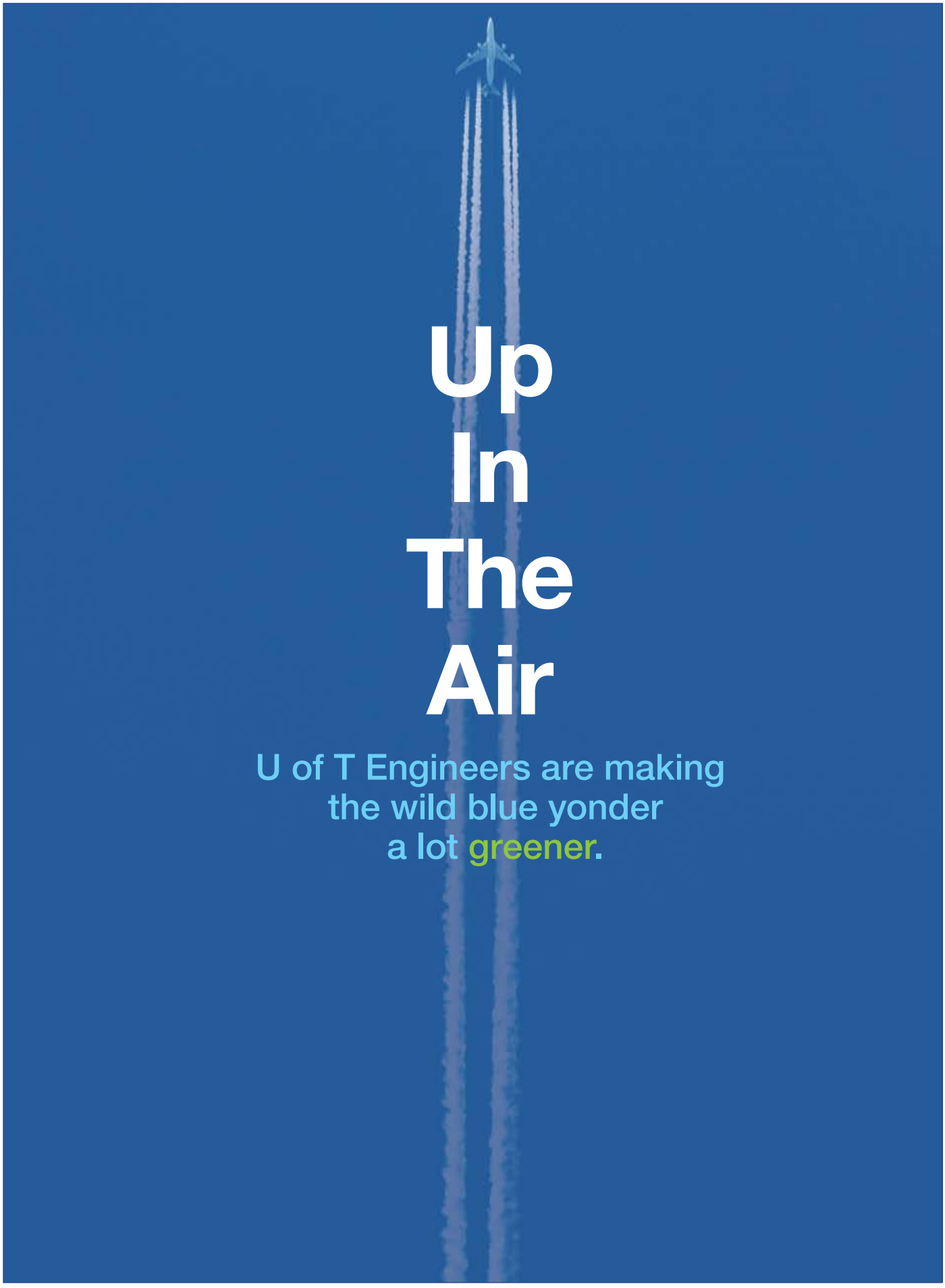
Evans is the founding director of the Southern Ontario Centre for Atmospheric Aerosol Research (SOCAAR), an interdisciplinary group at the University of Toronto. He and his team evaluate sources of harmful air pollutants in cities, especially particles from car and truck exhaust. For example, they have just started a project to evaluate soot filters on diesel trucks.

"Filters trap the soot, but the challenge is that it may not be soot that is causing toxicity. In fact, that soot may be helping to trap some of the toxic compounds," says Evans.

Evans not only evaluates emissions technologies, he also examines the impact of various airborne particles on human health. Working with the SOCAAR team, he examines how lung cells react to such particles, and also how real human volunteers react to very bad air quality days.

Photo/Michael Tenaglia

Chemical Engineering Professor Greg Evans (ChemE 8T2, MASc 8T4, PhD 8T8)



Up In The Air

U of T Engineers are making the wild blue yonder a lot greener.

Photo/John Hryniuk

Professor David Zingg (EngSci 7T9, AeroE MASc 8T1, PhD 8T8), Director of the University of Toronto Institute for Aerospace Studies (UTIAS)

Demand for air travel is projected to rise roughly 5% a year, a figure that is never far from the minds of University of Toronto Engineers working to reduce the industry's environmental impact.

Currently, air travel is responsible for 5% of man-made greenhouse gas emissions. But the industry's goal is a 50% reduction in carbon dioxide emissions by 2050, says Professor **David Zingg** (EngSci 7T9, AeroE MASc 8T1, PhD 8T8), Director of the University of Toronto Institute for Aerospace Studies (UTIAS) and a Canada Research Chair in Computational Aerodynamics and Environmentally Friendly Aircraft Design.

"That means we need to take into account the growth in air travel. So not just a 50% reduction per passenger kilometre, but 50% overall," says Zingg.

To that end, UTIAS engineers are developing and evaluating unconventional plane designs to reduce their drag and weight, both of which cause a plane to use more fuel. Use less fuel, produce fewer emissions.

UTIAS engineers are also designing the most efficient engines for combusting fuels – including biofuels, which promise to lower emissions even further.

Currently, there are some demonstration flights in which one engine is partially powered using biofuel, but Zingg says it will be several years before such technology is commercially viable.

Why combustion physics matter

That's why UTIAS Associate Director, Professor **Ömer Gülder** is studying high altitude combustion not only of biofuels, but also of hydrocarbon fuels. He wants to better understand the physics of combustion so we can reduce emissions and increase energy output for both types of fuels.

"Combustion produces 85% of the world's energy usage, so any improvement in using these fuels will be beneficial," he says. "There are still basic gaps in our knowledge even though we've been using conventional hydrocarbon fuels for 150 years."

The research is particularly tricky because the stakes are much higher up in the air, where atmospheric pressure and temperatures are extreme. "If worse comes to worst, a truck stops on a highway. When you are flying, if that happens, it's not desirable," says Professor Gülder.

How not to obsolesce an entire airplane fleet

While the bulk of work at the University of Toronto in this field happens at UTIAS, engineers in other Faculty departments are also influencing the aerospace industry's sustainability.

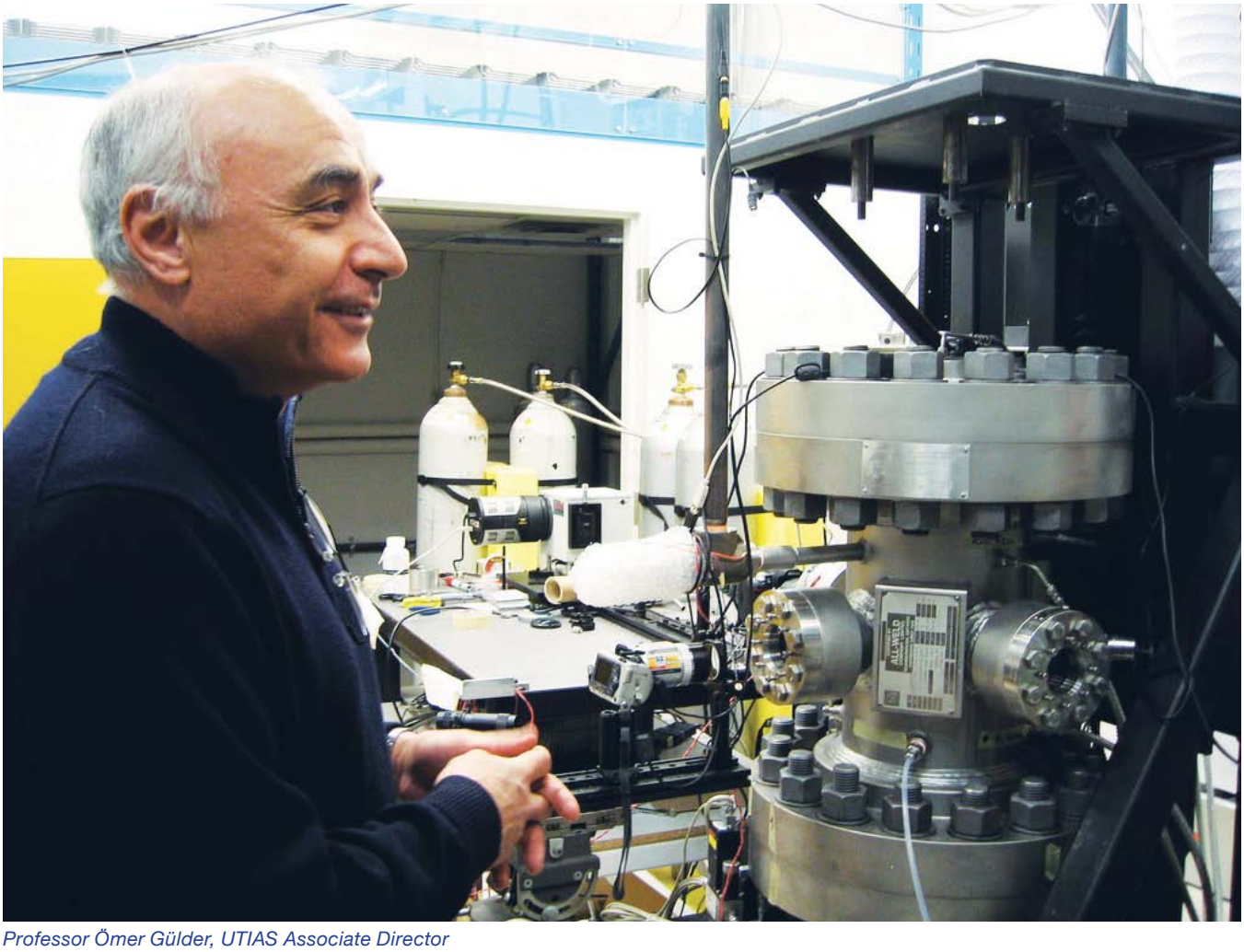
Mechanical and Industrial Engineering Professor **Murray Thomson**, for example, is collaborating with European colleagues in a program called ALFA-BIRD (Alternative Fuels and Biofuels for Aircraft Development) to research biofuel combustion in jet engines.

Thomson runs super-computer simulations to uncover the type of emissions biofuels give off and how well they work when blended with conventional jet fuel.

"The thing about aviation fuels is you have to be able to put them in an existing engine and know it will work. You can't modify the engine," says Thomson. "Airplanes are around for a long time – 30 years or more. You can't obsolete the entire fleet. Airplanes are too valuable."

Mechanical and Industrial Engineering Professor Murray Thomson

"If worse comes to worst, a truck stops on a highway. When you are flying, if that happens, it's not desirable," says Professor Ömer Gülder, on the tricky nature of the engineering physics of combustion.



Professor Ömer Gülder, UTIAS Associate Director

Industry: The Sustainable Green Giant

Industry doesn't have a great record for being environmentally friendly – until now.

From decreasing the carbon footprint of data centres, replacing plastics with plant-based material, to resource extraction and smelting, to the leading edge of the concrete industry – our engineers minimize environmental footprints while keeping manufacturers profitable.

Professor of Electrical and Computer Engineering **Alberto Leon-Garcia**, for one, is designing a sophisticated dispatching system to reduce carbon dioxide emissions from computer data centres.

These centres act as hubs of on-demand computing, thereby avoiding the need for every personal computer to be loaded down with software and huge hard drives. Computer users access the power of these centres through the web only when they need it – such as when they use their Gmail.

Photo/JasonKB Photo

Electrical and Computer Engineering Professor Alberto Leon-Garcia

"What you can do is dispatch the jobs to the centres that have renewable energy and away from those that don't," says Engineering Professor Alberto Leon-Garcia.

But it takes a lot of power to run these centres. As it stands, information and communications technology systems are responsible for about 2% of annual man-made carbon dioxide emissions. “But it’s growing fast,” says Leon-Garcia, a Canada Research Chair in Autonomic Service Architecture.

That’s why he is creating a system for maximizing the amount of computing done at data centres powered by clean renewable energy.

“Data centres have computing tasks assigned to them. Most tasks don’t really care where they are executed. So what you can do is dispatch the jobs to the centres that have renewable energy and away from those that don’t,” he says.

Because solar and wind power is intermittent, this is easier said than done. But Professor Leon-Garcia is confident there are solutions, for example spreading data centres over a large area. After all, the wind is always blowing and the sun is always shining somewhere in the world.

Building better “plastics”

Chemical Engineering Assistant Professor **Emma Master** is working to reduce the environmental impact of our rising use of plastic by replacing its non-renewable petroleum-based ingredients with renewable and biodegradable plant-based material.

“We’ve become accustomed to using plastics, particularly in food preservation and shipping, and we should continue to benefit from the advantages plastics have offered. But now we realize the disadvantages in their persistence in the environment and some of the problems associated with their synthesis,” says Master.

Of course, plant-based material such as wood fibre doesn’t have all of the characteristics we’ve come to expect from plastic, such as water repellency. The answer is to tweak plant fibres by using nature’s own catalyst – enzymes. Enzymes are proteins that launch chemical reactions that make cells behave in specific ways.

Master is building enzymes that can tailor the physical and chemical properties of plant fibres to increase their performance in new, biodegradable materials. Such advances have the added benefit of finding new markets for forestry products, an important but declining Canadian industry.

Chemical Engineering Assistant Professor Emma Master is working to reduce the environmental impact of our rising use of plastic by replacing its non-renewable petroleum-based ingredients with renewable and biodegradable plant-based material.

Photo/John Hryniuk

Chemical Engineering Assistant Professor Emma Master

Taming the trouble with tailing ponds

What to do about tailing ponds is another longstanding environmental concern. In fact, it is one of the mining industry's most intractable problems. Recent headlines about ducks dying after landing on Alberta's oil sands tailing ponds, and the seven people killed in Hungary when a reservoir of chemical sludge at an alumina plant spilled, have driven the point home.

Enter Civil Engineering Associate Professor **Murray Grabinsky** (CivE MASc 8T9, PhD 9T2). He is designing systems for storing the by-products of mining underground in a solid form so that they don't seep out and contaminate the environment. Grabinsky is taking advantage of a process developed at the University of Toronto about 50 years ago to extract water from tailings and turn them into thickened sludge.

Specifically, Grabinsky optimizes the building of underground infrastructure in the void left from mining operations so that industry can store the semi-solid sludge. "In underground mining, one of the challenges is that some of these mines are a couple kilometres long and they can go kilometres deep," he says.

Grabinsky's designs ensure that despite the vastness of such underground spaces, the sludge is stored quickly and safely.

Civil Engineering Associate Professor Murray Grabinsky (CivE MASc 8T9, PhD 9T2)

Materials Science and Engineering Professor Torstein Utigard (MMS MASc 8T3, PhD 8T6)

Refining the capture of SO_2 emissions in mining

Meanwhile, Materials Science & Engineering Professor **Torstein Utigard** (MMS MASc 8T3, PhD 8T6) is taking a hard look at how to reduce sulphur dioxide emissions from mining for nickel, copper, aluminum, as well as solar grade silicon. While there have been important advances in capturing acid-rain causing sulphur dioxide, Utigard wants to make those systems even more efficient.

Utigard is also working on a copper mining operation in Chile to create a system for recovering energy from slag, a hot molten by-product of mining.

"We want to turn it into steam and the steam can turn a generator," says Utigard, a Gerald R. Heffernan Chair in Materials Processing. "But it's difficult because the liquid is hot – 1,500 C – so it is very corrosive and has a tendency to explode."

Concrete solutions to greenhouse gas emissions

Civil Engineering Professor **Doug Hooton** (CivE 7T4, MASc 7T5) is also making inroads into sustainability. He is investigating ways the concrete industry can reduce point source greenhouse gas emissions, increase the durability of concrete and make the material more sustainable.

"Concrete is the most widely-used building material in the world. On average, there is more than a cubic metre of concrete placed for every person on Earth every year," says Hooton, who is the Natural Sciences and Engineering Research Council of Canada/CAC Senior Industrial Research Chair in Concrete Durability and Sustainability.

Hooton's research zeroes in on Portland cement, the most common binder used to turn crushed rock into concrete. The manufacture of this binder is responsible for 90% of the carbon dioxide emissions in the concrete industry and about 5% of global CO_2 emissions.

The problem with Portland cement is that it's made using limestone, which releases carbon dioxide when it is heated up to create the binder.

"Even with the most efficient processes, they drive off CO_2 into the atmosphere," he says.

Hooton is working on replacing significant amounts of Portland cement with both unburned limestone and industrial waste-products that will not give off so much carbon dioxide. Blast furnace slag and power station fly ash are just two of the candidates he is investigating. In addition, he is working to reduce the quantity of binder needed in concrete.

Civil Engineering Professor Doug Hooton (CivE 7T4, MASc 7T5)

Power Profs

Energy storage is ripe for reinvention and is an important part of sustainability. U of T Engineers are at the forefront of that innovation.

Pity the poor batteries, solar cells and capacitors. They've been huddled on the sidelines watching memory prices plummet, computing processing power skyrocket and computers shrink from the size of filing cabinets to the scale of nail files. Blame chemistry.

By and large, batteries, fuel cells, capacitors and solar panels have resisted the lure of Moore's law, economies of scale and miniaturization. They've improved, sure, but not on the logarithmic scales of memory and processing power. Chemistry has constrained them to a more staid, linear kind of progress.

Materials Science and Engineering Associate Professor Keryn Lian (MMS MASc 9T0, PhD 9T4)

That's because, in the end, energy storage devices are all dependent on simple electrochemical bonds. And, there's only so much storage, energy and oomph you can coax out of anodes; cathodes; often leaky electrolytes and a delicate dosey doe of electrons.

"Battery chemistry, if you look at the lead acid battery, for example, hasn't changed in 100 years. There's a thermodynamic limit you just can't go beyond," explains Materials Science amd Engineering Associate Professor **Keryn Lian** (MMS MASc 9T0, PhD 9T4). "However, tremendous progress has been made on batteries, just like so much has been done to improve silicon."

So, refining energy storage – that's tricky.

Gnarly problems and engineering enigmas

And, try to quench the thirst of juice-hoarding gizmos while at the same time making sure the energy devices they use are produced, function and retire in sustainable ways? That's a gnarly, complex problem that would vex Thomas Edison, Richard Feynman or Nikola Tesla on their best days.

But, it turns out that those are just the kind of enigmas that U of T Engineering researchers love to dive into, headlong.

Lian, for example, has plunged into the world of capacitors, more specifically, ultracapacitors – the new superheroes of the energy storage world.

Let's step back. A capacitor, like a battery, stores energy. But a battery is like a big water tank with a small faucet – only a limited amount of energy can flow out. Capacitors, on the other hand, can store energy and send gushers of juice out in a sudden burst, sometimes dumping their charges in just milliseconds. To use another analogy, they're sprinters, not marathoners.

But ultracapacitors can store more energy than regular capacitors: they're like a capacitor-battery hybrid. Part of the ultracapacitor's superpowers come from the surface area of the electrodes inside them.

It turns out, the more surface area electrodes have, the greater their charge capacity. Lian and her team are working with chemically modified carbon nanotubes, which have dramatically greater surface area than in regular capacitors. Ultracapacitors with these scads of micropores not only have greater storage capacity, they discharge much faster than regular batteries, and their charge cycle doesn't deteriorate over time. Lian's team is also experimenting with super-thin, non-leaky polymer electrolytes, which give ultracapacitor longer life cycles and greater energy efficiency.

Printing power

But capacitors, even ultracapacitors, aren't solo players, especially when it comes to delivering sustainable,

practical energy. Often they're teamed up with batteries or solar cells, and that's where Chemical Engineering Professor **Tim Bender** comes in.

Bender and his team of researchers are developing inexpensive, organic solar cells with super vision. Most solar cells can convert only a very narrow slice of the light spectrum into electricity, from about near-ultraviolet up to what we see as green (about 800 nanometres). That's as good as non-organics can get.

"In order to get silicon to absorb beyond 800 nanometres, you basically have to break the laws of science," explains Bender. "It's a fundamental materials limitation."

However, Bender's panels, which are made from organic crystals, suck in light up to 1,600 nanometres, and beyond. That's because they're "printed" from separate laminates of light-sensitive materials that combine to cover the waterfront, so to speak. Imagine them like the yellow, magenta and cyan inks in your inkjet printer combining to make black, with black here representing how little light escapes from Bender's panels.

The design means that the same size of panel can generate far more electricity than standard solar cells and do it using recyclable, sustainable and organic materials. And do it more cheaply. "The silicon used in traditional solar cells is the same material that Intel, AMD and Apple compete for," explains Bender.

Photo/John Hryniuk

Chemical Engineering Professor Tim Bender

Photo/John Hryniuk

Electrical and Computer Engineering Professor Ted Sargent (ECE PhD 9T8)

That means market demand can push the price of silicon cells much higher than organic crystal ones. Plus, turning sand into silicon is a chemical and energy intensive process.

The downside of Bender's organic solar cells, right now, is that they are far less efficient in converting light to electricity – about 6% to traditional solar cells' 30-43%. But, if you have enough surface area (say your rooftop), it makes practical sense to use organics.

Bender imagines that in five years BlackBerries, iPhones and other smartphones will sport trickle-charging organic crystal solar cells – and the greater range of organics means those devices could charge in the light of a lecture hall, not just direct sunlight.

In a decade, he hopes you'll be able to walk into RONA or Home Depot and pick up a roll of organic cells and do your house with them. And, he imagines a time when offset printers, like the ones used to produce daily newspapers, will also be able to print organic cells. "Any community or country that has access to an offset printer could produce organic cells in large quantities," he explains.

Electrical and Computer Engineering Professor **Ted Sargent** (ECE PhD 9T8) also has his sights set on solar. But he thinks big sustainable solutions come in small packages – really small. So small you can measure them using two-dozen atoms as a yardstick.

Professor Ted Sargent thinks custom nanomaterials can produce paintable solar cells that could turn any surface, even any fabric into a sustainable energy generator.

Dr. Luke Brzozowski ECE PhD 0T4), Director of the Photovoltaics Research Program in Professor Ted Sargent's group

That's because Sargent and his team, funded in part by an investment from the King Abdullah University of Science and Technology (KAUST), are tackling sustainability solutions one nanoparticle at a time. He thinks custom nanomaterials can produce paintable solar cells that could turn any surface, even any fabric into a sustainable energy generator.

It turns out that nanoparticles can not only be laid down like paint, but are versatile as well. Build them right, from the atom up, and you have a flexible, wide-spectrum photovoltaic cell. You can even turn them into miniature ray guns. "We can paint these semiconductor particles right onto the chip," explains Professor Sargent, who also holds the Canada Research Chair in Nanotechnology, "and then turn the dried paint into a laser."

Configured a little differently, the nanoparticle matrix could even unclog Internet bottlenecks because nanoparticle-based routers don't have to convert fibre-optic signals to much slower electrical current and then back to light.

And the best part? According to Dr. **Luke Brzozowski** (ECE PhD 0T4), Director of the Photovoltaics Research Program in Sargent's group, nanomaterials use "bottom up," or chemically synthesized fabrication that's not only cheaper than traditional methods, it also takes less energy and will result in higher efficiency devices.

Look for devices using Sargent's group's "paint" to cover your world in five years or less. Some devices are being geared up for launch through the U of T spin-off company, InVisage Technologies. Meanwhile Xagenic, another spin-off, is commercializing research Sargent's team collaborated on with Professor Shana Kelley, of Pharmacy, Medicine and Institute of Biomaterials & Biomedical Engineering (IBBME), on nanobiosensors.

So, maybe someday sustainability will only be skin deep – and that's a good thing.

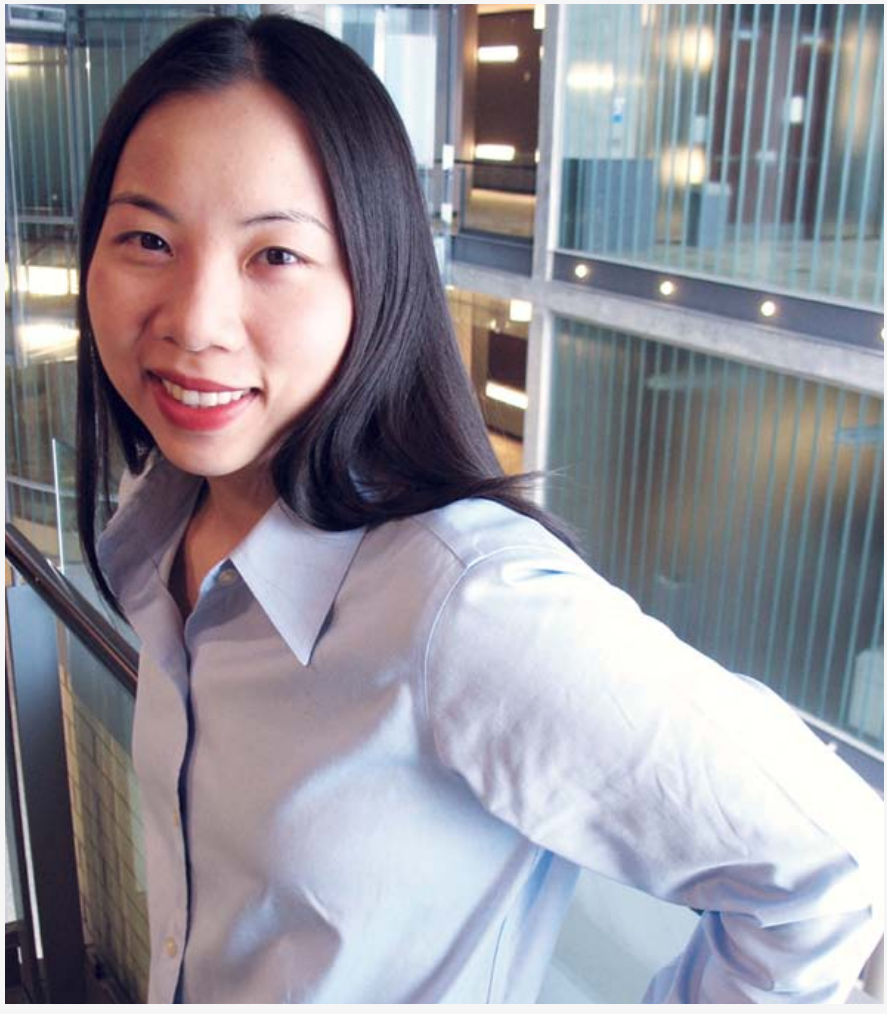
Fuel for Thought

Mechanical and Industrial Engineering Assistant Professor **Aimy Bazylak** would like to utilize energy from hydrogen – the same element that fuels the sun.

While batteries are closed systems, fuel cells rely on a fuel supply (often hydrogen) that maintains, along with a catalyst, the chemical reaction that produces electricity while producing only water and heat as waste products.

Hydrogen fuel cells for cars are the most high profile of fuel cells but there are many other types and applications, says Bazylak. "Right now, the public has a huge interest in hydrogen fuel cell vehicles. Purely battery-powered cars are also in the spotlight right now, but, in the long run, car companies see hydrogen fuel cells running together with batteries as the ultimate solution. Purely battery-powered cars have limited range, so they will not be the silver bullet," she explains.

Bazylak and her team are also interested in microfluidic fuel cells, so small (100 microns) that dozens of the high-density cells could fit in a container the size of a loonie. She imagines that these tiny cells, which could power portable electronics like cellphones and laptops, may become widely adopted before hydrogen fuel cell cars hit the road.



Mechanical and Industrial Engineering Assistant Professor Aimy Bazylak

"Like other kinds of sustainable storage devices, fuel cells are just one part of a sustainable energy future," says Bazylak. "In a portable energy system, fuel cells could provide the base power. Batteries could provide top-up, fluctuating power and ultracapacitors are there for very fast changes and power bursts, which are necessary when you turn on a device." It's a future where all the sustainable devices are in it together. "There is no one winner. You need everyone," says Bazylak.

The Silver Lining for BSE

If it weren't for mad cow disease – or bovine spongiform encephalopathy (BSE) – Professor Emeritus **David Boocock** might have just been another hard-working organic chemist fascinated by biodiesel.

Twenty years ago, Boocock, of Chemical Engineering, had discovered a unique way to turn waste animal fat (among other organics) into sustainable fuel. Great idea, but it was too rich for the blood of the Canadian fuel industry, which was already producing biodiesel from grain and feedstock.

That was before 2003, when mad cow disease dried up the import and export of animal carcasses redolent with adipose tissue. Suddenly, faced with brimming vats of waste fat with no market, the industry started to think Boocock's method didn't look so expensive after all. In fact, the procedure – which broke down the fatty acids in the waste animal parts and made biodiesel production a single phase, continuous process – turned out to be a silver lining for the BSE cloud that had descended on Canadian agriculture.

Through the University of Toronto's Innovation Foundation (now at the MaRS Centre), Boocock's patented process was sold to BIOX Corporation.

Boocock is still bullish on the sustainability of biodiesel. "In theory, you could run vehicles on 100% biodiesel," says Boocock. "In fact,

Photo/John Hryniuk

Professor Emeritus David Boocock of the Department of Chemical Engineering & Applied Chemistry

Rudolph Diesel's first engine ran on peanut oil, which is feedstock for the biodiesel process. But it was too viscous and the engine seized up."

Practically, though, Boocock says you only need about 2% biodiesel in a fuel mix to get the improved lubricity biodiesel gives petrochemical-based fuel. "The great thing about biodiesel is that when you grow the precursor to biodiesel (plant matter), you're absorbing carbon dioxide and balancing the CO_2 given off when the biodiesel is burned." Plus, biodiesel is biodegradable and even normal diesel with biodiesel mixed in breaks down faster.

But, he argues that the sustainability picture is even brighter for biodiesel using his method. "Waste fat-based biodiesel is not only twice as efficient at energy conversion than feedstock-based diesel, it is also making use of what otherwise would be a waste product," he says. "The waste fats my process uses would otherwise have to be disposed of some other way – which would have its own carbon footprint."

Beyond the Carbon Footprint

When you want to find out how everyone is doing where sustainability is concerned, you turn to **Heather MacLean**. She's a sustainability detective. But, for her, carbon footprints are just the most obvious piece of evidence.

MacLean, a Civil Engineering Associate Professor, is especially interested in Life Cycle Assessment, a sort of sustainability forensics that looks at the greenness of a product, device or process during its whole time on the planet, from its raw materials and manufacturing all the way to disposal, reuse or decomposition.

"Most people feel that their technology is going to improve things and make a difference. But some proponents have only looked at their technology in detail, they haven't looked at the upstream aspects and the full life cycle of that technology," says MacLean.

For example, MacLean thinks that electric cars, like the Ford Focus, appear to be sustainable, clean and green. But that's not true if you're

getting your charge from coal-fired plants. "In Canada, where we get a lot of our power from hydroelectricity and nuclear, it may make sense, but not so much in places where fossil fuels are providing the electricity," she explains.

MacLean also thinks it's important to consider how sustainable the raw materials are that go into traditional and alternative energies and processes. She considers how they're disposed of, how much water goes into the production, the type of feedstocks used, and how much energy is involved in producing raw materials for future energy creation (in the case of creating hydrogen for fuel cells, for example).

Broad thinking like that matters, MacLean argues. "More and more government funding in Canada, the U.S. and in Europe is tied to having studies done on the life cycle implications of technologies."

As well as doing pure research on sustainability, MacLean and her team also undertake life cycle assessments for companies. She often asks businesses whose process she's evaluating to tell her what's most important: then she can give the best advice on how to make processes cheaper, or more sustainable, or more effective.

She says life cycle assessment matters to industries and technologists, because it can save them time and money, allow them to respond to a growing public demand for sustainable products and processes and allow them to qualify for government grants and other funding. And, she's optimistic about the future. "I think more and more companies are coming to the realization that this is important," she says. "I really do."

Civil Engineering Associate Professor Heather MacLean

A Gem of an Idea for Solar Cells

Professor **Nazir Kherani** (EngSci 8T2, ChemE MASc 8T3, Physics PhD 9T4) hasn't given up on traditional silicon solar cells just yet. Kherani teaches in the Department of Materials Science & Engineering and The Edward S. Rogers Sr. Department of Electrical & Computer Engineering. He and his team have come up with a way of making silicon cells thinner and more efficient.

Thinner is good, because it means less material needs to go into a solar cell of the same surface area. Kherani does it by depositing nano-thin p-n (positive/negative) junction films onto the silicon wafer. A side benefit is that the cells can be made at 200 degrees Celsius – 800 degrees cooler than traditional methods. Less heat, less energy used, more sustainable cell manufacturing.

Problem is, the thinner the wafers get, the less efficient it is at converting light to electricity. Enter Kherani's second innovation, this one by way of opals, beetle shells and butterfly wings. What do they have in common? They contain photonic crystals, a special class of optical materials that change their index of refraction periodically. Translation? They're what give opals its rich, colour-shifting hues, the magic iridescence to the backs of beetles and the wings of certain Lepidoptera.

Photo/Maloney Aguirre, photographica

Professor Nazir Kherani (EngSci 8T2, ChemE MASc 8T3, Physics PhD 9T4)

It's also just what Kherani needed to make effective light traps for his thinner-than-average cells. In traditional solar cells, light traps are simply reflective metal backings, but they redirect all the light into the cell (and so heats it up). Using photonic crystals, made from nanoparticle- and nano-thin films, Kherani can redirect just the wavelengths he needs, letting the rest "vent" out the back.

Maybe, when it comes to solar energy innovation, "winging it" is not such a bad idea.

All Together Now

The Centre for Sustainable Energy is pulling all the threads of sustainable energy research at U of T together.

Imagine two futures.

In one, we have passed peak oil, nations fight not for land but for fossil fuels, and clean water and electricity are scarce. Global warming has raised sea levels, shifted the Gulf Stream and has sunk islands and economies. The skies are brown and prospects are bleak.

In another, we have come together as a species to create new ways of making modern life sustainable. Greenhouse emissions are down and in control; clean, renewable energy fuels our lives and the blue-sky thinking of thousands of collaborative researchers has created clear skies for everyone.

In that brighter, second future, the U of T Engineering's Centre for Sustainable Energy will play a vital role.

Mechanical and Industrial Engineering Professor **Olivera Kesler** is the Centre's Director. She wants to bring synergy to sustainable energy. The centre is weaving together all the separate strands of energy research and innovation on campus into a strong, collaborative fabric. Her goal is to unite the dozens of teams of researchers, educators, students and partners scattered in the faculties, buildings and labs in downtown Toronto.

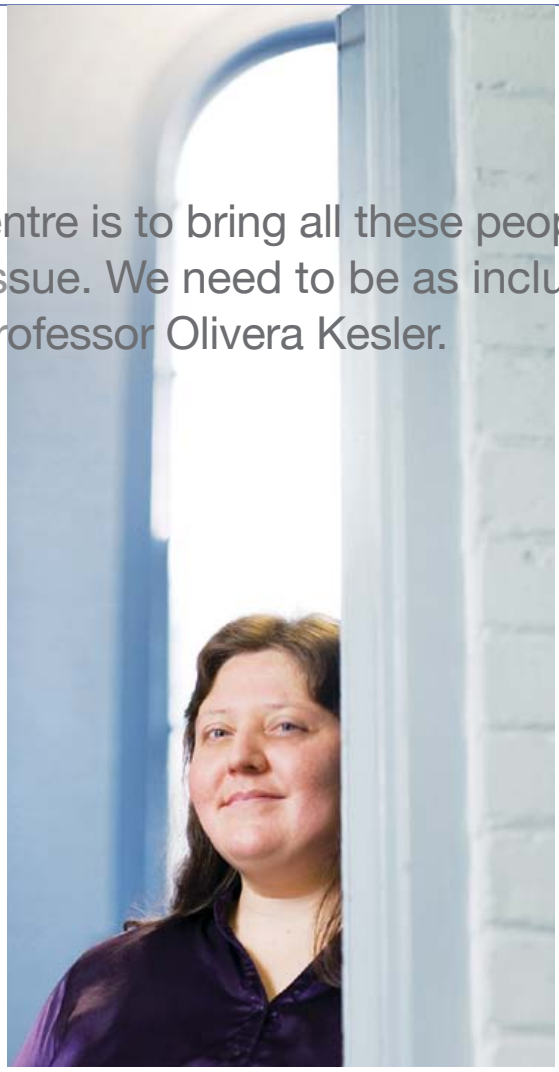
The end game? To make sure that conversation, community and collaboration happen among the fine minds working on supplying the demanding world with earth-sensitive energy.

Kesler's admirably suited to the task. She's a passionate sustainable energy proponent, an avid cyclist and the Canada Research Chair in Fuel Cell Materials and Manufacturing. Her specific research focuses on sustainable solid oxide fuel cells, including ones using coal gas as a fuel while producing efficient energy with zero pollutants.

But the Centre's mandate goes much wider, embracing not only engineering expertise and research, but also the political, sociological and culture implications and impacts of energy shortage and inequity.

Kesler's quick to point out, she didn't come up with the idea for the new Centre. "That credit belongs to **Jean Zu**, the Chair of our Mechanical & Industrial Engineering department. She felt there was an opportunity to have more collaborative efforts going on related to clean energy.

"The goal of the Centre is to bring all these people together to work on the same vital issue. We need to be as inclusive as possible," says Engineering Professor Olivera Kesler.



Photo/John Hryniuk

Mechanical and Industrial Engineering Professor Olivera Kesler, Director of the Centre for Sustainable Energy

I think she was inspired by the fact there were some other centres starting up around the same time, focusing on issues like robotics and mechatronics," explains Kesler.

"Clean energy has been my primary interest since the beginning of my career. I'm biased, but I think it's the number one most crucial issue that we face for our species and for the other species with which we share the planet," she says. "The goal of the Centre is to bring all these people together to work on the same vital issue," Kesler adds. "We need to be as inclusive as possible. The Centre is fully interdisciplinary. The only barrier for participation is people's individual time constraints."

The Dean of the Faculty of Applied Science & Engineering **Cristina Amon** says, "We have strong researchers and large and small groups working on incredibly challenging and remarkably complex problems that require an interdisciplinary approach to solve them in innovative ways." Dean Amon believes cross-pollinating solutions is key to maintaining the University of Toronto at the forefront of innovation.

Professor Kesler says the committee that oversees the Centre meets about once or twice a term to coordinate the Centre's activities. The first task was the creation of a growing website that attempts to pull together all the clean energy activities and research on campus.

"Someone coming to the site may just want information on what U of T is doing about wind energy, regardless of department. They might not know that Aerospace is doing research in that area, or that a place where airplanes are studied also study wind turbines, but they can find it on the site," she said. It took Kesler and her team about six months prior to the Centre's official launch to start pulling together all the disparate research that makes up the core of the Centre's site. Also, the site is designed so that anyone on campus can now easily add their own energy-related research or information.

"Our role is really to facilitate the connection between different groups and hopefully engender new research as a result of those relationships. The research was already going on here. We're just giving it more visibility for people who may not have known what was going on here, its scope and where the research was taking place," she says.

Since the Centre has launched in March 2010, it has hosted seminars on energy-related topics and has helped promote events held by other groups on campus or elsewhere in Toronto – if they've been energy related.

And, Kesler says in the future she'd like to the see the Centre take on an increasing advocacy role, offering public seminars. This includes an Energy Showcase that took place in May 2011, at which officials involved in energy policy presented public lectures that stressed the political and societal issues associated with sustainable energy. "We've also got folks involved in life cycle research trying to assess the full life cycle costs of different technologies. We intend to provide the public with as much information as possible about these issues. Often public and political choice is economic."

Dean Amon says the young Centre is actively seeking funding for its endeavours.

"[The Canadian engineering firm] Hatch provided a $1 million endowment for fellowships for graduate students studying sustainability and sustainable energy. That endowment was matched one-to-one by the federal government," she said.

While a Centre for Sustainable Energy is not unique among universities, Dean Amon says U of T sets itself apart by the density of researchers who have proven they can tackle and solve problems of "immense complexity with remarkable innovation and creativity." She believes the Centre won't just connect existing researchers, but spawn whole new kinds of research and innovations in the future.

The Dean of the Faculty of Applied Science & Engineering Cristina Amon, with the Faculty's Vice-Dean of Research Stewart Aitchison

Electrical and Computer Engineering Professor **Stewart Aitchison**, the Faculty's Vice-Dean of Research, agrees. He believes the Centre is perfectly aligned with the Faculty's future vision. "Sustainable energy is one of our key research areas in our strategic plan moving forward. The Centre will become a nucleus for that activity."

A $1.65 million, six-year CREATE (Collaborative Research and Training Experience) grant for the Centre's work has already been awarded by NSERC (Natural Sciences and Engineering Research Council of Canada). The funding, led by Dean Amon and Assistant Professor **Aimy Bazylak**, will provide graduate students with additional specialized training.

He said additional funding for Centre research could come from the provincial and federal government, as well as from industry.

"We have engineers working on all facets of the renewable energy issue: solar, wind, even tidal, but we can also tie into researchers in arts and science, as well as medicine, that look at other aspects of renewable energy. We can work with folks in social science to look at the impact of harvesting crops for biodiesel or for food. That's where our uniqueness lies – in our amazing diversity of expertise," Aitchison explains.

You can learn more about the Centre for Sustainable Energy by visiting:
www.mie.utoronto.ca/CSE/index.php

Sustainability in a Major and Minor Key

Clusters of energy and environmentally focused courses set U of T Engineering students on the leading edge.

One of the great advantages of knowing a good deal about energy and sustainability is that it makes you stand out in the job market like a sunflower in a field of soya beans. That's why, three years ago, U of T Engineering started tailoring minors and a major aimed at giving students a deep understanding of the ways the planet produces energy, how humans govern its use and how best to create processes and devices that harness, value and protect global resources.

The Sustainable Energy minor, introduced in 2009, consists of six semester-long courses that immerse students into public energy policy, regulation, transmission, storage and development. It also explores conservation, pricing, greenhouse gas product and control.

"Students also get a strong understanding of traditional energy systems as well, so they can compare and contrast," says Professor **Bryan Karney**, the Associate Dean of Cross-Disciplinary Programs and Chair, Division of Environmental Engineering & Energy Systems.

The six courses are typically completed in the final two years of the four-year undergraduate program. That means that U of T Engineering has already graduated students with the minor into the workforce.

"Students are ideally suited for jobs in government policy, industry or consulting," says Karney.

The Environmental Engineering minor focuses on technology, and its role in society and the biosphere. It delves into environmental impact and risk assessment, urban engineering ecology, alternative energy systems

Professor Bryan Karney, the Associate Dean of Cross-Disciplinary Programs and Chair, Division of Environmental Engineering & Energy Systems

and tools for measuring the impact of processes and products on the environment. Like the Sustainable Energy minor, it's a cluster of six semester-long courses of students' choosing.

Finally, the Energy Systems Engineering major, which was launched in 2008, is really a "souped-up version of the Sustainable Energy minor," says Karney. Students in Engineering Science – which is regarded as one of the top engineering programs in the world – dive more deeply not only into technical issues but into terrestrial energy systems (how the planet produces energy) and energy policy, especially around electrical, heating and cooling, as well as transportation. "The three great ways humans deal with energy," Karney says.

A minor edge, a major advantage

All the minors and the major show up on student transcripts. "And, of course, they'll want to add them to their CVs," says Karney.

He says the relatively new minors and major are a "huge advantage" for U of T Engineering and for its graduates.

"These programs are an all-around win. It's a win for the university, a win for the students and a win for industry that gets graduates that understand environmental and sustainability issues, which everyone understands are enormously important issues these days."

Engineering students Stephen Pinto (ChemE 1T1), Sahar Tolami (CivE 1T1), Camila Campos (CivE 1T1) and Patrick Young (ChemE 1T1), who are minoring in Environmental Engineering

Engineering Alumni Association Awards

Each year, the Engineering Alumni Association (EAA) is proud to recognize graduates who lead in the engineering profession in remarkable ways. Fall 2010 saw nine more extraordinary alumni honoured for their achievements.

"We are delighted to be able to honour this outstanding group of graduates for their accomplishments and contributions to the profession of engineering," said Dean **Cristina Amon**, Faculty of Applied Science & Engineering. "I am also grateful to the Engineering Alumni Association's Honours and Awards Committee for their tremendous efforts in making the awards dinner an outstanding success for another year."

EAA award winners and Hall of Distinction inductees' group photo. Back row: Dawn Demetrick-Tattle, Geoffrey Siu, Nadine Ibrahim, William Dimma, EAA President Claire Kennedy (ChemE 8T9). Front row: Donald King, Joseph Paradi, Dean Cristina Amon, Anne Sado, Marc Rosen, Manuel Fine and EAA Honours & Awards Committee Chair Barry Adams

Dawn Demetrick-Tattle

CivE 8T5

Dawn received the 2T5 Mid-Career Award. Dawn has distinguished herself as a leader in the very competitive and risky industry of excavations and shoring.

In the 25 years since her graduation, Dawn has worked for Anchor Shoring & Caissons Ltd., a well-respected group of three companies focused on excavations and shoring, and has served as its President since 1997. During this time, Dawn increased Anchor's revenues fourfold and took a leading role in several high-profile projects, including the Air Canada Centre and BCE Place. Anchor's innovative and practical solutions have resulted in substantial time- and cost-savings to numerous projects.

Dawn has authored numerous articles in trade publications and has been a presenter at several industry conferences. She has also volunteered extensively in her community as a leader, mentor and a contributor to industry organizations.

Recently, she was named one of the "Top 100 Most Powerful Women in Canada" – Canada's most recognizable award for the country's highest achieving female leaders in the private, public and not-for-profit sectors.

William "Bill" Dimma

ChemE 4T8

Bill is the 2010 recipient of the Engineering Alumni Medal – the Engineering Alumni Association's highest honour. For more than four decades, Bill has been sought after for his knowledge of corporate governance, and for his dedication to improving the practice of directorship.

An Honours graduate in Chemical Engineering, Bill began his career with Union Carbide in 1948, and then became its Executive Vice-President by the mid-1960s. After earning a doctorate in business administration from Harvard University in 1973, he was the Dean of the Faculty of Administration Studies at York University.

But the excitement of the bottom line drew Bill back to the business world. He took on the role of President and Director of Torstar Corporation and the Toronto Star Newspaper Limited, before becoming the President and Director of A.E. LePage Limited in 1979. Bill soon became President and Chief Executive Officer of Royal LePage Limited, and later Deputy Chairman.

Bill has sat on no less than 56 corporate boards and more than 40 not-for-profit boards. He is a founder of the Canadian Journalism Foundation, and helped establish the Jarislowsky Dimma Mooney Chair in Corporate Governance at Osgoode Hall Law School and the Schulich School of Business at York University.

Nadine Ibrahim

CivE 0T0, MASc 0T3

Nadine was honoured with the 7T6 Early Career Award. An exceptional student, it was what Nadine did after graduation, overseas, that set her apart.

Nadine has worked extensively in the environmental and global-social arena, devising multiple corporate social responsibility initiatives for the private sector, and building capacity in the private and public sectors.

After graduating with an MASc in structural engineering, Nadine moved to Egypt in order to improve environmental conditions in the third world. Working at a Cairo-based environmental consulting firm, Nadine started a business development unit to provide direction to the company, and took part in implementing the company's strategic plan.

In 2009, Nadine launched an internship program at Taking It Global, a not-for-profit organization that engages youth to create a more inclusive, peaceful and sustainable world.

Donald "Don" King

ChemE 5T0

Don is the 2010 recipient of the Malcolm McGrath Award. He has been a stalwart in organizing anniversary, reunion and other alumni events in the 60 years since his graduation with honours from Chemical Engineering.

An early example of Don's personal commitment to the Faculty was seen in 1951, when he gave $300 to the Faculty in recognition of the $250 he had received to enable him to complete his final year of schooling.

From his graduation year onward, Don threw himself into alumni organizing, joining the 5T0 Engineering Alumni Committee, and the Engineering Alumni Junior Council. Then in 1957, Don drafted a new 5T0 Engineering Alumni constitution.

Over the years, Don has organized dinners with speakers, music evenings, trips, and 50th and 60th anniversary galas. Don also spearheaded a collection of nearly $500,000 to build Ajax House for the Innis Residence on St. George Street, one suite of which recognizes his own financial contribution.

Geoffrey Siu

EngSci 0T9 + PEY

Geoffrey received the L.E. (Ted) Jones Award. Geoffrey married his love of music and Engineering when he founded the Skule™ Orchestra in 2006.

In its five years of existence, Geoffrey has led it from a small orchestral group to the largest of the Skule™ music ensembles. His guidance as managing director has allowed Skule™ Orchestra to expand from a basic ensemble to one capable of performing at Moment – the Valentine's Ball, which Geoffrey also founded and managed – and at the Engineering Science 75th anniversary concert.

Geoffrey was also a founding member and co-chair of the first Skule™ Arts Festival, a week-long showcase of the artistic talents of engineering students. Between his involvement in the orchestra and Skule™ Arts Festival, he has helped hundreds of engineering students find a way to express their artistic abilities.

Photos/Michael Tenaglia and Mike Causi

Engineering Hall of Distinction

The following four new inductees to the Engineering Hall of Distinction truly define engineering success. The Engineering Alumni Association would like to congratulate 2010's inductees for their lifelong achievements and their dedication to the engineering profession.

Manuel "Manny" Fine

CivE 5T2

Manuel Fine has been called the "Dear Abby" of the heavy construction and deep foundations world. Manny is known around the world as a leading expert in the heavy construction and deep foundation industries, and although he has been semi-retired since 1994, he continues to be actively consulted within the industry.

After graduation, Manny went to work with the Department of Public Works, Canada, Harbours and Rivers Engineering Branch. Five years later, Manny joined Russell Construction Limited in Toronto, where his projects would include the deepening of the Welland Canal and the Homer Bridge spanning it. He then spent another decade at McNamara Corporation, where he managed the design and full implementation of the Poe Lock in Sault Ste. Marie, Michigan, under contract for the U.S. Army Corps of Engineers; this project was the largest of its kind.

From 1972 to 1994, Manny worked for the Bermingham Group of Companies in a variety of positions including President of one of its corporations and led the century-old company to be a principal exporter of deep foundation and heavy construction equipment worldwide.

Manny has volunteered his time generously, lending his expertise in developing amendments to Ontario's Health and Safety Act, acting for many years as managing editor of *DFI Journal,* and serving several terms on the executive of the Canadian Geotechnical Society's Southern Ontario Section.

Joseph Paradi

ChemE 6T5, MASc 6T6, PhD 7T5

Professor Emeritus Paradi has distinguished himself through the practice, study and teaching of engineering entrepreneurship.

A three-time graduate of the Department of Chemical Engineering & Applied Chemistry, he founded Dataline Inc. in 1969, which grew to become an industry leader in providing real-time database and communication-oriented services. He has founded or led the growth of 11 companies and has been a member of numerous industry organizations. Always an entrepreneur, he continues to be involved in the management of four lucrative small businesses: Parcorp Ltd., Translucent Technologies Inc., Softek Computer Services Ltd. and VeraPar Kft.

Professor Paradi has also been a dedicated instructor and researcher of entrepreneurship and the management of technology. Rejoining the Department of Chemical Engineering & Applied Chemistry in 1983 as an Adjunct Professor, he became a full Professor in 1991. He now holds the Chair in Information Engineering and is Executive Director of the Centre for Management of Technology and Entrepreneurship (CMTE), which he founded in the Faculty. He has taught 13 undergraduate courses and five graduate courses, and supervised 12 PhD candidates, 43 MASc candidates, seven MEng candidates and 137 BASc theses.

Marc Rosen

EngSci 8T1, MechE MASc 8T3, PhD 8T7

As an educator and scholar, Marc Rosen has transformed educational institutions throughout his career and made exemplary contributions to research.

In 2002, Marc became the founding Dean of the Faculty of Engineering and Applied Science at University of Ontario Institute of Technology in Oshawa, contributing significantly to building Ontario's first new university in 40 years. From 1986 to 2002, Marc was a Professor in the Department of Mechanical Engineering at Ryerson University, where he served as department Chair and Director of Aerospace Engineering and helped in Ryerson's transition to a university.

Marc has also worked for such organizations as Argonne National Laboratory and the Institute for Hydrogen Systems. As a researcher, he has become an international authority on sustainable energy and a pioneer in the development of advanced thermodynamic methods based on energy.

Marc has served as President of the Engineering Institute of Canada (EIC), and previously served as President of the Canadian Society for Mechanical Engineering (CSME). He has received numerous awards and honours, and is a Fellow of many societies, including EIC and CSME. In the community, Marc has mentored through Big Brothers, and spoken and volunteered in schools, educating on engineering principles and applications and about careers in technological fields.

Anne Sado

IndE 7T7

During her steady progression up through the ranks of the business world and into academia, Anne Sado has been a role model to female engineers in particular.

Anne began her career at Bell Canada in 1977, and in 2002 had become a Senior Vice-President (Business Processes and Operational Effectiveness). In this position, she was instrumental in increasing the company's earnings by $450 million in 2001 and $550 million in 2002, in part through her development of a "One-Stop Shopping" model and improvement in high-speed data service provision. In 2003, Anne was Principal in Helix Commerce International, helping build the company into a multimillion-dollar telecom/high-tech service business.

Since 2004, Anne has been President of George Brown College. Under her leadership, George Brown has doubled in size and established itself as a key part of Toronto's social, economic and cultural fabric. The college has established strong community partnerships, including with at-risk communities; developed new programs in partnership with arts organizations and industry; and advanced international and interdisciplinary collaboration.

Anne has also travelled to China and India on Ontario government trade missions to foster better relations and built collaborative partnerships with institutions in these countries. She has served as a Director of several organizations, including the Ontario Society of Professional Engineers and the Association of Canadian Community Colleges, and has been a member of the Presidents' Council of the Engineering Alumni Association (Class of 7T7).

In late 2010, she was named one of the "Top 100 Most Powerful Women in Canada" – an honour bestowed upon the country's highest-achieving female leaders in the private, public and not-for-profit sectors.

Illustrations/Don Taylor

Faculty Awards & Accolades

Congratulations to all members of the Engineering community who received major recognitions from 2009 to 2011. Our Faculty remains at the forefront of education and research, both nationally and globally. Among Engineering faculties in Canada and abroad, our Faculty garnered some of the most prestigious awards in the country and the world, including those listed below:*

International Awards

1906 Award:
International Electrotechnical Commission
Alf Dolan

Acta Biomaterialia Gold Medal:
Society for Biomaterials
Michael Sefton ChemE 7T1

Arthur R. Anderson Medal:
American Concrete Institute
Doug Hooton CivE 7T4, MASc 7T5

Babcock-Hart Award:
Institute of Food Technologists
Levente Diosady
ChemE 6T6, MASc 6T8, PhD 7T2

Dennis Gabor Award:
NOVOFER Foundation
Warren Chan

Early Career Award:
IEEE Robotics and Automation Society
Yu Sun

Fellow:
American Association for the Advancement of Science
Stewart Aitchison; **Nasser Ashgriz**; **Will Cluett**; **Elizabeth Edwards**; **Bryan Karney**; **Javad Mostaghimi**; **Jun Nogami** EngSci 8T0; **J. Paul Santerre**; **Ted Sargent** ECE PhD 9T8; **Molly Shoichet**

American Oil Chemists Society
Levente Diosady
ChemE 6T6, MASc 6T8, PhD 7T2

Electrochemical Society
Roger Newman

Hungarian Academy of Engineering
Levente Diosady
ChemE 6T6, MASc 6T8, PhD 7T2

IEEE
Ted Sargent ECE PhD 9T8

Institute of Materials, Minerals and Mining
Hani Naguib
MechE PhD 0T1

Foreign Associate:
National Academy of Engineering
Edward Davison EngPhys 6T0; **Prabha Kundur** ElecE MASc 6T5, PhD 6T7; **Jonathan Rose** EngSci 8T0, ElecE MASc 8T2, PhD 8T6

H.A. Krentz Award:
Steel Structures Education Foundation
Jeffrey Packer

Maurice Wilkes Award:
Association for Computing Machinery
Andreas Moshovos

St. Lawrence Section Outstanding Teaching Award:
American Society for Engineering Education
Greg Evans
ChemE 8T2, MASc 8T4, PhD 8T9

Young Scientist Research Award:
American Oil Chemists Society
Edgar Acosta

National Awards

25 Transformational Canadians:
The Globe and Mail
Tom Chau
EngSci 9T2, ElecE MASc 9T4

A.G.L. McNaughton Gold Medal:
IEEE Canada
Alberto Leon-Garcia

Award for the Support of Women in the Engineering Profession:
Engineers Canada
Cristina Amon

Brockhouse Canada Prize:
NSERC
Sanjeev Chandra; **Thomas Coyle**; **Javad Mostaghimi**; **Valerian Pershin**

Camille Dagenais Award:
Canadian Society for Civil Engineering
Barry Adams

Canadian Pacific Railway Medal:
Engineering Institute of Canada
Mark Fox

Clara Benson Award:
Canadian Society for Chemistry
Molly Shoichet

C.N. Downing Award:
Canadian Society for Mechanical Engineering
Jean Zu

Excellence in Education Award:
Canada Mortgage and Housing Corporation
Kim Pressnail CivE 7T6, MASc 8T5, PhD 9T1; **Chris Kennedy**

Fellow:
Canadian Academy of Engineering
Barry Adams; **Cristina Amon**; **Stavros Argyropoulos**; **William Bawden**; **Michael Collins**; **Elizabeth Edwards**; **Bruce Francis** MechE 6T9, MEng 7T1, ElecE PhD 7T5; **Andrew Goldenberg** ElecE PhD 7T6; **Masahiro Kawaji** ChemE 7T8; **Javad Mostaghimi**; **Farid Najm**; **Chul Park**; **Jonathan Rose** EngSci 8T0, ElecE MASc 8T2, PhD 8T6; **Torstein Utigard** MMS MASc 8T3, PhD 8T6; **Willem Vanderburg**; **Safwat Zaky** CompE MASc 6T7, PhD 7T0; **David Zingg** EngSci 7T9, AeroE MASc 8T1, PhD 8T8; **Jean Zu**

Canadian Institute of Food Science and Technology
Levente Diosady
ChemE 6T6, MASc 6T8, PhD 7T2

Canadian Society for Mechanical Engineering
Markus Bussmann MechE 1T0; **Ridha Ben Mrad**; **Jan Spelt** MechE 7T9, MASc 8T0, PhD 8T5

Engineering Institute of Canada
D. Grant Allen ChemE 8T1, MASc 8T3; **Andrew Goldenberg** ElecE PhD 7T6; **Doug Hooton** CivE 7T4, MASc 7T5; **Shaker Meguid**; **Javad Mostaghimi**; **Konstantinos Plataniotis**; **Larry Seeley** ChemE 6T6, MASc 6T8, PhD 7T2

Royal Society of Canada
Stewart Aitchison; **George Eleftheriades**; **Harry Ruda**

G.H. Duggan Medal:
Canadian Society for Mechanical Engineering
Lidan You

Gold Medal Award:
Engineers Canada
Julie Payette CompE MASc 9T0

Gold Medal Student Award:
Engineers Canada
Jane Chui EngSci 1T0; **Mike Klassen** EngSci 1T0

I.W. Smith Award:
Canadian Society for Mechanical Engineering
Axel Guenther; **Aimy Bazylak**

Jules Stachiewicz Medal:
Canadian Society for Mechanical Engineering
Javad Mostaghimi

National Awards *continued*

Julia Levy Award:
Society of Chemical Industry
J. Paul Santerre

Julian C. Smith Medal:
Engineering Institute of Canada
Robert Andrews; **Chul Park**

Kalev Pugi Award:
Society of Chemical Industry
Elizabeth Edwards

Killam Research Fellowship:
Canada Council for the Arts
Frank Kschischang ElecE MASc 8T8, PhD 9T1; **Andreas Mandelis**

K.Y. Lo Medal:
Engineering Institute of Canada
Levente Diosady
ChemE 6T6, MASc 6T8, PhD 7T2

Medal for Distinction in Engineering Education:
Engineers Canada
Greg Evans
ChemE 8T2, MASc 8T4, PhD 8T9

Officer of the Order of Canada
Julie Payette CompE MASc 9T0

Outstanding Engineer Award:
IEEE Canada
Edward Davison EngPhys 6T0

Robert W. Angus Medal:
Canadian Society for Mechanical Engineering
Jim Smith

R.S. Jane Memorial Award:
Canadian Society for Chemical Engineering
Douglas Reeve
ChemE MASc 6T9, PhD 7T1

Sir John Kennedy Medal:
Engineering Institute of Canada
Gordon Slemon
ElecE 4T6, MASc 4T8

Synergy Award for Innovation (Large Company Category):
NSERC
Elizabeth Edwards

Top 40 under 40:
The Globe and Mail
John Poulos ElecE 9T7; **Som Seif** IndE 9T9

Willet G. Miller Medal:
Royal Society of Canada
R. Paul Young

Young Alumni Award:
McMaster Alumni Association
Milica Radisic

Young Engineer Achievement Award:
Engineers Canada
Constantin Christopoulos

Regional Awards – Provincial and City-wide

OCUFA Teaching Award:
Ontario Confederation of University Faculty Associations
Susan McCahan

Order of Ontario:
Government of Ontario
Levente Diosady ChemE 6T6, MASc 6T8, PhD 7T2; **Paul Godfrey** ChemE 6T2; **Molly Shoichet**

Ontario Professional Engineers Award:
Engineering Excellence
Stephen Armstrong; **Deborah Goodings** CivE 7T5

Ontario Professional Engineers Award:
Entrepreneurship
Andrew Goldenberg ElecE PhD 7T6; **Joseph C. Paradi** ChemE 6T5, MASc 6T6, PhD 7T5

Ontario Professional Engineers Award:
Research and Development
Jeffrey Packer

Ontario Professional Engineers Award:
Young Engineer
Mansoor Barati

Woman of Distinction:
YWCA Toronto
Cristina Amon

U of T Awards

Arbor Award:
John Barrie Blanshard CivE 5T3; **Michael Branch** CompE 0T3; **Jim Burgess** CivE 5T6; **Anton Davies** MechE 7T2, MASc 7T4, PhD 7T7; **Byron (Ike) Goodfellow** ElecE 5T3, MASc 5T4; **Betty Hill** ChemE 4T8; **Margaret Kende** CivE 6T0; **Derek Little** CivE 5T3; **Orlando Martini** CivE 5T6, MASc 6T8; **Michael May** ChemE 9T1, PhD 9T8; **Alec Monro** ChemE 5T9; **Sandra Odendahl** ChemE MASc 9T0; **Fabian Papa** CivE 9T5, MASc 9T7; **H. Ross Pitman** GeoE 7T4; **David Frederick Poirier** IndE 8T1; **Donovon Pollitt** MinE 0T4; **Randy Sinukoff** ChemE 8T2, MASc 8T4; **Mathew Szeto** CompE 0T4; **Robert West** ChemE 8T1; **Helen Wojcinski** CivE 8T7

Faculty Award:
Frank Kschischang
ElecE MASc 8T8, PhD 9T1

Inventor of the Year Award:
Constantin Christopoulos; **Yu Sun**

McLean Award:
Baochun Li; **Yu Sun**

Vivek Goel Faculty Citizenship Award:
Safwat Zaky CompE MASc 6T7, PhD 7T0

Stepping Up: Individual:
Renzo Bassett CivE 8T0, MASc 8T3

Stepping Up: Group
Linda Espeut ECE; **Susan Grant** ECE; **Leslie Grife** Office of the Registrar; **Lesley Mak** Office of the Registrar; **Liam Mitchell** ChemE; **Shannon Osborne** IndE 0T6, MIE; **Austra Ozolins** ECE; **Nisha Panchal** Engineering Career Centre; **Deborah Peart** ChemE; **Rosanna Reid** ECE; **Sarah Steed** EngSci; **Rosemary Tersigni** ECE

University of Toronto Engineering Awards

Agnes Kaneko Citizenship Award:
2010 – **Joe Baptista** MIE
2011 – **John MacDonald** CivE

Early Career Teaching Award:
2010 – **Glenn Hibbard** MSE PhD 0T2
2011 – **Sean Hum**

Emerging Leader Award:
2010 – **Helen Bright**, Office of the Registrar
2011 – **Ryan Mendell** MIE

Faculty Teaching Award:
2010 – **Ali Sheikholeslami**
ECE MASc 9T4, PhD 0T0
2011 – **Jim Wallace**

Influential Leader Award:
2010 – **Arlene Smith** ChemE
2011 – **Nelly Pietropaolo** CivE

Innovation Award:
2010 – ChemE: **Joan Chen**, **Pauline Martini**, **Liam Mitchell** and **Deborah Peart**
2011 – ECE/Dean's Office: **Bruno Korst**, **Steve Miszuk** and **Joe Wong**

McCharles Prize for Early Career Research:
2010 – **Craig Simmons** MechE PhD 0T0
2011 – **Sean Hum**

Quality of Student Experience Award:
2010 – **Pierina Filippone**, Office of the Registrar
2011 – **Leslie Mak**, First Year Office and **Annie Simpson**, Institute for Leadership in Engineering

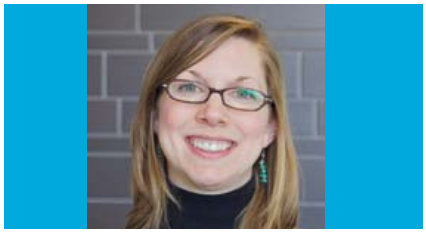
For a full list of Faculty Awards & Accolades, please visit* **www.engineering.utoronto.ca

2011 Gordon Cressy Student Leadership Awards

Just as it may take a village to raise a child, it takes outstanding students to make a Faculty great. Recently, the University of Toronto recognized 18 U of T Engineering students with the 2011 Gordon Cressy Student Leadership Awards for their outstanding extra-curricular contributions to improving the University's community. The following is a sampling of the rising stars that have done Skule™ proud.

Shahed Al-Haque EngSci 1T1

Shahed launched a student group named Tetra, designed to help build assistive devices for people with disabilities, and co-led NSight, a mentorship program developed to improve the quality of student experience in the first-year Engineering Science program. As a member of Leaders of Tomorrow, he helped his peers develop leadership skills and empowered them to create positive change in their community.

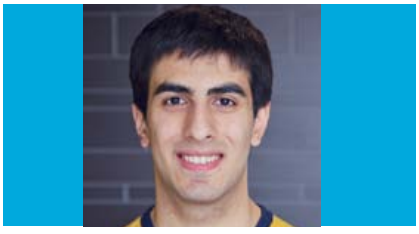


Maygan McGuire ChemE PhD 1T1

Maygan served on the Dean's Task Force on Engineering Leadership Education where she participated in discussions and assisted in the preparation of a report that contained a list of recommendations. Her most lasting contribution was the conception of a scholarly journal the *Engineering Leadership Review (ELR)* that reflects on and cultivates engineering leadership.

Evelyn Mukwedeya EngSci 1T1

As a member of the National Society of Black Engineers, Evelyn contributed to building a support network among U of T's black engineering students and alumni. She started a bi-monthly club newsletter for Women in Science and Engineering, and successfully encouraged members to become active leaders in the club. Beyond U of T, Evelyn has enjoyed volunteering as a cultural performer at various fundraising events while highlighting the importance of youth sharing their unique cultures.



Arian Omidzohour ElecE 1T1

Arian revolutionized the University of Toronto Robotics Association's (UTRA) vision to become more student focused. This newly adopted culture has increased participation and involvement of engineering undergraduates and put UTRA as a top Canadian Robotics contender. As Chair for the ECE Leaders of Tomorrow Working Group, he was able to encourage students to further develop their leadership and networking skills.

Chris Siemieniuch MechE 1T1

As Co-Chair of the Mechanical Engineering Club, Chris helped initiate leadership and professional development seminars, and organized academic, social and networking events for students. He served on numerous committees such as Leaders of Tomorrow and acted as Student Ambassador for the Mechanical & Industrial Engineering department.

Katelin "Cyrene" Wu CivE 1T1

With a deep affinity for Skule™ and its community, Cyrene has participated in many extra-curricular activities. She served as the Vice-President of Finance for the Engineering Society and Co-Chair of the National Conference on Women in Engineering. Cyrene also founded the Toronto Swift Women's Volleyball team, organized events such as Gradball and Cannonball and led numerous sports-related initiatives.

To read more about all 18 engineering recipients of the 2011 Gordon Cressy Student Leadership Awards, visit:
www.engineering.utoronto.ca/Page1683.aspx

Biz Skule™

A Fresh Take on Business Networking

Where can you find leading entrepreneurs, advisors, investors and managers in one room? At Biz Skule™: A new and exciting initiative by the Engineering Alumni Association, the event lets Engineering alums network, mingle and learn from the best in the business.

Why Biz Skule™ Matters

"Having become an entrepreneur a few years out of school, I was starting to feel very disconnected from the engineering community, so Biz Skule™ was the cure for me. I was happy to be part of the first Biz Skule™ event and found myself looking forward to the upcoming sessions. Overall, I have found all the events to be inspiring, thought-provoking and exactly what I need. The ability to connect with other successful engineers and obtain tips and insights from the incredible speakers leaves me with the belief that I belong to a great community that supports innovation and drives great change."

Bailey Vaez (IndE 0T5), founder and CEO of Proactive Movement

"Biz Skule™ has become a very important networking opportunity for me, as it is a great place to connect with fellow entrepreneurs and business professionals. I always learn something new from the speakers, and meeting new people in interesting businesses is awesome as well. Biz Skule™ has also allowed me to leverage these events into further meetings with business leaders in our community. The events are a must-attend for Skule™ types to learn, meet and enhance careers."

Arun Channan (CivE 8T0), President of myndwerx

"I have enjoyed three Biz Skule™ events so far. The concept for networking combined with success stories of other Skule™ graduates is both enlightening and encouraging. Also, the contact with faculty and engineering students is a learning experience not to be missed. I would encourage any alumnus or alumna to attend and reap the benefits at these events."

Mark Hinchcliffe (ChemE 6T9), Director of Hennessey & Hinchcliffe Inc.

PENCIL IT IN! SEPT. 28

On Wed., Sept. 28, Biz Skule™ is proud to welcome **Erol Uzumeri** (IndE 9T2), the co-founder of Searchlight Capital Partners. Learn how Erol helped turn the global private equity investment firm into a worldwide success, with offices in London, New York and Toronto.

Recent Headliners

Michael Serbinis
(IndE MASc 0T1)
April 2011
CEO
Kobo eReader

Som Seif
(IndE 9T9)
September 2010
President
Guggenheim/Claymore Investments, Inc.

Hana Zalzal
(CivE 8T8)
April 2010
Founder, President & CEO
CARGO Cosmetics Corp.

Anthony Lacavera
(CompE 9T7)
September 2009
Chairman and CEO, Globalive Communications Inc.

The New Biz Minor & Certificate: A Fresh Take on Business Education

U of T Engineering wants to mix business education with an engineering degree.

That's why the Faculty is launching an Engineering Business minor and certificate in fall 2011.

A powerful collaboration between the Faculty of Applied Science & Engineering and the Rotman School of Management, the initiative will give engineering students exposure to the key concepts and skills they need to move across the technology-business border, while also enabling them to better contribute to the economy.

"We think there's going to be a huge demand for engineering students with business skills," says **Bryan Karney**, Associate Dean of the Cross-Disciplinary Programs office.

"And that view is supported by our alumni. We think this is going to be a distinguishing feature in a significant way, in terms of getting jobs, and we also think it's going to be a big help if someone wants to get an MBA down the road. The bottom line is that our engineering students will be better educated about business."

Professor **Jonathan Rose** (EngSci 8T0, ElecE MASc 8T2, PhD 8T6), the new Program Director, agrees. "Students will be able to engage in the strategic business thinking that goes on, and bring much more to the table when combined with their technological and scientific acumen."

The Engineering Business minor is made up of six semester-long courses, an engineering economics core course and three joint Rotman Engineering core courses – all of which touch on key business concepts, such as strategy and marketing, accounting and entrepreneurship.

"We don't want to create business people with a bit of engineering background," says Karney. "We want to create engineers who are brilliant business people."

Along with the Engineering Business minor and certificate, U of T Engineering is also proud to launch a new Global Engineering certificate in fall 2011, through which students will be able to enhance their knowledge of global issues.

DEPARTMENT OF CHEMICAL ENGINEERING & APPLIED CHEMISTRY

Allen Named Department Chair

Professor D. Grant Allen (ChemE 8T1, MASc 8T3)

Chemical Engineering Professor **D. Grant Allen** (ChemE 8T1, MASc 8T3) has been appointed the new Chair of the Department of Chemical Engineering & Applied Chemistry. He succeeds Professor **Douglas W. Reeve** (ChemE MASc 6T9, PhD 7T1), who has served as Chair since 2001.

"I am very honoured to have the opportunity to further support the success and growth of our Department," said Allen. "Doug Reeve has ensured we are on a strong upward trajectory as evidenced by our recent external review and our ranking as number one in Canada and number 14 in the world according to the inaugural *QS World University Rankings* for Chemical Engineering. I look forward to continuing this forward momentum."

A proud Skule™ alumnus, Allen obtained his bachelor's degree from the Department in 1981. He completed his master's degree, conducting research on the development of an insulin micropump for diabetics under the supervision of University Professor **Michael Sefton** (ChemE 7T1). He went on to complete his PhD at the University of Waterloo, where he worked on transport phenomena in bioreactors that produce microorganisms used in a wide range of pharmaceuticals and industrial biochemicals.

As a researcher, Allen is an international leader in the treatment of wastewater and waste gases utilizing microbiological processes. More recently, he has been focusing on value-added products (i.e., energy or biopolymers) produced through biological processes from waste.

In addition to his research and teaching, he has been serving as the Faculty's Vice-Dean of Undergraduate Studies since 2007. He has previously served as the Associate Director and Director of the Pulp and Paper Centre from 1988 to 2001 and 2001 to 2003, respectively. From 2003 to 2007, he was the Department's Associate Chair (Graduate).

Allen's contributions to engineering and science have been widely recognized. He is a fellow of the American Association for the Advancement of Science (AAAS), the Engineering Institute of Canada (EIC) and Chemical Institute of Canada (FCIC). In 2007, he was recognized for his teaching excellence with the Chemical Engineering Teacher of the Year Award. He also has a long record of service to the Canadian Society for Chemical Engineering (CSChE). He served as President from 2008 to 2009, during which the CSChE was the host to the 8th World Congress of Chemical Engineering.

Allen begins his five year-term on July 1.

Wallberg Building Expanding with BioZone

The Wallberg Building – home to Chemical Engineering – is being transformed to create additional space for BioZone, an exciting new centre for collaborative bioengineering research.

Led by Chemical Engineering Professor **Elizabeth Edwards**, as founding Director, BioZone is home to nine professors and their multidisciplinary research teams, who bring their varied expertise to investigate important environmental and health issues through the application of cutting-edge biotechnology.

To house BioZone's 136 researchers and students, laboratories on the third floor have been consolidated and renovated. Construction has also begun on the roof of the Wallberg Building to add new laboratories that will house Professors **Alexander Yakunin** and **Alexei Savchenko**, who are cross-appointed with the Banting and Best Department of Medical Research. Their work in structural proteomics and enzyme genomics will broaden the research conducted within BioZone and provide researchers with access to sophisticated technology and equipment.

BioZone has attracted more than $40 million in funding to date, including federal and provincial grants for renovation, construction and equipment purchases.

DEPARTMENT OF CIVIL ENGINEERING

Sky Garden: An Urban Oasis

PhD candidates Sarah Wilson, Kyla Smith and Heather Wray

Deep in the heart of downtown Toronto is an oasis of urban space reclamation and the city's most productive green roof. The Sky Garden is an initiative borne out of the work of Civil Engineering graduate students studying novel ways to purify water. Using a system of partially hydroponic growing containers sponsored by a City of Toronto grant and Canadian agriculture company, BioTop, the garden grew more than 200 kilograms of fresh, local and organic produce for area food banks, student cafes and volunteer kitchens this year.

The garden attracted volunteers from across U of T, and is currently expanding.

Your Tax Dollars at Work: Our Research in the News

Professor **Doug Hooton**'s (CivE 7T4, MASc 7T5) research into alkali-silica reactions will save the Government of Ontario's Ministry of Transportation an estimated $72 million over the life of its 1,800 concrete bridges.

The Ministry of Transportation calculates that implementation of the changed concrete standards can add one extra year of bridge life before rehabilitation or replacement occurs – at a savings of $40,000 per structure.

The government initially invested $29,000 into the research project, a payback of more than 2,400%.

Professor Hooton is the NSERC/CAC Senior Industrial Research Chair in Concrete Durability and Sustainability at the University of Toronto.

Peter Halsall Spearheads Gull Lake Camp's Sustainable Curriculum

Peter Halsall (CivE 7T7, MASc 8T0), President of Halsall Associates, has built his career on the active pursuit of sustainable engineering. This year, he made a significant donation to Civil Engineering's Gull Lake Camp as part of an exciting new sustainability-themed curriculum to be delivered to students starting next academic year.

The funds will be used to secure the participation of outstanding thought-leaders to establish, promote and strengthen environmentally and sustainability-focused programming for the camp.

Areas of interest include sustainable forest management, sustainable building design, environmental awareness and cradle-to-cradle engineering, which aims to view all engineering activities in terms of a total life cycle impact.

The enhanced curricular initiatives will complement the current redevelopment of the camp's facilities and plans.

Construction Nears Completion at Lassonde Mining Building

The Lassonde Mining Building, home to the Lassonde Mineral Engineering Program and the Lassonde Institute for Mining, as well as housing space for classes and research in the Department of Civil Engineering, will soon be expanded.

Funded jointly by the Government of Canada, Pierre Lassonde, Goldcorp Inc. and U of T, the Centre for Innovation in the Canadian Mining Industry and the Goldcorp Mining Innovation Suite will boast research space for new graduate students, an interdisciplinary under-graduate design studio and high-tech, low-energy conference space.

The building will serve not only as a model for urban space reclamation, but for the possibilities that innovative, environmentally friendly retrofits hold for heritage structures.

The latest in green-building techniques are being incorporated into the retrofit, championed by Civil Engineering expertise. The project will apply for LEED certification once completed.

Lassonde Mining Building

THE EDWARD S. ROGERS SR. DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

ECE's First Alumni Networking Event

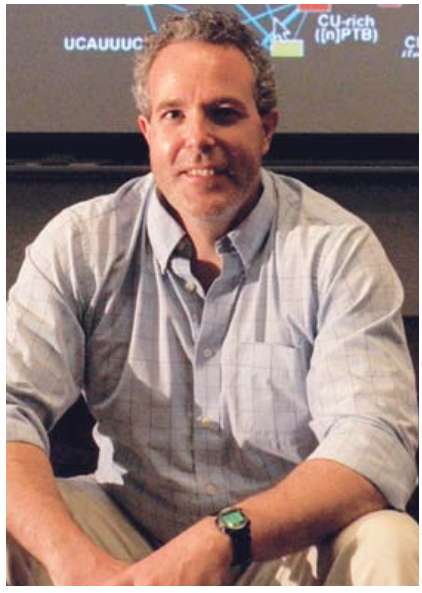
Electrical and Computer Engineering held its first alumni networking reception in November, in response to feedback from the summer 2010 survey. In the alumni survey, the overwhelming request was for short lectures describing new ECE technology and applications.

Professor **Brendan Frey** (ECE PhD 9T7) discussed how tools developed in ECE led to his team's groundbreaking deciphering of the human super-genetic code. Following the lecture, there was a networking reception where alumni had a chance to catch up with classmates, meet new ones and connect with ECE professors.

You can also learn more about ECE alumni events at: **www.ece.utoronto.ca**

Anahita Panthaky 1T0 and Gin Jang 7T1

Kia Puhm 9T5 talks with ECE Professor Ali Sheikholeslami (ECE MASc 9T4, PhD 0T0)



Photo/Keith Beaty/Toronto Star

Professor Brendan Frey (ECE PhD 9T7)

ECE Student & Alumni Awards

Vincent Cheung

Vincent Cheung (ECE PhD candidate) was named Global Graduate Student Entrepreneur of the Year at the 2010 Global Student Entrepreneur Awards (GSEA). The competition focuses on students taking a full course load of classes while running a revenue-generating business.

Cheung is the owner and creator of Shape Collage Inc., a digital media software company that automatically arranges photos into a collage, in any form. With the help of U of T's Innovations and Partnerships Office, he is in the process of obtaining a patent for his work.

Sujoy Ghosh Hajra (CompE 0T7 + PEY) – a systems analyst with the National Research Council's Institute for Biodiagnostics – was awarded the 2010 IT Rookie Award by IT World Canada. Hajra was recognized for his role in building the organization's IT infrastructure capacity.

Also, **Eric Wan** (CompE 1T0), another one of the Department's many talented former students, is the winner of the Alumni Centennial Thesis Award. He was cited for his demonstration of courage and perseverance in the face of adversity. Wan, a quadriplegic since age 18, helped to develop software that lets people living with paralysis experience the joy of playing music.

Faculty Awards

Professor **Ted Sargent** (ECE PhD 9T8) has been elected a Fellow of the Institute of Electrical and Electronics Engineers (IEEE) for contributions to colloidal quantum dots optoelectronic devices. Each year, the IEEE Fellow Committee recommends a select group of recipients for one of the association's most prestigious honours – an elevation to IEEE Fellow. IEEE is the world's largest professional association for the advancement of technology.

Professor **Frank Kschischang** (ElecE MASc 8T8, PhD 9T1) was awarded a Killam Research Fellowship. Kschischang's research develops approaches that improve transmission rate and reliability of communications through wireless relay networks and fibre-optic communications channels. A significant focus for his study is on self-organizing radio networks, which can be useful in public safety and disaster recovery efforts.

University Professor Emeritus **Ted Davison** has been elected a Foreign Associate of the National Academy of Engineering (NAE). The NAE provides engineering leadership in service to the U.S. and globally. Members and Foreign Associates of the NAE rank among the world's most accomplished engineers. Davison also received the IEEE CANADA 2010 Outstanding Engineer Award.

DIVISION OF ENGINEERING SCIENCE

EngSci Receives Global Recognition for Sustainable Education and Design

Alexandra Heeney

Alexandra Heeney (EngSci 1T1) visited Delft, Holland in October 2010 to present a paper at the European Roundtable on Sustainable Consumption and Production and Environmental Management for Sustainable Universities. The conference brings together academics and industry members from each continent to share ideas about sustainability in education and design. Heeney's presentation discussed integrating design for sustainability into existing first-year design courses – an initiative she is working on with **Jason Foster**, Senior Lecturer in the Division of Engineering Science.

During the conference, participants lauded EngSci's leadership. "EngSci students must consciously decide what to consider within the scope of their first-year design activities in Praxis. Because of this, Engineering Science at U of T is seen as a world leader in sustainable education and design," said Heeney.

"EngScis are challenged very early on to balance environmental, economic and social considerations within their design activities." Next year, Heeney will further investigate quantitative methods for balancing these considerations in her doctoral studies. For her paper, or more information on the conference, visit **www.alexandraheeney.com**

> "Engineering Science at U of T is seen as a world leader in sustainable education and design." *Alexandra Heeney, EngSci 1T1*

UTERN Turns Sustainability Up A Notch

Megan Lund

The University of Toronto Environmental Resource Network (UTERN) is a campus levy group dedicated to increasing environmental programming on campus through funding and networking opportunities. **Megan Lund** (EngSci 1T1 + PEY) got involved through UTERN's Environmental Working Groups and went on to become the club's internal liaison, and now, President. As President of UTERN, she oversees the group's events fund, the establishment of a new Environmental Resource Centre for students, and the continuation of networking and skill development initiatives, including UTERN's partnership with Student Life for the Sustainable Leadership Program. Lund believes that future generations have rights, and it is the duty of Skule™ engineers to protect those rights.

Through her position with UTERN, her PEY placement with Toronto Hydro and the forward-looking curriculum offered to her through EngSci's Energy Systems Option, she has seen how engineers – along with those in other professions – can affect the environment on a daily basis.

> Lund believes that future generations have rights, and it is the duty of Skule™ engineers to protect those rights.

New Option in Engineering Mathematics, Statistics and Finance

In September 2010, EngSci welcomed 31 Year 3 students into its new Engineering Mathematics, Statistics and Finance Option – the first undergraduate program of its kind in Canada. Created in response to student demand, this new Option provides graduates with a competitive advantage in the marketplace. With a quantitative/engineering background, graduates are equipped to apply their skills across many different fields, including engineering consulting, government, energy, mining, insurance, banking, aerospace and manufacturing.

Faculty members from the Department of Mechanical & Industrial Engineering lead the new Option in cooperation with the Department of Statistics, Department of Mathematics and the Rotman School of Management.

DIVISION OF ENVIRONMENTAL ENGINEERING & ENERGY SYSTEMS

The Water-Energy Nexus

Photo/Bryan Karney

Near Minden, ON, Canada

When you think of two things that naturally fit together, what comes to mind? If you are Forrest Gump, you might think of peas and carrots. If you are hungry and conventional, you might think of meat and mashed potatoes. If you are ready to escape a long Canadian winter, you might think of the beach, of sun and sand. But if you are thinking about big challenges, and big threats, and those topics that are likely to dominate humanity over this century, you might think of water and energy. This coming together, sometimes termed, the water-energy nexus, creates a congruency that is worth attending.

In the natural system, the Earth as seen from space, is visually dominated by water in three phases, from the blue of the oceans, to the white of the poles and clouds. This water, along with its transformation between these phases, is one of the key planetary energy carriers. Kinetic energy associated with water in motion, thermal energy as water warms and cools, latent energy as water changes phase – water energy is everywhere and continuously bringing and moderating change. Whether as the Gulf Stream that warms Europe, floods that can wash out whole communities, and cyclones that bring dramatic and sometimes catastrophic change, the water-energy concept underpins any realistic assessment of sustainability.

From an engineering perspective, too, the water-energy nexus is crucial.

Whether engineers use water to generate electrical power from waves, tides, currents or river flows, or to cool thermal power systems, or to transport other energy carriers, or to manufacture components, water and energy are inseparable. This is also true at the level of demand, from treatment, pumping, to use of disposal, it invariably involves large quantities of energy. The water-energy nexus is a fascinating, perplexing and often neglected set of interactions that we celebrate and enhance to our benefit, neglect to our loss, exploit to our profit and abuse to our peril. It is a topic that touches almost all of engineering, either directly or indirectly, and needs to feature in courses and research even as it already does in our lives.

Professor Bryan Karney (CivE)
Chair, Division of Environmental Engineering & Energy Systems and Associate Dean, Cross-Disciplinary Programs

> "The water-energy nexus is a fascinating, perplexing and often neglected set of interactions that we celebrate and enhance to our benefit, neglect to our loss, exploit to our profit and abuse to our peril."

INSTITUTE OF BIOMATERIALS & BIOMEDICAL ENGINEERING

Groundbreaking Discoveries

In the area of Biomaterials-Tissue Engineering and Regenerative Medicine, our researchers are at the forefront in Canada.

In 2010, the research teams of Professor **Peter Zandstra** and Professor **Milica Radisic** were named by the *Toronto Star* as "People to Watch" for their innovative work in tissue engineering.

Both Professor Zandstra, CRC Tier 1 Research Chair, and Professor Radisic, a "Scientist to Watch," according to *The Scientist*, are investigating the use of stem cells to repair injured heart tissue in diabetes and heart attack patients. As their efforts progress in 2011, it won't be long until their tissue engineering research will have a significant, lasting impact on the health of Canadians.

Photo/Richard Lautens/Toronto Star

Professors Peter Zandstra and Milica Radisic

More great news for tissue engineering programs was announced in December 2010 with the awarding of a $15 million investment from the Canadian Government and an equivalent industry partner match for a Centre of Excellence for Commercialization and Research. Led by Professor Zandstra, the centre will focus on the commercialization of regenerative medicine technologies.

IBBME Celebrates 25th Anniversary of Master's in Clinical Engineering

Institute of Biomaterials & Biomedical Engineering
UNIVERSITY OF TORONTO

CELEBRATING
25 YEARS
OF EXCELLENCE IN
CLINICAL ENGINEERING!

We provide U of T and its Toronto affiliated clinical partner institutions with programs that result in internationally recognized research in the biomedical field.

Putting students first is topmost on IBBME's agenda. And this was celebrated this year with the Institute's 25th Anniversary of our flagship Master's in Clinical Engineering program.

Leading the way is CRC Chair in Pediatric Rehabilitation Engineering, Professor **Tom Chau** (EngSci 9T2, ElecE MASc 9T4), who has been endlessly dedicated to enhancing the graduate student experience.

Photo/Paul Stoloff

From left: Professor Tom Chau and Eric Wan (centre)

This year, Professor Chau welcomed **Eric Wan** (CompE 1T0) to his lab, a member of IBBME's collaborative graduate program with The Edward S. Rogers Sr. Department of Electrical & Computer Engineering. At age 18, Wan was diagnosed with transverse myelitis, leaving him paralyzed from the shoulder down. The duo's research, on intelligent computer systems for pediatric rehabilitation, led to an international da Vinci Award.

Photo/Nathan Denette/Canadian Press

Professor Warren Chan

World-Class Researchers

IBBME faculty members generated an astounding $16.1 million in research activity in the 2009-2010 academic year. Its researchers have been recognized on both the national and international stage, capturing more than 35 awards of recognition, including the prestigious 2009 International Dennis Gabor Award to Professor **Warren Chan**, by the NOVOFER Foundation for Technical and Intellectual Creation.

IBBME's success in biomedical engineering was further recognized with the awarding of research chairs to Assistant Professor **Anthony Easty**, recipient of the Baxter Chair in Health Technology, as well as Associate Professor **Alex Mihailidis** (MechE 9T6, BME MASc 9T8), recipient of the Barbara G. Stymiest Chair in Rehabilitation Technology Research. Professor Mihailidis is also the incoming Coordinator for the Clinical Engineering MHSc program on July 1.

IBBME has also started off 2011 in a very big way – with the announcement that University Professor **Michael Sefton** (ChemE 7T1), as well as Professors Shana Kelley and Gang Zeng have received approximately $6.5 million in funding from the Canadian Institutes of Health Research (CIHR).

DEPARTMENT OF MECHANICAL & INDUSTRIAL ENGINEERING

Industrial Engineering Celebrates 50 Years

From the factory floor to the offices of consulting firms, hospitals, banks and telecommunications companies, industrial engineers have come a long way.

This year, the Department of Mechanical & Industrial Engineering is celebrating 50 years of industrial engineering at U of T, a program that was the first of its kind in Canada, and one of the earliest in North America.

Industrial Engineering Professor **Michael Carter** is spearheading anniversary planning in hopes of shedding light on the Department's rich history, as well as showcasing alumni success.

"I want to make industrial engineers aware of the history, and it's an opportunity to talk about what we do," said Carter. "I think we have a very colourful history, and I don't think many are aware of it, or the accomplishments of our graduates."

Part of that colourful history is the two figures that ran the program at U of T for the first twenty years: Professors **Arthur Porter** and **Ben Bernholtz**. Porter, a worldwide ambassador of industrial engineering, was a recipient of the Order of Canada. Bernholtz's accomplishments are equally notable: he pioneered much of the work that industrial engineers do in health care, and mentored some of our current leaders in the health care industry.

The 50th anniversary celebration began with a series of monthly seminars sponsored by Canadian Tire, and will culminate with a one-day symposium and dinner in September 2011.

For more information, please visit: **www.mie.utoronto.ca/IE50th** or contact **ie50@mie.utoronto.ca**

New Faculty

Assistant Professor **Timothy C. Y. Chan** develops advanced mathematical techniques to solve complex problems in health care such as designing radiation therapy-based cancer treatments, scheduling outpatient clinics and optimizing the locations of public access defibrillators. His research team is based in the Applied Optimization Lab.

Assistant Professor **Birsen Donmez** is a human factors researcher, delving into issues surrounding human adaptation to technology and designing feedback for guiding operator behaviour in complex socio-technical systems, such as surface transportation, mining operations and health care.

New MIE Capstone Design in Need of Industry Participation

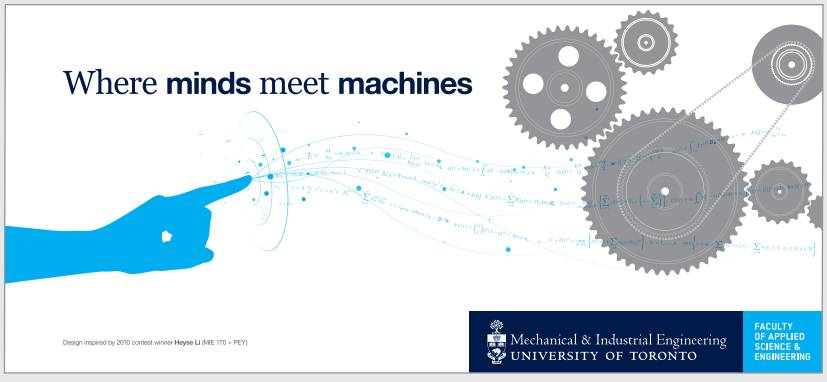
Undergraduates are getting the chance to work closely with some of the industry's biggest names. This fall, the Department launched a capstone design course (MIE490), which combines engineering practice and design with hands-on experience in the workforce.

Through a series of networking events, industrial engineering students paired up with companies to work on specific design-oriented projects. The collaboration yields two principal benefits: students get the opportunity to apply their skills and knowledge to real-life projects and make connections within the industry, while clients get the opportunity to improve their business by working with students who are at the forefront of engineering practices. The Department will launch a Mechanical Engineering capstone design in fall 2011.

For more information on how your company can partner with capstone design, go to: **www.mie.utoronto.ca/industry/capstone** or email **capstone@mie.utoronto.ca**

MIE Debuts Banner

Inspired by banner contest winner, **Heyse Li** (IndE 1T0 + PEY), the first MIE building banner was installed on the front façade of the Mechanical Building at 5 King's College Road this past October.



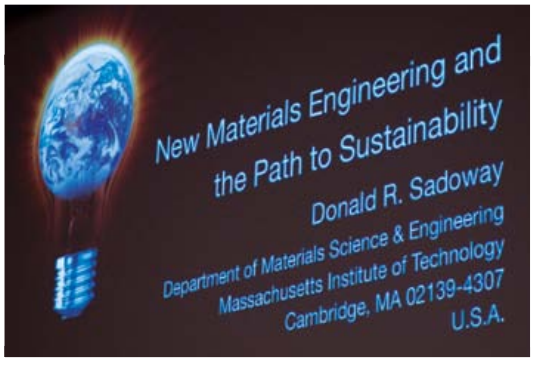
DEPARTMENT OF MATERIALS SCIENCE & ENGINEERING

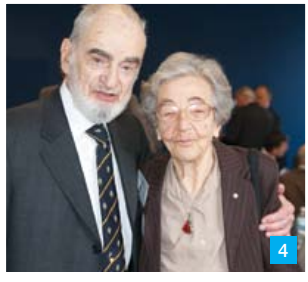
1st Annual Winegard Visiting Lectureship in New Materials Engineering

In Fall 2010, alumni, students, faculty and staff gathered for the inaugural Winegard Visiting Lectureship. Featuring renowned materials scientist, MIT Professor **Donald R. Sadoway** (EngSci 7T2, MMS MASc 7T3, PhD 7T7) as the keynote speaker, topics included *New Materials Engineering & the Path to Sustainability* and *Reinvigorating Engineering Education by Innovation in the Core Science Subjects.*

This lectureship is made possible through the support of The Honourable Dr. **William C. Winegard** (MMS 4T9, MASc 5T0, PhD 5T2). Held annually, the event is designed to encourage professional interaction between students, professors, researchers, alumni and industry associates of the Department with a recognized leader in the field.

"This event is an important opportunity to bring inspirational speakers in to meet our students and faculty," said Professor **Jun Nogami** (EngSci 8T0), Chair of Materials Science & Engineering. "It was great to see the tremendous attendance from our alumni, and I know that Bill Winegard was gratified to see so many of his former students."





1 Dr. Walter Curlook and Professor Donald R. Sadoway; 2 The Honourable Dr. William C. Winegard; 3 Alumna Dr. Mary Ruggiero and Professor Emeritus Bangalore Ramaswami; 4 Alumnus Ted Gerson and University Professor Emerita Ursula Franklin; 5 Alumni Dr. Donald Mills and Dr. Allan Kupcis; 6 Professor Emeritus Alex McLean and Alumnus Dr. Alfred Kucharski; 7 Alumni George Valenta and Martin Gagné; and 8 Professor Jun Nogami, Chair

Photos/Maloney Aguirre, photographica

Be sure to check out *IMPACT*, MSE's new alumni + industry magazine. Find out more about our impact on sustainability through the latest in advanced materials research and education, and the people who make it all happen. To read the debut issue, visit **www.mse.utoronto.ca**

UNIVERSITY OF TORONTO INSTITUTE FOR AEROSPACE STUDIES

Message from Director David Zingg

Climate change is an enormous challenge faced by all inhabitants of planet Earth. Engineers will have to play a major role in reducing anthropogenic greenhouse gas emissions. Aviation's contribution is not huge, but it is significant and growing. The combined effect of carbon dioxide and nitrogen oxide emissions from aircraft as well as contrails is estimated to cause roughly 5% of all anthropogenic contributions to global warming.

The International Civil Aviation Organization has set a goal to reduce total carbon dioxide emissions from civil aviation by 50% by 2050, even accounting for the expected growth in demand for air transport. This is a stiff challenge that will require extensive research in a broad range of areas. Important topics include unconventional aircraft configurations with improved fuel efficiency, drag reduction technology, such as flow control, weight reduction concepts, such as lightweight multifunctional materials, low emissions combustors, and biofuels.

UTIAS has made such research the major focus of its strategic research plan, complementing our space-related activities such as microsatellites and space robotics. We currently have nine Professors whose research is related to this important challenge, which requires an interdisciplinary and systems-based approach. This places UTIAS in a unique position to be a global centre of excellence in research toward reducing the environmental impact of aviation.

Professor David Zingg
Canada Research Chair in Computational Aerodynamics and Environmentally Friendly Aircraft Design

Notable Mentions 2010

International media embraced the achievement of PhD candidate **Todd Reichert** (EngSci 0T5) who, under the supervision of Professor Emeritus **James DeLaurier** and with the help of **Cameron Robertson** (AeroE MASc 0T9), made aviation history with the first human-powered ornithopter flight.

Professor **Philippe Lavoie** won an Early Researcher Award for his research in fluid mechanics and flow control. The implementation of active flow control technology has the potential to greatly reduce harmful emissions and running costs in a wide range of transport systems, especially civil aviation.

The UTIAS Space Flight Laboratory launched AISSat-1, a seven-kilogram satellite used to detect ships in Norwegian waters. Built for the Government of Norway, it is one of the first "nanosatellites" in the world to have inertial pointing control.

Photo/Mike Campbell

The human-powered ornithopter in flight

The UTIAS SFL also received its second Alouette Award, this time for the highly successful CanX-2 nanosatellite mission.

There were headlines across Canada when the Canadian Air and Space Pioneer Award was presented to the UTIAS team who helped to bring the Apollo 13 mission safely back to earth 40 years ago. In response to the award, the Hon. Ken Dryden read a Standing Order 31 in Parliament, which recognized the achievements of the team and of UTIAS.

2nd UTIAS-MITACS International Workshop on Aviation and Climate Change

Professors **David Zingg** (EngSci 7T9, AeroE MASc 8T1, PhD 8T8) and **Joaquim Martins** hosted the second International Workshop on Aviation and Climate Change at UTIAS in May 2010. The invitation-only event brought together some of the world's leading experts from Bombardier Aerospace, NASA, NASA/GE, Shell International Petroleum, the FAA, the IATA, the ICAO, DLR, MIT, Purdue University, University of Michigan, and Pratt & Whitney. The purpose was to exchange ideas, establish research priorities, and identify opportunities for collaboration. For further information on this workshop, please visit: **oddjob.utias.utoronto.ca/~IWACC2/IWACC2/About.html**

Skule™ Events Calendar

Gull Lake Survey Camp Reunion
Sat., Sept. 17, 2011

If you are a Civil, Geological or Mineral Engineering graduate, we invite you to come back to Survey Camp for the day. Enjoy a delicious lunch and relax by the dock, tour the historic facilities, walk the trails and reunite with old friends. For details, contact: Colin Anderson, **colin@civ.utoronto.ca** or visit **www.civ.utoronto.ca**

Biz Skule™ – Special Guest, Erol Uzumeri
Wed., Sept. 28, 2011

Do you have a professional interest in business and entrepreneurship? Join us at the next Biz Skule™ networking event, featuring **Erol Uzumeri** (IndE 9T2), co-founder of Searchlight Capital partners, a global private equity investment firm. For more information, contact Deirdre Gomes at: **deirdreg@ecf.utoronto.ca** or +1-416-978-4274

IBBME Alumni and Awards Dinner
Thurs., Oct. 20, 2011

The IBBME community welcomes you to celebrate alumni and student achievements as well as the Institute's 50th anniversary. Free for IBBME faculty, students and alumni. For event information, contact Sachiko Murakami at: **comm.ibbme@utoronto.ca** or +1-416-978-4801

Skule™ Comes to Asia Pacific
Mid-October 2011

Join Dean **Cristina Amon** and fellow alumni in Hong Kong, Singapore or Beijing, as Skule™ travels through the Asia Pacific. To get on our mailing/emailing list, please contact Deirdre Gomes at: **deirdreg@ecf.utoronto.ca** or +1-416-978-4274

Calgary Skule™ Alumni Chapter Fall Reception
Mon., Nov. 14, 2011

Professor **Brenda McCabe** (CivE 9T4), Chair of the Department of Civil Engineering, is the guest speaker at this annual reception for Skule™ alumni in Calgary. For information, contact Deirdre Gomes at: **deirdreg@ecf.utoronto.ca** or +1-416-978-4274

San Francisco Alumni Event
Tues., Feb. 21, 2012

Skule™ alumni unite at the 2nd Annual reception. Join members of the Engineering Faculty to hear of the latest news from Skule™ For information, contact Deirdre Gomes at: **deirdreg@ecf.utoronto.ca** or +1-416-978-4274

Skule™ Nite Musical Comedy Revue
March 14-17, 2012

Don't miss out on reserving your seat for the highly anticipated, much loved, always sold-out Skule™ Nite. For details, contact Megan Murphy at: **meganm@ecf.utoronto.ca** or +1-416-978-4941

Skulematters

Faculty of Applied Science & Engineering

UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

Office of Advancement
Faculty of Applied Science & Engineering
University of Toronto
Galbraith Building
35 St. George Street. Room 116

Tel: +1 416-978-0380
Fax: +1 416-946-3450
engineering.advancement@utoronto.ca
www.engineering.utoronto.ca

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