



UNIVERSITY OF TORONTO  
FACULTY OF APPLIED SCIENCE & ENGINEERING



**ENGINEERING  
ENERGY  
RESEARCH  
SHOWCASE**

# WELCOME

## Message from the Dean Cristina Amon

It is a privilege to welcome you to the inaugural Faculty of Applied Science and Engineering's Energy Research Showcase. This event brings together researchers and practitioners from industry, government and academia to share energy research advances and foster collaborations that will build on the momentum in Engineering to provide innovative solutions to global energy challenges.

There is an unprecedented need to meet global energy challenges, and our innovative research initiatives in solar energy, wind energy, high efficiency silicon photovoltaics, fuel cells, nuclear power, bio-fuels, sustainable transportation, clean water, and more are receiving major awards and recognition on a global scale. Our scholars serve as an important resource for the media, industry and government on a myriad of energy related issues including policy, sustainability and energy efficiency.

On behalf of the Faculty of Applied Science and Engineering, I would like to thank our professors, students, staff, alumni and the Engineering community for attending this event at U of T, and for your commitment to excellence in Energy research and education. I hope you enjoy this energy research event, and that the stimulating discussions it generates and the collaborations it promotes prove productive and rewarding for us all.

Cristina Amon, Dean

## Message from the Vice-Dean, Research Stewart Aitchison

I would like to welcome you to the Faculty of Applied Science and Engineering's Energy Research Showcase. Energy is one of the key research priorities within the Faculty - many of our researchers are working to find solutions to key challenges in energy generation, distribution and conservation. In addition we have new research collaborations with the School of Public Policy on Energy Policy and a new Division of Environmental Engineering and Energy Systems.

It would be impossible to showcase all of the energy-related research within the Faculty in just one afternoon, so we hope that this will be the first in a series of meetings - not just in energy but in other key areas such as nanotechnology, IT, and bioengineering. Our aim for these meetings is to showcase our research, highlight student projects and provide a forum for discussion of future research directions.

Thank you for attending the Energy Research Showcase. I hope to see you at many more such events in the future.

Stewart Aitchison, Vice-Dean, Research

# SCHEDULE OF EVENTS

Time	Activities
11:45	<b>Registration in Bahen Atrium</b>
12:10	<b>Presentations in Bahen 1160</b>
12:10	Welcome by Cristina Amon, Dean Overview by Stewart Aitchison, Vice-Dean, Research
12:25	Bryan Karney <i>New Energy Options in our Undergraduate Program</i>
12:40	Frank Vecchio and Shamim Sheikh <i>Plant Life Extension of Concrete NGS Structures</i>
12:55	Doug Reeve <i>Energy Policy</i>
1:10	<b>Lunch and Poster Presentations in Bahen Atrium</b>
2:00	<b>Presentations in Bahen 1160</b>
2:00	Roger Newman <i>Materials Issues in Nuclear Power Generation</i>
2:15	Ömer Gülder <i>Combustion Research for Energy Efficiency and Emissions Reduction</i>
2:30	Emma Master <i>Biofuels: Feedstocks, Process Options, and Challenges</i>
2:45	Tim Bender <i>Inorganic and Organic Solar Cell Activity within the Faculty of Applied Science and Engineering</i>
3:00	<b>Panel Discussion Chaired by Doug Reeve in Bahen 1160</b> Tim Bender, Masahiro Kawaji and Jim Wallace <i>Challenges Facing Renewable Energy</i>
4:00	<b>Reception in Bahen Atrium</b>

## SPEAKERS

Cristina H. Amon

Dean - Faculty of Applied Science and Engineering

Alumni Professor - Mechanical and Industrial Engineering

Cristina H. Amon is Dean of the Faculty of Applied Science and Engineering and Alumni Professor in Mechanical and Industrial Engineering at the University of Toronto, which she joined in 2006. She received a Mechanical Engineering degree from Simon Bolivar University in 1981 and, after two years of teaching and Engineering practice, continued her education at the Massachusetts Institute of Technology where she earned her M.S. and Sc.D. degrees in 1985 and 1988, respectively. Dean Amon's research pioneered the development of computational fluid dynamics for formulating and solving thermal design problems subject to multidisciplinary competing constraints. The focus of her current research is the investigation of nano-scale thermal transport and interface phenomena in semiconductors with hierarchical multi-scale modeling by atomistic molecular dynamics, lattice-Boltzmann and phonon Boltzmann transport, for applications to thermo-electric energy conversion, novel nanostructures and thin-film silicon devices. Other research contributions include transport in biological systems, intravenous blood oxygenators and abdominal aortic aneurysms, and transport in micro-scale direct methanol fuel cell. She is Member of NAE and Fellow of AAAS, ASEE, ASME and IEEE.

J. Stewart Aitchison

Vice-Dean, Research - Faculty of Applied Science and Engineering

Professor - Electrical and Computer Engineering

J. Stewart Aitchison is the Vice-Dean, Research for the Faculty of Applied Science and Engineering and a Professor in the Edward S. Rogers Sr. Department of Electrical and Computer Engineering. Since 2001, he has held the Nortel Chair in Emerging Technology. His research interests cover all-optical switching and signal processing, optoelectronic integration and optical bio-sensors. His research has resulted in 7 patents, 195 journal publications, and 200 conference publications. From 2004 to 2007 he was the Director of the Emerging Communications Technology Institute at the University of Toronto where he worked towards the establishment of open access micro and nano-fabrication facilities. Professor Aitchison is a Fellow of the Optical Society of America, a Fellow of the Institute of Physics London and a senior member of the IEEE.

Bryan W. Karney, Professor

Civil Engineering

Bryan W. Karney, is a Professor of Civil Engineering at the University of Toronto, where he has worked since 1987. He is currently Chair of the Division of Environmental Engineering and Energy Systems. Professor Karney has spoken and

written widely on subjects related to water, energy, environment, hydrology, climate change, Engineering education and ethics. He was an Associate Editor for the Journal of Hydraulic Engineering for the ASCE from 1993 to 2005. Professor Karney was one of the top 10 finalists in TVO's "Best Lecturer" competition in 2007. He has published two books, including the Comprehensive Water Distribution Systems Analysis Handbook for Engineers and Planners (2nd Edition, MWH Press) as well as over 150 papers and scientific contributions on topics ranging from water hammer, energy system performance, life cycle analysis, hydrology, flows of frazil ice, and Engineering education.

### Shamim A. Sheikh, Professor Civil Engineering

Shamim A. Sheikh, a Professor of Civil Engineering at the University of Toronto, is a Fellow of the American Concrete Institute (ACI). He is a member and former Chair of ACI-ASCE Committee 441, Reinforced Concrete Columns, and a member of ACI Committee 374, Performance-Based Seismic Design of Concrete Buildings. He also serves on three Code Committees of the Canadian Standard Association dealing with certification of fibre reinforced polymer (FRP) composites and their use in bridges and buildings. His relevant research interests include earthquake resistance and seismic upgrade of concrete structures, and confinement of concrete. In 1999, he received the ACI Structural Research Award for a paper on the design of ductile concrete columns.

### Frank J. Vecchio, Professor Civil Engineering

Frank J. Vecchio has been a professor with the Department of Civil Engineering, University of Toronto, since 1985. His interests relate to nonlinear analysis of reinforced concrete, constitutive modelling, assessment of structural integrity, analysis of repaired and rehabilitated structures, and forensic assessment of distressed or failed structures. Professor Vecchio is currently Deputy Chair of fib Commission 4 - Modelling of Structural Behaviour and Design, and is a member of ACI-ASCE Committee 445 - Finite Element Analysis of Reinforced Concrete, and ACI Committee 441 - Columns. He received the ACI Structural Research Award in 1997, and the ACI Structural Engineering Award in 1998, and is a Fellow of the American Concrete Institute.

### Doug Reeve, Professor Chemical Engineering and Applied Chemistry

Professor Doug Reeve is Chair of the Department of Chemical Engineering and Applied Chemistry, University of Toronto. He was founding Director of the Pulp & Paper Centre (1987-2001) and has led substantial research on pulp and paper manufacture. He has recently focused his attention on Engineering education. In 2002, he established a

student leadership development program in the Department and is presently Co-leader of Leaders of Tomorrow, a leadership development program that reaches across the Faculty of Applied Science and Engineering. As Chair of the Task Force on Engineering and Public Policy (EPP) he has been engaged in the development of concepts for teaching EPP at the undergraduate and post-graduate level. He is the Co-Chair of a university-industry-government initiative on electricity policy perspectives for Ontario. He is appointed to the new U of T School of Public Policy and Governance and is a member of the University's Governing Council.

Roger Newman, Professor  
Chemical Engineering and Applied Chemistry  
Materials Science and Engineering

Roger Newman is a materials scientist by training. He obtained his degrees from the University of Cambridge, then spent four years at Brookhaven National Laboratory and 20 years as an academic in UMIIST, Manchester. He joined U of T in 2004. His main research interests lie in metallic corrosion and the fabrication and properties of nanomaterials. He holds a Senior Industrial Research Chair jointly funded by the Natural Science and Engineering Research Council of Canada (NSERC) and the University Network of Excellence in Nuclear Engineering (UNENE).

Ömer Gülder, Professor  
University of Toronto Institute for Aerospace Studies

Before joining the faculty at UTIAS in 2001, Ömer Gülder worked at the National Research Council Canada as the head of the combustion research group. His research interests are in the general area of combustion and propulsion covering transportation fuels, emissions, soot formation at high pressures, turbulent premixed flames, combustion in gas turbines, and combustion diagnostics. He served on the editorial boards of Combustion and Flame, International Journal of Engine Research, and International Journal of Thermal Sciences. Currently he is on the Board of Directors of the Combustion Institute, and was the Chair of the Canadian Section of the Combustion Institute from 1991 to 2001.

Emma Master, Assistant Professor  
Chemical Engineering and Applied Chemistry

Emma Master is currently applying genomic and proteomic technologies to identify novel biocatalysts for processing and Engineering softwood fibre. She is also investigating the molecular basis for non-productive binding of enzymes to pretreated wood fibre, and the bioconversion of industrial waste to methane. Before joining U of T, Professor Master led an Enzyme Discovery group in the Department of Wood Biotechnology at the Royal Institute of Technology (KTH) in Sweden, and completed a PhD in Environmental Microbiology at UBC.

Tim Bender, Assistant Professor  
Chemical Engineering and Applied Chemistry

Tim Bender joined the University of Toronto in September of 2006 after a seven year career with Xerox Corporation. During that time his research was targeted towards advanced organic materials, more specifically organic materials for application in photoreceptive devices. Organic photoreceptive devices are structurally similar to organic photovoltaic devices and the pursuit of new materials for the latter dominates his current research interests. Professor Bender has 39 issued U.S. patents and over 20 pending applications generally in the area of new compositions of matter. He also has 14 peer reviewed publications mostly from his time as a PhD student and post doctoral fellow. He is an Assistant Professor in the Department of Chemical Engineering and Applied Chemistry with a cross-appointment to the Department of Chemistry. He lectures on introductory Physical Chemistry, second year Organic Chemistry and graduate level Polymer Chemistry.

Masahiro Kawaji, Professor  
Chemical Engineering and Applied Chemistry

Masahiro Kawaji, a Professor at U of T's Department of Chemical Engineering and Applied Chemistry, is a Fellow in the Chemical Institute of Canada, as well as the American Society of Mechanical Engineers. During the course of his career he has been recognized with several honours and awards, including the Chemical Institute of Canada's Jules Stachiewicz Medal in 2002 and the Japan Multiphase Flow Society's Best Paper Award in 2000. His research interests lie in multiphase flow and phase change heat transfer, transport phenomena, microfluidics, micro-heat pipes, nuclear reactor thermal-hydraulics and safety analysis, microgravity fluid physics and transport phenomena, thermal diffusion, advanced instrumentation, numerical simulation of free surface problems, compact heat exchangers, thermal analysis of Kraft Recovery boilers and lime kilns, sustainable energy, biomass gasification, thermal energy storage, hydrogen production by electrolysis.

Jim Wallace Professor  
Mechanical and Industrial Engineering

A Professor at U of T's Department of Mechanical and Industrial Engineering, Jim Wallace's main area of research is alternative fuels combustion. Specifically, the combustion of alternative fuels, including natural gas, propane, methanol, dissociated methanol, hydrogen and biodiesel. His current projects include ignition studies in natural-gas fueled diesel engines, the emissions impact of biodiesel fuel blends, and research into hydrogen-fueled IC engines as a technology that will help build fueling infrastructure for fuel cells. His other interests include clean diesel engine technology, fuel cell ancillary systems and systems integration issues, and optical diagnostic techniques for in-situ measurements of combustion systems.

# POSTERS

No.	Authors	Poster Titles
1	Jennifer McKellar Jon McKechnie Kim Mullins Martina Betkova Heather MacLean	Canada's Transportation Energy Future
2	Alex Caspary Michael Colalillo David Johnson James Liu	Life Extension of Nuclear Plants Using Innovative Retrofit Techniques
3	Nalina Nadarajah Edward Acosta D. Grant Allen	Microalgae Biorefinery
4	Minqing Ivy Yang D. Grant Allen Elizabeth Edwards	The Impacts of Effluent Type and Concentration on Methane Production from the Anaerobic Treatment of Pulp Mill Wastewaters
5	Nicholas Wood	Improvement in the Anaerobic Digestion of Waste Sludges
6	Jason D'Souza	Uranium Super Phthalocyanine as a Photon Absorbing Crystal for Organic Solar Cells
7	Andrew Paton Daniel Skruch	Boron Subphthalocyanines as Photon Absorbing Crystals for Organic Solar Cells
8	Colin Powell Katrina Maka	Organic Solar Cells: Using a Business Model to Determine Technical Objectives
9	Madeleine McPherson Jonathan Lee	Phthalocyanines for Solar Cells
10	Sabrina Francey	Process and Economic Impacts of Burning Alternative Fuels in Lime Kilns
11	Sonam Mahajan	Proteomic Analysis of the Secretome of Softwood-Degrading Fungi
12	Jacqueline MacDonald Thomas Canam Malcolm Campbell Emma Master	Identification and Characterization of Genes Encoding Lignocellulose-Modifying Enzymes in the White-Rot Fungus, <i>Phanerochaete Carnosa</i>



## No. Authors

## Poster Titles

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|----|--|--|
| 13 | Alice Yip<br>Michael Massad  | Biomass Gasification Research  |
| 14 | Zheko Karchev<br>Hooman Foroughi   | Nuclear Energy Research  |
| 15 | Jin Chang  | Electro-thermal Characterization of Supercapacitors  |
| 16 | Dale Dolan<br>Peter Lehn   | Harmonic Mitigation in a Virtual Air Gap Variable Reactor via Control Current Modulation                               |
| 17 | Abdelrahman Abbas<br>Peter Lehn  | Introducing the Electronic Power Hub   |
| 18 | Abraham Yoo<br>Marian Chang<br>Olivier Trescases<br>Wai Tung Ng          | High Performance Low-Voltage Power MOSFETs with Hybrid Waffle Layout Structure in a 0.25 $\mu$ m Standard CMOS Process |
| 19 | Paul O'Brien<br>Anthony Hertanto<br>Pratish Mahtani<br>Barzin Bahardoust | Amorphous-Nanocrystalline-Crystalline Silicon Photovoltaics  |
| 20 | Cai Michael Wang<br>Xiang Li   | An Overview of Current and Prospective Utility-Scale Electricity Storage Solutions                                     |
| 21 | Rafal Dittwald<br>Stefanos Karterakis                                    | Energy and Society: The Need for, and Challenges of, a Unifying Vision   |
| 22 | Scott Flemming   | Considering Human Factors Perspectives on Sustainable Energy Systems   |
| 23 | Jess Currie<br>Keith Fung  | Biomimetic Design and TRIZ Applied to Fuel Cell Redesign   |
| 24 | Olga Arevalo-Quintero<br>Jeff Harris<br>Joel Kuhn<br>Craig Metcalfe      | Current Solid Oxide Fuel Cell Research   |
| 25 | Antony Hilliard  | The Human Factors of Transportation Energy Efficiency  |
| 26 | Anna Moser<br>Pierre E. Sullivan   | Vertical Axis Wind Turbines for Rooftops   |

No.	Authors	Poster Titles
27	Paul Radcliffe	Comparison of Energy Storage Technologies for Various Applications
28	Youliang Wang Tom Coyle	Solution Precursor Plasma Spray (SPPS) of Porous La <sub>1-x</sub> Sr <sub>x</sub> MnO <sub>3</sub> (LSM) Perovskite Coatings for Solid Oxide Fuel Cell Cathode Application
29	Daniel P. Sellan Javier V. Goicochea Cristina Amon	Thermoelectric Generation: Converting Waste Heat into Usable Electricity
30	James Davis Bernard Fitzpatrick John Sharpe Anthony Haasz	Oxidation of Carbon Dusts from the DIII-D tokamak
31	Adam McLean Peter Stangeby James Davis	Characterization of Chemical Sputtering Using the Porous Plug Injector in the DIII-D Fusion Reactor
32	Stephanie Hu Charles Jia Donald Kirk	Petroleum Coke-Derived Activated Carbon as Electrode Material for Electrochemical Double Layer Capacitor (EDLC)
33	Blue Sky Solar Car Team	The Blue Sky Solar Car

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