Empowering urban futures
through research and innovation

2012 ANNUAL REPORT

CUE

RYERSON UNIVERSITY

Everyone Makes a Mark

TABLE OF CONTENTS

> **“CUE not only makes Ontario a leader in reliable, sustainable and clean energy, but it also works to identify new solutions to global energy issues to keep cities powered, now and for many years to come.”**

Dr. Mohamed Lachemi
Dean, Faculty of Engineering and Archictectual Science (FEAS), Ryerson University

OUR PEOPLE: ADVISORY COUNCIL

Dr. Mohamed Lachemi
Dean, FEAS, Ryerson University and Chair of Advisory Council

David Curtis
Director, Asset Management - Asset Strategy Division, Hydro One Networks Inc. and Co-Chair of Advisory Council

Tom Chapman
Director, Transmisssion and Distribution Policy, Ontario Ministry of Energy

Dr. Lisa Dignard-Bailey
Director, Integration of Renewable and Distibuted Energy Resources Program, CanmetENERGY, Natural Resources Canada

Ivano Labricciosa
Vice President, Asset Management, Toronto Hydro-Electric System Limited

Andrew Pride
Vice President, Conservation, Ontario Power Authority

Ravi Seethapathy
Manager - Systems Innovation & Advanced Grid Development, Hydro One Networks Inc.

Kim Warren
Vice President, Operations and Chief Operating Officer, Independent Electricity System Operator

Dr. Bala Venkatesh
Academic Director, CUE

ACADEMIC DIRECTOR MESSAGE

> **"I welcome collaborators who share our passion to benefit society, the ecology and our economic futures"**

Dr. Bala Venkatesh
Academic Director

The Centre for Urban Energy continues to play an important role in providing solutions to research, educational and entrepreneurial energy challenges. Since its start in 2010, it has grown steadily and it is my pleasure to report on this growth.

In addition to our three founding sponsors, Hydro One, Toronto Hydro and the Ontario Power Authority, we now have secured 30 research partners. We currently have 16 research projects in a number of areas, such as renewable energy, energy storage and energy conservation.

2012 represented, for us, many accolades. CUE hosted Ontario Minister of Energy Chris Bentley when he made his FIT 2.0 announcement in March. CUE funded $197,000 in student research and we supervised 10 Capstone engineering design projects.

Through our partnership with the Anna University – Ryerson Urban Energy Centre, six students travelled to Toronto for summer internships and worked with CUE faculty on energy-related topics.

In the fall, we launched our certificate program Energy Management and Innovation through the G. Raymond Chang School of Continuing Education. We also opened the doors to the Innovation Centre for Urban Energy (i-CUE), Canada's first business incubator and accelerator solely devoted to urban energy.

Throughout the year, we have continued to position ourselves as thought leaders by speaking at external events and by hosting our own roundtables with industry executives. The latter has spawned intense dialogue, position papers and drew the attention of several key decision makers in Ontario and abroad.

CUE, itself, is growing. It is now supported by more than 85 people, including staff, research fellows, post-doctoral fellows, students and faculty members. This year, we have authored 29 academic papers and defended the theses of 15 Master's and PhD graduates.

Our success continues due to our multi-disciplinary approach that moves research results beyond traditional academic research, into the industrial realm, while responding to the public interest.

I welcome collaborators who share our passion to benefit society, the ecology and our economic futures, and I hope to share more successes in the years to come.

EXECUTIVE DIRECTOR MESSAGE

> **"We continue to measure our success by the success of our partners"**

Dr. Dan McGillivray
Executive Director

2012 was a banner year for CUE. As noted by Dr. Bala Venkatesh, we have grown our applied research program, launched the i-CUE and initiated the certificate in Energy Management and Innovation. We have established CUE as an important player in the Ontario energy landscape and this work will continue as we begin to measure our success by the success of our partners.

A *perfect storm* is brewing over the energy sector in Ontario. Our workforce is aging and in decline at the very time that our infrastructure is in desperate need of repair and refurbishment. We have rising supply and falling demand for power and we have a surplus of power for the foreseeable future. We have an energy market challenged by negative pricing and a consumer market challenged by rising prices. Then there's the consumer who has been raised on a culture of plenty and expects cheap, limitless reliable power without any generation or transmission in their own backyards. We persist in developing renewable generators of intermittent power without the capacity to effectively store that power. And, as we strive to reduce our dependency on carbon, we watch the astonishing resurgence of oil and gas production in the U.S., which is expected to become self-sufficient by 2020 and at a price that is significantly lower than the production costs required for Alberta gas and oil.

While this *perfect storm* spells a bumpy ride for bureaucrats and politicians, it guarantees opportunity for energy entrepreneurs and researchers. CUE, centred in the largest city in Canada, is in the perfect position to intensify our focus on urban energy challenges – storage, smart grid, intelligent infrastructure and conservation. We have developed an extensive network of Ontario's energy sector leaders and will draw upon these leaders in our research projects, roundtable dialogues and education programs. Our newly established i-CUE provides a place for energy innovation, experiential learning and entrepreneurship – a place where students will be able to complete their Capstone course and start a business at the same time.

The path forward for CUE is exciting and we invite you to join us as we work to see our *partners succeed!*

OUR PEOPLE

Faculty:

Dr. Chil-Hung Cheng, Assistant Professor

Dr. Joseph Chow, Assistant Professor

Dr. Seth Dworkin, Assistant Professor

Dr. Xavier Fernando, Professor

Dr. Alan Fung, Associate Professor

Dr. Robert A. Gossage, Associate Professor

Dr. Ling Guan, Professor

Dr. Yifeng He, Assistant Professor

Dr. Bryan Koivisto, Assistant Professor

Dr. Jelena Misic, Professor

Dr. Cory Searcy, Assistant Professor

Dr. Farrokh Janabi-Sharifi, Professor

Bob Singh, Adjunct Professor

Dr. Phil Walsh, Associate Professor

Dr. Bin Wu, Professor

Dr. David Xu, Associate Professor

Dr. Amir Yazdani, Associate Professor

Dr. Xiao-Ping Zhang, Professor

Staff:

Dr. Mohamed Lachemi, Dean, Faculty of Engineering and Architectural Science

Dr. Bala Venkatesh, Associate Professor and Academic Director

Dr. Dan McGillivray, Executive Director and Toronto Hydro Distinguished Fellow

Denis Arseneault, Administrative Assistant

Karen Parucha, Marketing and Communications Manager

Adnan Syed, Project Manager, Ontario Research Fund

Fellows:

Sean Conway

Peter Love

James MacDougall

Yuri Navarro

Dr. Gamal Refai-Ahmed

Dr. Magdy Salama

Photo: (Left to Right) Bala Venkatesh, Adnan Syed, Mike Pettigrew, Raj Ratnaraj, Seth Dworkin, Sarah Marchionda, Jim MacDougall, Denis Arseneault, Dan McGillivray, Karen Parucha, Sean Conway, Travis Xu, Daniel Cheng

Photo: (Left to Right) Sean Conway, Jim MacDougall

CUE VISION

To be a world class research and innovation centre dedicated to solving urban energy challenges

Photo (Left to Right): Peter Moore and Dr. Cory Searcy. Their carbon footprint study of Hydro One Networks Inc. is one of two projects completed in 2012.

ABOUT CUE

The Centre for Urban Energy (CUE) is an academic-industry partnership that is exploring and developing solutions to urban energy challenges, such as the advancement of clean energy technologies, energy policy and regulatory issues, energy storage, electric vehicles, smart homes and smart grid. CUE was founded in 2010 by Ryerson University with sponsorships from Hydro One, Toronto Hydro and the Ontario Power Authority.

CUE MISSION

Build academic, public and private sector partnerships

Conduct research, development and demonstration, leading to commercialization

Create the next generation of energy entrepreneurs

Encourage multidisciplinary and collaborative approaches

Provide scholarship and learning opportunities

CUE is solving real urban energy issues.

CUE BY THE NUMBERS

> **"As one of Ontario's most innovative academic institutions, Ryerson's CUE represents a great example of how thought leaders from both public and private sectors can work together to develop solutions that address real issues in the energy sector"**

Tom Chapman,
Director, Transmission and Distribution Policy,
Ontario Ministry of Energy

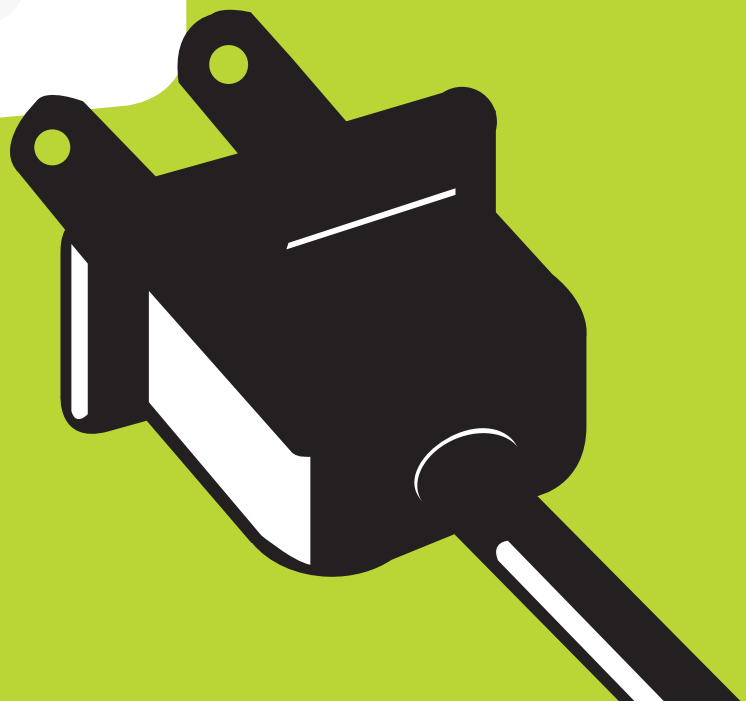
CUE PARTNERS

Founding Sponsors

Partners

RESEARCH FOCUS

- Energy Storage
- Smart Buildings & Net-Zero Homes
- Power Generation & Transmission Systems
- Efficiency, Conservation & Demand Management
- Environmental, Social & Economic Impacts
- Electric Vehicles & Infrastructure
- Energy Policy & Regulatory Issues
- Renewable Energy
- Smart Grid
- Microgrid
- Intelligent Infrastructure



RESEARCH PROJECTS

CUE's multidisciplinary teams are working on various research projects. Our expertise spans many faculties including the Faculty of Engineering and Architectural Science, the Ted Rogers School of Management as well as other departments within the university.

Principal Investigator	Title
Dr. David Xu	System Integration of Large-Scale Energy Storage System Using Lithium Batteries
Dr. Cory Searcy	Carbon Footprint Reduction (Completed)
Dr. Bala Venkatesh	Electrical Impact on Transformer Station Components due to Electric Vehicles
Dr. Bala Venkatesh	Electrical Impact on Transformer Station Components due to Solar Panels
Dr. David Xu	Electrical Impact on Transformer Station Components due to Storage Technologies
Dr. Bala Venkatesh	Intelligent Algorithms for Integrating Wind Power to the Distribution System
Dr. Bin Wu	Control and Interfaces for Urban Clean Energy Microgrid
Dr. Alan Fung	Development of Residential HVAC and Air Conditioning Demand Management and Control Systems
Dr. Ling Guan	Secure and Reliable Data Communications for Smart Grid
Dr. Bala Venkatesh	Transmission Supply Diversification Challenges – Central and Downtown Toronto
Dr. Bala Venkatesh	Energy on Time - Temporal Power Flywheel Project (Completed)
Dr. Bin Wu	PHEV Charging Station for Urban Energy Systems
Dr. Seth Dworkin	Time of Use Customer Analysis (Phase 1)
Dr. Alan Fung	Comprehensive Study of Residential Scale Trigeneration System based on ClimateWell Technology
Dr. Alan Fung	Energy Assessments and Cost-Benefits Analysis Within a Program of Energy Management Expertise Development
Dr. Bala Venkatesh	Applications of Alternative Auxiliary Electrical Storage for High-Density Urban Usage

RESEARCH PROJECT HIGHLIGHTS

> **“Unlike other forms of energy storage, this project can be commercialized in an urban environment, where space is at a premium and the demand for energy is great.”**

ALTERNATIVE AUXILIARY ELECTRICAL STORAGE FOR HIGH-DENSITY URBAN USAGE >>

Research Team: Dr. Bala Venkatesh, Dr. David Xu, Dr. Phil Walsh

Partners: OCE, Hydro One Networks Inc., Manitoba Hydro, Natural Resources Canada, Ontario Power Authority, Toronto Hydro-Electric System Ltd., Electrovoya, Manitoba HVDC, Tennessee Valley Authority

Previous research has shown that end-of-automotive-life electric car batteries still retain 70 per cent of their potential to store energy. These are good for stationary energy storage applications. Applying this knowledge, this project examines the use of these batteries as a way to store energy and return it back to the grid, providing another market for used car batteries.

The first of its kind in Canada to use Lithium Polymer batteries, this project has many potential benefits. First, it has the ability to store massive amounts of energy and readily deploy it when it’s needed, such as on hot, humid days in the summer when capacity is at its peak. Second, it can support intermittent wind or solar power generation. And lastly, unlike other forms of energy storage, such as pumped-storage hydroelectricity, this project can be commercialized in an urban environment, where space is at a premium and the demand for energy is great.

The project will use Electrovoya’s Lithium Ion SuperPolymer® battery technology. Electrovoya, a Mississauga-based company, will build three modules of batteries, each with a capacity of 340 kWh. These batteries will be installed on Ryerson University’s campus in a 40-foot trailer. A fourth module using repurposed batteries with a capacity of about 150 kWh will be later integrated. The four modules will be connected to Toronto Hydro’s grid.

Dr. Bala Venkatesh, the principal investigator for this project, has secured more than $4 million in funding.

The project is currently in the first phase of a three-year project plan.

RESEARCH PROJECT HIGHLIGHTS

HVAC DEMAND MANAGEMENT AND CONTROL SYSTEMS>>

Research Team: Dr. Alan Fung, Dr. Xavier Fernando, Dr. Farrokh Janabi-Sharifi, Abdul Afram, Nima Alibabaei, Sajjadul Latif, M. Ebrahim Poulad

Partners: Toronto Hydro-Electric System Ltd., MITACS, TRCA, NRCan, dx2 technologies, Mitsubishi, Union Gas

To cut down on rising energy costs and to contribute to a more sustainable living, homeowners are becoming aware of their energy consumption and are demanding more tools that allow them to make decisions about their energy use. They are choosing energy-efficient appliances, connecting to renewable energy sources and managing the timing of their electricity usage. What is needed is an intelligent energy management device that can make all of these decisions for them by automatically saving energy through communication with the smart grid and informing homeowners of their energy use.

With funding from Toronto Hydro, CUE researchers Dr. Alan Fung, Dr. Xavier Fernando and Dr. Farrokh Janabi-Sharifi are working on a multi-part project to address this missing piece. The development of a residential heating, ventilation and air conditioning (HVAC) demand management and control system involves research in adaptive control strategies, such as PeakSaver analysis and smart dual fuel switching systems; component control strategies; and a communication strategy between the utility and the home as well as between the sensors and equipment within the home.

The team's energy management device not only informs homeowners of their energy consumption via a user-friendly display, but it can also reduce energy use by load shifting appliances to off-peak times and/or optimizing the operation of HVAC systems, domestic water heating (DWH) and renewable energy equipment. Through partners dx2 technologies and Mitsubishi, the team has access to up-and-coming in-house communications and control technologies for their research.

This project will be of importance to government agencies looking for solutions to climate change; utilities looking for electrical-load shaving and peak-load shifting opportunities; and agencies interested in demand side management opportunities. This project also responds to priorities in the housing sector for higher-performing, less energy-consuming housing and addresses the needs of home builders who are looking for energy-saving HVAC and DWH equipment to offer prospective homeowners.

Hosted at the Archetype Sustainable House at the Toronto and Region Conservation Authority's Kortright Centre for Conservation, the project takes advantage of the facility's innovative HVAC, DWH and renewable energy equipment and on-site monitoring system to identify opportunities for systems integration and optimization.

This project is in the second year of a three-year plan.

RESEARCH PROJECT HIGHLIGHTS

CARBON FOOTPRINT STUDY AT HYDRO ONE NETWORKS INC. >>

Research Team: Dr. Cory Searcy, Peter Moore, Jonathan Pryshlakivsky

Partner: Hydro One Networks Inc.

The purpose of this study was to implement a strategic approach for greenhouse gas (GHG) management at Hydro One Networks Inc. with an emphasis on reducing the company's carbon footprint over the next 10 years. The study involved close consultation with employees from across Hydro One's lines of business, representing a diverse range of disciplines.

The study produced three principle outputs:

1. Process maps to assist Hydro One with systematically identifying its current carbon footprint,
2. A strategic scenario analysis to help project changes to its carbon emissions over the next 10 years, and
3. A set of recommended actions for reduction of the company's GHG emissions over the next decade.

An ancillary objective included the completion of an industry benchmark study. Researchers reached out to other electric utilities to determine and share emission measurement and reduction best practices.

The three principle process maps identified a range of emission sources associated with Hydro One operations. The maps categorize emission sources according to a typology prescribed by the most widely used corporate GHG accounting standard, the GHG Protocol. The maps also include a data quality assessment for emissions currently tracked by the organization.

The scenario analysis resulted in the development of two key scenarios: (a) the electrification of the Ontario vehicle fleet, and (b) continued change to the generation mix and increased adoption of distributed generation and customer-owned renewable generation (load displacement). A feasibility study complemented the scenario analysis.

Based on assumptions made within the scenarios, Hydro One could experience an increase in electricity demand due solely to the adoption of electric vehicles over the next decade. This increase naturally leads to higher line loss associated emissions as a result of heavier loading on the system. The study also projects a greater footprint associated with facility and fleet operations resulting from increased demand associated with population growth in Ontario, particularly in the Greater Toronto Area.

The team recommended nine actions for the reduction of the company's carbon footprint (to complement initiatives already pursued by the organization). These recommendations included:

1. Screen Scope 3 Supply Chain Emission Source
2. Manage Indirect Employee Travel and Business Travel Emissions
3. Solicit Employee Initiative Suggestions
4. Track and Measure Emissions Associated with Leased Assets and Outsourced Activities
5. Purchase Carbon Offsets
6. Account for Electricity Exports to Fossil-Fuel Intensive Systems
7. Support the Research and Development of EV Charging Infrastructure
8. Recommendation for Scenario 1 Timeline: EV charging for Employees
9. Recommendation for Scenario 2 Timeline: On-Site Renewable Energy Sources to Offset Grid Demand

Hydro One has made considerable progress in its ongoing efforts to manage its corporate carbon footprint. The company has taken significant steps to particularly address its Scope 1 and Scope 2 emission sources. As indicated by the benchmark study and a review of relevant literature suggests, the company has positioned itself as an industry leader with respect to emissions management. However, opportunities and risks associated with the corporate carbon footprint are continually emerging. The scenario analysis has provided some insight into how the carbon footprint may fluctuate due to external forces over the next decade. While both the scenario analysis and the feasibility study suggest an increase to the footprint, there are some opportunities for emission reductions over the 10-year period.

This project began in January 2011 and was completed in August 2012.

> **"The i-CUE is another successful example of Ryerson's 'zone' model."**
>
> **Sheldon Levy,**
> **President of Ryerson University**

From Left to Right: Tyler Baird, Curtis Yim, Sheldon Levy, Ryan Manchee

i-CUE

The Innovation Centre for Urban Energy

In November 2012, CUE officially launched the Innovation Centre for Urban Energy (i-CUE), Canada's first business incubator and accelerator devoted solely to urban energy.

The i-CUE is focused on research innovation (applied research in collaboration with industry); business innovation (entrepreneurship); and student innovation (experiential learning), all within the energy sector. Its goal is to help new energy companies turn their ideas into commercial products, services and/or technologies.

"The i-CUE is another successful example of Ryerson's 'zone' model," says Sheldon Levy, president of Ryerson University. "Instead of a co-op model where students work for someone else, the i-CUE gives entrepreneurial education through support, mentorship and collaborative learning, the opportunity to start their own company in the energy sector."

There are four companies currently in the i-CUE:

Energy Savers is a student-led, not-for-profit social enterprise developed by CUE and Ryerson's Students in Free Enterprise (SIFE, now Enactus). Energy Savers' mission is to help Torontonians save on their costs by educating them on the value of energy conservation and empowering them to take advantage of other existing opportunities. The company performs energy-saving home retrofits, which can save homeowners up to 50 per cent on their energy bills.

Plug'n Drive Ontario is a not-for-profit organization dedicated to creating public awareness and promoting the environmental and economic benefits of electric vehicles within the province. It currently has partnerships with government, electricity companies, car and infrastructure manufacturers, researchers, non-governmental organizations and other commercial partners.

DanTeb Enterprises is creating battery charging stations that can be placed in high-traffic, public places where people do not have immediate access to a charge. These stations supply more than a dozen connections capable of simultaneously charging a number of different electronic devices including smartphones and tablets. A typical charging session lasts 10 to 15 minutes, and the users are able to interact with the digital media components of the stations or simply continue to use their phone while charging.

Grid Resources is commercializing a combined heat and power concept that will maximize the value of distributed energy for its clients.

The i-CUE is open to anyone with an energy idea. Applicants are interviewed by CUE's executive director Dr. Dan McGillivray.

CAPSTONE ENGINEERING DESIGN PROJECTS

Ontario Minister of Energy Chris Bentley with Engineering Student Rawie Neil Laborce

In the final year of their undergraduate program, Ryerson University engineering students must complete a Capstone Engineering Design Project (EDP).

The Capstone EDPs serve as a great experiential learning tool as students are given the opportunity to solve real industrial problems. Working with a supervisor, a student team builds a design, simulation or experimental project. They must identify a problem, carry out the research and design as well as demonstrate results.

In 2012, CUE supervised 10 Capstone EDPs.

Students: Abrar Naeem, Adil Hussain, Umair Javed
Supervisor: Dr. Amir Yazdani

Photovoltaic Array Simulator (PAS): This project developed equipment to create a simulation, which allowed students to analyse the impact of external factors (e.g. temperature, sunlight variation) on the power-electronic inverter – the component that will allow photovoltaic arrays to be integrated into the grid.

Students: Boomethiyan Nadesan, Noushad Ali, Ethayaroopan Thambirajah
Supervisor: Dr. Amir Yazdani

Single-Stage, Single-Phase, Grid-Tied PV System for Smart Home: By designing, implementing, and testing a 2.5-kW, single-stage, single-phase, grid-tied PV system, this project helped students develop a control system and user interface software for a smart home.

Students: Mihal Andoni, Nicholas Jowlabar, Ang Li
Supervisor: Dr. David Xu

Programmable Three-Phase Power Supply (PTPPS): The PTPPS helped students understand and test the power converters that are necessary for renewable energy sources to get connected to the grid.

Students: Sang Lee, Keyvan Sadidi, Rahal Siriwardena
Supervisor: Dr. David Xu

Smart Circuit Breaker: By designing the solid-state power circuit breakers with intelligent functions, including metering, communication and fault diagnosis, students built the foundation needed to develop smart homes.

Students: Cameron Yeates, Pantelis Konidis, Saurabh Kulkarni
Supervisor: Dr. Bin Wu

Wind Energy Generation System: The project aimed to develop a working prototype of a 1.5kW wind energy conversion system that can be used to study the feasibility of wind energy generation at the residential level.

Students: Hesam Akbari, Majid Farahzad, Nour Ali
Supervisor: Dr. Bin Wu

Battery Charger for Plug-in Electric Vehicle (PHEV): This battery charger helped students develop a working prototype of a 1.5kW (AC Level 1) PHEV charger that can meet the SAE Standard J1772 developed by Society of Automotive Engineers. In the future, this will allow industry to figure out how the PHEV chargers will connect and impact the grid.

Students: Michael Paolo, Nikolay Lazarov, Theodore Eastmond
Supervisor: Dr. Bala Venkatesh

Smart Meter Design: By creating an energy meter that communicates with other energy devices and measures energy usage, industry will move one step further in creating a smart home.

Students: Swapnil Patel, Saad Awan, Rubina Memon
Supervisor: Dr. Bala Venkatesh

Smart Home Microgrid Optimization: By developing a master controller that optimizes the smart home's energy flow over 24 hours, students developed a system through which energy in the home can be managed efficiently.

Students: Farooq Qazi, Abir Newaz, Jehangir Qayyum
Supervisor: Dr. Bala Venkatesh

Toronto Transformer Stations Modelling and Evaluation: By modelling the transformer stations, students were able to develop mitigation strategies in case of a high-impact event, such as a loss of a key transmission station or supply path.

“We take pride in recognizing students who are doing great research on a variety of vital urban energy issues.”

Dr. Bala Venkatesh,
Academic Director

Our student awards are made possible by our sponsors Toronto Hydro and Hydro One.

WINTER 2012 STUDENT AWARD WINNERS

Student	Project
Miteshkumar Popat	Fault Ride-Through Method for Cascaded CSC-HVDC Based Offshore Wind Farm
Anil Yaramasu	Control of Grid-Connected Converter for EV Distribution Generation Application
Catherine Mule	Corporate Behaviour and Voluntary Energy Programs: Influences on Voluntary Participation
Mohammadsadegh Rahimian Emam	Current Waveform Parameters of the CN Tower Lightning Return Stroke and M-Components
Abdalla Elsayed	Improving Recyclability of Magnesium Alloy Castings for Automotive Applications
Saeideh Abedi-Doust	Heterogeneous Catalytic Wet Peroxide Oxidation of Lignin for Renewable Energy
Leon Chan, Rawie Neil Laborce, Alex Skidelsky	Smart Home Micro-Grid Optimization
Amogelang Moemba, Syed UmerAsif, Hassan Issa	Wind Energy Generation for Smart Homes
Ivan Vasyliv	Development of a Model for Urban Farming Initiatives in Canadian Cities
Thomas Behan	Embedded Building Temperature Inerential Sensor Using ANFIS
Shahram Aryanpour, Jovan Filipovic, Filip Topalovski	Wireless Electric Vehicle Manager
Aaron Hendershott	Retrofitting Suburbia - Patterns for Renewal
Priyatha Premnath	Increasing Efficiency of Silicon Solar Cells with the Addition of Gold-Silicon Nanoparticle-Networks
Venkata Yaramasu	Model Predictive Control of Permanent Magnet Synchronous Machine for Flywheel Storage
Morteza Mashayekhi	Developing a Model to Find the Shortest Path to Diffuse Electric Vehicles into the Car Market
Dahai Zhang	Development of a Novel PCM for Peak Load Shifting and Energy Saving in Urban Buildings
Fabio Almeida	Optimization of Integrated Thermal Storage in Net-Zero Buildings for Energy Efficiency
M. Ebrahim Poulad	Thermosyphon-PCM Combination to Store Thermal Energy in Buildings
Carolyne Khalil	Novel Dyes for Advanced Photovoltaic Devices
Sidhdharthkumar Patel, Mitesh Patel, Omar Mirza	Solid State Power Controller for Smart Homes
Tissan Ravindra, Raveenthan Thambirajah	Single-Stage, Single-Phase, Grid-Tied PV System for Smart Home
Ernest Ashwood, Saeid Biglary Makvand, Obrempong Boakye	High-Efficiency PV Micro-Inverter for Smart Home
Kathryn Atwell	Evaluation of Trajectory Type on Energy Efficiency in Reciprocating Load Driving
Hamoun Hayati, Ali Motebaheri Negad, Negar Honarmand	Battery Charger for PHEV for Smart Home

FALL 2012 STUDENT AWARD WINNERS

Student	Project
Runa Das	The Development of an Instrument to Assess Energy Literacy
Fabio Almeida	Retrofitting of Buildings with Phase Change Material
Venkata Yaramasu	Predictive Current Control of Hybrid Shunt Active Power Filters
Annie Chow	3-D Solar Energy Mapping and Optimal Community Design for Solar Neighbourhoods
Seyed Masih Alavy Ghahfarrokhy	A Methodology and Computerized Approach for Optimizing Hybrid Ground Source Heat Pump System Design
Peter Dash	Performance and Costs of a Building Integrated Photovoltaic/Thermal (B/PV/T) Panel Coupled with a Variable Capacity Air Source Heat Pump (VC-ASHP)
Daniel Zalcman	Experimental Study of the Impact of Insect Screens on Window Thermal Performance
Anahita Asadolahniajami	Wind Power Energy Development, the Role of Public Participation & Knowledge Broker in DMP
Devin Machin	Integrating Hole Transport Materials as Electrolytes in DSSC Applications
Pooja Thakur	Laser Fabrication of Nanocomposites for Enhanced Photovoltaic Energy Conversion

“My experience through this Certificate has highlighted our future energy options, a better understanding of how markets perform and a focus on innovation and energy entrepreneurship tied to skills required to be a better manager or business owner.”

Patrick McMahon
Student in the Energy Management and Innovation Certificate

ENERGY MANAGEMENT AND INNOVATION CERTIFICATE

“For every two people leaving the energy sector, one person joins. Ryerson’s new certificate program addresses this skilled labour shortage”

The demand for skilled workers in the energy sector is intensifying.

The Conference Board of Canada, the Electricity Sector Council and the Petroleum HR Council are all calling for skilled workers Canada-wide over the next four years. What remains is a real shortage for skilled employees.

“We have been witnessing this human resources challenge for years,” says Dr. Dan McGillivray, executive director of the CUE. “The skills needed in the energy sector are different from what they were 20 – or even 10 – years ago. We need to get people up to speed as to what’s happening in this industry, and we need to do it fast.”

In partnership with Ryerson’s G. Raymond Chang School of Continuing Education, CUE’s solution is the Energy Management and Innovation certificate program that addresses this skills disconnect.

Launched in fall 2012, students can expect to learn about energy management, conservation, sustainability and public policy that governs this regulated sector.

The certificate also covers innovation and entrepreneurship, which is needed to address the challenges and opportunities for developing new energy technologies and business enterprises.

“This program is driven by the needs of the sector,” adds Dr. Bala Venkatesh, CUE’s academic director. “The certificate allows those already in the energy industry to get the knowledge they need to advance into management or leadership roles, and it allows those looking to break into the industry the understanding they need to start their own energy business.”

Courses in the program include: Energy Innovation and Entrepreneurship, Current Topics in Energy Management and Innovation, Renewable Energy and Green Technology and Fundamentals of Project Management. A full list of required and elective courses can be viewed at the Chang School website: www.ryerson.ca/ce/energy

OUTREACH

With a vision to be a world class centre for research in solving urban energy challenges, CUE led many initiatives in order to partner with government agencies, industry associations, energy businesses and other universities around the world.

16 External Speaking Engagements

This year, fellows and staff spoke at various events including:

OCE Discovery
CanSIA Solar Ontario
Energy Matters Summit
Canada's Energy and Utility Regulators 2012 Energy Regulation Course
12th Annual MOPTA Conference
Electric Vehicle Day
Ontario Solar Summit & Expo
Optimization in Wind Energy
SmartGrid Conference
Sustainability Applied 2012
EUCI course on Canadian Electricity Regulation
APPrO 2012

3 Roundtables

CUE's Roundtable Series 2012 is a forum to support industry and identify research, technology and/or policy gaps. The CUE has the capability to assist industry stakeholders in bridging some of these identified gaps in the sector through an informed, innovation-focused dialogue, and in a proactive and rational manner.

12 CUE-Hosted Seminars and Conferences

In 2012, CUE has been involved in the planning, creation and hosting of many seminars, such as:

Toronto Hydro's Growing Grids

Portlands Energy Centre's Colloqium

Building an Energy Business: Are you an Energy Entrepreneur?

Control of Medium Voltage Drives

Innovating in a Regulated Sector

OEA's Conversations that Matter: The Merger Bill 75

GOOSE Publishing and Subscribing

Solar's High Noon: Winning the Day Through Photovoltaic Research and Investment

2 Research Days

Research Day is CUE's open house, where members of the Ryerson community, industry and academic partners visit the CUE and learn about the projects that researchers and students are currently involved in.

OUTREACH

Interns from Anna University

Brazilian Delegation visits the CUE

In April 2012, CUE along with other members of the Ryerson community, hosted a delegation from Brazilian universities and the Brazil's Servicio Nacional de Aprendizaje Industrial/ National Industrial Training Service (SENAI).

One of the aims for the visit was to agree on the mechanisms for sustainable collaboration within the Innovation Institutes.

The visit to the CUE was part of Brazil's investment in higher education that will include substantial numbers of international scholarships for their graduate and undergraduate students.

CUE Meets with InnovaChile

Chile is currently ranked 30th worldwide for economic competitiveness, and 1st in Latin-America. Through InnovaChile, an initiative of CORFO -the country's agency dedicated to promoting entrepreneurship and innovation, Chile recently embarked on an aggressive innovation agenda meant to stimulate productivity, growth and international competitiveness in key economic sectors.

In May 2012, the CUE met with a delegation from InnovaChile that has been studying Ontario's innovation eco-system. Having heard of Ryerson's success in encouraging entrepreneurship at the Digital Media Zone and at the Centre for Urban Energy, the meeting aimed to explore opportunities for Ryerson to join prestigious institutes such as the Fraunhofer Institute, Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Inria, as part of InnovaChile's initiative to establish partnerships with international centres of excellence.

UEC Internships at the CUE

Building on the CUE's partnership with Anna University, six undergraduate and graduate students from the Anna – Ryerson Urban Energy Centre (UEC) in Chennai, India, took part in internships at the CUE for the month of July 2012.

Toronto and Chennai face similar sets of challenges – they are densely populated and energy intensive. Research conducted at the CUE can be easily transferred to the UEC.

During their stay, the UEC students worked on various electricity projects including:

- Harmonic analysis of microinverters, which involves a power electronic interface for renewable energy sources
- Chaos theory in non-linear dynamics
- Micro-hydro electric generators - electrical/generator optimization
- Electrical impact on transformer station components due to electric vehicles
- Simulating and implementing the matrix converter to convert variable frequency
- Renewable energy source - wind energy

They were supervised by Dr. Bala Venkatesh, Dr. Bin Wu and Dr. Amir Yazdani.

Smart Grid Mission to China

Dr. Bala Venkatesh visited China as a member of the Canadian delegation for the Smart Grid Mission to China, which is led by the Cleantech and Infrastructure division of the Department of Foreign Affairs and International Trade (DFAIT) in co-operation with Smart Grid Canada.

Centre for Urban Energy
www.cue.ryerson.ca

Location

147 Dalhousie Street
Toronto, Ontario M5B 2M7

Mailing Address

Centre for Urban Energy
350 Victoria Street
Toronto, Ontario M5B 2K3

For more information

416 979 5000 x2974
info@cue.ryerson.ca