Technology Innovation & Policy Forum 2018

Unlocking Energy Innovation for a 'Low Cost-Low Carbon' Economy

November 7, 2018
Federation Hall
University of Waterloo

Innovation Showcase

The Technology Innovation and Policy Forum is pleased to present the Innovation Showcase featuring displays and projects, state-of-the-art products and information from institutional, corporate, government agencies and funding sources. Academia, entrepreneurs, innovators and industry representatives will be pleased to connect with you during the networking session times from: 8:00 to 9:00am, 12:30 to 2:30pm and 4:00 to 5:30pm.

The Waterloo Institute for Sustainable Energy (WISE) was established at the University of Waterloo in 2008. The Institute comprises more than 150 faculty members with graduate students and postdoctoral fellows working as multi-disciplinary research teams across Engineering, Science, Mathematics, Arts and Environment. The Institute is the focal point at the University of Waterloo (UW) for research in energy studies. In collaboration with utilities, private sector partners, government agencies and civil society groups, the Institute's goal is to foster the development of innovative technologies and alternatives to existing energy production and delivery systems, and to promote energy efficiency and environmental sustainability. At WISE, we have 31 state-of-the-art labs that can be used for applied research, technological development, and equipment testing.

The Department of Electrical and Computer Engineering (ECE) is Waterloo's largest academic department, with over 2,500 students, 86 full-time faculty members, and more than 50 supportive staff. Our research activities cover a wide range of fields, from high-voltage engineering and sustainable energy to breakthroughs in wireless technology that will enhance communications across our global society.

The High Voltage Engineering, Electricity Market Simulation and Optimization, Smart Distribution Research, Power Electronics, Advanced Battery Technologies, Center for Advanced Photovoltaic Devices and Systems, Solar Thermal Research, Fuel Cell and Green Energy R&D, Wind Energy, Green and Intelligent Automotive, and Maglev Microrobotics research lab facilities have been actively pursuing R&D and commercialization initiatives in the discipline of smart grid electrical systems at the national and international level.

In partnership with the Canadian Council for Clean and Reliable Energy we are pleased to offer this exciting opportunity to network with the innovators that are leading the way to a 'low cost-low carbon' economy.

Thank you to our event sponsors

INSTITUTIONAL SHOWCASE
STUDENT RESEARCH

UNIVERSITY OF WATERLOO

Application of Power to Gas Concept at an Automotive Manufacturing Plant

Azadeh Maroufmashat, Postdoctoral Fellow,
University of Waterloo

A promising Power-to-Gas energy hub concept is proposed for an automotive manufacturing plant in southern Ontario. This energy hub converts electricity from the power grid and solar panels to hydrogen gas to be used in multiple pathways. These applications include energy for fuel cell vehicles (FCVs), and injection in hydrogen enriched natural gas (HENG) pipelines which supplies for facility heating, and manufacturing processes. Ontario's surplus of electricity, combined with solar energy and natural gas, are all converted to supply electricity to the electrolyzer and output hydrogen gas. Some of the hydrogen that is produced is also blended into the natural gas pipelines and sent through a combined heat and power (CHP) unit to supply additional energy for the facility heating and manufacturing processes. Excess energy produced by the CHP can also be supplied back to the electrolyzer to create a continuous loop of renewable energy. Canada has one of the largest pipeline networks in the world, but there are limitations of introducing hydrogen at 5 vol% based on studies in Europe and Canada. Based on these findings there is restriction for the blending system to handle a concentration of 5 vol% hydrogen gas. The demand profile for the refuelling stations shows that the system is capable of supplying for 100 forklifts and 40 FCVs operating around the municipal region with a total capacity of 222 kg per day. The foundation of the Power-to-Gas system is based on a formulation of a mixed integer-linear-programming-model which optimizes the operation of all energy pathways and determines the installation capacity of the electrolyzer and compressors.

Our primary objective is to minimize capital costs, operational costs, as well as produce revenues selling hydrogen, and providing the demand response for ancillary services to the power grid. Power-to-Gas also creates a net-emission reduction which could be used to sell emission allowances in the provincial Cap & Trade program in Ontario.

Next, the available area for the energy hub is 2400 m2 which will account for the electrolyzer facility, hydrogen storage, and compressor units. This site is in close proximity to the refueling stations, CHP unit, controls center, and electrical substation, so the existing logistical pathways for energy transfer can be taken advantage of. Additionally, unshaded roof space of 160,000 m2 is available throughout the plant for solar arrays to generate a daily energy output between 117 to 150 MWh. Hydrogenics will provide their PEM electrolyzer for the system which can produce 99.999% pure hydrogen gas to supply for the dispensing stations. A Greenfield reciprocating compressor will compress the hydrogen gas to 172 bar to store in the ASME storage tank with a capacity of 89 kg. Finally, the post-storage compressors will compress to 825 bar and 250 bar for refueling the FCV and forklifts, respectively. The blended hydrogen will be injected into the natural gas pipelines at 5%vol and led to two CHP units (Centaur 50 CHP) with a nominal output power of 9200 KWe in total. The HENG will supply for facility heating demands which include the paint booths and plastics department. All of these processes have considered applicable safety instrumentation and are in accordance with all relevant codes and standards.

The installation of the Power-to-Gas system will require a total capital investment of $2,620,448. The electrolyzer and 1500 solar panels will account for 41% and 17% of the capital costs, respectively, as they are major processes used to supply electricity and hydrogen gas. The compressors will account for most of the operating costs which total $237,653. The energy hub, 76,073 kgH2 per year will be produced for all the end-use applications. Based on a sensitivity analysis, the annual revenue for selling hydrogen at $1.5 to $12 per kgH2 can sum to $54,741 to $437,928. In the Cap & Trade program, CO2 allowances can be sold at $18 to $30 per tonneCO2 and the model predicts a CO2 offset of 2359.7 tonnes. The optimal streams of revenue include selling hydrogen at $12 per kgH2 and selling CO2 allowances at $30 per tonneCO2. The ancillary services incentives are kept constant at $15 per MWh. With a combination of these optimal revenue streams the automotive manufacturer can expect a payback period of 2.8 years.

INSTITUTIONAL SHOWCASE
STUDENT RESEARCH

Random Field Modelling of Wall Thinning due to Flow Accelerated Corrosion

Sreehari Ramachandra Prabhu, PhD Candidate,
University of Waterloo

Flow accelerated corrosion (FAC) is a degradation mechanism which causes wall thinning of carbon steel piping in power plants. The uncertainties involved in the factors leading to FAC mechanism introduces varying thinning rates in the feeder pipe population, which leads to various pipe wall thicknesses. The local thinning at the vicinity of welds introduces additional uncertainties. Probabilistic approaches have been used for reducing the uncertainty by considering the minimum thickness point as a random variable. However, the concept of a single random variable cannot capture the real nature of this problem since the wall thinning is a spatially distributed mechanism. This paper describes a random field modeling approach to effectively account for the spatial variation in wall thickness and to simulate samples of wall thickness patters using the spectral representation method. The simulated samples can be used in Stochastic Finite Element Analysis for a probabilistic study on pipe structural integrity.

Smart Operation of Four-Quadrant Electric Vehicle Chargers in Distribution Grids

Mauricio Restrepo, Post Doctoral Fellow,
University of Waterloo

An average model of a single-phase, four-quadrant EV charger is developed. The steady-state and step responses of the proposed model for different P-Q requests are used to validate its performance against a four-quadrant EV charger prototype. Also, a three-stage algorithm to coordinate the operation of four-quadrant EV chargers with other volt/var control devices in distribution feeders is proposed. The first stage of the algorithm is operated on a day-ahead basis, and defines the LTC and capacitor schedules while minimizing the peak load associated with EVs.

The second and third stages update their operation every five minutes, to fairly allocate the aggregated and individual EV loads in the MV and LV feeders, while minimizing active power losses and voltage deviations.

Impact of Battery Energy Storage of Transmission Systems

Fabian Mauricio Calero, PhD Candidate,
University of Waterloo

A Battery Energy Storage System (BESS) dynamic model is presented, which considers average models of both voltage source converter (VSC) and bidirectional buck-boost converter (dc-to-dc), for charging and discharging modes of operation. The dynamic BESS model comprises a simplified representation of the battery cells, which allows to simulate the effects of battery degradation, dc-to-dc converter, VSC, and the dynamics associated with the filter and transformer connecting the BESS to the grid. Decoupled dq-current control is used for the VSC, allowing the operation of the BESS in several modes: constant active and reactive power, constant power factor, voltage regulation, frequency regulation, oscillation damping, and a combination of these. The importance of modeling the current control and dynamics of the dc-to-dc is demonstrated when the battery cells are degraded due to, for instance, ageing. The proposed model is implemented in DSATools and tested for different contingencies, connected to a benchmark system and compared with one of the most common existing BESS models.

Modelling of Compressed Air Energy Storage for Power System Studies

Ivan Calero, PhD Candidate,
University of Waterloo

A detailed mathematical model of a diabatic Compressed Air Energy Storage (CAES) system and a simplified version are presented, considering independent generators/motors as interfaces with the grid. The model includes the compressor, synchronous motor, cavern, turbine, synchronous generator, and associated controls. The configuration and parameters of the proposed model are based on the existing bulk CAES facilities of Huntorf, Germany. The performance of the CAES system model are the first evaluated with step responses, and then examined when providing frequency regulation in a test power system with high penetration of wind generation, comparing them with existing models of CAES systems.

INSTITUTIONAL SHOWCASE
STUDENT RESEARCH

Steady-State Analysis and Optimal Power Routing of Standalone Hybrid AC/DC Microgrids

Mahmoud A. Allam Alsanbawy, Postdoctoral Fellow, University of Waterloo

Conventional power flow analysis approaches cannot be applied to standalone hybrid ac/dc microgrids due to their distinctive features, such as droop characteristics, lack of a slack bus, and coupling between the ac and dc variables. To overcome these hurdles, a generic steady-state analysis approach that accommodates the system characteristics has been developed. First, mathematical models of various ac and dc distributed generator (DG) types and interlinking converters (ICs) have been developed, based on their different structures and control topologies. Second, a power flow algorithm integrating these models has been proposed to solve for the hybrid microgrid's variables. Furthermore, the developed power flow algorithm has been used to identify some operational challenges of these microgrids, such as their restricted loadability due to the unbalanced ac subgrid's operation. Accordingly, a novel optimal power routing scheme has been proposed to resolve the identified operational issue. The results show the effectiveness of the developed tools in analyzing the system and alleviating the loadability restriction.

Innovative Energy Research at the Waterloo Institute for Nanotechnology (WIN)

Oleg Stukalov, Business Development Manager, WIN, University of Waterloo

Next Generation Energy Systems is a key thematic area in nanotechnology research with WIN members focussing efforts on meeting global energy needs for sustainable energy production. Nanotechnology seeks to address these challenges by investigating novel materials for improved battery design and storage systems, efficient solar cells, waste energy harvesting, thermoelectric conversion and new low-carbon innovations that will lead to greener and cleaner power for today and tomorrow. Under WIN's banner, students will present research results on efficient hydrogen generation for fuel cells, recent advances in battery and supercapacitors research for energy storage, and micro-power generators.

Strategic Support for Circular Economy in the Construction Industry through Product Recovery Management

Ben Sanchez,[1] Chris Rausch,[1] & Carl Haas,[2]

1 PhD Candidate, Civil & Environmental Engineering;
2 Professor, Civil & Environmental Engineering,
University of Waterloo

Buildings contribute significantly to the global environmental load caused by human activities. From a life cycle perspective, the building industry is responsible for about 30 per cent of global annual Greenhouse Gas (GHG) emissions, 40 per cent of energy consumption, 32 per cent of earth's resource depletion, 12 per cent of water consumption, and 40 per cent of waste to landfill. As such, there has been growing interest to improve a building's performance over its life cycle stages (production, construction, operation, and End-of-Life [EoL]) to increase sustainability within the construction industry. Our research team is developing novel strategies to address these ongoing sustainability challenges by promoting product recovery management and a circular economy (CE) for existing building infrastructure. Our strategies merge cutting-edge technologies with the most updated and realistic building databases to improve the monetization of environmental impacts. The first aspect of our research examines adaptive reuse for buildings which involves restoring and, in some cases, changing the existing use of buildings that are obsolete or are nearing their disuse stage. By analyzing data provided by our industry partners, we are demonstrating how to utilize Life Cycle Assessment (LCA) in decision making to quantify and monetize the environmental savings of adaptive reuse. We have developed an optimization tool using computational algorithms to assist in maximizing the environmental benefits in the process of adaptive reuse by recovering as much of the economic and ecological value of an existing building as possible. On a future stage, our research will be extended across the entire building stock to determine the potential environmental benefits in a typical city which include factors such as initial embodied energy, initial embodied GHG emissions, initial embodied water, and material stock. By quantifying and mapping the potential environmental benefits embedded in the building stock, governments and city councils will have data to better understand, plan, and transform existing infrastructure systems towards sustainable development, resilient configurations, and CE by using the existing redundancy of the built environment. Our research represents an advance to the forefront of regulations for energy and natural resource value chain in the construction industry.

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INSTITUTIONAL SHOWCASE
STUDENT RESEARCH

Transformer Insulation Diagnostics and Condition Monitoring of Line Insulators

Satish Kumar Polisetty, Graduate Student -MASc, University of Waterloo;
Anurag Anand Devadiga, PhD Candidate, University of Waterloo

The significant global growth in renewable energy production has led to increasing concerns about the problems associated with electrical equipment in power plants connected with this type of energy. The crucial electrical components of renewable energy generation are step-up transformers, with respect to which, gassing problems and premature insulation failures have been extensively reported in recent years. One of the factors related to the reported problems is the presence of high-frequency high-dV/dt voltages that are created by switching operations in wind energy plants. The present work deals with diagnosis of wind turbine step-up (WTSU) transformers by using various techniques like dissolved gas analysis, frequency response analysis, partial discharge measurements, and dielectric frequency response. The work mainly involves detailed understanding of the influence of repetitive transient over-voltages on WTSU transformers and developing possible mitigation techniques.

On another note, on-line condition monitoring of critical assets is one of the ways the electrical insulation industry can contribute to safeguard the grids by avoiding system outages due to insulator failure. As such, the electric utilities are now focusing online monitoring in the field of condition monitoring of power system components. Here in high voltage engineering laboratory at the University of Waterloo, attempts have been made to study the condition of line insulators using radio frequency and acoustic emission techniques. Artificial intelligence tools are employed in the analysis and decision making in an effort to detect the defected insulators effectively.

PEV Charging Infrastructure Siting Based on Spatial-Temporal Traffic Flow Distribution

Ahmed Abdalrahman, PhD Candidate, University of Waterloo

Plug-in electric vehicles (PEVs) offer a solution to reduce greenhouse gas emissions and decrease fossil fuel consumption. PEV charging infrastructure siting must ensure not only a satisfactory charging service for PEV users, but also a high utilization and profitability for the chosen facility locations. Thus, the various types of charging facilities should be located based on an accurate location estimation of the potential PEV charging demand. In this research, we propose a spatial-temporal flow capturing location model. This model determines the locations of various types of charging facilities based on the spatial-temporal distribution of traffic flows. We utilize the dynamic traffic assignment model to estimate the time-varying traffic flows on the road transportation network. Then, we cluster the traffic flow dataset into distinct categories using the Gaussian mixture model and site each type of charging facilities to capture a specific traffic pattern. We formulate our siting model as a mixed integer linear programming (MILP) optimization problem. The model is evaluated based on two benchmark transportation networks, and the simulation results demonstrate effectiveness of the proposed model.

The Accelerator Center

Tabatha Laverty, Manager, Marketing & Communications;
Cam Wind, Manager, Programs & Client Experience, The Accelerator Center

The Accelerator Centre (AC) helps entrepreneurs grow and scale their companies quickly and efficiently. The award winning program, which was ranked one of the top accelerator programs in the world by UBI Global, provides education, one-to-one mentorship and funding opportunities to startups across Southwestern Ontario. This year, the AC has launched a specialised program and facility for clean tech entrepreneurs known as the TD Sustainable Future Lab. Stop by and learn about the program and discover some of the incredible innovations being developed through the program.

INSTITUTIONAL SHOWCASE
STUDENT RESEARCH

Enhanced Active and Reactive Power Sharing in Islanded Microgrids

Mehdi Parvizimosaed, PhD Candidate,
University of Waterloo

Due to the urgent need to develop a more efficient, more reliable, and cleaner electric power grid, the energy sector is currently moving towards the introduction of smart grid. Within the smart grid, a microgrid is a low-voltage distribution network which consists of a variety of distributed generators (DGs), energy storages, and both controllable and uncontrollable loads. The microgrid operates in two modes: 1) interconnected mode linked to the main grid through a distribution substation called power common coupling (PCC), and 2) islanded (autonomous) mode when the microgrid is isolated from the main power grid during a fault or disturbance. In the islanded mode, the microgrid control system for frequency and voltage is more challenging than that in grid-connected operation mode, especially when there are more than one energy source. we present a new distributed transient droop control (DTDC) for frequency and voltage regulation in an islanded microgrid based on active and reactive power data communicated among nearest-neighbour distributed generators. The controller requires no knowledge of microgrid topology, line impedances, and types of loads, and rapidly regulates the frequency and voltage of islanded microgrid to their nominal values while accurate active and reactive power sharing is maintained among distributed generators. Our proposed controller provides simplicity, flexibility, and redundancy of control scheme while keeping the frequency and voltage stability margins. Small signal state space model of the islanded microgrid is developed for frequency and voltage stability analysis under the DTDC. Analytical time-domain simulation results demonstrate the effectiveness of proposed DTDC in frequency and voltage control under communication disruption and fully cooperated control model.

PEV Charging Infrastructure Siting Based on Spatial-Temporal Traffic Flow Distribution

Yasaman Masoudi , PhD Candidate, Autonomous Vehicle Team, University of Waterloo

Research at the Smart Hybrid and Electric Vehicle Systems (SHEVS) Laboratory is focused on connected and automated vehicles where we specialize in developing novel control systems for ecological, safe, and smooth vehicle operations in complex and multi-vehicle driving situations, primarily on connected and automated hybrid and electric vehicles which represent next-generation sustainable transportation systems.

Prof. Nasser L. Azad directs the Smart Hybrid and Electric Vehicle Systems (SHEVS) laboratory, a centre of excellence in vehicle control systems design and optimization. In addition he has investigated the application of computational intelligence and evolutionary optimization techniques to the solution of a variety of engineering problems.

Differential Power Processing in Offshore Wind Farms

Marten Pape, PhD Candidate,
University of Waterloo

Large-scale offshore wind farms contain many wind turbines in a locally confined space. As such, the wind conditions experienced by individual turbines at a given time contain certain similarities. These similarities represent an opportunity to reduce the electrical conversion equipment required to be deployed offshore and indicate potentials for conversion efficiency improvements. In this research, wind turbines featuring a DC-voltage collection system, as well as converter arrangements only processing output power differences among wind turbines are investigated. Modeling has confirmed the expected benefits, compared to today's technology, as well as similar

INSTITUTIONAL SHOWCASE
STUDENT RESEARCH

Development of Polymer Composites for Power Industry

Khadija Kanwal Khanum, Postdoctoral Fellow, University of Waterloo

As the World's energy demand seems to be all time high and increasing, the focus of research is now more on renewable and sustainable energy. The power industry needless to mention acts as a bridge between all types of energy generation and the consumers. In this study, the importance of nanocomposites materials and its processing with respect to power industry are discussed. Nanocomposites are remarkable class of materials, consisting of various types of nano-fillers which acts as reinforcement in the matrix and thus enhance the desired properties. These nanomaterials have to be dispersed homogeneously in the matrix to gain optimized effects and therefore require special processing tools. Therefore in this research, processing of various polymer nanocomposites of silicone filled with silica and alumina fillers are highlighted. Various processing techniques such as high shear mixing and electrostatic dispensing are evaluated and the effect of processing methods on the electrical insulation properties of nanocomposites are studied. Also along with the results, other ongoing research and facilities of high voltage laboratory would be presented.

Apart from reactor design and catalyst selection, it is key that the methanation system be designed and optimized to study the feasibility of this technology. The process design for the methanation system utilizes design software ASPEN HYSYS and aims to address the challenges mentioned above. To evaluate the feasibility of this technology, techno economic assessments of the system have been done to analyze the project costs, profit margins and overall economics. Sensitivities have been conducted to test the effects of various parameters on the project costs. Various configurations of plant design have been considered and assessed to allow optimization. With the results obtained thus far, the project seems feasible and its economics highly depend on both the selling price of renewable natural gas and the price of electricity.

Stress Grading System of Medium Voltage Motor Fed by Adjustable Speed Drives

Alireza Naeini, PhD Candidate, University of Waterloo

Meeting today's energy demand is one of the most important issues in the world, so it is essential to enhance the efficiency of power consumption. An induction motor with an adjustable speed drive (ASD) results in a high efficiency system and flexible control of processes and machinery, and can cover a wide range of applications. Therefore, the application of this combination has increased rapidly. Over the past ten years, the demand for ASDs has been growing, especially at medium voltage and in many applications. This trend creates a challenge for the insulation structures of motors because of the presence of repetitive pulses in the output voltage of ASDs. The immediate output of inverters is a pulsed voltage or current, and the objective of the controller is to control the fundamental component of the output voltage or current. Stress grading systems are among the most important part of insulation system of medium voltage (MV) motor winding. They are used to prevent partial discharge (PD) in the air gaps between the surface of coils, and also in the end winding region. In these regions, the electric field is increased more than the critical electric field, so PD is produced. PD can deteriorate the insulation system and eventually cause motors to fail. In addition, they produce ozone, which is harmful for insulation and also for the metal parts of motors. A stress grading system consists of two main parts: conductive armour tape (CAT) and stress grading tape (SGT).

INSTITUTIONAL SHOWCASE
STUDENT RESEARCH

Techno-Economic Assessment of Power-to-Gas for Synthetic Natural Gas Production from Biogas

Sogol Mottaghi-Tabar, MASc Candidate,
University of Waterloo

Energy demands are forecasted to grow with increasing global populations and further industrialization. As a result, an increase in greenhouse gas (GHG) emissions is expected in the years to come. Although research is underway for carbon dioxide capture technologies, a viable option for dealing with these GHGs is to utilize them for synthesis of chemicals or fuels. Photochemical and electrochemical reduction of carbon dioxide are currently being evaluated as a means to produce various hydrocarbons without the use of petroleum products. Although these approaches display potential, they are inherently limited by carbon dioxide solubility in water and show severe diffusion limitations. Alternatively, thermo-catalytic conversion of carbon dioxide shows promise with its ability to pair high temperatures with heterogeneous catalysis. One particular reaction to consider is the methanation of carbon dioxide; where carbon dioxide molecules are reacted with hydrogen to produce methane and water. This technology can be implemented for biogas, landfill gas or flue gas treatment and presents a viable route for obtaining synthetic natural gas (SNG). This power to gas system can allow for generated SNG to be stored in the existing natural gas infrastructure for long periods of time and dispatched when required for use by both natural gas end users and combined cycle generators to meet power grid demand peaks.

This project presents many challenges which must be addressed. The methanation reactor's highly exothermic nature requires an adequate heat removal system for both safety and operational optimization. The process requires considerable amounts of hydrogen to be produced. It is important that the hydrogen be obtained feasibly and with low emissions as synthetic natural gas will be renewable only if the hydrogen required for the reaction is generated using renewable energy sources. Inert gases and any other undesirable gases must be removed from the SNG prior to compression and pipeline injection to meet pre-existing pipeline specifications. Additionally, sour biogas must be sweetened as H_2S is poisonous to the methanation catalyst.

Apart from reactor design and catalyst selection, it is key that the methanation system be designed and optimized to study the feasibility of this technology. The process design for the methanation system utilizes design software ASPEN HYSYS and aims to address the challenges mentioned above. To evaluate the feasibility of this technology, techno economic assessments of the system have been done to analyze the project costs, profit margins and overall economics. Sensitivities have been conducted to test the effects of various parameters on the project costs. Various configurations of plant design have been considered and assessed to allow optimization. With the results obtained thus far, the project seems feasible and its economics highly depend on both the selling price of renewable natural gas and the price of electricity.

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CORPORATE SHOWCASE
FUNDING AGENCIES & ASSOCIATIONS

Waterloo Region Electric Vehicle Association (WREVA)

Mark Coughlan, Founder, Waterloo Region Elecrtic Vehicle Association (WREVA)

Waterloo Region Electric Vehicle Association
WREVAG@gmail.com @WREVAGroup

The Waterloo Region Electric Vehicle Association (WREVA) is a group of EV Owners and Enthusiasts in the region dedicated to Electric Vehicle promotion and education. We host and participate in many EV Events and Meetings throughout the year, in order to educate the public on the benefits of EV Ownership. Interested in receiving our emailed monthly newsletter? Contact us via email WREVAG@gmail.com or via Twitter @WREVAGroup

Mictacs Inc.

Ashley Hannon, Business Development Specialist, Waterloo, Mictacs

Mictacs

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The Affordable Energy for Humanity Global Change Initiative (AE4H)

Nigel Moore, Manager, Global Programs & Initiatives, Waterloo Instituite for Sustainable Energy

AE4H Global Change Initiative

The Affordable Energy for Humanity Global Change Initiative is an emerging international collaboration between the world's leading scientists, technology developers and practitioners on the topic of universal energy access. Our Vision is to deliver the next generation technologies, innovations and practical solutions that will drive the costs of energy services to a level low enough for a revolution in energy access without the need for tax incentives and subsidies.

Participants in this initiative are guided by a common purpose to apply their skills, expertise and knowledge to the urgent cause of improving the affordability of clean energy in contexts where it matters most. Harnessing the resources and enthusiasm of researchers in order to change the energy access equation is the primary inspiration behind the initiative.

Keysight Technologies

Peter Schweiger, University of Waterloo Account Manager; **Nizar Messaoudi**, University of Waterloo Application Engineer, Keysight Technologies

KEYSIGHT TECHNOLOGIES

Keysight, formerly Agilent Technologies Electronic test and Measurement group, is a leader in enabling test engineers to bring their technologies to market faster and at lower cost. Our automotive & energy industry and solution group focuses on measurement and development solutions for on Connected Car, Automotive Radar, electric vehicle, battery, power semiconductor, Smart Grid, & renewable energy technologies.

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Ontario Centres of Excellence (OCE)

Dan Ruby, Business Development Manager
Ontario Centres of Excellence

Ontario Centres of Excellence
Where Next Happens

Ontario Centres of Excellence (OCE) drives job creation, economic development and the province's global competitiveness on behalf of the Government of Ontario. OCE co-invests with industry to accelerate the commercialization of innovation originating in the province's publicly-funded colleges, universities and research hospitals, resulting in new, made-in-Ontario products, services, technologies and solutions.

Lime

Meghna Kedia, City Launcher, Lime

Lime

Lime is revolutionizing micro mobility and empowering a new urban lifestyle. The mobile app lets riders easily find and unlock our fleet of shared smart bikes and scooters, providing them with a fun, efficient and sustainable way to move around the city. By partnering with local communities, Lime is working to not only improve transportation, but cultivate a culture centered around active, healthy and sustainable urban living. Since launching in June 2017, the company has logged over 13 million rides across the US, Europe and Oceania. Lime is based in San Francisco, CA, and is funded by leading VC firms including Google Ventures, Fifth Wall and Andreessen Horowitz.

Pond Technologies

Punyama Jayasinghe, Chemical Process Engineer;
Philipp Garber, Manager, Marketing, Pond Technologies

pondtech

Pond (TSX.V:POND) is a Canadian technology company with applications in pollution abatement, nutrition and cannabis. Pond designs and operates scalable bioreactors that use society's most abundant product – industrial greenhouse gas emissions – and Pond's specialized growing systems to cultivate algae and other valuable biomass. Pond's systems effectively close the carbon loop and create wealth from waste.

With support from Ontario Centres of Excellence, the National Research Council, and other partners, Pond has been refining its technology at St. Marys Cement since 2011 and is currently building its first two Ontario commercial plants, at Stelco Steelworks in Nanticoke and at Markham District Energy in Markham. Both plants are expected to produce valuable algae by the end of 2019 and sell into several sectors: the burgeoning natural food colouring, health supplements and bio-ink markets, as well as the vast volume markets of fishmeal and bioplastics.

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CORPORATE SHOWCASE
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iGEN Technologies

Alan Clarke, Director of Business Development, iGen Technologies

iGEN Technologies Inc. is an Ontario based company specializing in the manufacturing and turn-key installation of innovative power generation systems. The two principal owners of the company are Michael Chatzigrigoriou and Patrick Lai, both with engineering and business experience in the energy management industry.

The iGEN system simultaneously provides both space heat and power to satisfy basic societal needs across well-established market sectors. The mission of iGEN is to reduce fuel costs for communities through the deployment of an innovative packaged heat-and-power generation system that functions by either burning a common fuel source or recovering waste heat to generate supplemental power.

The iGEN system is built up from components, all sourced and installed from carefully chosen technology partners. The payback is aggressive, the technology clean, and operation is seamless. iGEN is confident the triple bottom line (economics, environment, end result) expectations of prospective clients will be met with this solution.

Canadian Gas Association Fund

John Adams, Managing Director, Natural Gas Innovation Fund, Canadian Gas Association

CANADIAN GAS ASSOCIATION
ASSOCIATION CANADIENNE DU GAZ

Founded in 1907, the Canadian Gas Association (CGA) is the voice of Canada's natural gas distribution industry. Our members are natural gas distribution companies, transmission companies, equipment manufacturers and other service providers. Canadian natural gas distribution companies deliver natural gas to approximately 7 million homes, schools, hospitals, places of worship, to meet their energy needs. Combined this represents almost one-third of all the energy needs in Canada, coast to coast to coast. By our estimate that is well over 20 million Canadians who currently have the opportunity to benefit from the safe, clean, reliable, abundant, and affordable energy service that natural gas utilities provide.

We also develop educational information and organize and sponsor training schools, workshops, seminars and conferences to foster dialogue on energy policy and achieve a better understanding of natural gas.