

NSERC Smart Net-Zero Energy Buildings Strategic Research Network



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Planning for the Fourth Annual General Meeting By A. K. Athienitis, Scientific Director

The Network received a highly positive evaluation of its Mid Term Report to NSERC and is now planning its Fourth Annual General Meeting in Saskatoon, May 19-21, 2015. This extensive issue of the newsletter reports on some of the Network achievements, activities and recent events.

The Network recently lost Concordia Professor Paul Fazio, one of its founding Theme Leaders and senior members who passed away in September 2014. He left behind a legacy of tremendous contributions to Canada, Concordia University and building engineering, a new discipline that he established and led. An article on Paul's many achievements is included in this newsletter.

The Network also lost one of its key industry supporters – Gordon Shields, who led the establishment of the Net-zero Energy Home Coalition. An article on Gordon is included in this newsletter as well.

Our Network manager Josef Ayoub successfully completed his secondment to the Network and returned to the NRCan CanmetENERGY Laboratory in Varennes, playing a key role in further developing our collaboration with CanmetENERGY. Josef is still very much involved in the Network in technology transfer, the 4th AGM and many other collaborative activities. The duties of network manager are now split between two staff members at Concordia's Centre for Zero Energy Building Studies (CZEBS): Gerald Parnis (Communications and organization of

scientific meetings) and Jacques Payer (Project management, industry interaction). Our main output under IEA SHC Task 40 / EBC Annex 52 – a book on modelling, design and optimization of NZEBs is now available from Wiley. About 10 researchers and graduate students contributed to this important publication. Josef was Operating Agent of the Task and the book is co-edited by Liam O'Brien and myself. This newsletter includes an article by Josef.

I would like to welcome our new researchers : Dr. Hua Ge (an expert in building envelope) from Concordia, Dr. Philippe Pasquier (an expert in geothermal) from Polytechnique and Caroline Hachem-Vermette (building engineer, architect and expert in solar community design) from Calgary. We also welcome our three new industry partners: s2e (a leader in smart community design – led by Milfred Hammerbacher) , Arctic Energy Alliance and Internat Energy Solutions Canada Inc. Each of these partners gave presentations at the Montreal AGM in May 2014. An article on the new partners is included in this newsletter.

We look forward to seeing you all in Saskatoon in May 2015. We will follow a similar format to the Montreal AGM with the first day (May 20th) being an Industry Day and research reporting taking place on May 21st. We will also have a poster session and a student-focused event. More details can be found on our website: www.solarbuildings.ca

Montreal 3rd Annual General Meeting, Day 1 Workshops

Gerald Parnis, J. Bambara, A. Kayello, V. Dermardiros, Y. Chen, T. Yang, K. Capsis,
Concordia University

Day 1 of the 3rd SNEBRN AGM, held in Montreal, May 2014 included three Industry/Stakeholder Collaborative Workshops and a Poster Presentation Session (see the story in this newsletter). The Workshops consisted of panel discussions on aspects of Net-Zero Energy Buildings (NZEBS) with panelists including researchers and professionals from academia, industry and government (Network industry partners and stakeholders) working in the area of NZEBs.

The first workshop entitled Design of NZEBs and Communities, was co-chaired by Milfred Hammerbacher, CEO, S2E Technologies Inc. (a Network partner) and Network researcher Caroline Hachem-Vermette from the University of Calgary.



Milfred Hammerbacher, chair and Caroline Hachem-Vermette, co-chair of the 1st Day 1 workshop

The main theme of this workshop was the evolution/integration of low-energy and sustainable techniques/technologies from buildings to communities. Yichao Chen from the Arctic Energy Alliance, a not-for-profit organization working mainly in Northwest Territories (see the article on the new Network partner AEA in this newsletter), presented the many challenges related to the design and deployment of high performance housing in a Northern Canadian environment where the housing challenges are very significant. These challenges include construction integrity for building on permafrost, potential snow accumulation at solar collector and photovoltaic (PV) installation sites and durability issues. Installing collectors and PV panels at higher tilt angles (60° or more) is advisable.

Martin Roy, President of Martin Roy et Associés (a Network partner) highlighted his experiences in the design of Québec's first NZEB, the municipal library at Varennes. The design included a BIPV/T system, an airtight and highly insulated envelope, the use of geothermal heat pumps, centralized efficient indoor and outdoor lighting systems with motion sensors, natural and heat recovery ventilation and radiant heating/cooling flooring. Building performance data is being collected and will be used for ongoing commissioning (building operation fine tuning) as well as evaluating the difference between the actual and modeled building performance. Network researchers and students provided input to the early design stages of the building.

Continued...

Montreal 3rd AGM, Day 1 Workshops...continued

Another Network partner, Mark Bessoudo, Project Associate, Halsall Associates, Toronto, pointed out that new building surfaces often have conflicting priorities with energy rarely being the only priority. Budgets are often limited and designs need to satisfy many objectives. The example of a semi-transparent PV-based greenhouse satisfies 3 potential design objectives: food production, energy production and rainwater harvesting. Often neglected during the initial design phase, plug loads are important to take into account as they can overburden energy budgets. One presented solution entails the allocation of tenant energy quotas and charges applied for energy consumption above these quotas.



AGM Collaborative Workshop #1: (L to R) Martin Roy, Yichao Chen, Roland Charneux, Tom Hootman, Mark Bessoudo, Milfred Hammerbacher, Caroline Hachem

Tom Hootman, Director of Sustainability, RNL, Colorado, discussed issues related to integrating the grid with energy systems of a net zero energy community. These include: engaging utilities with PV, managing the mismatch of energy demand with energy production, and islanding. Community level micro-grids can help to reduce this mismatch by combining various renewable energy generation techniques (solar, wind, biomass, etc.) that have different production peaks. Storage is also an important complement to a micro-grid.

Roland Charneux, Executive Vice-President of Pageau Morel & Associates Inc., Montréal (a Network partner) presented plans for a new large community development in Montreal that will include both residential and commercial buildings. Measures for both high energy efficiency and for optimizing renewable energy generation will be required to attain aggressive energy consumption targets that are a fraction of the consumption estimate of the community built according to the national building code. These include high performance and dynamic envelopes, daily and seasonal energy storage, waste energy reuse and optimal solar energy capture. This development will have a district heating and cooling loop.

Mr. Milfred Hammerbacher, CEO of S2E Technologies Inc., Waterloo, Ontario described a new “Smart Community” in London, Ontario being designed and developed by a team of partners led by S2E. The team includes developers, a utility company and researchers from the Network, industry and government. The 70 acre development will include residential units, office space and retail space. Milfred emphasised that holistic design is essential for achieving a net-zero energy community design. For example, the excess heat from the grocery stores’ refrigeration system will be used to heat a rooftop greenhouse in winter or used in a local ice rink.

Continued...

Montreal 3rd AGM, Day 1 Workshops...continued

The second workshop, entitled Operation of high performance net-zero energy buildings, was cosponsored by the NSERC/Hydro-Québec Industrial Research Chair held by Dr. Athienitis at Concordia University. It was co-chaired by Dr. Jocelyn Millette, Chef Technologie – Clientelés, Institut de Recherche d'Hydro-Québec, and Dr. Athienitis, SNEBRN Scientific Director and Director of Concordia Centre for Zero Energy Building Studies. Dr. Millette introduced the workshop by pointing out that most high performance buildings do not perform as they were modeled and this discrepancy needs to be addressed by refining and validating existing models.

Dr. Athienitis presented the challenges that are needed to be met for operating buildings to achieve Net-Zero Energy operation: peak energy demand reduction and shifting, assuring occupant comfort and integrating renewable energy production with smart grids.

Ahmed Daoud, a researcher from Hydro Québec elaborated on one of the central motivations of research at Hydro Québec: to shift and reduce peak electricity demand during the winter season. Case studies were presented that included occupant behaviour and comfort.

Marc Dugré President, Regulvar Inc., Québec (a Network partner) spoke about the need to integrate mechanical and Building Management Systems into an information technology framework. Many advanced devices are not plug-and-play, difficult to optimally operate and difficult to monitor. For example, a “smart” chiller that does not report instantaneous energy consumption or COP. Building systems operate too independently of each other and do not communicate (HVAC, security, elevator, lighting, fire). Occupancy behaviour cannot be well predicted using schedules and IR sensors alone. There is a need for HVAC, electrical and security systems to connect to or at least be aware of personal devices (e.g. cellphones) for occupancy-related decisions to be made accurately.

Robert Patenaude, President, Energenia, Québec described his experiences of implemented energy efficiency measures at many bank branches throughout Québec. He emphasised that energy efficiency is not the top priority of the landlord or tenants and that comfort could not be sacrificed for energy efficiency improvements. Bank buildings offer a good opportunity to integrate security systems with the Building Management Systems: the building’s alarm state can be used both by the HVAC system to determine occupancy and to activate all lights when an intruder is detected.



AGM Collaborative Workshop #2: (L to R) Martin Bazinet, Robert Patenaude, Liam O’Brien, Marc Dugré, José Candanedo, Andreas Athienitis, Jocelyn Millette.

Continued...

Montreal 3rd Annual AGM, Day 1 Workshops...continued

Martin Bazinet, Director, Energy Group, Cofely DF-Suez, Québec described the experiences of Cofely, the operator of large and complex buildings located in Montreal. Martin emphasised the importance of comfort and highlighted the challenges of taking over a building with obsolete infrastructure: it is sometimes impossible to add monitoring tools. New buildings rarely achieve their LEED energy target due to issues such as: building complexity, energy models disregarding after hours “ghost” consumption (computers, billboards, security lighting, etc.) and a design based on a full occupancy model. Thermal storage and energy reduction during unoccupied periods can play a significant role in energy efficiency measures.

Dr. José Candanedo, Research Scientist with CanmetEnergy, Natural Resources Canada, pointed out that model-based predictive control (MPC) can be used to improve load management, utilize renewable energy and facilitate grid-building interaction. MPC strategies need to be robust and reliable but do not need to be perfect during short time scales. MPC models are not the same as design and validation models (simulation tools): control strategies should be based on simple models that can be understood and implemented easily and perform well for control purposes.

Dr. Liam O’Brien, Assistant Professor, Carleton University presented his research aimed at integrating occupant behaviour with building design and operation. The uncertainty of occupant behaviour requires: (i) static qualities of a building that contribute to comfort; (ii) adaptive controls that learn from occupant actions and auto-adjust to zone size at installation and varying occupant numbers; and (iii) operational (marketing) policies that encourage desirable occupant behaviour.

The third workshop entitled Enabling technologies for net-zero energy buildings, was co-chaired by Dr. Gilles Jean, Director General, NRCan/CanmetENERGY (a Network partner) and Dr. Cynthia Cruickshank, Associate Professor, Carleton University and Network Researcher.

Craig Hamilton from Celestica Inc., Toronto gave a manufacturer’s perspective on BIPV (Building Integrated Photovoltaics) uptake in Canada and the US. With BIPV installations at less than 2% of the global PV installed capacity, BIPV is one of the fastest growing segments of the solar industry and yet in Canada, BIPV is still at the demonstration phase. Craig presented some changes required to increase the North American uptake of BIPV: thermal and daylighting performance data needs to be available to the customer, certification and testing standardization needs to be established, reliability standards must be in the 20 -25 year range and BIPV products need to serve the “form-fit-function” like other components of building facades.

Sophie Hosatte, Director of the Buildings Program, CanmetEnergy, Natural Resources Canada, described heat pump technology as being a key component in the design and development of Net Zero Energy Buildings. Heat pumps (HP) are central to the operation of efficient HVAC systems, thermal storage systems and energy management. Integrating heat pumps with solar collectors offers many benefits for NZEB design including: high renewable energy fractions, more system design flexibility and a solution to the intermittent availability of solar energy. Sophie presented an example of the integration of solar collectors, a heat pump and thermal storage (ice-based) used in research at Canmet Energy. The current barriers to wide market penetration of HP in Canada are: the relatively high initial cost, a lack of small-medium capacity HP for residential applications and a lack of variable speed compressors.



AGM Collaborative Workshop #3: (L to R) Thanos Tzempelikos, Doug McClenahan, Sophie Hosatte, Alistair Sproul, Craig Hamilton, Cynthia Cruickshank

Continued...

Montreal 3rd Annual AGM, Day 1 Workshops...continued

Doug McClenahan, Manager, Active Solar R&D, Canmet Energy, Natural Resources Canada presented research in seasonal energy storage applications in Canadian communities. Thermal storage can bridge the mismatches between seasonal periods when renewable energy is available and when demand occurs. For example, one site in Alberta has 60% of the annual heating load occurring during months with 16% of the annual solar collection. Similarly, using seasonal storage, summer cooling loads can be met by the abundant cool air and water available during the winter in most Canadian regions. At the Drake Landing Solar Community, long-term and short-term storage have been successfully deployed for solar and geothermal energy, resulting in steadily increasing COPs of solar collection and storage pumps over 6 years.

Alistair Sproul, Associate Professor and Program Leader of the Integrated Building Systems Program, CRCLCL, University of NSW, presented an Australian perspective on PV, BIPV and BIPV/T (Thermal) uptake. Australian PV prices are high compared to Europe and North America, but electricity prices are much higher than Canada and solar irradiance levels are very high and reliable. With milder winters as well, PV/T is well suited to Australian climates due to low heating demands. In order for the cost of PV/T systems to follow the dropping cost of standard PV systems, more innovation and production scale is required. Alistair described a PV/T retrofit in Sydney and pointed out that more such practical implementations are needed to prove this technology and to demonstrate its utility for making low energy buildings mainstream.

Thanos Tzempelikos, Assistant Professor, Civil Engineering, Purdue University, USA, discussed issues related to indoor lighting, daylighting and thermal/visual comfort in the context of building façade design. Effective building façade design needs to give priority to occupants' visual and thermal comfort and in addition, balance conflicting requirements/factors such as solar gains, view to the outdoors, lighting energy, glare and heating/cooling energy. Integrated thermal-daylighting simulation tools are necessary for evaluating effective façade designs. Although it is well-known that glare is a significant determinant of visual comfort, there is a lack of reliable metric for evaluating glare that is simple to implement. Thanos presented such glare evaluation models, developed at Purdue University.

Cynthia Cruickshank closed the workshop with a detailed description of the Echo house, Team Ontario's entry in the 2013 Solar Decathlon. She described the mechanical system, envelope construction, air distribution system and PV installation of Echo that led to the house scoring 1st place in Engineering, 2nd place in affordability, 1st place in Hot Water Draws and Energy Balance and 6th place overall. Cynthia's presentation of Echo's mechanical system at the 2014 Heat Pump Conference in Montreal is described in this newsletter.

**NSERC SMART NET-ZERO ENERGY
BUILDINGS STRATEGIC
RESEARCH NETWORK**

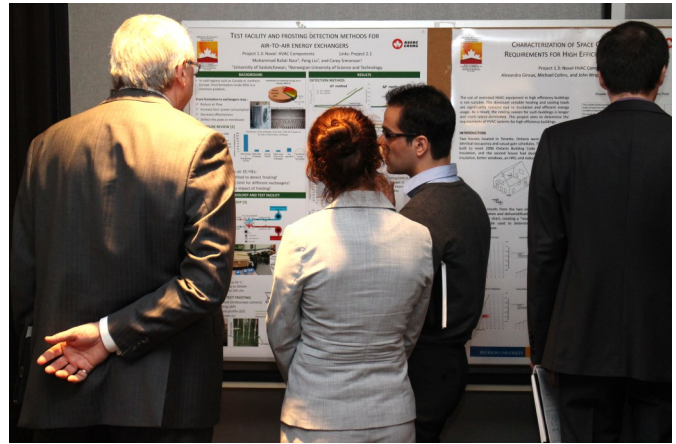
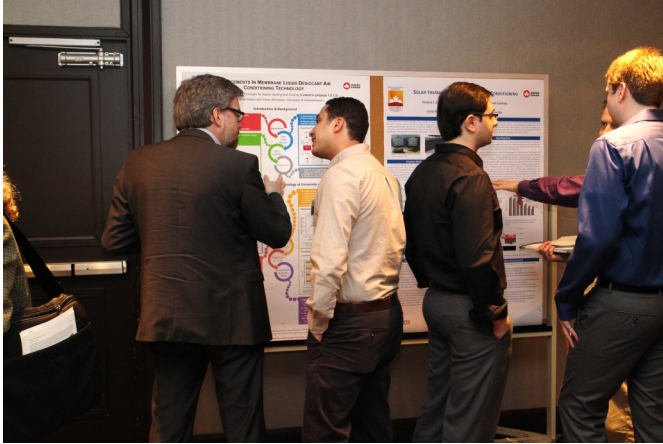


**RÉSEAU DE RECHERCHE
STRATÉGIQUE DU CRSNG SUR LES
BÂTIMENTS INTELLIGENTS À
CONSOMMATION ÉNERGÉTIQUE
NETTE ZÉRO**

Poster Presentations at SNEBRN 3rd AGM, Montreal

Gerald Parnis, Concordia University

This year's AGM held in Montreal, May 2-5, 2014, had a new item added to its already full agenda: Network Poster Display and Poster Session. 44 posters presenting the work of 37 Network Projects and 7 other projects were displayed outside of the main meeting area, providing an area where AGM attendees had the opportunity to hold impromptu discussions about specific Network research projects. The posters were on display during the 2 days of the AGM in the foyer where coffee breaks and lunches were served, encouraging collaborative discussions amongst Network HQPs, Researchers and Partners. During the scheduled one hour Poster Session held on Day 1, poster authors (Network HQPs) were asked to stand by their poster to answer questions about their research and project.

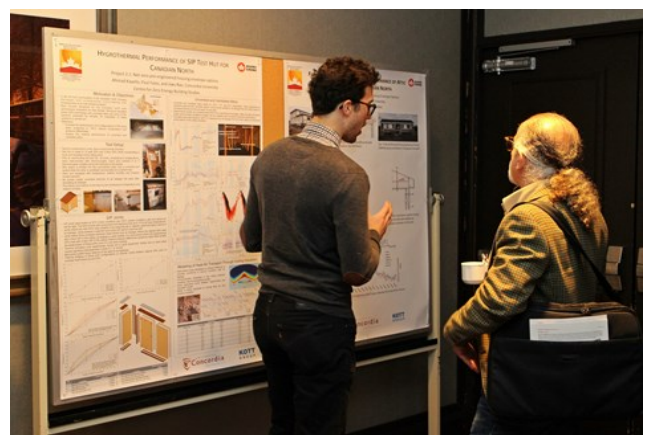


Montreal AGM attendees discuss Network Projects during the Day 1 Poster Session

Also during this Poster Session, Network Researchers circulated amongst the poster displays asking presenters questions in order to rank the poster presentations. The ranking was based on poster content/organization as well as the presenter's communication skills and knowledge of the topic. Prizes consisting of funding for future conference expenses were awarded for the top 3 presenters-posters (see below). Three presenter-posters tied for 3rd place.



AGM poster award presentation: (L-R) Colin Beattie (3rd), Danial Salimzad (3rd), Chris McNevin (3rd), Terry Hollands (Board Chair), Nick Zibin (2nd), Ahmad Kayello (1st)



Ahmad Kayello discusses his poster during the AGM Poster Session

Congratulations to SNEBRN HQP Ahmad Kayello whose presentation and poster entitled "Hygrothermal Performance of SIP Test Hut for Canadian North" was awarded 1st place ranking.

PDF files of all 2014 AGM posters have been placed in the Network's secure document sharing system and are available to Network participants through the Network's website: www.solarbuildings.ca

SNEBRN participation at 11th IEA Heat Pump Conference

Gerald Parnis, Concordia University

The 11th International Energy Agency (IEA) Heat Pump Conference was held in Montreal on May 12 - 16, 2014, bringing together researchers and industry professionals from around the world to discuss the latest research and developments related to heat pump technologies. SNEBRN was well represented at the conference, leading a workshop that included 6 presentations and publishing 5 papers.

On the first day of the conference, SNEBRN Network Manager Josef Ayoub chaired a workshop entitled *Heat Pump Concepts for Nearly Zero-Energy Buildings* which included presentations from SNEBRN Researchers Andreas Athienitis, Portia Murray, Cynthia Cruickshank, YuXiang Chen, Alan Fung and CanmetEnergy researcher Justin Tamasauskas.

The workshop began with Andreas Athienitis giving an overview of SNEBRN activities. These included the ÉcoTerra house, the John Molson Building solar system and the Varennes Library. The use of Building Integrated Photovoltaic/Thermal (BIPV/T) systems connected to a heat pump (solar-assisted heat pump: SAHP) was highlighted as a potential synergy resulting in both efficient electric and thermal power generation that can form the basis of Net-Zero Energy Building (NZEB) design.

Portia Murray presented the results of testing a Carbon Dioxide (CO₂)-based heat pump water heater at Queen's University. The benefits of using CO₂ as the refrigerant in heat pumps includes a negligible Global Warming Potential and no Ozone Depletion Potential. CO₂ is also naturally occurring, non-toxic and inflammable. Due to the low critical temperature of CO₂, the heat pump is operated with a tran-

sferential cycle that provides high heat rejection temperatures which are suited for natural convection applications. These and other benefits make CO₂-based heat pumps particularly efficient for hot water heating applications. CO₂-based heat pumps are popular in Japan with the Japanese government providing subsidies since 2002. An Eco-cute CO₂-based heat pump water heater was coupled with a 273L hot water tank and was tested at a range of operating conditions.

Cynthia Cruickshank's presentation discussed the design and evaluation of an integrated mechanical system, which incorporated a dual tank indirect solar-assisted heat pump, that offset space heating, cooling, and domestic hot water loads for ECHO, Team Ontario's entry in the 2013 Solar Decathlon. This system was developed and tested under the guidance of Dr. Stephen Harrison and Dr. Cynthia Cruickshank within Themes 1.1 and 1.2 of SNEBRN. The experimental results indicated that the coefficient of performance of the heat pump reduced with lower flow rates. However, lower flow rates could result in higher temperature rises across the condenser and greater levels of the stratification which could improve the overall performance of the system by reducing the auxiliary energy consumption. Results from the modelling and experimental work were compared and the experimental results were used to improve the heat pump performance map that was used in the simulations. The simulation results showed that the system could achieve a free energy fraction of 0.506 (neglecting energy draws from circulation pumps and fans) for space-heating, cooling, and domestic hot water. This result suggests that the system does have the potential of reducing energy consumption in the residential sector in Canada.



Cynthia Cruickshank presents at the IEA workshop:
Heat Pump Concepts for Nearly Zero-Energy Buildings

Continued...

SNEBRN participation at 11th IEA Heat Pump Conference ...continued

YuXiang Chen described the integration of a ground-source heat pump into the heating and cooling system of a single family, detached, low energy house (*ÉcoTerra*) located in Quebec, Canada and the monitored system performance. The heat pump provides space heating/cooling and some heat to the domestic hot water tank. The efficiency of the heat pump was found to increase with lower heating and cooling loads.



Andreas Athienitis poses a question to presenter YuXiang Chen concerning heat pump integration in EcoTerra



Alan Fung presents at the IEA workshop: *Heat Pump Concepts for Nearly Zero-Energy Buildings*

Alan Fung presented studies on using BIPV/T systems as the solar-thermal component of a solar-assisted air source heat pump (ASHP) in Canadian domestic heating applications. The test hut facility at the Toronto and Region Conservation Authority Kortright Centre was used to investigate wall and roof mounted BIPV/T systems. In one performance study (Oct. to May), the ASHP electricity consumption was reduced by just over 20% and the COP increased by 25% when the heat pump was integrated with the BIPV/T system. Simulation studies indicated further improvements to ASHP COP could be achieved with the addition of thermal mass such as concrete slab and gravel beds below conditioned and unconditioned zones.

Justin Tamasauskas presented a novel solar heat pump system using ice slurry as a latent storage material. The use of ice storage allowed for a significant improvement in solar collector efficiency and energy storage density, while also offering demand side reduction potential. Results from TRNSYS simulations highlight the strong energy savings potential of the system in three climate regions in Canada (Montreal, Toronto, and Vancouver), with an over 50% reduction in energy use in comparison to a base case.

In addition to this workshop, five conference papers were also given by SNEBRN researchers: Michel Bernier (Polytechnique Montréal) gave two presentations (1 keynote) and authored one poster while Alan Fung (Ryerson University) authored two posters.



Michel Bernier Receives the Prestigious Rittinger International Heat Pump Award

At the 11th IEA Heat Pump Conference, held in Montreal 2014, SNEBRN Researcher Michel Bernier and four other international researchers were given the Rittinger Award recognizing their "outstanding contributions to the advancement of international collaboration in research, policy development and applications for energy-efficient heat pumping technologies". This award is given every three years in conjunction with the IEA Heat Pump Conference. The accompanying medal shows a portrait of Peter Ritter von Rittinger who is credited with the design and installation of the first energy-conserving heat pump system at a salt works in Upper Austria in 1855.

Concordia Hosts SNEBRN/IABP PhD Summer School, Montreal

Gerald Parnis, Concordia University

From August 20-28, 2014, 21 students from Brazil, Canada, Denmark, Estonia, Italy, Romania, and Sweden attended the PhD Summer School *Net-Zero Energy Building Modelling and Design for High Performance*, held at Concordia University, Montreal. This summer school was organized by SNEBRN and the International Association of Building Physics (IABP) and brought together students from 6 Canadian and 7 overseas universities as well as 14 researchers from Canada, Denmark and the US. SNEBRN was well represented with 12 students from 6 Network universities attending and 4 Network researchers lecturing at the school.

The school was organized with financial support from NSERC (SNEI) and was open mainly to PhD students working in the areas of Building Physics, Building Systems and Energy Efficiency. The aim of the summer school was to train students in modelling, simulation and design of high performance Net Zero Energy Buildings (NZEBs) including the integration of enabling technologies (e.g. photovoltaics, shading technologies, controls). For 9 consecutive days, students attended 2-3 lectures in the morning and worked on modelling exercises in the afternoon. Building Engineering researchers presented lectures on topics including Passive Design, Thermal Storage, Occupant Behaviour, Wind Analysis, Heat and Moisture Transfer Modelling, Active Building Envelopes (solar technologies) and Controls. Afternoon sessions were spent working on modelling exercises designed to reinforce the lecture material and provide modeling strategies that students could use when working on their course project.



PhD Summer School Students and Staff at Concordia University

SNEBRN / IABP PhD Summer School ...continued

Students worked on the course project in groups of 4, submitting a written report and giving a 20 minute presentation during the last day of the school. Students were given a base case model of a 2 zone rectangular shaped house, based on the ÉcoTerra design from which they were asked to design a net-zero energy house that could include a 5 kWp BIPV system. This project provided students with the opportunity to model and design a net zero energy house while evaluating the performance of various aspects of a building and integrating technologies. The project presentations and reports were ranked based on: the modelling approach and justification, demonstration of reaching net-zero energy, quality of the house including indoor comfort and group communication skills.



PhD Summer School Students Touring the Solar Simulator, Concordia University

Congratulations to the following students, whose design and presentation ranking is shown below:

Ranking	Group Members
1 ST	Zixiao Shi, Üllar Alev, Christopher Baldwin, Trent Hilliard
2 ND	Edvinas Bigaila, Nunzio Cotrufo, Vasken Dermardiros, Efstratios-Dimitrios Rounis
3 RD	Ana Paul De Almeida Rocha, Shahryar Garmsiri, Maria Ferrara, Benedetto Nastasi

Thank you to all the students who participated in the PhD Summer School and special thanks to the lecturers who donated their time and expertise to the school.

eSim 2014 in Ottawa a Success

Liam O'Brien, Carleton University



Conference Chair, Prof. Liam O'Brien Opens eSim 2014, Ottawa

On May 8-9, Ottawa hosted the 8th biennial eSim building simulation conference organized by IBPSA-Canada (the Canadian chapter of the International Building Performance Simulation Association). The conference presented a record of 72 papers, covering a wide variety of topics from daylighting, net-zero energy buildings, and occupant behaviour, to ESP-r simulation on palm-sized computers. Nearly half of the papers had at least one author who is a SNEBRN researcher, indicating the importance of the Network's role in fostering building performance simulation research and training highly qualified personnel in Canada. In total, 150 delegates attended eSim with representation from ten countries and five continents. This year, eSim had the rather unusual venue of a former church located in Ottawa's main entertainment district: St. Brigid's Centre for

the Arts in the ByWard Market. The nature of the 150 year old building stimulated many conversations about daylighting, infiltration and thermal comfort.

In addition to the two day academic conference, there were seven workshops hosted mainly at Carleton University that were very well attended by approximately 140 participants. Notably, SNEBRN co-organized two of the workshops with IBPSA-Canada: Occupant Behaviour & Indoor Environments and ESP-r/TRNSYS Co-simulation. The occupant behaviour workshop was organized by Prof. Liam O'Brien and was given by eight instructors from a variety of backgrounds (industry, academia and government). The instructors included Dr. Jennifer Veitch who taught research methods for the built environment, Dr. Jim Love who discussed case studies of high-performance buildings and SNEBRN PhD student Burak Gunay who demonstrated the use of occupant behaviour modelling. Profs. Ian Beausoleil-Morrison and Michaël Kummert led the Co-simulator workshop where building simulation fundamentals and the theory of co-simulation was presented and implemented using the ESP-r/TRNSYS co-simulator. Other workshops included OpenStudio taught by NREL researchers, eQuest/CanQuest taught by MMM Group and NRCan researchers, IES VE taught by IES experts, and a workshop on digitizing existing buildings led by Dr. Mario Santana.



Burak Gunay, a Network HQP supervised by Profs. Liam O'Brien and Ian Beausoleil-Morrison, presenting his implementation of occupant behaviour models in EnergyPlus at the Occupant Behaviour workshop.

Special thanks to all who attended eSim and the workshops, to the IBPSA-Canada Board, to the volunteers and to the generous sponsors! The next eSim conference will take place in 2016 and the IBPSA-Canada Board is currently finalizing the selection of the host. A call for papers will be made in approximately September 2015. The IBPSA-Canada Board of Directors has many new members and continues to have excellent representation from SNEBRN researchers. IBPSA-Canada strives to continue to represent and provide services to the large community of simulationists in Canada.

3 New Industry Partners Join SNEBRN

SNEBRN recently added 3 organizations to its growing group of industrial partnerships:



Formed in 1997, the Arctic Energy Alliance (AEA) is a not-for-profit, non-governmental organization with a mandate "to help communities, consumers, producers, regulators and policymakers to work together to reduce the costs and environmental impacts of energy and utility services in the Northwest Territories."

In response to increased energy prices and concerns about climate change in recent years, the AEA has grown and is playing a more active role working with other circumpolar regions and partnering on potential research projects. In 2014, AEA is opening another regional office in addition to the existing five offices across the Northwest Territories.

Formally joining SNEBRN in 2014, AEA attended the 3rd AGM in Montreal and presented on the topic of high performance northern buildings. As part of the organizational mandate, AEA has supported graduate students on their research endeavors by creating and furthering projects related to their thesis, including research support to a formal Network student. As a new partner to SNEBRN, AEA is looking forward to collaborating with Network researchers and students to explore projects of common interest, namely, to advance the development of energy efficient buildings and suitable renewable technologies in the North.

In addition to on-the-ground activities such as general advice, home/commercial energy audits, workshops and trainings, and to carrying out governmental incentive programs, AEA is actively involved in research and consulting projects including various feasibility studies, retrofit cost optimizations, monitoring and reporting of buildings and renewable systems, cold climate electric vehicle testing, etc. The AEA is also open to sharing data on multi-year housing stock, energy audits, and monitoring projects for research purposes (e.g. energy model validation, data-driven simulation, influence design guidelines, etc.). The intention is to provide linkage between ongoing projects with immediate tangible impacts and researchers' interest/expertise.

More information about AEA can be found at: www.aea.nt.ca



S2E is an experienced organization that has a significant network of reliable investors, project developers and government bodies.

On June 26, 2014 S2E announced a partnership with Sifton Properties Limited that began the development of the "first State-of-the-art SMART Community called 'The Village at RiverBend' " consisting of residential units and commercial space developed on a 70 acre site in West London, Ontario. The community will be designed to generate as much energy as it will use from renewable sources and will include solar rooftops and façades, urban gardens (greenhouses), community-wide electric vehicle charging capabilities and low-impact water management.

Recently, S2E was the catalyst in the development of over 600MW of solar projects in Ontario resulting in over \$2 billion in investment.

For more information, please visit <http://www.s2etech.com>.

New Industry Partners continued



Based in Toronto, Internat Energy Solutions Canada (IESC) is an independent engineering consulting firm offering clients specialized services in the areas of energy conservation and building efficiency, renewable energy feasibility, design and implementation, and greenhouse gas emission (GHG) reduction strategies. IESC aims to enable clients to achieve their energy efficiency, sustainability and renewable energy goals through a multi-dimensional approach supported by data-driven analysis and a promotion of long-term cohesion between the built and living environments. IESC offers project management and implementation services that help organizations operate more efficiently and incorporate environmental considerations into their daily operations.

IESC is actively involved in the building-integrated photovoltaic (BIPV) industry having developed a heat reflecting, insulating BIPV glazing unit. This technology has been integrated into Toronto Harbourfront Centre's Enwave Theatre as part of a building envelope retrofit project that has significantly improved the indoor comfort and external aesthetics of the historic theatre, while generating electricity. For further information, please visit <http://www.internatenergy.com>.

Associated Industry Collaborations (ecoEII Program)



Centennial Global Solar Company has been manufacturing solar photovoltaic panels in Canada since 2003. As an ecologically aware company, Centennial Global's mission is to provide technical and economical photovoltaic solutions that fulfill customer energy requirements.

Centennial Global Solar Company manufactures high-performance solar modules using proprietary technologies and production facilities. The company has production flexibility enabling it to adapt to specific application requirements. Centennial Global has distributed solar modules in Europe, North and South America, Arica and South Asia and has received prestigious international recognition for product quality.

Research at Centennial Global Solar Company is currently centered on technologies for manufacturing Mono, Polycrystalline, Thin Film, Spherical Crystalline and BIPV/T modules. For further information, please visit www.centennialglobaltechnology.com.



Montréal ZERO is a multi-disciplinary firm specializing in housing and is committed to building better neighbourhoods (net zero energy and autonomous buildings), recognizing their potential for improving people's lives. Montréal ZERO employs architectural, engineering and planning skills, aiming to design net zero energy and autonomous buildings and neighbourhoods that are self-sufficient and sustainable. The mission of this Montreal-based firm is to contribute towards making the transition from the current status quo to renewable resource and energy utilization. Montréal ZERO started collaboration with SNEBRN in May 2014. For further information, please visit montrealzero.com.

Remembering Paul Fazio

Andreas Athienitis and Gerald Parnis

On September 28, 2014, Building Engineering in Canada lost its key founder and the Network lost one of its most respected researchers. Concordia Professor Paul Fazio, a Member of the Order of Canada, distinguished researcher and pioneer in building envelope research passed away peacefully in his sleep at a Montreal hospital at the age of 75 leaving behind his family – his wife, Lucy, and their three children: Mark, Teena and Luke and two grandchildren: Julien and Simon.

Paul's distinguished career began in 1967 when he became a professor in the Civil Engineering Department at Concordia University. At this early stage he recognized the need for educational programs that addressed the need for the design of buildings as systems, including the structure, the envelope, heating/cooling systems and automation while also considering the comfort, health and safety of the occupants. With this forward thinking, he established the Centre for Building Studies (CBS) in 1977, becoming the Centre's leader until 1997.

"He was a visionary," says Radu Zmeureanu, Associate Dean, Student Academic Services [Concordia University]. "He developed from scratch a new engineering program, still unique in Canada, with the hope of creating a critical mass of professors and researchers that would enhance the quality of the building industry in Canada, and especially in Quebec. Dr. Fazio's memory will be forever with us. May he rest in peace."

Not only did the Centre attract a strong team of researchers that became internationally recognized, but also, through Paul's perseverance and efforts to create a Centre of education and research in Building Engineering, Concordia University became the first Canadian University to establish an accredited program in Building Engineering at the undergraduate, Masters and PhD levels. To this day Concordia is still the only university in Canada to offer this program at all three levels.

Recognizing the need to transfer new technology and innovative techniques to design and construction stakeholders, he also founded the Société d'informatique et de recherche pour l'industrie de la construction (SIRICON), Quebec Building Envelope Council and AQME (l'Association Québécoise pour la Maîtrise de l'Énergie).

Recently, Paul played a key role as a co-founder of the NSERC Smart Net-zero Energy Buildings Strategic Research Network (SNEBRN), led by Concordia and a group of internationally recognized researchers that he helped hire. He was co-leader of Theme 2 (Dynamic Building Envelope).

"His moral support and continuous mentoring in the establishment of the NSERC Smart Net-zero Energy Buildings Strategic Research Network and the Concordia Centre for Zero Energy Building Studies (CZEBS) gave us the strength to continue and build Concordia's leadership in Canada in sustainable buildings. We will remember him as a spiritual father" says Dr. Athienitis, leader of SNEBRN (and Director of CZEBS, the Centre that evolved from CBS).

Paul was recognized numerous times for his outstanding contributions to his field. He was the recipient of the Galbraith Prize and the Gzowski Medal; he was named a Fellow of the Canadian Society for Civil Engineering, a Fellow of the Canadian Academy of Engineering and a Fellow of the American Society of Civil Engineering. In 2007 he was invested into The Order of Canada for his contributions to building a stronger Canada.



Paul Fazio Receiving the Order of Canada from Governor General Michaëlle Jean in 2007

Continued...

"Remembering Paul Fazio" ...continued

He was a true inspiration for us here at Concordia and his impact and legacy will be felt for a long time. Several events are planned to honor Paul. The internationally unique Solar Simulator & Environmental Chamber Laboratory that he helped establish with Dr. Athienitis, will be named in his honor: *The Paul Fazio Solar Simulator & Environmental Chamber Laboratory* in an upcoming event. Until the last few days of his highly productive life he actively participated in the NSERC Smart Net-zero Energy Buildings Strategic Research Network (SNEBRN) and in the Concordia Centre for Zero Energy Building Studies, the successor research unit that evolved from CBS.

Paul was extremely generous toward Concordia University and especially towards students who he cherished greatly. Through past contributions and a recent major gift, Paul established an endowment fund close to \$400,000. This endowment will yield a total of eight renewable scholarships of \$2,000 each per year, for Concordia undergraduate students entering building engineering.

Quotes from a few of his former students and colleagues:

V Ismet Ugursal (Professor Dalhousie, SNEBRN researcher): "In addition to being a brilliant teacher and researcher, Paul was a true gentleman. He was kind and considerate, ready to provide help to whoever needed it. He was a genuinely wonderful human being. Knowing him made my life richer and better. I will miss him and will always remember him fondly."

Caroline Hachem (former PhD student, professor at Calgary): "I worked with Dr. Fazio for almost 8 years, during which he gave me continuous support, as a student and later on as a Post-doctoral Fellow and Assistant Professor. His wisdom was broad, not limited to his research and profession. 'The Ego Is Our Greatest Enemy' was one of his beliefs that most affected me."

Miljana Horvat (former student, professor at Ryerson University): "Today, as the need for reducing energy consumption in built environment have become an imperative, we know that in order to design and build nearly net-zero energy and/or high-performance buildings, all actors in the process such as architects, civil, mechanical and electrical engineers, renewable energy consultants and others, have to work together through Integrated Design Process (IDP). Being a true visionary, Dr. Paul Fazio understood the importance of interdisciplinary approach almost 30 years ahead of time and implemented it through the Centre for Building Studies. I feel genuinely privileged that I was a part of that environment during my PhD studies, and able to learn, contribute and develop as a researcher and academic under his mentorship. In my career, I continue to further this vision ever since."

Ted Stathopoulos (Colleague, Concordia): "Paul was actually the person who brought me to Concordia when he wrote to me in the late seventies inviting me to come for an interview! The rest is a history! During this "history" I have always admired Paul for his vision regarding building engineering and research related to buildings. His dedication, zeal, determination and hard work were second-to-none! He has been a great asset for Concordia and a source of inspiration for all the people who worked with him over the years. He has created a legacy for his students and colleagues to follow."



Professor Paul Fazio with student Sara Wyss working on the IGLOO project in 2010. Concordia University Communications.



Paul Fazio and Andreas Athienitis put their heads together in 2010. Concordia University, Faculty of Engineering and Computer Science Newsletter.



The Gordon Shields Graduate Entrance Scholarship in Sustainable and Net-Zero Energy Buildings

Gordon Shields was a visionary held in high esteem for his great passion, dedication and valuable contributions in the field of net-zero energy buildings. He was instrumental to the success of the Net-Zero Energy Coalition as its founder in 2003, and later as its Executive Director. Sadly Gordon passed away on January 17, 2014 after a brave battle with cancer.

We will be honouring his memory and legacy by establishing a memorial scholarship at Concordia University in collaboration with the Net-Zero Energy Coalition and s2e Technologies, to be known as ***"The Gordon Shields Graduate Entrance Scholarship in Sustainable and Net-Zero Energy Buildings"***.

We have chosen to create this memorial scholarship at Concordia because of the strong ties that exist between the Coalition and the NSERC Smart Net-Zero Energy Buildings Strategic Research Network (SNEBRN) whose headquarters is located at the university and is led by Andreas Athienitis. This graduate scholarship will help students to continue research in a field that was of utmost importance to Gordon.

We need to raise a minimum of \$75,000 to endow the graduate scholarship. This would enable the scholarship to be maintained in perpetuity and therefore would continue Gordon's legacy and the advancement of research of sustainable building practices for many years to come.

As colleagues of Gordon and collaborators of the Coalition, we invite you to join us in building this important initiative. We plan to award the first scholarship in the autumn of 2015 and to do so, we will need the majority of contributions to be made before this time period. Your support is vital and is appreciated greatly.

Gordon always strove to make a difference. Your donation will enable us to do this for him and will contribute toward a more environmentally sustainable and energy-efficient future for Canada.

For further information or to donate, please contact Sarah Kenny at Concordia University at (514) 848-2424 ext. 7026 (email: sarah.kenny@concordia.ca).

Sincerely yours,

A handwritten signature in blue ink that reads "Gary Hamer".

Gary Hamer
President, Net-Zero Energy Coalition
Gary.hamer@bchydro.com

A handwritten signature in black ink that reads "Milfred Hammerbacher".

Milfred Hammerbacher
CEO, s2e Technologies
mhammerbacher@s2etech.com

A Message from the outgoing Network Manager of The NSERC SNEBRN

Dear colleagues and co-workers in the smartest NSERC network,



During the past three years, it has been my privilege and pleasure to serve as Network Manager of the Smart Net Zero Energy Building Strategic Research Network. My term at the Network, which began on September 15th, 2011 and ended on June 30th, 2014, was arranged under the auspices of Natural Resources Canada's *Industrial and Scientific Assignment Program*. The Program enables federal public servants to be placed in the private sector positions that foster mutual benefits to both organizations. I would like to add that I also benefited so much from the daily interactions with the brightest and most dedicated students, professors and support staff at Concordia University as well as in the partner institutions that make up the community that we know as SNEBRN.

In my capacity as the Network Manager I was proud to be a part of a research community whose members embraced innovative ideas and strategic thinking in advancing the work of the Network. Most valuable, were your tireless efforts to increase the credibility and visibility of SNEBRN in the national and international smart-energy-building policy community, resulting in so much goodwill that has become a huge asset to me. This has enabled me to foster relationships with our supporters and partners that will ensure SNEBRN will prosper and continue to offer opportunities to our members worldwide.

In my capacity as the Operating Agent of the International Energy Agency joint Solar Heating and Cooling Task 40/ Energy in Buildings and Communities Annex 52: Towards Net Zero Energy Solar Buildings (T40A52), I would like to acknowledge the tireless effort and leadership of Andreas in leading the Canadian participation in the T40A52 since 2009. The culmination of his effort is a one-of-kind text book entitled *Modelling, Design and Optimization of net-Zero Energy Buildings*. This will be published by Wiley & Sons in Spring 2015 and is truly an accomplishment in which we should all take pride.

From a personal point of view dear colleagues, your warm friendship and support have been very important to me throughout the last three years. It is my very great pleasure to thank you for making my job easy. As I return to CanmetENERGY, I would like wish you all the very personal best in your future endeavours and I look forward to my ongoing involvement in the Network – albeit now wearing the hat of NRCan.

A handwritten signature in blue ink, appearing to read 'Josef Ayoub'. The signature is stylized and written in a cursive-like font.

PS: My present coordinates are below, should you wish to contact me.

1615 Lionel-Boulet Blvd, Varennes QC, J3X 1S6

Telephone: 450-652-1981

Cellulaire : 514-917-2557

E-Mail : Josef.Ayoub@rncan-nrcan.gc.ca



**NSERC SMART NET-ZERO ENERGY
BUILDINGS STRATEGIC RESEARCH NETWORK**

**RÉSEAU DE RECHERCHE STRATÉGIQUE DU CRSNG
SUR LES BÂTIMENTS INTELLIGENTS À CONSOMMATION
ÉNERGÉTIQUE NETTE ZÉRO**

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