SNEBRN Newsletter Issue 01 July 2012

NSERC Smart Net-Zero Energy Buildings Strategic Research Network

NSERC CRSNG

Vision

The vision of SNEBRN is to perform the research that will facilitate widespread adoption in key regions of Canada, by 2030, of optimized NZEB energy design and operation concepts suited to Canadian climatic conditions and construction practices. We aim to influence long-term national policy on the design of net-zero energy buildings and communities in association with our partners.

Inside this Issue

Editorial by the Scientific Director, Andreas K. Athienitis

The NSERC Smart Net-zero Energy Buildings Strategic Research Network (SNEBRN) is now a reality, building on the success of the NSERC Solar Buildings Research Network (SBRN) that completed its research program in early 2011, receiving awards and recognition for its national and international impact. We are at an important junction in building and solar energy research that needs to integrate effectively solar and energy efficiency technologies so as to develop cost effective net-zero energy building (NZEB) design and operation concepts for widespread adoption by around 2030. Building energy design is currently going through a period of major changes driven largely by three key factors and related technological developments:

1. The increasingly widespread adoption in most developed countries and by influential engineering societies such as ASHRAE of net-zero energy as a long term goal for new buildings. To achieve this goal in an efficient way, a rigorous quantitative approach is required to design a building as an integrated energy system that consumes low amounts of energy and produces in an average year an equal amount of energy from on-site renewables, while maintaining a comfortable indoor environment.

2. The need to reduce the peak electricity demand for buildings through optimal operation, thus reducing the need to build new central power plants that often use fossil fuels. A net-zero energy building should be a smart building that is optimally linked with a smart grid – otherwise NZEBs will create a large energy distribution and storage problem.

3. The need to efficiently integrate new advanced energy technologies into buildings such as semitransparent photovoltaics, controlled shading/daylighting devices and integrated thermal storage.

A building must provide a controlled indoor environment for people to live in and perform different functions (e.g. work, study, shop, leisure activities). Since the development of the art, science and technology of heating ventilation and air-conditioning (HVAC) over the last 100 years or so, it is only recently that the generation of building-integrated power and heat from renewable energy sources (primarily solar) has been included as an essential element of high performance building design – with a specific goal: an average annual energy balance of zero, with the building sometimes exporting energy to the grid (usually electricity) and sometimes receiving energy from the grid.

Net-zero energy buildings (NZEBs) around the world, including EcoTerra from Canada, were reviewed by International Energy Agency SHC (Solar Heating and Cooling) Task 40 / ECBCS (Energy Conservation in Buildings and Communities) Annex 52: Towards Net-zero Energy Solar Buildings. The integration of the on-site generation functions with energy efficiency measures requires a more rigorous and scientific approach to building design and operation than in the past. Achieving the goal of net-zero energy is expected to be easier for houses than commercial buildings because the latter include more energy consuming electronic equipment and lighting and generally have a lower surface area-to-volume ratio (lower solar potential).

A NZEB may be designed with optimal combinations of traditional and recent advanced technologies that depend on location, climatic conditions and function. In the modern NZEB concept, the physical separation of HVAC from energy generation systems and the building envelope becomes blurred and obsolete such as a photovoltaic/thermal façade that simultaneously generates electricity, performs the usual insulating envelope function and preheats fresh air. This concept requires a transformation in building design and control, a transformation in which our team and network (SBRN and SNEBRN) play a leading national and international role.

However, there are a number of challenges: first and foremost, we have the education of engineers and architects; second, the fragmented nature of the building industry and process; and, third the design of our communities for a net-zero energy balance at the community level.

Continued...

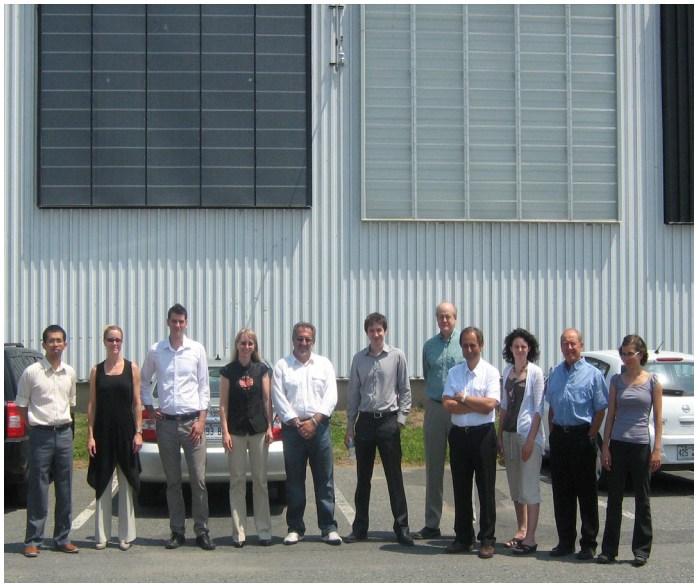
.. Editorial by the Scientific Director(cont.'d)

The Network was officially launched in a special ceremony at Concordia on Dec. 16, 2011 by the President of NSERC Dr. Suzanne Fortier, who also inaugurated the new Solar Simulator – Environmental Chamber (SSEC) Laboratory developed with $4.6 M funding from the Knowledge and Infrastructure Program (KIP), and the John Molson School of Business building photo-voltaic/thermal system funded by the NRCan TEAM program. This ceremony, which was attended by federal and provincial politicians and over 100 guests, served as a promotional and dissemination event of the Network with several articles in the media, including a joint interview with Dr. Fortier in the Globe and Mail.

The first Annual General Meeting (AGM) of the Network was recently held in Halifax during April 29-May 1, 2012, including building simulation and modeling workshops and presentations by partners. It was followed by a well-attended Canadian Building Simulation Conference – eSim 2012, in which about half of the papers were presented by SNEBRN graduate students. I am happy to report that Network students and researchers received the best paper awards at this conference and I would like to congratulate them and encourage them to continue their high quality work! In addition, the SBRN received the ADRIQ-NSERC Celebrate Partnerships Award for the high impact of our work on May 17, 2012 during a special ceremony in Montreal.

Finally, we recently organized meetings with several industry partners (some of them at the partner locations), including Hydro Quebec, Kott, Unicel, Canadian Solar and Gaz-Metro. More meetings are planned to enhance our collaborative efforts and partnerships. Our second AGM will be held in Ottawa (Carleton University) during May 22-25, 2013 including an Industry Day and Workshop.

Visit of SNEBRN team at the Canadian Solar Solutions plant, Guelph, June 18, 2012. Photo shows 300 kW roof top system built by Canadian Solar on the roof of their assembly plant.



Visit of SNEBRN team at the National Gas Technology Centre (associated with SNEBRN partner Gaz-Metro).

A message from the Chairman of the Board of Directors, Terry K. Hollands

Congratulations to the team of researchers of the SNEBRN for putting together such a fine plan of work and such an excellent team. The SNEBRN is not simply a continuation of its highly-successful antecedent, the SBRN. It is a new enterprise with a new goal, which is both reachable and highly worthwhile: to lay the foundation for zero-net buildings to be the new norm for Canada. Zero-net buildings are internationally recognized as the goal for tomorrow's buildings. Through the SNEBRN, Canada is in a position to help the international community in achieving that goal and to put Canada at the forefront of the new technology. We, the members of the Board of Directors, feel proud to be a part of this endeavour, and look forward to playing our part in guiding the SNEBRN to ultimate success.

SBRN's Industry and Stakeholders Workshop, 2010: The Plan for SNEBRN

Liam O'Brien, Carleton University and Jose Candanedo, NRCan

In August 2010, SBRN organized at Concordia University a one-day Industry and Stakeholders Workshop at which about 60 solar energy and building industry and government representatives and SBRN researchers and students, who came from as far as Australia, had the opportunity to debate pressing issues.

The day was divided into four major themes ranging from building systems to community design, including:

1) Net-zero energy housing
2) Building integration of solar energy systems and energy efficiency
3) Net-zero energy commercial buildings and demand management
4) Net-zero energy communities

A panel discussion, typically represented by 5-6 experts, was held for each theme. Some of the major conclusions from the panels follow.

Steven Crowell of the Nova Scotia Homebuilders' Association and a SBRN Board Member, proposed that a repository be created to share state-of-the-art knowledge on NZEH construction techniques and technologies. Prof. Jim Love, University Calgary, reiterated this, stating that knowledge-sharing between research institutions and industry will lead to demonstration projects, which will ultimately educate the public. Prof. Andreas Athienitis, Concordia University, discussed numerous demonstration projects in the Montreal area that he has led, including the John Molson School of Business building-integrated photovoltaic/thermal (BIPV/T) system and the EcoTerra house. Both of these projects have doubled as important and innovative research projects as well as high-profile demonstration projects to educate industry and the public.

SBRN Board of Directors

A common topic throughout the day was that the greatest source of uncertainty in building performance, and particularly important to net-zero energy buildings, is occupant behaviour. Remi Charron, who represented CMHC and the EQuilibrium Sustainable Housing Demonstration Initiative, estimated that 50% of building energy use can be directly related to occupant behaviour and that the 15 EQuilibrium home designers predicted that appliances, lighting, and other plug loads would account for between 2,000 and 5,500 kWh per year. Guy Newsham of the National Research Council, proposed that two major research initiatives could address the uncertainty of occupant behaviour, including monitoring and analyzing current occupant behaviour and using smart building systems that are capable of adapting to occupant preferences while minimizing energy use.

Another recurring theme was the importance of integration of technologies and the balance between active and passive technologies. Marc Dugré, President, Regulvar, emphasized the importance of having a non-proprietary protocol between all building equipment and sensors to maximize integration of building system. Dr. Sophie Hosatte of CanmetENERGY, Natural Resources Canada, stressed that it is the combination of multiple building technology and systems - not single technologies - that should be used to achieve net-zero energy.

On community-level design, Prof. Luichen Chang, University of New Brunswick, proposed research in high-level controls that accounts for the intermittent behaviour of renewable energy and individual buildings. Prof. Chris Kennedy, urged building researchers and industry to expand their scope to consider broader impacts on transportation, urban infrastructure, climate, and land use.

The Workshop panels, which included numerous leading industry representatives, consisted of both SBRN partners, and in some cases, built up relations that led to the inclusion of new industry partners for SNEBRN. The event framed the research needs and objectives for SNEBRN in the next five years.

Launch of the NSERC Smart Net-Zero Energy Buildings Strategic Research Network

Diane Bastien and Caroline Hachem, PhD candidates, Concordia University

On Friday December 16, 2011, Concordia University hosted a special event to celebrate three great achievements: the launch of the NSERC Smart Net-zero Energy Buildings strategic Research Network (SNEBRN), the inauguration of the new Solar Simulator – Environmental Chamber lab, and the official opening of the solar installation (building integrated photovoltaic/thermal hybrid system) at the John Molson School of Business.

From left to Right: Andreas Athienitis, Scientific Director for the NSERC SNEBRN; Kathleen Weil, Minister of Immigration and Cultural Communities and M.N.A. for Notre-Dame-de-Grâce; Gilles Jean, Director-General of CanmetENERGY in Varennes, Natural Resources Canada; Frederick Lowy, President and Vice-Chancellor; Louise Dandurand, VP Research & Graduate Studies; Marc Garneau, Member of Parliament for Westmount-Ville-Marie; Suzanne Fortier, President, Natural Sciences and Engineering Research Council of Canada (NSERC); Robin Drew, Dean of Concordia's Faculty of Engineering. - Photo courtesy of Concordia University

Andreas Athienitis at solar simulator

Distinguished guests attended this event. In particular we would like to thank dignitaries Kathleen Weil, Minister of Immigration and Cultural Communities, Marc Garneau, deputy of Westmount-Ville-Marie, Suzanne Fortier, President of the Natural Sciences and Engineering Research Council of Canada, and Gilles Jean from Natural Resources Canada for their presence and support for the SNEBRN and its projects. Frederick Lowy, President and Vice-Chancellor and Louise Dandurand, Vice-President of Research and Graduate Studies from Concordia University, hosted the event.

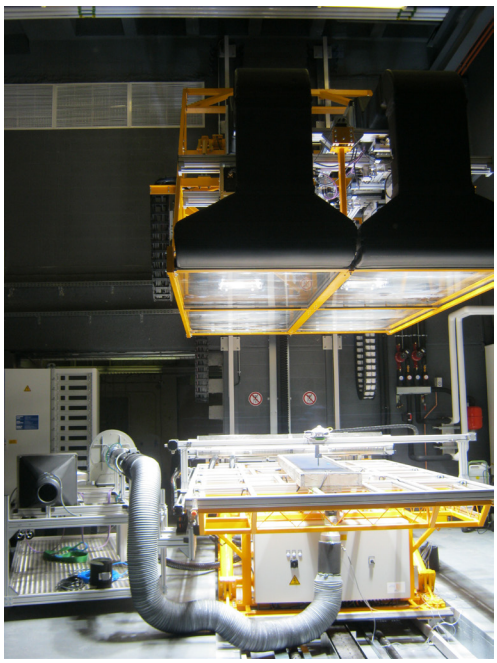
The ceremony started with speeches from the dignitaries and closed with a virtual ribbon cutting. Dr. Athienitis, Scientific Director of the previous Solar Buildings Research Network (SBRN) and Scientific Director of the newly formed SNEBRN, was praised for his ability to guide large teams including members with different but complementary backgrounds from research institutions and industries, and provide leadership to achieve ambitious but achievable projects.

The new strategic network builds upon the achievements and successes of the previous SBRN, which were praised by all key speakers. From successful demonstration projects to improving the efficiency of Building Integrated Photovoltaic/Thermal (BIPV/T) prototypes and the training of more than a hundred graduate students who are now working within universities, governments and industry, the achievements of the previous network pave the way to even greater accomplishments. By moving from individual buildings to communities, the SNEBRN wants to address not only reduction of energy use but also ways to reduce peak demands to lessen or eliminate the burden of building new electrical infrastructures.

The ceremony was followed by a reception, during which tours were organized giving the opportunity for the attendees to visit the new lab equipped with the solar simulator and the environmental chamber.

More than 60 people had the opportunity to visit this unique state-of-the-art facility. Graduate and undergraduate students supported the organization by welcoming guests, registering guided tours, providing explanations and ensuring the smooth running of the event.

On a personal note, we want to congratulate Amélie Allard, a Master's student under the supervision of Andreas Athienitis, for giving birth to Agathe on this very same day. Congratulations to Amélie and many thanks to everyone involved in the success of the triple-launch of Dec 16!



Solar Simulator

1st SNEBRN Annual General Meeting

Josef Ayoub, Network Manager, SNEBRN

The Network held its First Annual General Meeting at the Nova Scotian Hotel, in Halifax, Nova Scotia on April 30 – May 1, 2012. The two-day event was structured so that on the first day the leaders and their associates of the 14 current Network projects presented the progress of their work since the start of the Network on June 20, 2011. The second day was dedicated to Network researchers, industry partners and potential collaborators presenting on a variety of Network-related activities. There were presentations on the next generation R2000, the net-zero energy house at McMaster University, Team Ontario's 2013 Solar decathlon Competition house, the planned net-zero energy library at Varennes, the Drake Landing solar district heating community (Okotocks), and the newly announced 1000 solar heating homes community project in Halifax. Parallel to these presentations there were also Network organized and led workshops tailored for students' research interests in net-zero energy house design, building energy modeling, and geothermal boreholes.

There were about 80+ researchers, students and industry partners that attended and participated in the first AGM. The second AGM is planned for the third week of May, 2013 in Ottawa and is to be hosted by Carleton University. There are many exciting ideas for workshops that we are planning for this event and we will be informing you about them in due time.

All of the presentations will be posted in the Network's secure document sharing system available through the Network's website (www.solarbuildings.ca). Login access information will be provided to you upon receiving your request.

SNEBRN Scientific Director, Andreas Athienitis (L) and Network Manager, Josef Ayoub open the first AGM

SNEBRN Researchers and students attending the first Annual General Meeting

Dr. Alan Fung from Ryerson University giving a presentation with his research team

Dr. Michel Bernier from École Polytechnique giving a presentation with his research team

Dalhousie University Workshops & eSim 2012 Building Simulation Conference

Lukas Swan, Assistant Professor, Dalhousie University

The 7th biennial eSim Building Simulation Conference (May 2012) was hosted in Halifax Nova Scotia by Dalhousie University in collaboration with Natural Resources Canada from May 1 to 4, 2012. The successful conference presented 42 peer-reviewed technical papers, was attended by 130 delegates, and received lots of sunshine from the beautiful harbour-front view. The four day event consisted of 9 workshops held at Dalhousie University and 2 full technical session days held at the Pier 21 Immigration Museum. Keynote speakers Christoph Reinhart of MIT, Mark Riley formerly of NRCan, and Andreas Athienitis of SNEBRN/Concordia, presented their unique work and insight into advanced building performance simulation techniques, applications, and the impact it has on policy.

Conference co-chairs Dr. Lukas Swan and Prof. Richard Kroeker of Dalhousie University showcased Halifax with technical and social events at 5 different locations, all within walking distance of one another. Of particular note were the evening reception/tour at the new Seaport Farmers' Market, a LEED platinum building, and the technical tour led by Dr. Alain Joseph at the NSCC Centre for the Built Environment, a LEED gold teaching facility. Both faced the George's Island in the Halifax Harbour and were accessed by the boardwalk or ferry system. Delegates were delighted and entertained to experience a true Atlantic lobster banquet, complete with bagpipes.

Seven awards were distributed for top technical papers. The 52 person international eSim scientific committee, led by Alex Ferguson of NRCan, gave 3 outstanding contributions awards to lead authors: Patrice Pinel, Parham Eslami Nejad, and Caroline Hachem. IBPSA-Canada, led by Stephen Kemp of Enermodal Engineering, awarded four $1000 travel grants for outstanding student paper lead authors: Annie-Claude Lachapelle, Jason Ng Cheng Hin, Neetha Vasan, and Patrice Pinel. Dr. Lukas Swan was unexpectedly awarded the title "Halifax Ambassador" by Destination Halifax for his efforts in utilizing several unique venues for the eSim 2012 Conference.

The conference was well supported by contributing sponsors: Efficiency Nova Scotia Corporation, NSERC Smart Net-Zero Energy Buildings Strategic Research Network (SNEBRN), CBCL Consulting Engineers Limited, Integrated Environmental Solutions Limited, and Lydon Lynch Architecture. Their participation greatly enhanced the overall quality and experience of the eSim Conference. The next eSim Conference will be held in 2014 in a location to be decided by IBPSA-Canada. We hope you enjoyed the Halifax eSim experience and look forward to seeing you again at the next conference.

eSim Paper Awards

Outstanding contribution: New developments in modelling
Coupling soil heat and mass transfer models to foundations in whole-building simulation packages
Patrice Pinel and Ian Beausoleil-Morrison, Carleton University

In this well-written paper, Mr. Pinel explores the state-of-the-art in modelling heat and moisture transfer in residential foundations. By examining prior work in detail, his work provides an excellent starting point for new, integrated foundation heat loss models.

Outstanding Contribution: Applications in Modelling
Simulations of a New Double U-tube Borehole Configuration with Solar Heat Injection and Ground Freezing
Parham Eslami Nejad and Michel Bernier, Polytechnique Montréal

In this paper, Dr. Eslami Nejad demonstrates the use of advanced simulation models in the parametric study of novel geothermal technology. His work serves not only to investigate the feasibility of a new geothermal system, but also as an excellent case study in the use of simulation to support technology development.

Outstanding Contribution: Innovative directions in building simulation research
Solar Optimized Neighbourhood Patterns: Evaluation and Guidelines
Caroline Hachem, Andreas Athienitis and Paul Fazio, Concordia University

In this paper, Ms. Hachem proposes novel methods for modelling the impact of urban- and suburban-form on the integration of renewable energy. Her work promises new research directions that will likely prove highly relevant to urban planners and developers.

Outstanding papers presented at eSim 2012 in Halifax by a student at a Canadian University as determined by the IBPSA-Canada student award committee:
Annie-Claude Lachapelle, Masters of Environmental Studies Candidate, University of Calgary, "Simulink® Model of Single CO_2-Sensor Location Impact on CO_2-Levels in Recirculating Multiple-Zone Systems"

Jason Ng Cheng Hin, M.A.Sc. Candidate, Concordia University, "Optimization of a Residential Solar Combisystem for Minimum Life Cycle Energy and Cost"

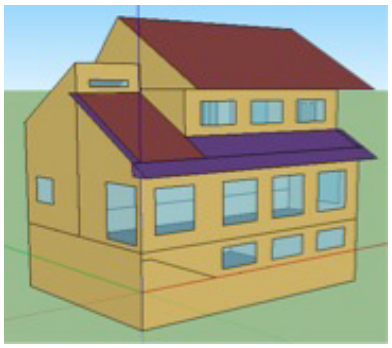
Patrice Pinel, Ph.D. Candidate, Mechanical and Aerospace Engineering, Carlton University, "Coupling Soil Heat and Mass Transfer Models to Foundations in Whole-building Simulation Packages"

Neetha Vasan, M.A.Sc. Candidate, Concordia University, "Wind Tunnel Assessment of the Wind Velocity Distribution on Vertical Façades"

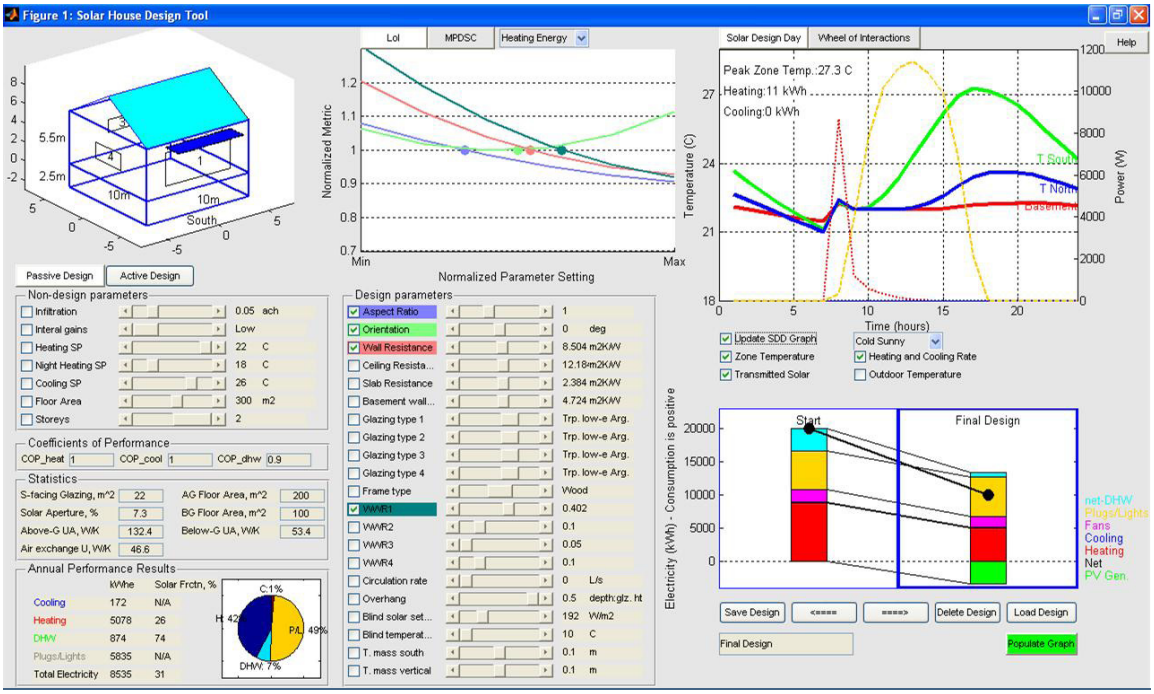
Workshop on Net-Zero Energy Building Design Hosted by SNEBRN and Dalhousie University at eSim 2012

Dr. Liam O'Brien, Carleton University

On May 1, Prof. Liam O'Brien held a half-day workshop on net-zero energy building (NZEB) design in Halifax. The focus was on good design principles and how to use building performance simulation to support design in the early stage. A major theme will be achieving the appropriate balance between energy efficiency and renewable energy systems. The participants of this hands-on computer-based workshop were taught several simple software tools, including "Ecos" (a highly-visual and efficient tool that Prof. O'Brien developed for net-zero energy house design) and use of EnergyPlus was discussed. Several building case studies were explored for their potential to be pushed to achieve net-zero energy. The Workshop was intended for advanced graduate students and other researchers or industry professionals who have some background in building design and simulation. - Prof. Liam O'Brien can be contacted at liam_obrien@carleton.ca



The EcoTerra House: One of the case studies used during the Workshop



Screenshot of Ecos, an early stage design tool for solar house design

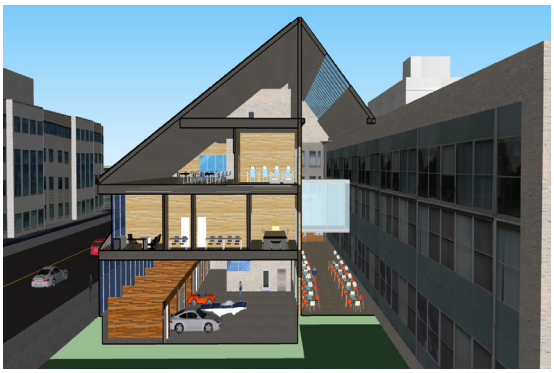
SBRN Receives ADRIQ Award Celebrating a Successful Partnership

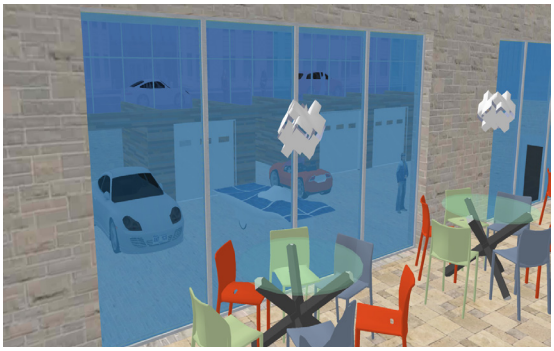
Article: ENCS Website, Concordia University

On behalf of the nationwide SBRN, Dr. Andreas Athienitis, Hydro-Québec, Natural Resources Canada, Régulvar and Murs EcoTerra Walls were honoured by the Association pour le développement de la recherche et de l'innovation du Québec (ADRIQ) and NSERC. The SBRN was one of eight university-industry partnerships celebrated at a ceremony held at Marché Bonsecours in Montreal.

"I am delighted this progressive partnership his received such positive attention," says Dr. Athienitis. "Our efforts to build a greener Canada - and world - are the result of a collective investment of time, money and talent." Established in 2005, the SBRN was then the largest Canadian research effort focused on solar energy and buildings. Due to the fragmented nature of the building process, the research undertaken by the SBRN could only have been conducted through a network partnership approach - collaboration between university research groups with industry and government partners.

L-R: Marc Dugré, Régulvar; Gilles Jean, NRCan; Radu Zmeureanu, Concordia University, accepting award on behalf of Dr. Andreas Athienitis; Jocelyn Millette, Hydro-Québec; and Jean-Louis Legault, President, ADRIQ





Engineering Center for Experiential Learning (ExCEL)

Dr. Marilyn Lightstone,
McMaster University

Being one of the first net-zero energy institutional buildings in Canada is one of the goals of the proposed Engineering Center for Experiential Learning (ExCEL) to be located at McMaster University in Southern Ontario. Along with providing engineering students with more opportunities for learn by doing, the ExCEL building will function as a living lab of sustainability.

To achieve this, a new sustainability focused approach to the building design process has been proposed where first sustainable energy engineers design the thermal envelope, HVAC and related energy systems, next the sustainable infrastructure engineers determine the most sustainable construction materials and finally the architect works within these constraints to come up with the building layout.

To provide a hands on learning opportunity, student teams were the first to be given the task of designing the energy related components of the building to see if it was possible to reach a net-zero energy building. Students first focused on energy conservation to reduce both electrical and thermal loads. Examples include vacuum insulation panels and windows, occupancy sensor based ventilation and lighting load matching and passive solar design for day lighting and solar winter heating.

The students then analysed HVAC systems to determine which required the least input energy to meet the remaining thermal loads. Systems suggested are high efficiency enthalpy recovery ventilators, geothermal with radiant free cooling as well as ventilation free cooling and building automation to utilize building thermal mass in anticipation for weather changes. Finally students considered site generation methods to provided energy to meet the remaining electrical and HVAC system loads to determine if renewable energy harvested from the footprint of the building would be enough to achieve the net-zero energy goal. Students concluded that continuous surface solar PV array on the roof connected to a building direct current microgrid was required to maximize site renewable generation.

The design process has now moved to the Integrated Design Process (IDP) to include building design professionals to integrate the non-standard systems into a synergistic, high performance building. At this early stage building product and service suppliers have been asked to become involved in the IDP to help with the integration of their products and services in the building. During the SNEBRN meeting in Halifax, members of the ExCEL design team presented the building design and received feedback from SNEBRN members on the proposed design. From this novel and thorough design process, the living lab features of the ExCEL building are expected to advance the knowledge of sustainable building design in students, researchers and society.

Team Ontario to Participate in 2013 U.S. Department of Energy Solar Decathlon

Dr. Cynthia Cruickshank, Carleton University

Team Ontario, a partnership between Queen's University, Carleton University and Algonquin College, has been selected as one of twenty teams to compete in the U.S. Department of Energy Solar Decathlon 2013 in Irvine, California. The Solar Decathlon competition is a 10-day event, held every two years, where homes are judged for energy efficiency, architecture, marketability, consumer appeal and design excellence. This prestigious competition is no stranger to the Network - past Decathlon entries have included student and faculty members from the Solar Buildings Research Network, e.g., Concordia University (2005), University of Waterloo and Ryerson University (2009), and University of Calgary (2009, 2011). Two Canadians teams have been selected to partake in next year's competition - for the third time, the University of Calgary and for the first time, Team Ontario.

Aligning with the goals of the Solar Decathlon, Team Ontario has developed a mission to work collaboratively as a multi-disciplinary and multi-institutional team to design, construct and operate an affordable, net-positive, sustainable house. The Team is a student-led initiative, with a volunteer team comprised of 50 students from architecture, skilled trades, engineering and business, across all three institutions. Together, the Team's diverse skills will ensure success in meeting the design, funding, and technological requirements of building Team Ontario's entry into the 2013 Solar Decathlon, The Aurora Home.

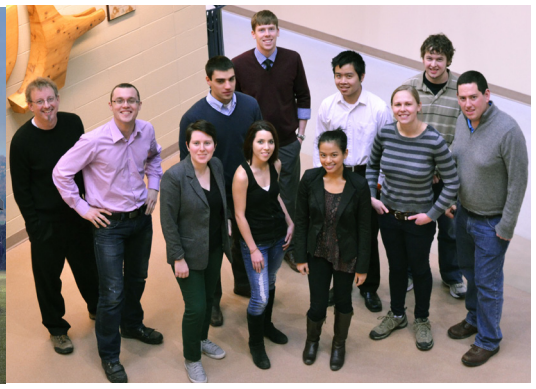
The Aurora Home will promote the use of high performance insulation materials, innovative solar thermal heating and cooling systems and high efficiency photovoltaic systems. During the design and construction process, the students will have the opportunity to apply their classroom knowledge to create viable, real-world solutions for energy-efficient housing.

One of the unique aspects and greatest challenges of this competition is that teams must design their house using a modular construction approach. Once the house is built on campus, it must be entirely disassembled for transportation and reconstructed in 10 days at the competition site in California.

The Solar Decathlon competition represents a rich opportunity for students to contribute to sustainable and innovative housing solutions for the future. Since 2002, the Solar Decathlon has involved 92 collegiate teams and 15,000 participants. Last year's competition homes were visited more than 350,000 times in 10 days.

The next Solar Decathlon competition will take place October 3-13, 2013 at the Orange County Great Park in Irvine, California.

The Aurora Home



Team Ontario team members

More information on the 2013 Solar Decathlon can be found at http://www.solardecathlon.gov/

University of Calgary to Participate in 2013 U.S. Department of Energy Solar Decathlon

Dr. Jim Love, University of Alberta

A student-led group at the University of Calgary has been selected as one of the 20 teams to participate in the 2013 U.S. Department of Energy Solar Decathlon. “It truly is a remarkable achievement for the University of Calgary to be able to compete for the third time in the Solar Decathlon” said Alexandre Ste-Marie, University of Calgary business student and Team Alberta member who took part in the 2011 competition in Washington. D.C.

The U.S. Department of Energy recently announced the 20 collegiate teams selected to compete in the biannual competition to design, build and operate a highly efficient and sustainable house. Teams are required to compete in ten different categories - ranging from best architecture and engineering to energy production for heating and cooling - while gaining valuable real-world experience in a growing global industry. Early competitions were based on off-grid technology, but recent competitions have been based on grid-tied systems.

Next year’s contest will take place in Irvine, California at Orange Country Great Park, in the first Solar Decathlon to be held outside of Washington. As in past competitions, teams design and build modular homes that are disassembled for transport to the competition.

The homes are reassembled at the competition site and operated during the 10 day public display and competition. A second Canadian team from Queen’s University/Carleton University/ Algonquin College was also selected to take part.

Team Alberta’s concept is based on addressing the housing needs that are so pressing in remote communities and industrial camps such as those in the Fort McMurray region. The team intends to produce a modular home that is easy to transport and assemble and is affordable for working families, as well as for remote working populations. Under the umbrella of Team Alberta, the project is expected to draw expertise from institutions across the province and to foster a greater sense of inter-institutional and inter-faculty collaboration.

“The Solar Decathlon competition provides an incredible opportunity for students from all disciplines and backgrounds to work together on a complex project that pushes the envelope in terms of showcasing the possibilities of sustainable construction and design,” said University of Calgary Provost and Vice-President (Academic) Dru Marshall. “This is exactly the kind of student-led project the University of Calgary values as a leading teaching and research and teaching institution in Canada’s energy capital.”

2013 Team Alberta House Preliminary Rendering

ASHRAE Graduate Student Grant-in-Aid Award

Costa Kapsis, Concordia University

In April 2012, Costa Kapsis, a PhD candidate, received the ASHRAE Graduate Student Grant-in-Aid Award, a prestigious international award granted to outstanding graduate students from around the world for their research contribution.

Initially, Costa joined the Solar Building's Research Network (SBRN) in January 2007, during his Master's degree at Concordia University, under the supervision of Dr. Athienitis and Dr. Zmeureanu, with concentration on daylighting and design of commercial building façades. During this period, he had the chance to get involved in several major projects such as the renovation and optimization of the P.E. Trudeau International airport existing perimeter and the control and thermal optimization of the shading systems on the John Molson School of Business (JMSB) building. Moreover, he participated voluntarily on the design of an energy efficient office building through the Concordia Volunteering Abroad Program (CVAP) in Gulu, Uganda. During his strong research participation in SBRN, he identified the need for fundamental research on building technologies that will contribute towards the target of net-zero energy commercial buildings (buildings that produce as much energy as they consume, annually).

Costa had the privilege of starting his Ph.D. at Concordia University at the SNEBRN's conception stage, under Dr. Athienitis's supervision, and participated in the design of the Bibliothèque de Varennes, a net-zero energy institutional building in Canada, currently under construction. The primary objective of Costa's research is to develop a general methodology and design guidelines to inform architects and engineers of the impacts of use of building integrated semi-transparent photovoltaic (STPV) technologies during preliminary design when there is an opportunity to have the greatest impact on the final design. Cooling energy costs are a major concern in most office buildings and for this reason double-glazed facades with an integrated strategy to reduce the transmission of solar radiation is becoming the norm. Instead of using reflective coating or ceramic frits to reduce the solar radiation, STPV could be integrated, thus optimizing solar heat gains and lighting loads while concurrently producing electricity; providing more energy benefits and possibly turning the facade into a net energy generator. This will support efforts of the U.S., Canada, and others to develop net-zero energy commercial buildings in order to meet our commitments for reductions in greenhouse gas emissions. This work explores a wide variety of STPV technologies; from spaced cells and spherical silicon crystals to silicon and organic thin films. Costa's work is funded by the NSERC Photovoltaic Innovation Network.

A unique in its kind experimental facility is used to assess the thermal, daylighting and electrical performance of various STPV technologies. The Concordia Solar Simulator is a fully controlled lamp field able to simulate the sunlight spectrum and intensity. Coupled with a full scale two-storey high environmental chamber able to reproduce arctic to desert conditions (from -40°C to +60°C), it will be used to utilize different curtain walls technologies with integrated STPV, test and characterize their performance under different scenarios (sunny cold day, sunny hot day, etc).

Costa can be contacted at c_kapsis@live.concordia.ca, and would be happy to share his experiences and passion for net-zero energy buildings.

Caroline Hachem, Concordia University

The primary objective of Caroline Hachem's research is to develop a design procedure or algorithm for solar neighbourhood design that is based on optimized building shape, density and site layout. Building shape study includes the general geometrical shape and the roof design for optimal roof integrated solar collectors. The research addresses issues such as: how to design building shapes to maximize their solar potential, under a given density, how to position buildings to avoid mutual shading, and how to benefit from street shape, or to include street shape as a design parameter in order to enhance the overall energy performance of a neighbourhood.

This research is multidisciplinary - it plays a bridging role between building engineering and architectural design, combining energy management, building technology and structural and architectural design. It indicates a methodology for systematic integration of solar efficiency considerations in the design of residential neighbourhoods from the earliest stages of the design. The developed design procedure can be applied to different parts of the world with different climatic conditions. Ultimately this research will provide architects and engineers with a set of design guidelines that reduce energy consumption and provide energy supply, while enabling architectural design flexibility.

Caroline Hachem is a PhD candidate in Building Engineering at Concordia University. She is an architect by training and profession, and has a Master's degree in Architecture and Urban Planning from the Technion Institute of Technology of Israel (graduated Summa cum Laude) and a Master's degree in Building Engineering from Concordia University.

Caroline has obtained several awards including the "Natural Sciences and Engineering Research Council of Canada (NSERC) - Alexander Graham Bell Graduate Scholarship," "The International Hangai Prize" for young researchers in the field of space structures and the "Thesis Research Prize of Excellence" from the Technion Institute of Technology.

Caroline Hachem focuses her PhD research on the investigations of solar potential and energy implications of housing units' shapes and neighbourhood patterns. Her research is multidisciplinary, it plays a bridging role between building engineering and architectural and urban design. She has published journal and conference papers on her research topic.

She is the first Canadian to be awarded a Grant-in-Aid grant from the American Society of Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE) for 2011.

An Update on the joint IEA SHC Task 40 / ECBCS Annex 52: Towards Net-Zero Energy Solar Buildings

Josef Ayoub, Network Manager, SNEBRN / Operating Agent Task 40/Annex 52

Energy consumption in commercial and residential buildings worldwide accounts for about one-third of the world's energy and one-quarter of greenhouse gas emissions. If current trends continue, by 2025, buildings worldwide will be the largest consumers of global energy, using as much power as the transportation and industrial sectors combined.

Recent studies have found that improving energy efficiency in buildings is the least costly way to reduce a large quantity of carbon emissions. By changing energy management practices and instituting technologies that enhance energy efficiency, building owners and managers can reduce energy consumption by up to 35 per cent. However, energy efficiency efforts in buildings alone cannot address future demand for more energy by this sector. In order to achieve breakthrough solutions to this problem, it is evident that a coordinated effort in whole-building systems approach that emphasizes the necessity of integrating and optimising renewable on-site generation systems and energy efficiency is required to design the buildings of the future. Several International Energy Agency (IEA) countries have adopted a vision of so-called 'net zero energy buildings' (NetZEBs) as long-term goal of their energy policies. However, what is missing is a clear definition and international agreement on the measures of building performance that could inform 'zero energy' building policies, research, development and deployment programmes, and industry adoption around the world.

In October 2008, the International Energy Agency (IEA) had approved the creation of a new five-year (to September 2013) international collaborative research initiative between the Solar Heating and Cooling (SHC) and the Energy Conservation in Buildings and Community Systems (ECBCS) Implementing Agreements entitled "Towards Net-Zero Energy Solar Buildings." To-date, some 70+ National Experts and regular participants from 19 member countries have joined the Task/Annex.

The principle objective of this Task 40/Annex 52 work is to study very low energy, near net-zero and net-zero buildings with the aim of developing harmonized international definitions framework, design tools, innovative solutions sets and guidelines to facilitate wider industry uptake. To achieve this objective the work of the Task/Annex has been allocated along four major activities:

• The first activity deals with establishing an internationally agreed understanding on NetZEBs based on a common methodology. This is done by reviewing and analyzing existing NetZEB definitions and data with respect to the demand and the supply side, studying grid interaction (power/heating/cooling) and time dependent energy mismatch analysis, developing harmonized international definition framework for the NetZEB concepts considering large-scale implications, exergy and credits for grid interaction, and developing a monitoring, verification and compliance guide for checking the annual balance in practice (energy, emissions and costs) harmonized with the definition.

• The second activity is headed by Prof. Andreas Athienitis and it aims to identify and refine design approaches and tools to support industry adoption. This is done by documenting and analyzing processes and tools currently being used to design NetZEBs and under development by participating countries, assessing gaps, needs and problems to inform simulation engine and detailed design tools developers of priorities for NetZEBs, qualitative and quantitative benchmarking of selected tools, and selecting five case studies of buildings (detailed analysis of simulated/designed vs. actual performance), and proposing the redesign/optimization of these buildings.

• The third activity focuses on developing and testing innovative, whole building net-zero solution sets for cold, moderate and hot climates with exemplary architecture and technologies that would be the basis for demonstration projects and international collaboration. This is achieved by documenting and analyzing current NetZEBs designs and technologies, benchmarking with near NetZEBs and other very low energy buildings (new and existing) for different climates, conducting literature review and practitioner input (workshops), developing and assessing case studies and demonstration projects in close cooperation with practitioners, investigating advanced integrated design concepts and technologies in support of the case studies, and developing NetZEB solution sets and guidelines for the market uptake by builders and developer.

• The fourth and final activity is a crosscutting work that focuses on disseminating the results to support knowledge transfer and market adoption of NetZEBs on a national and international level.

There are many articles and reports and presentations submitted and can be downloaded from the Task/Annex website: http://www.iea-shc.org/task40/. I invite you to navigate through it for your pleasure. For more information, don't hesitate to contact me.

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SNEBRN is currently the major Canadian research effort in smart net-zero energy utilization in buildings. It brings together 29 Canadian researchers from 15 universities to develop the smart net-zero energy homes and commercial buildings of the future. The Network also includes researchers and experts from Natural Resources Canada (NRCan), the Canada Housing and Mortgage Corporation (CMHC) and Hydro-Québec. Industrial partners from the energy and construction sectors are involved in most projects, developing the know-how that will help them compete in the global market.

For more information on upcoming events, visit our website

Upcoming Events

• IEA Task 40 / ECSBCS Annex 52 2nd PhD Autumn Workshop on Net Zero Energy Buildings: Solutions Sets, Case Studies, at IESC, Scientific Research Institute of Cargese, Corsica (France)
September 24-28, 2012

For information on the Workshop, please visit http://www.iea-shc.org/task40/events/PhD2012/index.html

• IEA Task 40 / ECSBCS Annex 52 8th Experts Group Meeting
October 1-3, 2012, Barcelona, Spain

By invitation of the operating agent only

• 7th International ENERGY FORUM on Solar Building Skins
December 6-7, 2012, Bressanone, Italy

For the complete conference program, please visit www.energy-forum.com

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