



# Increasing Energy Efficiency in BC’s Built Environment

## *CIRS-PICS Project Year 1 Annual Update – March 2016*

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## Background/Overview

The priorities of the Energy Efficiency in BC's Built Environment research program were framed by a multi-disciplinary group of stakeholders at the workshop on June 10, 2014. These were subsequently organized into the structure of the project during the development of the LOI in the fall of 2014.

Broadly this include three research streams:

- 1) *Neighbourhood/Cross-Scale Energy Solutions*: explores the design, evaluation and relevant policy for innovative, integrated community energy solutions developed around nodes or hubs of such things as buildings, transportation or energy services.
- 2) *Building Scale Energy Solutions*: explores integrated design and policy approaches to improve building performance, inhabitant satisfaction, and embodied/operational energy and carbon.
- 3) *Financing/Policy Solutions*: explores effectiveness of financing mechanisms and policy instruments used to improve both new and existing buildings and communities.

Each stream is divided into individual sub-projects under the direct supervision of an academic researcher at the University of Victoria, Simon Fraser University or the University of British Columbia. The LOI outlined a high level description of each project and suggested practice or policy oriented deliverables. It also allocated funding based on the recommended level of expertise, that of a Master student, PhD student or post-doctoral fellow, and estimated duration to undertake the work.

Each researcher expands on the project description, as well as the deliverables, engagement activities, timelines and other components, in a project proposal which is reviewed by the stream lead and the principal investigator, at the start of each project before funds are released. Opportunities for peer review and feedback are provided at meetings and workshops.

## Research Team

### *Building Stream*

- Ray Cole (PI and stream lead), UBC School of Architecture and Landscape Architecture
- Lyn Bartram, SFU School of Interactive Arts & Technology
- Kendal Bushe, UBC Department of Mechanical Engineering
- Bob Gifford , Uvic Psychology - Environmental, Social and Personality Lab
- Kasun Hewage, UBC School of Engineering (Okanagan Campus)
- Sheryl Staub-French, UBC Department of Civil Engineering
- Rob Woodbury, SFU School of Interactive Arts & Technology

### *Neighbourhood Stream*

- Ron Kellett (stream lead), UBC School of Architecture and Landscape Architecture
- Maged Senbel , UBC School of Community and Regional Planning
- Larry Frank, UBC School of Population and Public Health

### *Policy/Finance Stream*

- Mark Jaccard (stream lead), SFU Department of Resource & Environmental Management
- James Tansey, UBC Sauder School of Business

## Milestones

Project Official Start	January 2015
Project Actual Start	April 2015
First Advisory Committee Meeting	September 2016
Second Advisory Committee Meeting	January/February 2017
Mid-project Review	April 2017

## Seed Projects

(Updated September 2016) With the agreement of the project team, an allocation of resources has been set aside as seed funding to support small research activities outside the original sub-project structure. This is available to all team members, though a proposal process. To date the seed projects have been launched to help frame aspects of the larger research project, expand on key areas within to enhance the original projects or to inform/enrich the general research. They include a scoping project for the neighbourhood stream, preliminary research on the human dimensions of energy efficiency in the built environment, additional support for financial modelling within the policy stream, and a workshop with Salvador Rueda, an internationally acclaimed urban ecologist with local practitioners and team members.

## Year 1 Projects Initiated

Project	Researcher	Student/PDFs
Community Scale - Energy Efficiency Redevelopment Practices	Ron Kellett	1 PDF, 5 MS
Community Scale – Community Energy Efficiency Best Practice Initiatives	Maged Senbel	1 PhD
Building Scale - Integrated Design Approaches to Built Environment Energy Efficiency	Ray Cole	1 PDF, 2 MS
Building Scale - Lifecycle based Methodologies to Improve Energy Efficiency in Buildings	Kasun Hewage	3 PhDs
Building Scale - Human Dimensions of Energy Efficiency in the Built Environment	Bob Gifford	1 PDF, 1 PhD
Policy/Finance - Financial and Intangible Costs of Environmentally Sustainable Cities	Mark Jaccard	1 PDF, 1 PhD, 2 MS
<i>Year 2 Projects launched by September 2016</i>		
Building Scale - Innovation in BIM and IPD	Sheryl Staub-French	1 PDF
Policy/Finance - Exploring Capital Markets and Evaluating New Financial Instruments and Policies	James Tansey	1 PDF

## Year 1 Activities and Events

The predominant focus of the activities undertaken in 2015-2016 were related to project launch, engaging and developing the research team and establishing connections with other PICS initiatives.

- *Individual Researcher meetings (January – February 2015)*  
 As Principles Investigator for the project, Dr. Cole met with each of the individual researchers to explain the overall project objectives and discuss their individual research projects and deliverables. The Stream leads also met during this time to coordinate stream agendas.
- *Initial Research Team meeting (March 11, 2015)*  
 This was the first time many of the researchers had met each other in person. Discussion included the overlaps between projects and research topics, and the need to consider how they fit together, the overall project timeline and allocation of funds over the 5 years including the suggestion of seed funded project to more fully engage the team, the need to connect to research already being developed and to leverage the PICS project to address larger questions, the need to emphasize collaborations and frame the project as a single cohesive multi-faceted project, rather than multiple independent sub-projects. This discussion has informed the process and structure of the project as it's been developed over the last year.
- *PICS 5 Project Workshop (October 2, 2015)*  
 The workshop was attended by many of the researchers and students and provided an excellent opportunity to learn about the other four major projects and start to build connections with other researchers.
- *Collaborations Discussions with other PICS project leads (September 2015)*  
 Ahead of the PICS workshop Dr. Cole met with Dr. Walter Merida, Transportation project lead, and Dr. Werner Kurtz, Forestry project lead. The purpose of these initial meetings was to gain a greater understanding of each other's project as a first step to identifying areas of collaboration and partnership. There are clear connections between the project objectives and some overlaps and other connections amongst researchers on the three projects. There's been some follow-up between the Building and Transportation projects, which will definitely expand in the next year as the work becomes more established. A meeting between UBC-based researchers working on the Forestry and Building project is currently being scheduled for May 2016.
- *Stream Research Team Meetings*  
 The research teams within each stream have been meeting and in communication around their respective projects. The Neighbourhood and Policy/Finance streams have been engaging on a more informal level, as the teams are smaller and the researchers already have active collaborations in a number of areas. The Building stream team is both the largest and the most geographically diffuse, and therefore required a more formal organization. An initial meeting of the Building stream research team, faculty and active students, took place on January 15, 2016, and included a review and critique of active and proposed projects.
- *Second Research Team meeting (January 15, 2016)*  
 This meeting included updates from each of the stream leads and some of the students on the research project status and activities being planned or currently undertaken, followed by discussion around next priorities: updates to the new Director, establishment of an advisory committee and suggestions for representation, strategies for community engagement with practitioners and policy-makers.

## Practitioner Engagement

In the LOI it was originally proposed to hold a series of engagement workshop for the project as a whole, with a broad range of participation representing different constituencies within the building industry. At the second research meeting it was decided that it would be both more valuable and manageable for each individual project to focus on a target demographic and develop a specific strategy for a deep engagement focused on the specific research topics. It was generally felt that this approach would lead to a more informative and useful exchange on both the research side and the practice/policy side.

## Advisory Committee

(Updated September 2016) An advisory committee has been assembled to provide high-level and strategic guidance and direction to the project as a whole. In discussion, the research team recommended a few changes and additions to the preliminary list of participants in the LOI – this included a more direct link to policy-makers, and representative from the practicing architectural and development communities.

Committee members:

- Dr. Sybil Seitzinger, Director, PICS (chair)
- Ben Finkelstein, Communities and Built Environment Manager, Climate Action Secretariat
- Deanna Grinnell, Senior Director, Real Estate BC Region, Canada Lands Company
- Thomas Mueller, President and CEO, Canadian Green Building Council
- Jorge Marques, Innovation and Advances DSM Manager, BC Hydro
- Martin Nielsen, Principal, DIALOG
- Andrea Reimer, Councillor, City of Vancouver

The introductory advisory committee meeting was held on September 8, 2016. This meeting primarily served as an opportunity for the committee to be introduced to the project and to each other. The agenda included overview of PICS, the 5 major Projects, the Built Environment project and the work being undertaken by the three streams, as well as discussion around how the research team can best engage with practitioners and policy makers. The committee was quite impressed with the work to date and supportive of the overall direction and objectives of the project. A second meeting is planned for early in 2017, in addition to pursuing opportunities for individualized engagement of the committee members (and their organizations) with specific projects.

## Additional Collaborations and Engagements

Individual researchers have identified their own targeted practitioner and policy related collaborations. For the overall project, two more in-depth collaborations are in discussion:

- *Pembina Institute*: we are currently in discussion with the Pembina Institute on strategies for collaboration. Focus areas include collaboration on specific graduate student projects or internships, convening events and development of communication pathways for research/policy knowledge exchange. (Update) We are engaging with Pembina around the planning of the annual Thought-Leaders Forum which this year will be focusing on accelerating deep retrofits as a strategic pathway towards Net-Zero buildings. Christina Bollo, the building stream post-doctoral fellow, is participating in the TLF advisory group identifying policy opportunities and designing forum sessions to best leverage the knowledge of participating experts. Her participation helps

bring PICS interests and agenda in the forum and provides a mechanism for aligning research interest of the building stream with priorities of stakeholders in the field.

- *Integral Group*: there have been some initial discussions around local and provincial stretch codes for energy/carbon emissions of building projects.
- (Update) Mark Jaccard led a practitioner and policy orientated seminar-workshop on the City of Vancouver's 100% Renewable Commitment on September 9<sup>th</sup>, 2016. This workshop was held under Simon Fraser University's Professional Program with an audience of 75, including representation from regional municipalities, developers, architects and engineering firms, financial agencies, and energy companies and consultants. Discussion and feedback was extremely informative for the research project, and the engagement response was positive that a follow-up workshop is under consideration.

## Relating PICS Research to 2016 BC Climate Leadership Plan Action Area: Communities and Built Environment

The energy and resource use and associated greenhouse gas emissions associated with the construction and operation of buildings are acknowledged as a major cause of both global warming and environmental degradation. Importantly, buildings also offer the largest low-cost potential carbon reductions in all world regions and will play a critical part of any global low carbon future.

The recent release of the *British Columbia Climate Leadership Plan* coincides and stands in contrast to a number of progressive plans and commitments by other jurisdictions such as the *City of Vancouver*, the *Government of Ontario* and the *Government of Alberta*, as well as initiatives by the *Canada Green Building Council*. One of the positive aspects of the Plan is that it recognizes that the built environment represents both a significant contributor to the Province's overall emissions profile and a "real ongoing opportunity for change."

*Taking Action* in the *Communities and Built Environment Action Area* in the Plan is organized in four strategies: Regulations for more efficient buildings; Encouraging the development of Net Zero Buildings; Refreshing the Climate Action Charter for Communities; and, Creating a strategy to turn waste into resources. While energy/carbon "taking action" strategies related to the built environment are also evidenced in other Actions Areas within the Plan, the scope and emphasis of the *Communities and Built Environment Action Area* permits the opportunity to illustrate and position the current and planned research activities within the *PICS Energy Efficiency in the Built Environment* research project.

Relevant concerns with the Plan include:

- Of the four recommended 'Taking action' strategies — the two *Encouraging the development of Net Zero Buildings* and *Refreshing the Climate Action Charter for Communities* call for emissions reduction 'plans' that have largely already been made, and decision support tools, information and 'stretch codes' already available. That stated, the declared commitment to a net-zero ready target for buildings and providing the means to achieve it represent an important and necessary step.
- Many of the proposed strategies are too vague to fully understand their implications. For example, it is unclear what 'the use of decision support tools that provide the information needed to create more resilient green infrastructure' in the *Refreshing the Climate Action Charter for Communities* will do for energy and emissions and there is no mention of better enabling or implementation actions.
- Reference is made to "creating innovation opportunities and financial incentives for advanced, energy-efficient buildings, including an increase in funding for design and innovation. This is followed by the acknowledging the "partnership between the Province's Innovative Clean Energy Fund and the Canadian Passive House Institute, international Passive House standard." In the absence of anything more specific, the support of the Passive House Training program seems to be the extent of this action.

- Taking Action strategy: *Regulations for more energy efficient buildings*, appears to target narrow segments of building sector energy demand, focusing only on increased efficiency requirements for gas fireplaces and air source heat pumps and high-efficiency technology requirements for natural gas space and water heating equipment. There is no reference to building envelope standards or cross-reference to Passive House standards.
- Trip demand goals and associated actions seem to have slipped away between the *Communities and Built Environment* and the *Transportation* Action Areas. Without effective land use, transportation and community planning actions, technical improvement in the fuel efficiency of private vehicles will be overwhelmed, at best neutralized, by increases in vehicle kilometres traveled.

There are some other notable absences from the plan such as:

- The absence of an acknowledgment of the significance of energy use and carbon emissions associated with *existing* buildings and offering any concerted strategies to address it. Given that existing buildings represent by far the most ‘improvable’ of building sector emissions contributors, the call to “Get involved – upgrade your home’s energy efficiency” by referencing existing rebate programs is a woefully inadequate recognition of its importance.
- It is surprising that there is no reference to building energy benchmarking given that “...the Province supports benchmarking as an important strategy in increasing the energy efficiency of large buildings and reducing carbon emissions in the region. While legislative amendments are not under consideration at this time, the Province is exploring approaches and policy options in relation to enabling potential benchmarking activities, in particular for commercial and large multi-unit residential buildings in BC.”<sup>1</sup> Building energy benchmarking and public disclosure is a low cost practice that enables building owners to identify savings opportunities, enables evaluation of the effectiveness of municipal strategies to reduce energy use in existing buildings and enables measuring progress in building energy performance over time.

While it is anticipated that the PICS Built Environment project will make contributions to these specific issues, the lack of cross-connection both between and within the Action Areas represents a troubling feature in the overall formulation and communication of the plan. Here, current and planned research in the PICS *Energy Efficiency in the Built Environment* research project, through specific projects, will offer:

- An urban policy model that assesses a range of options for Vancouver to achieve its 100% renewables target, that focuses on buildings, urban form and transport.

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<sup>1</sup> British Columbia Ministry of Community, Sport and Cultural Development. (2015, February). *Provincial Response to 2014 UBCM Resolutions*. Retrieved from <http://www.ubcm.ca/assets/Resolutions~and~Policy/Resolutions/Provincial%20Response%20to%202014%20UBCM%20Resolutions.pdf>, p95

- A comprehensive overarching framework illustrating the relationships within and between the policies, mechanisms and stakeholders associated with the production and use of buildings in order to combat the fragmentation of the building delivery industry.
- An approach to simulating and comparing combinations of existing and contemplated energy and emissions reducing policies and practices through spatial models representative of BC communities.

The common feature here is this work takes a cross-scale, systems approach concerned equally with understanding the complex inter-relationship between key issues and domains as understanding and offering strategic direction within them. Moreover, whereas much of the policy/regulatory context for carbon reductions in the built environment relates to technical systems, the PICS research places considerable emphasis on understanding inhabitant behaviour, stakeholder’s interests and priorities together with their knowledge, skills and capabilities to create the necessary improvements (*see Figure 1*).

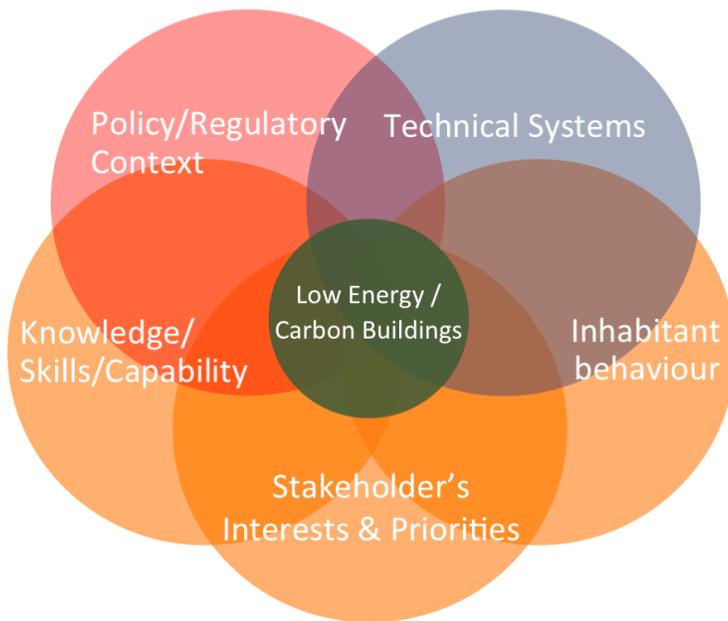


Figure 1: Expanding the scope beyond technical issues

## Increasing Energy Efficiency in BC's Built Environment

### *2016-2017 Activities & Objectives*

#### Overall Project Objectives for 2016-17

The CIRS-PICS Energy Efficiency in BC's Built Environment project enters its second year cycle on May 1st 2016. During the initial year, two key meetings involving all research faculty provided an opportunity to establish overarching ambitions of the research program, the role of the various projects within it and the status of those that were operational. This report highlights the key objectives and activities planned for year two of the project.

- 1) The overall objectives for 2016-17 fall into three categories: Engagement with representatives of practice and policy involved in building/community-scale energy efficiency and emissions reductions:
  - a. Finalise membership of the Advisory Committee and hold two meetings to report the status of the project and garner high-level strategic feedback on its scope and direction;
  - b. Establish an effective collaboration with Pembina and reach out to similar organizations that can act as a conduit for input, participate in the review of our research activities and offer complementary research experience;
  - c. Encourage and support individual projects/stream based engagement activities. Each of the specific research projects will engage relevant stakeholders and the outcomes will be reviewed and compiled by the PI and project manager for collective feedback.
  
- 2) Strengthen collaboration and communications among researchers: As of May 15th 2016, all three sub-streams of the Energy Efficiency in BC's Built Environment project – Community scale, Building Scale and Policy & Financial – will have Post-Doctoral Fellows in place. In addition to their specific responsibilities within the respective sub-streams, these PDFs will:
  - a. Support continued communication and engagement across streams and identify/facilitate areas for cross-fertilization;
  - b. Launch the new research projects within the policy and building streams drawing on experience gained from those in progress;
  - c. Build relationships with researchers and projects of mutual interest in other PICS Major Projects, particularly the Future of Transportation and Forest Carbon Management;
  - d. Support/facilitate individual researchers collaborations;
  - e. Establish student networks and events to building sense of community and shared ambition.



- 3) Revisit project organization and goals: While the initial LOI required a detailed description of the research activities for the full five-year funding period identifying researchers, projects & deliverables, after year one it is evident that adjustments to the original plan are needed. Specific objectives here are:
  - a. Review the first year deliverable from the active projects and stakeholder feedback, if necessary, recalibrate the scope and direction of the respective projects;
  - b. Work with the researchers who were granted seed funding in year one to develop full research project workplans.

## Active Projects

### *Policy/Finance*

- 1) Mark Jaccard PDF – Financial and intangible costs of environmentally sustainable cities. Explore 3 actions for improving environmental performance of cities as it related to energy use: energy efficiency (reduction of energy consumed per unit of energy provided), fuel switching (low or no CO<sub>2</sub>) and energy conservation (reduction of demand). Track and analyse incentive mechanism to simulate these actions at different scales (building, site, node, system).
  - a. Activities: Phase 1 background research and lit review on financial and intangible costs and effectiveness of reducing energy use and GHG emissions for incentive mechanism and scale, to develop a matrix of estimates to analyse characteristics of each combination. Made available to inform other projects, and provide foundation for phase 2 and 3. Phase 2 conduct analysis of uncertainty and seek answers to set of related questions.
  - b. Engagement: City of Vancouver Renewable City Action Team (input and review)
  - c. Deliverables: Phase 1 report, modelling tools, responses to policy

### *Community*

- 1) Ron Kellett PDF – Community energy efficiency redevelopment. Research, evaluate and recommend policy and best practices that reduce energy demand and GHG emission in BC communities: improve community-scale modelling capabilities to assess interactions of different variables, explore alternative energy scenarios in different urban for patterns, provide actionable guidance to practitioners.
  - a. Activities: Analyse current redevelopment policy and identify bundles of innovative practices that can be used to develop alternative energy and emissions scenarios; develop “sand box” representations of urban form types and development patterns common to BC municipalities; develop modelling approaches and metrics that to improve community-scale energy and GHG modeling accuracy and to support model iteration of alternative combinations of interventions.
  - b. Engagement: Practitioner workshop with research partners –Esri Canada, Concert Properties, District of West Vancouver and Natural Resources Canada.
  - c. Deliverables: A matrix framework that cross-references energy variables with urban form types and relevant policies and practices. A spatial modeling environment for rapid iteration and evaluation of energy and GHG emission interventions. A white paper on the developed modeling methodology. A white paper on research outcomes and the resulting policy and practice recommendations.
- 2) Maged Senbel PHD – International community energy efficiency best practices. Review and assessment of case studies for applicability of policies and projects to BC urban and rural contexts, focused on addressing barriers to and suggest solutions for community scale energy initiatives framed within a regenerative approach.
  - a. Activities: Inventory comprehensive climate change mitigation strategies that embed energy through broader community values and goals (energy reduction and conservation, GHG sequestration, distributed energy production)
  - b. Engagement: Municipal, rural and First Nations planners
  - c. Deliverables: International case study report

### *Buildings*

- 1) Kasun Hewage PHD – Lifecycle based methodologies to improve energy efficiency in buildings. Develop/improve a systematic framework to increase lifecycle energy efficiency of retrofitted building, specifically multi-unit residential: energy assessment, lifecycle energy management decision support tool, best management practices.
  - a. Activities: Develop framework, benchmarks and tools for assessing asset and operational performance of MURBS; review energy consumption surveys, lit reviews and empirical studies, expert interviews
  - b. Engagement: Building users and operators – buildings are being identified over the summer.
  - c. Deliverables: Framework and tool to assess energy performance against building type and location specific benchmarks.

### SEED Projects

#### *Buildings*

- 1) Bob Gifford – The human dimensions of energy efficiency in the built environment”
  - a. Research the human behavior driven “rebound effect” of energy efficiency measures in building to identify boundary conditions. Pilot project – use several buildings, likely at University of Victoria, to examine helpful and not helpful human reactions and choices to energy efficiency
  - b. Research the impacts of energy efficiency measure on welfare of occupants and “love” of building. Pilot project comparing occupants of LEED certified building and conventional buildings at University of Victoria campus.

Both project area anticipating completion in July, 2016, and are expected to provide useful information to inform other project within all three streams.

### Launching Projects

#### *Buildings*

- 1) Ray Cole PDF – Integrated approaches to optimize interaction between building systems, policies and regulations, and industry stakeholders
- 2) Kendal Bushe PHD – design guidelines, polices, best practices and application strategies for smart building technologies in British Columbia
- 3) Sheryl Staub-French PDF – building information modelling and management tools and practices for urban and rural contexts

#### *Policy/Finance*

- 1) James Tansey PDF – energy efficiency incentive program solutions and adaptations for commercial and industrial buildings in BC