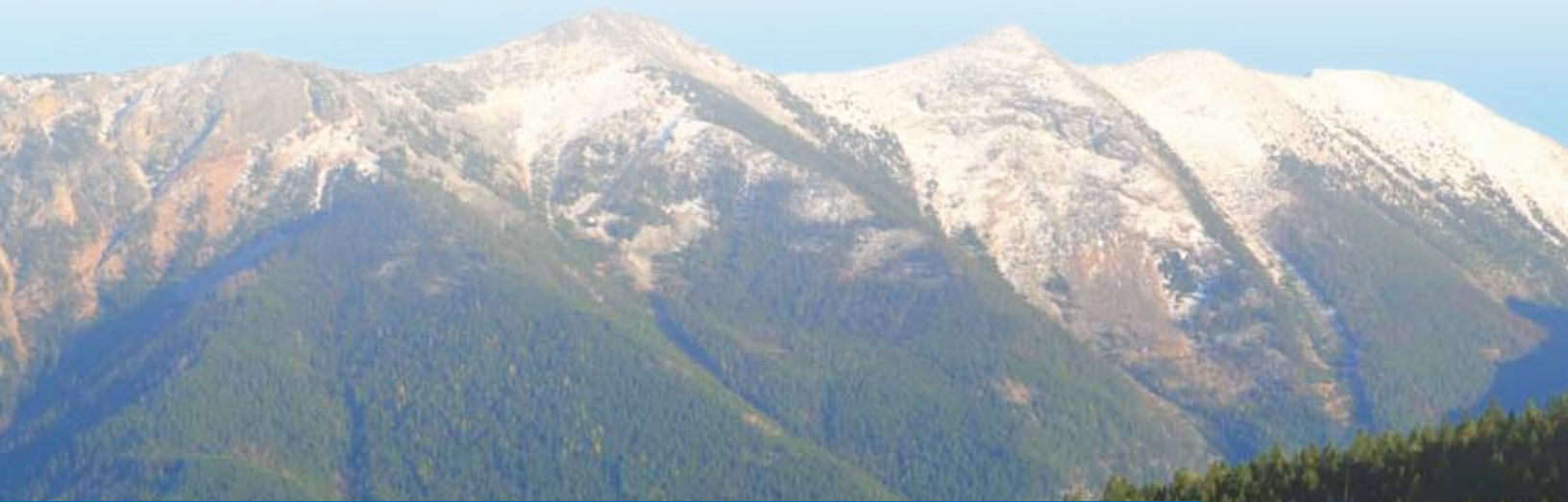




Pacific Institute
for Climate Solutions
Knowledge. Insight. Action.



ANNUAL REPORT 2010/11



The Pacific Institute for Climate Solutions gratefully acknowledges the generous endowment provided by the Province of British Columbia through the Ministry of Environment in 2008. This funding is enabling ongoing independent research aimed at developing innovative climate change solutions opportunities for adaptation and step toward achieving a vibrant low-carbon economy.

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1. MESSAGE FROM THE EXECUTIVE DIRECTOR



Three years and five months have passed since the Pacific Institute for Climate Solutions (PICS) first raised its sails and caught some wind in 2008. Those sails are now filled, and I am very pleased to report our progress as British Columbia

(BC) continues to face the climate-change challenge that is so interwoven with our environmental and economic future. The last twelve months—September 2010 through August 2011—have been simultaneously hectic, stimulating, and fruitful as our research, communication, outreach and fellowship programs reached their full form. It has been particularly satisfying to see PICS evolve as a vigorously interacting and interdisciplinary community of scholars that, despite being spread across four universities, enjoys a high degree of collaboration.

This report describes many highlights: PICS now funds some 32 research projects through our five major research pillars. We support about three dozen graduate students and post-doctoral fellows, issue a weekly news scan and episodic briefing notes through a collaboration with the ISIS group at the Sauder School of Business at the University of British Columbia (UBC), commission and publish white papers—in-depth explorations of specific issues as diverse as electricity export policies, clean tech access to venture capital and pay-as-you-drive car insurance—and host an annual expert forum on topics that relate directly to the mitigation and adaptation challenges. We support annually a slate of interns, many of whom spend their work terms working directly on policy issues in BC government offices, and we host seminars and public lectures designed to bring clarity to the many shapes and guises that the climate issue takes. We are particularly pleased to have launched our free, online “Climate Insights 101” short-course series in late August with the release of the first module, “Climate Science Basics”. Early indicators show that the uptake is far exceeding the original target audience of BC’s 26,500 civil servants, with broad media coverage of the launch attracting several thousand

independent site visitors from around the world within the first week alone. Feedback from within BC, Canada and overseas encouragingly shows the user base is growing steadily as the word spreads about this free resource.

All of the above mentioned initiatives and programs are described in the following pages, and additional details can be found on our website at pics.uvic.ca.

Although we are now past the steep section of a young institute’s building curve, much remains to be done in the policy realm associated with the science-engineering-social science-policy spectrum. Earth’s climate, with all its implications for society, is not standing still. Indeed, the most recent data reinforce both scale and urgency of the climate-change challenge. As I write, we are on the verge of setting a new historical minimum in summertime ice cover on the Arctic Ocean. Intense precipitation events are increasing in their severity across the face of the planet. Global carbon-dioxide emission rates are accelerating at the same time as the atmospheric concentration of another key greenhouse gas—methane—has jumped up again after several years of relative stability. And eight months ago, it was announced that 2010 would share the title with 2005 as the warmest year in recorded human history.

Despite such a parade of key observational evidence for climate change, there remains a paucity of national or international efforts either to mitigate the ongoing warming or to put in place programs that will support adaptation. Last year, I wrote these words for the annual report: “The need for an organization like PICS to provide sound policy-relevant research and analysis to governments—to turn climate knowledge into climate action—has never been stronger”. Twelve months on, little has changed, and in that light, PICS must work even harder. In the year to come, we will do our best to meet that challenge, including building international collaborations into our research and outreach efforts.

Let me close by recognizing the sterling efforts of those who work so hard on PICS’ behalf: at PICS central, they include Dr. Lawrence Pitt, Associate Director; Megan Jameson, Administrative Officer;

our communications experts Robyn Meyer and Jessica Worsley; Wendy Phelan, the Executive Assistant to the Director; and Coralie Breen, our short-course executive producer. Over the course of the year, others have moved on to new opportunities: Katharine McCallion, Ivan Watson, and Anna Rozwadowska. On the continent, PICS relies heavily on our Campus Coordinators, Kyle Aben (UNBC), Nastenka Calle (SFU) and Sarah Muir-Owen (UBC), each of whom works diligently to promote the PICS mission. I remain grateful to them all.

2. ABOUT PICS

Hosted and led by the University of Victoria (UVic), the Pacific Institute for Climate Solutions (PICS) is a collaboration among BC's four research-intensive universities — UVic, Simon Fraser University (SFU), the University of British Columbia (UBC), and the University of Northern British Columbia (UNBC). The Institute was founded in March 2008 through a major endowment from the BC Ministry of Environment and works to develop innovative climate change solutions that will help lead the way to a low-carbon economy. In doing so, PICS brings together local, national and international researchers from a variety of disciplines to work with all levels of government as well as the private and the non-profit sector in addressing the climate change challenge.

The Institute's five main objectives are:

- understanding the magnitude and patterns of climate change and its impacts;
- evaluating the physical, economic and social implications;
- assessing mitigation and adaptation options and developing policy and business solutions;
- evaluating and strengthening educational and capacity-building strategies to address climate change; and
- communicating climate change issues to government, industry and the general public.

Within this framework, the Institute supports a wide range of research aimed at developing and integrating alternative energy technologies, better forms of transportation, sustainable communities,

ecosystem resilience, carbon management strategies for BC forests, and ways to mobilize public support as well as socio-behavioural change. The Institute also works to communicate climate change information and ideas to the research community, business, government and the general public through a series of weekly news scans, policy briefing notes, white papers, lectures, and seminars and other events. In collaboration with the Pacific Climate Impacts Consortium at UVic, PICS has also developed the first in a series of online short courses that deal with various aspects of climate change, now available at www.pics.uvic.ca.

The Institute is governed by a program committee consisting of researchers from the four partner universities as well as a representative from the provincial Climate Action Secretariat (CAS); an executive committee, and external advisory board comprising representatives from across the public, private and non-profit sector. More information about the Institute's governance structure is available as Appendix 1.

3. RESEARCH

3.1 Research Themes

The Institute's research strategy is built around four broad themes initially identified by the program committee in April 2009: the low carbon emissions economy, social mobilization, sustainable communities and resilient ecosystems. A fifth theme, carbon management in BC forests, was later added in response to a specific request from the Province of British Columbia. Each theme is overseen by a subcommittee comprising a theme leader from one of the collaborating universities, two members of the program committee, a CAS member and other representatives from academia, government, and industry as appropriate (see Appendix 2).

Initial calls for applied research applications under each of the five themes were issued during the period of March 2010 to May 2011 and a total of \$2.7 million over two years has now been allocated to 32 research projects, all of which are now underway. Short descriptions of each follow.

The Low Carbon Emissions Economy

This theme focuses on the opportunities and policy requirements for building a vibrant low carbon economy in BC and beyond. Key research areas include:

- improving and sustaining BC’s carbon pricing initiative
- preventing greenhouse gas (GHG) emissions from BC’s natural gas extraction industry
- ensuring environmentally sound development of renewable electricity generation
- rapidly reducing GHG emissions from BC’s transportation system
- rapidly reducing GHG emissions from BC’s buildings
- managing BC’s solid wastes from urban, industrial, forestry and agricultural activities in ways that reduce GHG emissions
- accelerating the energy efficiency trend in BC

Current funded projects include:

Next step on BC’s carbon tax: assessing alternatives and searching for common ground

Decisions are pending about the future of BC’s carbon tax. This project is exploring the design of alternative carbon tax policies for post-2012 through a mix of interviews, polling and economic modeling.

Project team: SFU, Pembina Institute

Accelerating GHG reductions in BC’s economy

BC has ambitious policies to achieve deep cuts in greenhouse gas (GHG) emissions. These policies include carbon taxes, technology subsidies for carbon efficient equipment, and the carbon neutral government mandate. This project is assessing these policies and, working with the government, aims to provide further support for BC residents and organizations

who are working to reduce their GHG emissions.

Project team: UBC

Closing the loop: opportunities to reduce GHG emissions and create green jobs through zero waste policies

This project is investigating the potential for green job creation and GHG reductions through attempts to “close the loop” on economic production involving energy and material flows. Consistent with the ideal of “zero waste”, the reprocessing of recycled materials can lead to dramatic reductions in energy use (and thus GHGs) compared to raw materials. It also represents an opportunity for green jobs associated with (i) integrated and harmonized collection programs, (ii)

sorting and processing depots, and (iii) domestic recycling and remanufacturing of material inputs.

Project team: UBC, UBC Okanagan, Canadian Centre for Policy Alternatives, Wilderness Committee, Canadian Union of Public Employees, Ecolnspire Planning Services

“The majority of research project teams involve inter-university researchers as well as experts from within government, the private sector, and other research bodies. Such collective intellectual effort will help ensure BC has the sound research base it needs to develop innovative climate change policies, and to ensure its ongoing leadership in this crucial area.”

Dr. Tom Pedersen

Flogging a dead policy: estimating the environmental impact of the luxury vehicle surtax in BC

This project aims to answer a simple question: did BC’s luxury vehicle surtax steer consumers towards cheaper, smaller and more fuel-efficient vehicles? This study is comparing sales in the taxed and non-taxed categories of vehicles from other provinces to sales in the corresponding categories in BC, as well as sales in BC over time as the tax threshold varies. The results will reveal the impact of this tax on different vehicle categories and provide important lessons for policy-makers around the

world with respect to the benefits and costs of a broad range of luxury taxes.

Project team: UBC

[Just transition in BC: a framework for dealing with the employment impacts of the shift to a low-carbon economy](#)

Fear of job loss could have a paralyzing impact on the transition to, and acceptance of, industrial production with major GHG emissions reductions. This project is developing a framework for labour market transitions through review of best practices in other jurisdictions, case studies from past labour market transitions and planning in BC and the rest of Canada. It is engaging directly with people working in affected industries in the context of terms for a fair deal, and it will show what a just transition should look like.

Project team: UBC Okanagan, Canadian Centre for Policy Alternatives, Communication, Energy and Paperworkers Union

[Development of novel nanostructured photocatalysts for highly efficient solar reduction of carbon dioxide to clean energy fuels](#)

Turning the GHG carbon dioxide (CO₂) into a clean energy fuel is a potential innovative solution for both the future shortage of fossil fuels and the global warming problem. This project is investigating new catalysts for the conversion of CO₂ into fuels with the help of solar energy, a clean and renewable energy source. Such a process would help convert and remove industrially generated CO₂ and allow for the geo-engineered removal of CO₂ from the air.

Project team: UBC

[Experimental validation of the performance of wave energy converters of the point-absorber class](#)

Wave energy is often cited as an important part of our renewable energy sources portfolio, yet we lack precise information about the opportunities it offers. This project is using numerical models and testing of scaled physical models (structured to replicate wave conditions observed off the coast of Vancouver Island) to determine how a type of wave energy converters, called point-absorbers, can serve BC's electricity demands. Physical models will be fabricated at UVic and operated in a wave tank at the Ocean Engineering Research Centre at Memorial University of Newfoundland.

Project team: UVic

[Wind turbine design and siting for unsteady conditions](#)

BC is home to one of the largest Canadian producers of small wind turbines (<100kW). These machines can provide enough electricity to power consumer' homes and businesses. A better understanding of the conditions they need and how to design for them is vital to improving technical performance and cost effectiveness. This project is developing computer-based design and simulation tools for small wind turbines, and comparing

the results with actual operating machines outfitted with monitoring equipment. The goal is to produce better performing machines and deploy them in a wider range of location types than is currently possible.

Project team: UVic



David Wilkinson of UBC's Clean Energy Research Centre is working to lower CO₂ emissions by converting the gas into methane, methanol and other chemicals for combustion or electric cells. Photograph by: Jason Payne, PNG, Vancouver Sun.

Social Mobilization

This theme focuses on research designed to foster and evaluate social mobilization on climate solutions throughout BC. Overall, the purpose of social mobilization research in British Columbia is to:

- engage British Columbians in developing and implementing climate change solutions through collective, 'bottom-up', informal, organizational and institutional initiatives.
- change collective behaviour toward reducing carbon footprints.
- build public support for (and contributions to) low-carbon climate change policies and actions focused on the green economy, ecological resilience and sustainable communities, in order to achieve greenhouse gas reduction targets by 2020 and beyond.
- build capacity and resilience to plan and respond to climate change adaptation and mitigation.

In addition to supporting the following five projects, PICS appointed a social mobilization coordinator, Shirlene Côté, for a one-year term to facilitate the theme's administrative, research and outreach activities.

Greenest City Conversations

Greenest City Conversations (GCC) is a multi-partner research project aimed at fostering and evaluating public engagement on sustainability policies. Its two goals are: (1) to create discussion and analyze public attitudes towards sustainability policies; and (2) to assess the impacts of different modes of public engagement including digital media, scenario visualization, mobile applications, tabletop games, and art performances.

Project team: UBC, SFU, City of Vancouver



A computer visualization scenario (bottom) of sustainable community design for the Burnaby Corridor (top) produced by UBC's Collaborative for Advanced Landscape Planning (CALP). Courtesy of David Flanders.

Measured visualizations as catalysts for mobilization

Researchers are working with Revelstoke community residents to imagine how their communities might change over the next 30 years. Based on the characteristics of the neighbourhoods that residents envision, researchers will use computer models to calculate how much energy the communities might consume in the future. The work will ultimately help Revelstoke and other cities throughout BC to plan for a more efficient future that requires less, rather than more, energy, without compromising quality of life.

Project team: UBC, City of Revelstoke

A day in my carbon neutral life

What we can do as individuals to reduce our carbon footprint can be significantly limited by the world we live in – for example, where we can afford to live, how the goods we buy

are produced and what transportation systems exist. Through a reality-TV style multimedia production, this project is exploring the changes needed to get there. This project – which profiles real BC families from different income, cultural and geographic backgrounds – will help demystify the changes needed in how we live, work, play and move around, if BC is to become carbon neutral.

Project team: UBC, SFU, Canadian Centre for Policy Alternatives, David Suzuki Foundation, Pembina Institute, SAP Canada, BC Healthy Communities, Vancity

Understanding the public uptake and acceptance of a municipal green energy incentive program

Communities need to find innovative ways to influence household choices related to energy sources and consumption if targets for reducing GHG emissions and other sustainability goals are to be met. The City of Colwood's "Solar Colwood" project seeks to have 1,000 homes plus local businesses install solar thermal water heating systems and other clean energy upgrades by 2014. This research is investigating methods, incentives and tools used to develop uptake in the community, and will examine the response of the population to the project.

Project team: Royal Roads University, City of Colwood

From communities of interest to communities of practice

A team of UBC researchers has partnered with goBEYOND, a non-profit campus climate action initiative, to promote reductions in energy consumption in student residences on BC campuses using social media. The research uses interviews and focus group discussions to examine the degree to which social media tools such as YouTube, Facebook and Twitter can be used to mobilize young people to value energy more and reduce their everyday energy consumption.

Project team: UBC, goBEYOND Campus Climate Network

Sustainable Communities

This theme promotes research designed to foster sustainable communities in BC. In order to achieve long-term climate change mitigation and adaptation goals, it is critical to address the underlying drivers of unsustainable patterns in our communities. Our society's networks of built structures, institutions and behaviours have a powerful influence on how we collectively use energy and materials and, in turn, how we both influence and respond to climate change; therefore, densification, mixed land use, a net-zero energy system and a diverse local economy are necessary characteristics for sustainable communities of all sizes in BC.

In 2010/11, the following four projects received funding under this theme:

A community energy and emissions simulation model

This project is developing a user-friendly computer model to facilitate energy and emissions planning by local governments, thereby building their capacity to reduce GHG emissions. The model will be freely available, operated by local governments, and capable of simulating the effect of policies and actions on the energy consumption and emissions of any BC community.

Project team: SFU, Nanaimo Regional District, Sunshine Coast Regional District

Integrated community sustainability planning: implications for rural BC

BC local governments for small communities, rural and remote areas are grappling with integrated community sustainability planning (ICSP) processes. The limited information available on rural sustainability tends to be US-based, and most literature on community sustainability is urban focused – e.g. improved transit, densification, and mixed land use in cities. This research project is directly addressing this knowledge gap, focusing on sustainability planning processes for BC rural communities and landscapes.

Project team: Fraser Basin Council

[Toward Sustainable Communities: The Living Edition](#)

This project is undertaking a comprehensive update of the made-in-Canada Toward Sustainable Communities resource guide. Content enhancements, plus a set of complementary digital companion pieces that aid sustainability analysis, will point readers to current BC-relevant sustainability resources, and deliver the book's message in innovative new formats. This 20th anniversary fourth edition, due for release in spring 2012, will trace the rapid growth of this field over the last two decades, and set the stage for future sustainable community development.

Project team: SFU

[Sustainable Communities Research Network](#)

The Sustainable Communities Research Network (SCRN), now being built, will be a bridge between researchers and local government practitioners that comprises several supports, including journals, conferences, publications, and a web-based network platform. The network will focus on catalyzing sustainable development at the local level in BC and beyond. The SCRN is scheduled to launch in BC in the fall of 2011, and then expand nationally and globally in spring 2012.

Project team: SFU, BC Climate Action Secretariat

[Resilient Ecosystems](#)

The scale, pace and range of climate change is having far-reaching impacts on BC's ecosystems. The resilient ecosystems theme seeks to promote and oversee research designed to understand these impacts and to develop viable management options to maintain ecosystems' viability. Given that many of BC's ecosystems are under threat from climate change, an increased emphasis on risk and adaptive management needs to be adopted to achieve the province's long-term climate change mitigation and adaptation goals.

The key objectives of this theme include:

- understanding existing rates of change
- predicting future ecosystem change and the vulnerability of ecosystem services
- promoting adaptive management, governance in the stewardship of natural resources

The following projects received funding in 2010/11:

[Impacts of climate change on natural disturbance regimes in British Columbia: planning for adaptive forest management solutions](#)

This research is exploring the response of BC interior Douglas-fir ecosystems to western spruce budworm outbreaks, the most damaging pest after the mountain pine beetle. The project is evaluating how climate change affects the ground rules for ecosystem management, and will provide insights into current stressors and the likely persistence of interior Douglas-fir forests in the face of ongoing change.

Project team: UVic, Canadian Forest Service, BC Ministry of Forests, Lands and Natural Resource Operations

[Understanding ecosystem responses to climate change in southwestern British Columbia forests: a paleoecological perspective on resilient ecosystems](#)

This research aims to understand how Douglas-fir forests and Garry oak savannas on southern Vancouver Island and the Gulf Islands have adapted to climate change and fire frequency over the last 10,000 years. Researchers are using fossil pollen and charcoal preserved in lake sediments to determine forest community response. This long-term perspective is crucial for understanding ecosystem responses to future climate change, and will improve future management of remaining forests and savanna communities in southwestern BC.

Project team: UVic, Parks Canada

Assessing the potential aquatic habitat value of streams responding to a changing climate

This project will produce numerical models that predict the impacts of climate change on potential fish habitat in BC streams, based on forecast changes in stream flow and sediment supply. The findings will be used to determine optimum approaches to protect fish stocks. If the pilot study is successful, researchers will develop a generic version of the model that is applicable to a wider range of BC stream types and fish species.

Project team: UBC, SFU, Fisheries and Oceans Canada, BC Ministry of Forests, Lands and Natural Resource Operations

The Alouette River basin – the developing urban fringe at the interface with protected landscapes in coastal British Columbia and consequences for ecosystem resilience

As temperatures warm, summer precipitation declines, and human demands for water increase, periods of water shortage are likely. This project is using long-term flow data from an urban and agricultural watershed to examine how changes in hydrology might affect water supplies to freshwater ecosystems downstream, and how different uses of water by humans (e.g. wells, diversions, legal and illegal withdrawals) might impact the fish and other species living in and alongside water.

Project team: UBC, SFU

Combining historical datasets, ecological modeling and sampling, and cutting-edge visualization techniques for adaptive management of biodiversity in mountain environments

The most detailed scientific models of British Columbia's future under climate change show that as much as 97% of the alpine habitat in the province may be lost by 2085. This research seeks to understand the factors that maintain biodiversity in alpine meadows, and provides solutions for managing and protecting the species that live there. This project is combining historical datasets, ecological

modeling and sampling, and cutting-edge visualization techniques for adaptive management of biodiversity in mountain environments.

Project team: UVic, Alberta Innovates, BC Parks, Alberta Parks



Rocky Mountain landscape. Photo by Anna Rozwadowska.

Evaluating the resilience of northern interior cedar-hemlock forests to western hemlock looper outbreaks

Forest companies are looking eastward for timber in the "wet-belt forests" dominated by western red cedar and western hemlock. These "ancient forests" suffered an insect outbreak from hemlock looper in the 1990s. Old sample sites will be revisited to re-assess tree health, forest regeneration and vegetation. Results will help land managers identify the conditions under which old-growth forest has recovered from defoliation, where it has regenerated, and where forest recovery is hindered by dense shrub growth and might benefit from rehabilitation activities.

Project team: UNBC, Canadian Forest Service, BC Ministry of Forests, Lands and Natural Resource Operations

Climate change and the decline of yellow cedar along the north coast of British Columbia

This laboratory team is using tree-ring analysis to determine whether diminishing snowpacks and late-winter freeze events are driving the decline of yellow-cedar over an estimated at 250,000 hectares along the Pacific Northwest coast, one of the most severe forest declines in the world. Yellow cedar is the most economically-valuable wood in the region and an integral part of the rainforest, so understanding its vulnerability to changes in climate is essential to guide resource planning and conservation efforts in British Columbia.

Project team: UBC, University of Guelph, BC Ministry of Forests, Lands and Natural Resource Operations, US Forest Service

Place-based policy-making and community resilience-building for climate change

Achieving integrated social, economic and environmental development and sustainability is one of the greatest challenges governments around the world face today. Given the complexity of the factors involved, an exclusively top-down approach to decision-making will not always yield the best solutions, especially on the climate-change front. This collaborative project is examining the capacity of local governments and communities to participate in multi-level government climate change decision-making and to implement high-quality evidence-based or place-based, policy initiatives.

Project team: SFU, University of Saskatchewan, Carleton University, Natural Resources Canada

Climate and ecosystem dynamics on southern Vancouver Island and the Gulf Islands: a historical perspective on strategies for restoration, management, and population recovery

Garry oak is BC's only native oak. Three major factors causing its decline are fire suppression, deer browsing, and climate change, along with related stressors such as invasive species. This project is involving "on-the-ground" research

using prescribed fire and deer exclosures, as well monitoring ecosystem change due to climate change. Understanding how these factors interact will help restore and maintain Garry oak ecosystems.

Project team: UVic, SFU, UBC, University of Guelph, University of Sherbrooke, Parks Canada

Operationalizing resilience over the long-term: learning from ecosystem baselines

Researchers will use historic (1930s) air photos that depict forest status in Clayoquot Sound prior to recent harvest. Mapping will specifically emphasize the distribution of large western red cedar, due to its importance for First Nations. This work will help determine the original distribution of this declining resource (large cedar) across the historic landscape, as well as track changes in environmental services such as timber supply, wildlife habitat and wood for cultural purposes. Knowing the baseline structure of historic forests, and the interplaying factors that affect them, will help ecologists make sound restoration decisions.

Project team: UBC, University of Toronto, BC Ministry of Forests, Lands and Natural Resource Operations

Carbon Management in BC Forests

Forests play a major role in the planetary carbon cycle through the uptake and release of greenhouse gases such as CO₂ and methane. Moreover, they host a very large amount of carbon in standing biomass and soils. The size of these carbon stocks in future will be affected by increased disturbance risk (e.g., by pests, fire, and/or drought) associated with climate changes and continued exploitation by humanity through, for example, land use change and harvesting practice.

The Carbon Management in BC Forests research themes seek to understand better and address the far-reaching impacts of climate change on BC's forest ecosystems as well as

related socio-economic implications. Key research challenges include:

- developing quantitative carbon and carbon-offsets accounting methods;
- exploring the bio-energy potential of BC's forests and associated environmental concerns;
- understanding the soil carbon pool and its future behaviour; and
- developing sustainable forest management policies in the face of a changing climate.

The following five projects are currently underway:

Striking the right bioenergy balance: promoting healthier carbon stores in our forests and forest product streams

In recent years the British Columbia government, independent power proponents, various forest companies, and industry associations have increasingly advocated for the production of energy from wood. What makes BC's situation unique is the importance that bioenergy proponents place on the mountain pine beetle outbreak and the fate of an estimated 675 million cubic meters of pine in the province. Modeling and new mountain pine beetle-affected forest-carbon balance data are being brought together in an attempt to inform policy that will be aimed at striking the right balance between environment, energy generation and the economy.

Project team: UBC, UNBC, Canadian Centre for Policy Alternatives

Estimating carbon storage and emissions from harvested wood products from BC

Wood products represent a significant carbon stock that remains stored for varying time periods depending on product attributes. Lumber used in buildings, for example, has a longer life than wood fibre in paper. There is an increased interest in quantifying the carbon storage and emissions associated with wood products but, to date, a lack of data specific to BC has constrained modeling activities. This project seeks to remedy this shortcoming by collecting BC-specific data.

Project team: UBC, BC Ministry of Forests, Lands and Natural Resource Operations

Predicting carbon storage for BC on seasonal to decadal timescales

This project will use a dynamic state-of-the-art terrestrial ecosystem model driven with present and future climate for BC to obtain a detailed picture of how the province's terrestrial ecosystems may evolve as climate warms. Quantification of near- and long-term changes in BC's carbon balance is expected to provide valuable information for policy-makers, especially when comparing natural changes in the carbon balance to those obtained from carbon offset programs. Projected changes in ecological zones and fire regimes in the province will inform forest managers in terms of implications for harvesting, reforestation, forest fire fighting, and property loss.

Project team: UVic, PCIC, Canadian Forest Service, Environment Canada



Forest canopy. Photo by Anna Rozwadowska.

Developing environmental-response functions of growth and mortality to forecast forest carbon stocks in BC under environmental change scenarios

This project will inform the forest sector of BC of the expected changes in forest growth and carbon stocks due to environmental change. To do this the project will quantify the relationships between current climate and annual volume increment, growth and mortality, and then map predicted changes using a model with historical climate and future environmental change scenarios. This project is being undertaken with the Canadian Forest Service, and will provide forest managers with better predictions of future forest growth.

Project team: UBC, Canadian Forest Service

Community fire-interface biomass utilization for heating fuel

This project is studying the potential for domestic heat generation from tree biomass discarded when managing the forests around BC rural communities, for example, removal of trees and undergrowth to reduce wildfire risks to urban areas. Using a combination of field work and modeling, this research will provide information on the ecological and socio-economic feasibility of substituting fossil fuels with forest biomass. Such substitution could reduce greenhouse gas emissions, heating costs and energy dependence while promoting job creation in the green energy sector in small communities in interior BC.

Project team: UBC, Community Energy Association, Green Heat Initiative

3.2 Fellowship Program

In addition to funding applied research under the above themes, PICS also awards fellowships on an annual basis to outstanding Masters and PhD students as well as post-doctoral fellows at the four collaborating universities. Fellowship recipients conduct research across a broad spectrum of climate change issues closely aligned with the Institute's principal research themes. Their work often spans a range of

disciplines. To date, PICS has awarded 54 fellowships totalling more than \$1.8 million, and currently supports 32 graduate students and four post-doctoral fellows at SFU, UBC, UNBC and UVic (see Appendix 3).

New fellowships announced in September 2011 will support:

- an international award-winning journalist and researcher who will work with First Nations to improve communities' resilience to climate change;
- a marine conservationist who will analyze optimum oceans management systems;
- a researcher who will investigate the use of bacteria as a low-carbon and renewable energy biofuel;
- a computer engineer who will quantify the environmental impact of the high tech sector; and
- an alpine ecosystem specialist who will study the impact of climate change on pollination and agriculture.

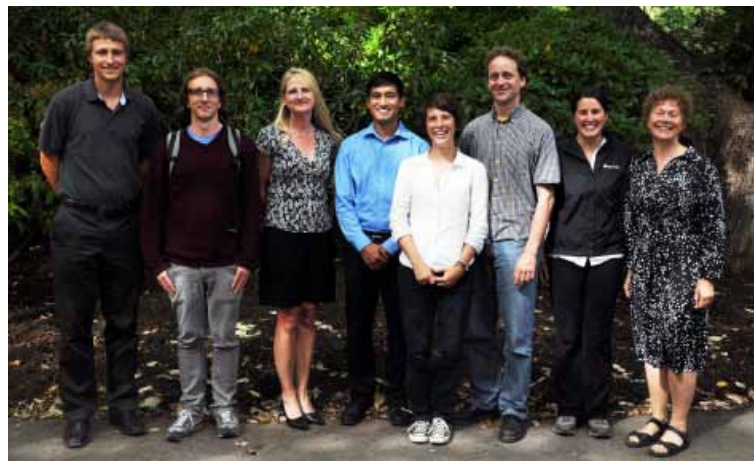
PICS fellowships are valued at \$12,000/year over two years for Masters, \$18,000/year over three years for PhD students and \$50,000/year over two years for post-doctoral fellows. The current annual fellowship budget across the three academic levels is \$600,000.

In order to facilitate both interdisciplinary and intercampus collaboration, PICS hosts an annual workshop that brings together fellowship holders from the four universities to share their research interests and results. These events are highly stimulating and effective in building community among the PICS scholars and in fostering critical cooperation in climate change research. PICS fellows also periodically present their research during special seminars at their home university, either to other fellows or the broader community.

3.3 Internship Program

Introduced in January 2010, the PICS Student Internship Program provides funding for public sector and non-profit organizations to hire students from the four PICS universities to work on leading edge climate-change related research and policy issues across the province. Now in its second year, the highly successful program provides an excellent opportunity for students to gain hands-on learning experiences and for employers to benefit from student input. To date, a total of 23 students have completed 14 four-month and nine eight-month work terms in local and provincial government, academia and non-profit organizations. Three additional positions will be funded this fall.

In the past year, students worked on renewable heat initiatives and low carbon transportation options for the Ministry of Energy, Mines and Petroleum Resources; ecosystem sustainability, water stewardship and carbon offsets schemes for the Ministry of Environment; as Research Assistants for SFU's Adaptation to Climate Change Team (water, crops and food), UVic's Institute for Integrated Energy System (wind energy) and the School of Environmental Studies (ecosystem modelling and mountain biodiversity), as well as for the District of Saanich and the City of Williams Lake. A full list of all internship placements from September 2010 to September 2011 is included in Appendix 4.



Victoria-based PICS interns (summer 2011) and their supervisors at UVic in July 2011. L to R: Lee Johnson, Simon Parkinson, Janice Larson (MEMPR), Richard del Rosario, Chloe Donatelli, Matt Takach (Dogwood Initiative), Robyn Hooper and Jenny Feik (BC Ministry of Environment).

3.4 White Papers

The PICS white paper series on topical subjects related to climate change adaptation and mitigation is an important component of the Institute's research activities. Papers are commissioned on a periodic basis and made publicly available on the PICS website. Since 2008, the Institute has published a total of 15 papers, an average of five per year, on climate change policy options for British Columbia in the areas of transportation, public health, carbon offsets and emissions trading, alternative energy technology, carbon sequestration in BC forests, and sustainable communities.

Papers completed in 2010/11 include an analysis of and recommendations for clean tech access to venture capital in BC; local content requirements in British Columbia's wind power industry; electricity export policy in BC; lessons from BC's carbon neutral government mandate; and a look at the potential for pay-as-you-drive insurance in BC. Notably, the UVic MBA students who produced the CleanTech Access to Venture Capital in British Columbia white paper as part of their thesis requirements received an award for the best graduating project of their year.

4. OUTREACH AND COMMUNICATIONS

4.1 Seminars and Lectures

Pacific Climate Seminar Series

The Pacific Climate Seminar series is co-hosted by PICS and its partner organization, the Pacific Climate Impacts Consortium (PCIC), at the University of Victoria. The joint monthly series was launched in September 2009 and will enter its third year this fall. Past seminars have covered a wide range of topics related to climate science and research, such as regional climate modeling, hydrological assessments, renewable energy, wildlife management strategies and the use of metaphors in climate change communication. Speakers often include local researchers or PICS-supported graduate students. All seminars are webcast for the benefit of remote audiences and archived recordings are available on the PICS website.

PICS UBC-SFU Public Lecture Series

The PICS UBC-SFU Public Lecture Series is a joint effort between the two Vancouver-based collaborating universities, typically featuring at least one speaker from each campus at either UBC Robson Square or SFU Harbour Centre in downtown Vancouver. Since its launch in September 2010, the series has brought more than a dozen SFU and UBC faculty together before public audiences to discuss core climate change topics ranging from issues of sea-level rise and coastal flooding to the socio-cultural factors that influence the public's uncertainty – and motivation to take action – on climate change. All lectures are webcast live and recordings of past events are available online at pics.uvic.ca.

PICS Lecture Tour

PICS has seen a broadening of its lecture tour series over the past year from a provincial level to an across-country outreach effort. In March 2010, PICS launched its BC lecture tour with Executive Director Tom Pedersen and SFU

economist Nancy Olewiler visiting several communities across the province in an effort to increase public awareness of the challenges and opportunities presented by climate change.

"It is increasingly clear that Canada could take steps that would simultaneously allow us to reduce carbon emissions, while yielding significant new economic value. Getting there will require recognition by the Canadian public and our politicians of both need and opportunity."

Dr. Tom Pedersen

This year, as the 2011 Canadian Meteorological and Oceanographic Society (CMOS) national speaker, Dr. Pedersen took his message about the urgent need for action and the PICS model from coast to coast in more than 20 public talks in 18 cities across nine provinces.

His lectures attracted extensive media coverage across the country, outlined the latest scientific findings and climate trends, highlighted the need for a collaborative effort to reduce greenhouse gas emissions and offered potential inter-provincial solutions for moving towards a low-carbon economy in Canada.

Guest Speakers

PICS regularly hosts public lectures by key climate change authorities from across North America and internationally. Over the past twelve months, these speakers have included China's leading environmental activist and journalist, Dai Qing; environmental psychologist Dr. Sabine Pahl from the UK; Dr. Julian Agyeman, Chair of Urban and Environmental Planning at Tufts University; award-winning Merchants of Doubt co-author and 2011 Climate Change Communicator of the Year Dr. Naomi Oreskes from the University of California;



Naomi Oreskes signs books and talks to audience members following her lecture at UVic on June 27, 2011.

computer scientist and technology expert Dr. John Mashey, who discussed the mechanics of the anti-science campaign; and co-chair of Working Group I of the UN Intergovernmental Panel on Climate Change (IPCC), climate physicist Dr. Thomas Stocker from the University of Bern. These lectures attracted considerable media coverage and strong public turnouts. Information about these speakers and recordings of their presentations, as well as details on upcoming lectures, are available online at www.pics.uvic.ca/events.php.

4.2 PICS Annual Forum

Resilient Communities: Preparing for the Climate Challenge

As part of its outreach efforts, PICS hosts an annual forum, bringing together researchers and decision-makers from across the public, private and non-profit sectors to discuss key climate change issues facing the province. PICS's third annual forum entitled Resilient Communities: Preparing for the Climate Challenge was held June 14 and 15, 2011 in Vancouver and addressed challenges and strategies for climate change adaptation at the community level. Previous fora were entitled Decoding Carbon Pricing: Achieving a Low Carbon Society in British Columbia (June 2009) and FutureGrid: BC's Energy Options in a Changing Environment (June 2010). This year's event included a one-day briefing for policy-makers on June 14 as well as a session for researchers and practitioners on June 15, where scientists, planners and decision-makers gathered to learn about the latest climate change projections for British Columbia and exchange information about best adaptation practices and available resources.

Speakers included Dr. Francis Zwiers, Director of the Pacific Climate Impacts Consortium, who

set the stage with the latest scientific findings, followed by speakers from BC, Canada, the UK and Australia who offered insights into community impacts and adaptation to climate change on a global scale. Selected case studies from BC municipalities, including the Cities of Vancouver, Williams Lake, and Prince George, the District of Elkford and the Cowichan Valley Regional District, demonstrated how communities are beginning to respond.

Part of the forum included a special public discussion on how climate change will affect food supplies and what it means for the agricultural sector, with speakers from the Province's Agriculture and Food Climate Action Initiative, BC's Agricultural Land Commission, the BC Food Systems Network Working Group on Indigenous Food Sovereignty and SFU's Centre for Sustainable Community Development. This public event enabled participants to discuss key issues,

"Global warming is not just about rising temperatures. It is also about declining mountain snowpacks that lead to reduced river flows in the summer affecting power generation, fisheries and community water supplies. It is about increased water vapour in the atmosphere which is expected to lead to more intense precipitation events, and it is about rising sea levels. Although there is uncertainty about how these changes will unfold we now know enough to manage the risks and ensure that our communities are as resilient as possible."

Ben Kangasniemi, Chair, PICS 2011 Annual Forum Organizing Committee



The public event entitled *Food Security: Preparing for Climate Change* took place on June 14, 2011 as part of the PICS annual forum in Vancouver.

question the experts and provide input to government and researchers. Selected speaker presentations are now posted online and highlights of the event will be featured in a short video to be made available later this year on the PICS website.

4.3 News Scan and Briefing Program

The PICS News Scan, launched in September 2009, is a weekly summary of climate change related science, technology and policy advances of direct relevance to the provincial and federal governments, and more generally to businesses, governments and civil society. The 100th weekly edition was issued on August 23, 2011 to over 600 subscribers from across all sectors throughout Canada and internationally. Weekly news items are categorized and analyzed for BC relevance under the four thematic areas of the low carbon emission economy, resilient ecosystems, social mobilization and sustainable communities, with additional emphasis placed on the topic of forest carbon management to reflect the Institute's major research themes. It is produced in partnership with ISIS, a research institute at UBC's Sauder School of Business.

"Building a solid knowledge base about climate change within the civil service is essential because of its impact not only on the environment but also on the economy, the way we live, and how we use our land and water."

Hon. Terry Lake

The PICS Briefing Program, launched in May 2010 produces briefing notes for key decision-makers in the BC government and the private sector, providing a brief and cogent analysis, including options for action, on timely policy, scientific, technological, or social issues related to climate change. Briefing notes produced in the past twelve months have address a wide variety of topics including cap and trade design in the Western Climate Initiative, electric vehicle charging infrastructure in BC, energy efficiency in BC's rental housing, the scope of BC's "carbon neutral government" mandate, climate change issues around natural-gas fracking in BC, the power of small businesses to reduce GHGs, an analysis of the Site C dam

project, climate change action in communities, the potential of BC's waste and by-product hydrogen, and reducing greenhouse gases in the cement industry.

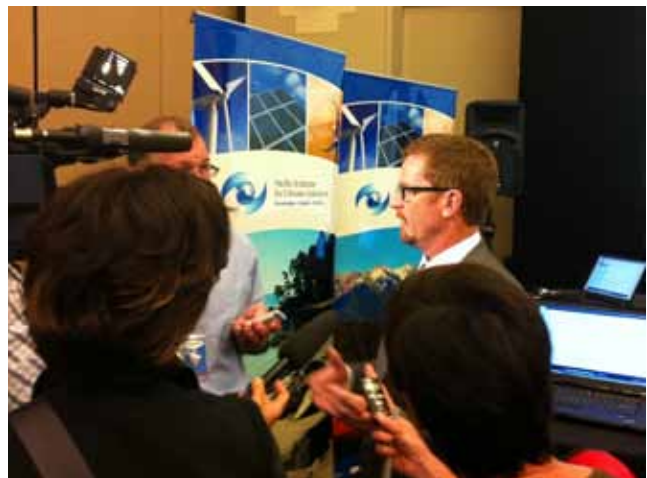
PICS briefing notes are posted on the PICS website and made publicly available after initial distribution to the BC government.

4.4 PICS Short Courses

Climate Insights 101 is now live! On August 29, 2011, PICS launched its series of innovative online climate change short courses, originally designed for the BC public service, but anticipated to be a valuable resource for schools, the media, decision-makers and the general public in better understanding the basics of climate science.

The first-of-its-kind product was unveiled by BC Minister of Environment, Terry Lake at the Institute of Public Administration of Canada's 63rd annual conference in Victoria.

Throwing the old-fashioned textbook approach out the window, "Climate Insights 101" uses a combination of animation, interviews and click-thrus to engage people on the basic concepts and findings of climate science research, thus clarifying what is often seen as a difficult or complicated issue.



BC Minister of Environment Terry Lake takes media questions during the 29 August launch.

Module one (Climate Science Basics) is now live at www.pics.uvic.ca/insights. Uptake of the courses has been global, with users recorded throughout BC and North America as well as in Europe, Australasia, South America, Africa and Asia. Additional modules on adaptation, regional climate impacts and mitigation will be launched next year.

Course highlights from module one are also available on YouTube at www.youtube.com/user/PICSClimateInsights.

4.5 Media Coverage

Over the past year, PICS has received increasing media coverage across Canada related to its research and outreach activities. Some of the more prominent items included the PICS national lecture tour (see 4.1); the launch of Climate Insights 101 short course series, new research (whitepapers) on shale gas, BC electricity exports and clean tech access to venture capital; as well as visits by noted researchers Drs. John Mashey, Thomas Stocker and Naomi Oreskes.

PICS featured in the following media outlets (September 2010 – August 2011):

Print: Globe and Mail; Vancouver Sun; The Province; Times Colonist; Business in Vancouver; St. John's Telegram; Fredericton Daily Gleaner; Montreal Gazette; Saskatoon Star Phoenix; Lethbridge Herald; Richmond Review; Nanaimo Bulletin; Nature Climate Change; Sightline Daily; Winnipeg Press; Black Press; Toronto Star; Alberni Valley News; The Cloverdale Reporter.

Radio: CBC News; CBC Radio One (BC Almanac, Early Edition and On the Island); CBC Radio One (Labrador); CBC Radio One (Saskatoon Blue Sky); CBC Radio One (Quebec); CBC French network; CFAX 1070 (Straight Talk); CKNW (Bill Good Show and Mike Smyth Show); CJAD 800 (Montreal); Radio Canada (Montreal); 660 News Radio (Lethbridge); AM 1150 Jacked In (Penticton-South).

Television: CTV news; CBC News Winnipeg and New Brunswick; Global News Maritimes and Lethbridge; FairChild TV; Global BC breakfast; Studio 4 Fanny Kiefer; Alberta Primetime Straight to the Source.

Online: Canada.com; The Canadian Press; Sun News Services; The Tye; The Newfoundland and Labrador Environment Network; Toronto Community News (insidetoronto.com); Yahoo News Canada; Climate News; Live Sciences BC; Free Republic Blog.

4.6 Website and Social Media

The Institute's website at www.pics.uvic.ca continues to be a valuable source of information about PICS programs and activities, with more than 30,000 visits annually or 80 visitors per day from 125 countries over the past year. Among the most frequently visited pages is the Climate Solutions Network, a comprehensive directory of researchers and organizations working on a broad spectrum of climate change issues in British Columbia, across Canada and internationally.

In an effort to strengthen its online presence, PICS has also ventured into the social media realm, joining both Twitter and Facebook over the past two years. This has allowed PICS to reach a younger audience and increase public engagement through online discussion. Both social networking sites continue to attract new members and followers.



Online courses in climate change free, accessible and locally grown
Pacific Institute rolls out the first of four modules
By Judith Lavoie, Times Colonist August 30, 2011

B.C.'s food systems need overhaul, says chair of climate change conference
By Randy Shore, Vancouver Sun June 14, 2011

5. SPONSORED INITIATIVES

In addition to funding research under its five themes, PICS also sponsors or supports a number of external activities throughout the year. In 2010/11, these included the following:

- January 2011 -13: North American Grid Integration and Renewable Energy Planning. Dr. Behdad Kiani, a Research Associate working with a team of PICS and Institute for Integrated Energy Systems (IESVic) researchers, is currently undertaking an optimization study in which electrical generation and transmission infrastructure is manipulated in a numerical model to determine the degree to which a broadly integrated North American electrical grid could incorporate and support intermittent renewable energy sources. A primary objective is to quantify the extent of CO₂ emissions reduction that can be obtained by substituting wind and solar-voltaic power for electricity generated by burning coal.
- September 2010 – 12: BC Agriculture and Food Climate Action Initiative. PICS is currently funding a two-year research associate position with the BC Agriculture Council to evaluate the sector's risks, vulnerabilities and opportunities associated with a changing climate. This project reflects the priorities identified in the recently completed BC Agriculture Climate Change Action Plan.
- December 2010: ECO Car Challenge (UVic Faculty of Engineering). During the annual ECO Car Challenge, UVic engineering students design and build transport solutions based on vehicle categories from the California Air Resources Board (CARB) zero emissions vehicle (ZEV) regulations.
- May 2011: Canada China Energy Workshop (IESVic). This collaborative initiative set up the framework to build research and graduate training collaborations between Canadian and Chinese universities and institutes in the area of clean energy sources and systems.
- May 2011: Climate Change and Health: Acting to Reduce Risks and Vulnerabilities (SFU Gerontology Research Centre). This free public lecture by Dr. Carlos Corvalan, Senior Advisor on Risk Assessment and Global Environmental Change from the Pan American Health Organization was part of the 2011 Friesen Conference on the interface between population aging and climate change.
- May 2011: Novel Ecosystems Policy Workshop (UVic School of Environmental Studies). As part of the annual UVic Restoration Institute, this one-day workshop brought together international ecosystem specialists to discuss the impacts of climate change and best practices for ecological management.
- June 2011: International Student Energy Summit (ISES). ISES is a bi-annual global forum that focuses on sustainable resource management and the role that students will play in defining the future of energy development. The 2011 Summit took place in Vancouver.
- June 2011: Carbon Governance Project Workshop (ISIS, UBC Sauder School of Business). UBC's Carbon Governance Project includes a series of international workshops aimed at helping both the public and private sector identify strategic opportunities in a low carbon economy.

6. CAMPUS UPDATES

6.1 Simon Fraser University

The PICS presence at SFU continues to grow under the leadership of SFU Campus Coordinator Nastenka Calle. Notable initiatives over the past year include the launch of the joint PICS UBC-SFU public lecture series, the development and delivery of hands-on science workshops for grade 4 – 7 students, PICS outreach to China and the launch of a new PICS-SFU climate website at www.sfu.ca/climatechange.

PICS UBC-SFU Public Lecture Series

This past year, UBC and SFU started a joint public lecture series in September 2010, where together professors from both universities presented diverse topics on climate change (see above). These lectures are intended to inform the general public on the impacts of climate change and opportunities to take action.

SFU climate initiatives

Over the past year, PICS-SFU has sponsored and supported many SFU climate initiatives, including the “Global Warming: A Science Perspective” seminar series organized by the Faculty of Science. PICS Executive Director Tom Pedersen wrapped up this series on March 30 with a lecture entitled “Responding to the Climate Change Challenge”, followed by a PICS-SFU “meet-and-greet” event to provide an opportunity for professors and graduate students to meet Dr. Pedersen and learn more PICS research priorities, initiatives and outreach programs as well as fellowships opportunities for graduate students and visiting scholars.

A special talk entitled “Taking Responsibility for a Low Carbon Economy” was presented by Bob Elton, special advisor to the board

and former president and CEO of BC Hydro, chair of SFU’s Board of Governors and a member of the PICS Advisory Board. PICS also sponsored a public lecture on “Climate Change and Health: Acting to reduce Risks and Vulnerabilities” as part of SFU’s 2011 Friesen Conference entitled “Growing Old in a Changing Climate: Exploring the Interface between Population Aging and Global Warming”; participated in SFU’s SustainABILITY Festival in September 2010; and was present at the Wellness and Health Festival on SFU’s Burnaby Campus in October.



PICS-SFU fellow Rupananda Widanage promotes PICS at the SFU Sustainability Festival in September 2010.

Science workshops for kids

In June 2011, PICS-SFU along with SFU Science in Action ran a pilot workshop of a new outreach program for children entitled “Exploring Energy: Conversion, Consumption and Conservation”. This program explores different ways to generate “green” energy using wind, sun and water as a power source. The program looks at topics such as generating electricity from renewable sources, finding out how much energy it takes to light different kinds of bulbs while pedaling a bike, and learning about the effects of greenhouse gases on the climate. The outreach program, developed under the PICS mandate for public engagement, will start this fall, when children

from grades 4 to 7 will have the opportunity to explore clean energy options through hands-on, interactive workshops.



An SFU graduate student shows a ten-year old boy how much energy it takes to light different kinds of bulbs.

PICS outreach to China

In August 2011, SFU hosted a three-week program for eleven Chinese visitors as part of the China Council for International Cooperation on Environment and Development (CCICED) project of SFU's International Development Office. As part of the program, PICS-SFU Coordinator, Nastenka Calle gave a presentation on the mitigation and adaptation measures being taken by BC to tackle global warming, and provided information about PICS programs and activities. She also accompanied the Chinese delegation to UBC's Institute of Asian Research, where the group toured UBC's first green building, "C.K. Choi", built in 1997. The visit to UBC included a presentation on "Security and Environment" led by PICS Program Committee member, Dr. Paul Evans, Director of the Institute of Asian Research, about the security implications of climate change. Finally, PICS-UBC Coordinator, Sara Muir-Owen gave a tour of UBC's new Centre for Interactive Research on Sustainability (CIRS), designed as a living laboratory to demonstrate leading-edge research, develop sustainable design practices, and house the PICS office at UBC.

6.2 University of British Columbia

Sara Muir Owen joined PICS as the UBC Campus Coordinator in May 2010. She works in concert with the UBC Sustainability Initiative (USI) team to support sustainability and PICS-related climate change activities on campus and beyond. A major USI achievement in 2011 was the completion of the Centre for Interactive Research in Sustainability (CIRS), designed to be the most innovative high-performance building in North America. CIRS will be a hub of sustainability research, teaching and learning, operational activities, and partnerships at UBC. The centre's doors opened on September 2, 2011. CIRS is home to both UBC Campus Coordinator Sara Muir-Owen and PICS Social Mobilization Coordinator Shirlene Côté, providing a vital PICS presence at UBC's centre for sustainability.

PICS-UBC fellows

Since their inaugural meeting in July 2010, PICS graduate and post-doctoral fellows at UBC have come together on a regular basis to share information about their research. In the 2010/2011 calendar year, PICS-UBC hosted the following talks:

- "Comparing Vancouver's greenhouse gas emission inventory of production vs. consumption" by PhD Candidate Jennie Moore
- "Retrofitting neighbourhoods for GHG reductions" by post-doctoral fellow Dr. Duncan Cavens
- "Lessons from the Western Climate Initiative" by post-doctoral fellow Dr. Sonya Klinsky (co-hosted with PICS-SFU)
- "Climate smart agriculture" by post-doctoral fellow Dr. Tara Moreau
- "Assessing the climate change mitigation potential of afforestation for bioenergy production systems," by PhD candidate Catalin Ristea



The Centre for Interactive Research in Sustainability (CIRS) opened its doors in early September 2011 and houses the PICS office at UBC.

PICS-UBC fellows and Vancouver's Greenest City 2020 program

Many of the PICS-UBC fellows have been working with the City of Vancouver on implementing climate change solutions through USI's Greenest City Action Team Scholars Program. During 2010 and 2011, this unique program supported ten UBC graduate students each summer to work with the City of Vancouver on its Greenest City 2020 (GC2020) Plan. GC2020 was the first joint initiative established under a multi-year agreement between UBC and the City of Vancouver to advance "common goals of sustainability, climate action and the development of a green economy." Of the ten scholars selected for 2011, three are PICS fellows.

Greenest City Conversations

The Greenest City Conversations (GCC) project is a two-year, multi-disciplinary public engagement research program led by UBC and SFU, and carried out in partnership with the City of Vancouver and others. It is one of the projects awarded funding under PICS' social mobilization theme in 2010/11. As of late summer 2011, the project's public engagement "channels" are in various stages of

development, data collection and completion. The channels—including public workshops, social media, mobile applications, table top games, and performing arts—cover a wide range of media and process types.

State of Climate Action Regional Dialogues

During the spring and fall of 2010, the Climate Action Secretariat, with funding support from PICS, partnered with UBC's Collaborative for Advanced Landscape Planning (CALP) and BC Healthy Communities on "State of Climate Action Regional Dialogues." These one and two-day forums brought together local citizens alongside private sector and NGO representatives to discuss climate change action issues related to energy, transportation, local food production and green business practices. The sessions aimed at increasing collaboration and coordination of effective climate action across BC's regions. CALP was instrumental in integrating "Local Climate Change Visioning (LCCV)" processes into the dialogue sessions, running workshops in Victoria, Kelowna, Dawson Creek and Terrace from June to October 2010 that involved nearly 400 people throughout these regions. CALP's LCCV workshops have participants mapping anticipated local and regional impacts and documenting the adaptation and mitigation actions needed to address them. This process results in a holistic climate change framework that local governments can use for future planning efforts and actions.

CIP International Congress on Climate Change

In October 2010, PICS-UBC Campus Coordinator, Sara Muir Owen attended the Canadian Institute of Planners' (CIP) International Congress—Climate Change and Communities: A Call to Action—in Montreal, where she joined PICS post-doctoral fellow Dr. Olaf Schroth and CALP research scientist, Ellen Pond to present on "Kimberley's Climate Change Adaptation Project: Visualizing Community Impacts, and Adaptation and Mitigation Options." Prior to joining PICS, Sara worked with CALP on the Kimberley

project as a researcher at UBC in 2009. Sara also attended the CIP awards reception for the City of North Vancouver's 100 Year Sustainability Vision for which she was project manager and which received a 2010 Award for Planning Excellence in Environmental Planning.

Conferences at UBC

Other conferences that involved PICS-UBC during the past year included:

- USI's inaugural Campus as a Living Lab symposium with a presentation by PICS Executive Director Tom Pedersen. The symposium was a one-day event involving close to 300 UBC students, faculty, staff and other community stakeholders.
- The Clean Energy Research Centre (CERC) Summit Meeting Collaborating for Sustainable Clean Energy held on May 13, 2011. The event brought together close to 200 people from industry, the government and academia, all with an interest to collaborate towards the development of "a sustainable clean energy powerhouse in the province."
- The International Student Energy Summit (ISES) held on June 9-11, 2011. ISES at UBC hosted approximately 400 students at an event that saw speakers, sponsors and attendees gather to share knowledge and exchange ideas on the future of energy. PICS provided support for students from the four collaborating universities to attend ISES, and shared a display booth with the USI team.

PICS visiting scholars at UBC and SFU

PICS hosted two visiting scholars at UBC and SFU in 2011: environmental psychologist Sabine Pahl from the University of Plymouth, UK joined UBC's Collaborative for Advanced Landscape Planning (CALP) from March 15 to 22 and Julian Agyeman,

Chair of Urban and Environmental Policy and Planning at Tufts University, Boston, USA was a guest of both UBC's School of Community and Regional Planning (SCARP) and SFU's Centre for Sustainable Community Development during March and April.

6.3 University of Northern British Columbia

Under the guidance of PICS UNBC Campus Coordinator Kyle Aben, the PICS-UNBC community has grown over the past year to nearly 65 members, including students, faculty and staff. The group meets once a term and brings an important northern perspective on climate change mitigation and adaptation to an area of the province that is likely to continue to see more extreme impacts from climate change than the southern regions. Kyle is a member of the UNBC Green University Committee and sits on the Natural Resources and Environmental Studies Institute Steering Committee, which ensures the day-to-day PICS operations are well represented at grassroots levels on the campus.

Teaching and outreach

PICS campus coordinator Kyle Aben instructed a two day course through UNBC Continuing Studies titled "Carbon 101: An Introduction to Carbon Offsets". The course was the first of its kind in northern BC and was very well attended. In addition to the continuing studies course, Kyle has been able to guest lecture for several classes at UNBC on topics ranging from current climate change policy to how to measure a carbon footprint.

Kyle was also part of the organizing committee for this year's PICS annual



PICS-UNBC Campus Coordinator Kyle Aben takes audience questions at the Resilient Communities forum on June 15, 2011 in Vancouver.

forum. He moderated the second day, which focused on local government responses to the climate challenge, and was instrumental in organizing a session featuring case studies on how BC communities have begun to address adaptation, mitigation and emission reductions.

PICS visiting scholars at UNBC

PICS-UNBC hosted three visiting scholars over the past year: Dr. Julian Agyeman, Professor and Chair of Urban and Environmental Policy and Planning at Tufts University, Boston on environmental justice; computer scientist and technology expert Dr. John Mashey on the mechanics of the climate anti-science campaign; and Dr. Sabine Pahl, Lecturer in Psychology at Plymouth University in the United Kingdom on the psychology of climate change and social mobilization. UNBC was proud to have such outstanding researchers visit BC's Northern University.

Year of Science activities

As part of BC's Year of Science initiative, PICS and UNBC hosted three workshops in Northern BC to help uncover the new opportunities provided by our forests. The workshops in Terrace, Quesnel, and Prince George aimed at highlighting the basic processes of a growing forest in order to help us understand the important relationship between forests, carbon and climate change. Topics discussed included bioenergy generated from wood waste, forest sustainability, carbon sequestration and carbon offsets from forestry. For more information on the above and other PICS-UNBC initiatives, see <http://www.unbc.ca/pics>.

7. WORKING WITH THE BC GOVERNMENT

PICS has continued to strengthen its relationship with the BC Government over the past year through working collaboratively to address climate change mitigation and adaptation priorities and information needs, with the shared goal of solutions-orientated results.

PICS continues to interact actively with the Minister of Environment and the BC Climate Action Secretariat. Among other stakeholders, provincial government representatives have been active participants in all of PICS' thematic workshops, and as such, are integral to developing the PICS research agenda. PICS also works closely with the province in the implementation of the briefing program; development of short course material; through joint initiatives with our sister organization, PCIC; and, through many of our outreach efforts. The majority of our intern placements are within various provincial government ministries, helping to increase the capacity of the province to address the climate change challenge.

8. THE PICS COMMUNITY: GETTING INVOLVED

The PICS community continues to grow rapidly and there are a number of ways to get involved:

Climate Solutions Network

The PICS Climate Solutions Network- an online community of climate change experts and stakeholders from government, academia, industry, business, NGO and civil society- has grown to 280 members since its launch in March 2009. The CSN is used as a tool to engage stakeholders in PICS and PICS sponsored activities, connect experts and practitioners working in various areas of climate change research and solutions, and to share information on key mitigation and adaptation issues. You can register for the CSN at: <http://www.pics.uvic.ca/research/>.

Social media

Follow us on Twitter at PICSCanada or join our Facebook group.

PICS mailing lists

You can also sign up to receive our quarterly newsletter, weekly news scans and to be notified of upcoming PICS events. To be added to any of these lists, please email us at pics@uvic.ca.

APPENDIX 1: PICS GOVERNANCE

BOARD AND COMMITTEE MEMBERSHIP

Executive Committee

Howard Brunt, Vice-President Research, University of Victoria (Chair)

Ken Denman, Senior Scientist, Canadian Centre for Climate Modelling and Analysis, Environment Canada and Institute of Ocean Sciences, Fisheries and Oceans Canada

Gail Fondahl, Vice-President Research, University of Northern British Columbia

John Hepburn, Vice-President Research and International, University of British Columbia

Peter Keller, Dean of Social Sciences, University of Victoria

James Mack, A/Head, Climate Action Secretariat, BC Ministry of Environment

Michael Miller, Associate Vice-President Research, University of Victoria

Tom Pedersen, Executive Director, Pacific Institute for Climate Solutions

Mario Pinto, Vice-President Research, Simon Fraser University

Advisory Board

Howard Brunt, Vice-President Research, University of Victoria (Chair)

Lyn Brown, Vice-President, Catalyst Paper Corp.

Michael Brown, Executive Director and Chairman, Chrysalix Energy Management Inc.

David Demers, CEO, Westport Innovations Inc.

Bob Elton, Special Advisor to the Board, BC Hydro

Richard Flury, former Chief Executive, Oil, Gas and Renewables, BP plc (retired)

Doug Horswill, Senior Vice-President, Teck Cominco Ltd.

John MacDonald, Chairman and CEO, Day4 Energy Inc.

Jonathan Rhone, President and CEO, Nexterra Energy Corp.

Peter Robinson, CEO, David Suzuki Foundation

Cheryl Slusarchuk, Climate Action Team Chair and President, Premier's Technology Council

James Tansey, Executive Director, ISIS Research Centre, Sauder School of Business, University of British Columbia

Joe van Belleghem, Partner, Windmill West

Tamara Vrooman, President and CEO, Vancity Savings Credit Union

Graham Whitmarsh, Deputy Minister, BC Ministry of Health

Program Committee

Tom Pedersen, Executive Director, Pacific Institute for Climate Solutions (Chair)

Paul Evans, Director, Centre for Asian Research, University of British Columbia

Art Fredeen, Professor, Ecosystem Science and Management, University of Northern British Columbia

John Fyfe, Research Scientist, Canadian Centre for Climate Modelling and Analysis, Environment Canada

Nancy Olewiler, Director, Public Policy Program, Simon Fraser University

Lawrence Pitt, Associate Director, Pacific Institute for Climate Solutions

Afzal Suleman, Professor, Department of Mechanical Engineering, University of Victoria

Tim Takaro, Associate Professor, Faculty of Health Sciences, Simon Fraser University

Lee Thiessen, Executive Director, Adaptation and Regulatory Development, Climate Action Secretariat

Ken Wilkening, Chair, International Studies, University of Northern British Columbia

David Wilkinson, Professor and Canada Research Chair, Department of Chemical and Biological Engineering, University of British Columbia

Monika Winn, Associate Professor, School of Business, University of Victoria

Past Program Committee members (2010/11)

Diana Allen, Professor, Department of Earth Sciences, Simon Fraser University (July 2008 – December 2010)

Ned Djilali, Canada Research Chair in Energy Systems Design and Computational Modeling, Department of Mechanical Engineering, University of Victoria (May 2008 – May 2011)

John Robinson, Executive Director, University Sustainability Initiative and Professor, Institute of Resources, Environment, and Sustainability, University of British Columbia (April 2008 – April 2011)

APPENDIX 2: PICS RESEARCH THEME GOVERNANCE

Theme 1: The Low Carbon Emissions Economy

Hillary Kennedy, Climate Change Analyst, BC Climate Action Secretariat (Chair)

Mark Jaccard, Professor, School of Resource and Environmental Management, Simon Fraser University (Research Theme Leader)

Ned Djilali, Canada Research Chair in Energy Systems Design and Computational Modelling, Department of Mechanical Engineering, University of Victoria

Nancy Olewiler, Professor, Department of Economics and Director, Public Policy Program, Simon Fraser University

David Wilkinson, Professor and Canada Research Chair, Department of Chemical and Biological Engineering, University of British Columbia

Past chair: Nygil Goggins, Senior Economic Advisor, Climate Action Policy, BC Climate Action Secretariat (April 2009 – April 2011)

Theme 2: Social Mobilization

Stephen Sheppard, Professor, Department of Forest Resource Management, University of British Columbia (Chair and Research Theme Leader)

John Robinson, Executive Director, University Sustainability Initiative and Professor, Institute of Resources, Environment, and Sustainability, University of British Columbia

Colleen Sparks, Director, Carbon Neutral Operations and Climate Outreach, BC Climate Action Secretariat

Monika Winn, Associate Professor, School of Business, University of Victoria

Theme 3: Sustainable Communities

Ben Finkelstein, Manager, Green Communities, BC Climate Action Secretariat (Chair)

Mark Roseland, Professor, School of Resource and Environmental Management and Director, Centre for Sustainable Community Development, Simon Fraser University (Research Theme Leader)

Emanuel Machado, Sustainability and Special Projects Manager, District of Sechelt

Sean Pander, Sustainability Officer, City of Vancouver

Lawrence Pitt, Associate Director, Pacific Institute for Climate Solutions

Ken Wilkening, Chair, International Studies, University of Northern British Columbia

Theme 4: Resilient Ecosystems

Dan Smith, Professor, Department of Geography, University of Victoria (Research Theme Leader)

Elizabeth Campbell, Research Scientist, Pacific Forestry Centre, Natural Resources Canada

Jenny Fraser, Climate Change Adaptation Advisor, BC Climate Action Secretariat

John Fyfe, Research Scientist, Canadian Centre for Climate Modelling and Analysis, Environment Canada

Eric Higgs, Professor, School of Environmental Studies, University of Victoria

Tory Stevens, Protected Area Ecologist, BC Ministry of Environment

Theme 5: Carbon Management in BC Forests

David Spittlehouse, Forest Climatologist, BC Ministry of Forests, Mines and Lands (Chair)

Peter Constabel, Director, Centre for Forest Biology, University of Victoria

Art Fredeen, Professor, Ecosystem Science and Management, University of Northern British Columbia

Tim Lesiuk, Executive Director, Business Development/Chief Negotiator, BC Climate Action Secretariat

Shannon Janzen, Manager, Strategic Planning, Western Forest Products Inc.

Ben Parfitt, Resource Policy Analyst, Canadian Centre for Policy Alternatives

Tom Pedersen, Executive Director, Pacific Institute for Climate Solutions



Photo by Anna Rozwadowska.

APPENDIX 3: PICS FELLOWSHIP HOLDERS (SEPTEMBER 2011)

GRADUATE FELLOWSHIPS

Simon Fraser University

Dionne Bunsha, PhD Candidate, School of Resource and Environmental Management
Supervisor: Dr. Ken Lertzman, School of Resource and Environmental Management
Research Topic: Community-based environmental monitoring networks: grassroots climate change detectives

Steven Conrad, PhD Candidate, School of Resource and Environmental Management
Supervisor: Dr. Wolfgang Haider, Resource and Environmental Management
Research Topic: Improving water allocation adaptation policies and decision-making through an integrated hydrological-stated preference water demand model

Sabine Jessen, PhD Candidate, Department of Geography/School of Resource and Environmental Management
Supervisor: Dr. Alison Gill, Department of Geography/School of Resource and Environmental Management
Research Topic: Planning for marine ecosystem resilience under climate change in BC

Mary Ann Middleton, PhD Candidate, Department of Earth Sciences
Supervisor: Dr. Diana Allen, Department of Earth Sciences
Research Topic: Evaluating the impacts of climate change and water use on groundwater sensitive streams

Cedar Morton, PhD Candidate, School of Resource and Environmental Management
Supervisor: Dr. Murray Rutherford, Resource and Environmental Management
Research Topic: Enduring waters: building resilient international water institutions in a changing climate

Vinu Subashini Rajus, PhD Candidate, School of Interactive Arts and Technology
Supervisor: Dr. Robert Woodbury, Interactive Arts and Technology
Research Topic: Ambient, interactive displays and controls for sustainable living

University of British Columbia

Maggie Baynham, MSc Candidate, School of Community and Regional Planning
Supervisor: Dr. Maged Senbel, School of Community and Regional Planning
Research Topic: Land-use tools for adaptation: opportunities for integration into official community plans

Laura Cornish, MA Candidate, Institute for Resources, Environment and Sustainability
Supervisor: Dr. Stephen Sheppard, School of Architecture and Landscape Architecture
Research Topic: Visioning to empower community action on climate change

Susanna Haas Lyons, MA Candidate, Institute for Resources, Environment and Sustainability
Supervisor: Dr. John Robinson, Institute for Resources, Environment and Sustainability
Research Topic: Greenest city conversations

Kim Lau, PhD Candidate, Institute for Resources, Environment and Sustainability
Supervisor: Dr. Hadi Dowlatabadi, Institute for Resources, Environment and Sustainability
Research Topic: British Columbia's "carbon-neutral" government: a critical evaluation

Jennie Moore, PhD Candidate, School of Community and Regional Planning
Supervisor: Dr. William Rees, School of Community and Regional Planning
Research Topic: Getting serious about sustainability: exploring the potential for “one-planet” living in Vancouver

Polly Ng, MSc Candidate, School of Community and Regional Planning
Supervisor: Dr. Maged Senbel, Community and Regional Planning
Research Topic: Case studies of community responses to the BC Green Communities Act

Georgia Piggot, PhD Candidate, Department of Sociology
Supervisor: Dr. Ralph Matthews, Department of Sociology
Research Topic: Collaborative networks and climate change action: a British Columbia case study

Catalin Ristea, PhD Candidate, Department of Forest Resources Management
Supervisor: Dr. Thomas Maness, Forest Resources Management
Research Topic: Climate change mitigation potential and economic feasibility of producing bioenergy from woody biomass: a multi-objective analysis and life-cycle assessment approach

Elizabeth Schwartz, PhD Candidate, Department of Political Science
Supervisor: Dr. Kathryn Harrison, Department of Political Science
Research Topic: Climate policy in Canadian cities: a comparative study

Gerald Singh, PhD Candidate, Institute for Resources, Environment and Sustainability
Supervisor: Dr. Kai Chan, Institute for Resources, Environment and Sustainability
Research Topic: Cumulative impacts and resilience in social ecological systems

Paul Teehan, PhD Candidate, School of Resource Management and Environmental Studies
Supervisor: Dr. Milind Kandlikar, Liu Institute for Global Issues
Research Topic: GHG implications of cloud computing: analyzing large data centre construction in the Columbia Basin

Lisa Westerhoff, PhD Candidate, School of Resource Management and Environmental Studies
Supervisor: Dr. John Robinson, Institute for Resources, Environment and Sustainability
Research Topic: Governance for climate change: local decision-making for low-carbon, resilient communities

Lilia Yumagulova, PhD Candidate, School of Resource Management and Environmental Studies
Supervisor: Stephanie Chang, Institute for Resources, Environment and Sustainability
Research Topic: Resilient by design: the role of institutional adaptation to environmental risk in cities

Kevin Zhang, MSc Candidate, School of Community and Regional Planning
Supervisor: Maged Senbel, School of Community and Regional Planning
Research Topic: The effect of urban design on transit rider perceptions and ridership

University of Northern British Columbia

Matthew Beedle, PhD Candidate, Natural Resource and Environmental Management
Supervisor(s): Dr. Brian Menounos and Roger Wheate, Geography
Topic: Communicating the implications of climate change through the study of glacier recession

Alana Clason, PhD Candidate, Natural Resources and Environmental Studies
Supervisor: Dr. Phil Burton, Ecosystem Science and Management and Canadian Forest Service

Research Topic: The resilience of high-elevation ecosystems to cumulative disturbances across a climatic gradient

Ian Picketts, Ph.D. Candidate, Natural Resources and Environmental Studies

Supervisor(s): Drs. John Curry, School of Environmental Planning and Stephen Déry, Environmental Science and Engineering Program

Research Topic: Community adaptation to climate change in Prince George, BC

University of Victoria

Torsten Broeer, PhD Candidate, Institute for Integrated Energy Systems

Supervisor: Dr. Ned Djilali, Department of Mechanical Engineering

Topic: Modeling of the existing conventional electricity generating system and the impacts of an increasing of wind energy to Canada's power generation system

Rod Davis, PhD Candidate, School of Environmental Studies and Department of Geography

Supervisors: Drs. Eric Higgs, School of Environmental Studies and Dennis Jelinski, Department of Geography

Topic: Conservation strategies for wildlife ecosystem resilience: an evaluation of land management policy alternatives to adapt to climate change

Anita Girvan, PhD Candidate, Departments of Political Science, English and School of Environmental Studies (Social, Cultural and Political Thought Concentration)

Supervisors: Drs. Warren Magnusson, Department of Political Science and Nicole Shukin, Department of English

Topic: Tracing the mediations of the carbon footprint: a critical analysis of the central role of the metaphor in climate change solutions

Christine Kormos, PhD Candidate, Department of Psychology

Supervisor: Dr. Robert Gifford, Department of Psychology

Topic: Social influences on the acceptance of new energy technologies: an investigation of the plug-in hybrid electric vehicle (PHEV)



2010/11 PICs fellowship holders at the annual symposium on February 14, 2011 in Vancouver.

Matthew Ooms, MSc Candidate, Department of Mechanical Engineering
Supervisor: Dr. David Sinton, Department of Mechanical Engineering
Research Topic: Sustainable solar fuel production: evanescent photo-bioreactor design and scale-up

Michael Shives, MSc Candidate, Institute for Integrated Energy Systems
Supervisor: Dr. Curran Crawford, Department of Mechanical Engineering
Topic: The efficiency of ducted tidal current turbine arrays

Amy Sopinka, PhD Candidate, Department of Geography
Supervisor: Dr. G. Cornelis van Kooten, Department of Economics
Topic: Economic and environmental effects of wind energy integration in the Pacific North West

Jason Straka, MSc Candidate, School of Environmental Studies
Supervisor: Dr. Brian Starzomski, School of Environmental Studies
Research Topic: Humming along or buzzing off? The resilience of pollination services to climate change in British Columbia

Trevor Williams, PhD Candidate, Institute for Integrated Energy Systems
Supervisor: Dr. Curran Crawford, Department of Mechanical Engineering
Topic: Probabilistic power flow modeling (PLF) of renewable energy and PEV grid interactions

POSTDOCTORAL FELLOWSHIPS

University of British Columbia

Dr. Sonja Klinsky, Institute for Resources, Environment and Sustainability
Supervisor: Dr. Hadi Dowlatabadi, Institute for Resources, Environment and Sustainability
Research Topic: Justice in the negotiation and implementation of emission trading: leveraging lessons from the Western Climate Initiative

Dr. Tara Moreau, Design Centre for Sustainability, School of Architecture and Landscape Architecture
Supervisor: Prof. Patrick Condon, School of Architecture and Landscape Architecture
Research Topic: Sustainable agricultural systems for the 21st century: integrating urban and peri-urban agriculture with human settlements to minimize GHG production and maximize carbon sequestration

Dr. Olaf Schroth, Collaborative for Advanced Landscape Planning
Supervisor: Dr. Stephen Sheppard, School of Architecture and Landscape Architecture
Research Topic: Energy landscapes: social acceptance of different renewable energy options

University of Victoria

Dr. Dan Wang, Institute for Integrated Energy Systems
Supervisor: Dr. Ned Djilali, Department of Mechanical Engineering
Research Topic: Modelling and comparative analysis of expanded power generation in BC: large-scale, centralized VS distributed generation systems

APPENDIX 4: PICS INTERN PLACEMENTS (SEPTEMBER 2010 - AUGUST 2011)

BC Ministry of Energy, Mines and Petroleum Resources

Richard del Rosario (UBC Chemical and Environmental Engineering), Low Carbon Transportation Researcher

Nick Clark (UVic Environmental Studies and Sociology), Low Carbon Transportation Systems Analyst

Julia Ratcliffe (UVic Geography), Renewable Heat Initiatives Analyst

BC Ministry of Environment

Danielle Jmieff (UVic Public Administration), Carbon Offset Analyst

Robyn Hooper (UBC Forestry), Climate Change Adaptation and Ecosystem Sustainability Specialist

Kameshwar Shergill (UVic Economics), WCI Generalist

Dogwood Initiative

Chloe Donatelli (UVic Environmental and Women's Studies), Community Researcher

District of Saanich

Lee Johnson (SFU Resource Management and Environmental Studies), Climate Action Technician

City of Williams Lake

Nigel Whitehead (UNBC Environmental Planning), Carbon Neutral Planning Assistant

Simon Fraser University

Jessica Dennis (UBC Resource and Environmental Management), Research Assistant

Ngaio Hotte (UBC Food and Resource Economics), Research Assistant, Crops and Food

Timothy McCann Shah (UBC Planning), Research Assistant, Climate Change Adaptation and Water

The Society for Promoting Environmental Conservation (SPEC)

Lis Chere Thomas (UBC Land and Food Systems), Climate-Smart Field School Coordinator

University of Victoria

Brendan Guy (UBC Forestry), Ecological Change Modeling Analyst

Simon Parkinson (UVic Mechanical Engineering), Research Assistant

Andrew Sheriff (UVic Environmental Studies), Mountain Biodiversity Intern

APPENDIX 5: FINANCIAL REPORT

PICS is funded through a \$90 million endowment received from the Province of British Columbia in 2008, and held by the University of Victoria Foundation. The 2009/10 yield provided PICS with a budget of approximately \$3.5 million for the fiscal year of 2010/11. Budget expenditures for 2010/11 are summarized in Figure A.1 below.

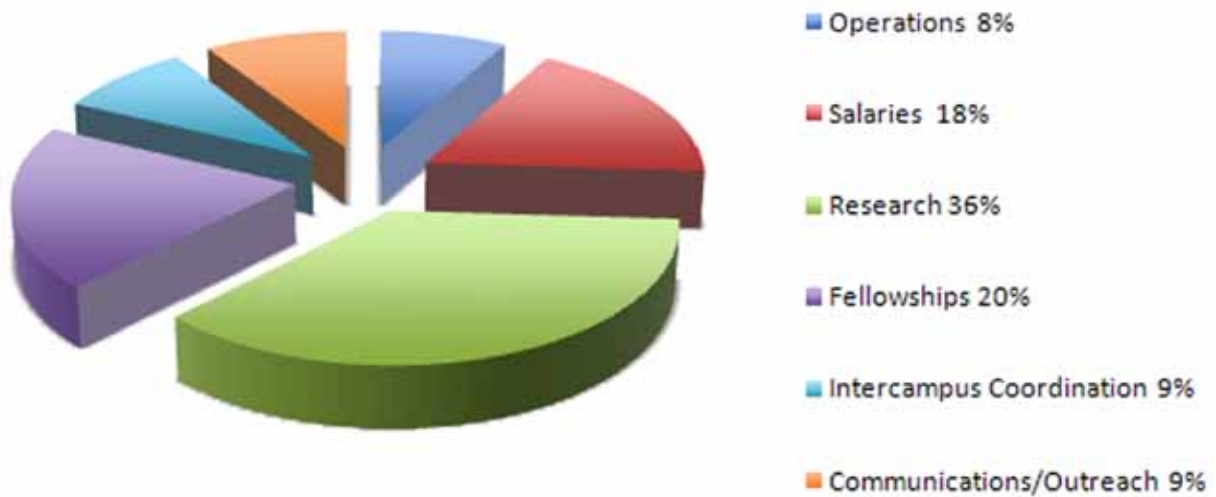


Figure A.1

Administration includes: UVic overhead and operational costs.

Research includes: Research theme and internship funding, white papers.

Communications/Outreach includes: PICS seminars and events, briefing note and news scan program, short courses, sponsorships and annual forum.



**Pacific Institute
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Knowledge. Insight. Action.

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