



Message from the Executive Director

Kicking the coal habit

Despite the persistence of a cooling La Niña effect throughout most of 2011, NASA announced that the year was the tenth warmest globally since the invention of the thermometer some three centuries ago. Coming in at tenth place in a La Niña year – although not record-breaking – was significant, adding yet another data point in the inexorable rise of average global temperature with time. The cause of that rise, of course, is well known: it's us, and particularly our accelerating emissions of carbon dioxide (CO₂), the biggest contributor to which is the burning of coal to produce electricity. In that context, humanity faces an immediate, specific challenge: we must eliminate coal from our energy diet.

This will not be easy, but recent advancements in the ongoing development of zero-carbon-emissions energy technology give us reason for some qualified optimism. The price of solar-voltaic panels plummeted in 2011, a trend that is continuing in 2012. The magazine *Photovoltaics World* reported on February 20 that prices for crystalline-silicon photovoltaic (PV) modules "fell below the \$1/Watt mark in January 2012, and in some cases well below even that, marking the first time that global average prices have fallen below this milestone." Intense competition amongst PV panel manufacturers coupled with recent increases in silicon refining capacity in Asia is fundamentally responsible for the ongoing decline in prices, as supply now trumps demand even in the face of burgeoning installation of PV generating systems around the world.

The extent to which pricing declines will continue is an open question but for now, solar PV power has never been as affordable, coming in at sunny industrial-scale sites at a levelized cost of energy (LCOE) of around CAN\$0.20/kWh. The LCOE is used internationally to compare electricity generation costs from differing sources, and is a comprehensive metric that considers capital (including financing) and installation costs, economic lifetime of the installation, and capacity factors (hours of sunshine). It essentially specifies the average electricity price needed to ensure that an

investor would break even on a solar PV investment. While 20 cents/kWh might not strike a British Columbian as an attractive price, a resident of Boston, where residential electricity rates are about 25 cents/kWh, would look upon the solar PV tariff as being in the ballpark. It's clearly a technology with a bright future and one that should threaten ongoing generation of coal-based electricity.

At any given location, the sun of course doesn't shine 24 hours per day and that limits the utility of solar electricity production, at least in principle. But that constraint is being weakened too, thanks to the introduction of concentrating solar thermal power plants with salt storage (CSP-SS), now in operation in Spain and soon, California and Morocco. Using either plane or parabolic mirrors, this technology reflects sunlight onto pipes containing a fluid that is superheated and run through a heat-exchanger. Extracted heat is used to produce steam that then drives turbines attached to generators. In a novel twist pioneered by Spanish engineers, CSP-SS plants hive off a fraction of the heat stream during the sunlit hours and store the heat in massive insulated tanks of molten salt (typically sodium or potassium nitrate at ~500°C). The liquid salt is circulated through the heat exchangers at night as needed to run the turbines, an approach that allows the plants to produce 24-hour power. The technology can bridge through occasional cloudy days: the flagship Gemasolar plant at Córdoba, Spain, for example has enough heat-storage capacity to provide full electricity production for 15 hours.



Solar panels and central tower receiver at the Gemasolar plant operated by Torresol in Córdoba, Spain.

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The costs for such installations are falling; Sandia National Laboratories in the US estimated last year that by 2020, the LCOE for a large (≥ 150 MW) installations in the US should run about CAN\$0.16/kWh. The potential is immense in sunny countries: Morocco now anticipates that indigenous CSP with salt storage will supply as much as 40% of its electricity needs by as early as 2020.

In the face of these technological and economic advances in the world of solartech, why aren't we seeing an all-out global effort to turn our collective back on coal-powered electricity? The answer is, of course, complicated. Coal is cheap, resistance to change is an endemic characteristic of all societies, the fossil fuel industry has deeply entrenched political and economic power, western governments think in four-year electoral cycles rather than in multiple-generation terms, there is essentially no charge (yet) for using the atmosphere as a CO₂ dumping ground, direct capital costs for the new technologies remain high despite the recent advances, and the sun shines only part of the time. But while all of these influences inhibit action, none is a valid excuse for inaction.

At PICS, we are now looking at the coal-electricity issue from a different angle and exploring what we might do in Canada. We don't have the hours of sunshine of a Morocco or southern Spain, but we do have wind, lots of it. Could we use hydropower in the three key hydro-rich provinces—BC, Manitoba and Québec—to provide the firming electricity required to support large-scale installation of wind power? We're now exploring that question via numerical modeling of a virtually integrated electrical grid—initially between BC and Alberta—that allows electricity to be exchanged as needed between the two. Initial results are promising, and suggest that wind could make a substantial contribution to the energy we need while eliminating coal from the generation mix.

Our view is that solutions to the coal dilemma are at hand; acting on them, however, remains a challenge that society needs to recognize and accept if we are to curb continued warming of this unique planet.

Science – not just for grown-ups

Hundreds of parents and kids of all ages stopped by the PICS booth at Family Science Days this February, learning about PICS research and outreach. Bob McDonald, CBC science correspondent and host of *Quirks & Quarks*, was among the many visitors. This year's Science Days event – part of the annual meeting for the American Association for the Advancement of Science (AAAS) – was the best attended in history, with more than 6,200 visitors.



SFU graduate student Jeremy Moorhouse demonstrates the use of wind and solar power.



PICS Executive Director Tom Pedersen shows visitors the PICS "bite size" lessons at AAAS Family Science Days.

At the PICS booth we showcased the Climate Insights "bite size" YouTube lessons – animated short lessons on climate change. Children and parents also discovered the PICS-SFU outreach program "Exploring Energy: Conversion, Consumption and Conservation", where they learned about

ways to generate clean energy using wind and sun as power sources. See the new Climate Insights "bite size" clips at youtube.com/PICSClimatInsights.

Why we disagree about climate change

Leading UK climate change expert Mike Hulme spoke

to a full house at SFU's Harbour Centre on February 15, sharing insights into why, in our quest for solutions, societies around the world struggle with the scientific and social complexities of climate change. A professor of climate change at the University of East Anglia and founding director of the Tyndall Centre, Professor Hulme's talk was based on his 2009 book, *Why We Disagree About Climate Change*. A recording of the talk can be viewed at pics.ubc.ca/events.php.

Professor Hulme continued his visit at AAAS, presenting alongside former IPCC members Drs. Richard Moss, John Robinson, Stewart Cohen and Stephen Sheppard. More than 120 participants attended the session, entitled "Beyond Climate Models: Rethinking How to Envision the Future with Climate Change," and many stayed on for smaller group discussions on topics of human imagination, scenarios and visualization. The discussions were facilitated and reported on by PICS UBC staff and fellows.

Can fusion transform our energy future?

There is no doubt that our growing energy demand will require a significant transformation of the current supply system, including new generation capability and cleaner, more sustainable sources. Fusion – the source of energy contained in our sun – could meet such demands, according to one of Canada’s leading experts on fusion energy, Dr. Allen Offenberger, who visited UVic in January to give a special talk on this subject.

Hosted by PICS Associate Director Lawrence Pitt, Dr. Offenberger’s visit also included a meeting with General Fusion Inc. in Burnaby to discuss the latest developments in this field and future collaborations. While the idea of generating power from fusion energy is not new, a newer approach employing lasers promises imminent ‘ignition’ without the problematic by-products of using carbon fuels. “Inertial fusion energy (IFE),” says Dr. Offenberger, “will have a profound influence on energy, environment and economic strategies worldwide.” The IFE process uses high-intensity laser bursts to compress tiny fuel pellets to extremely high temperatures and density, triggering fusion and releasing large amounts of energy.

The hockey stick and the climate wars

Also in February, PICS partnered with the David Suzuki Foundation to host a public lecture by Dr. Michael Mann, lead author of the ‘hockey stick’ chart that has been the focus of many attacks by global warming deniers. Published originally in *Nature* in 1998, the chart shows reconstructed Northern Hemisphere temperature over many centuries, and clearly indicates that temperature has risen with the increasing use of fossil fuels and resulting greenhouse gas emissions. Drawing a full-house at SFU Harbour Centre in downtown Vancouver, Mann talked about his new book, *The Hockey Stick and the Climate Wars* (2012), which provides a full account of the controversy generated by the reconstruction and resulting attempts to discredit him and other climate scientists. “The hockey stick,” he says, “became a central icon in the ‘climate wars’ because of the perceived threat it posed to those who oppose governmental regulation and other restraints to protect our environment and planet. Their attacks were about diverting attention away from one of the central scientific and policy issues of our time.”



Michael Mann, author of the ‘hockey stick’ chart, speaks in Vancouver.

Campuses as living labs

Close to 150 participants attended a PICS-sponsored conference hosted by SustainableSFU in mid-February, with delegates coming from as far away as the University of Manitoba and Oregon State University. The theme of the Western Canada Sustainable Campuses Conference, “Campuses as a Living Lab,” examined ways in which campuses are leading innovative efforts to curb emissions, produce local food, and reduce waste while providing educational opportunities along the way. Highlights included seven-minute student presentations on campus sustainability initiatives, sessions on community-based service learning, campus sustainability frameworks, and living lab buildings. For details, visit sfuscc.org. A conference report will be posted in late March.

Appetite for destruction

Over much of BC, the mountain pine beetle (MPB) has become a flagship species representing the potentially devastating link between climate change and forest disturbance processes. Unprecedented tree mortality in BC, however, is only part of the story. As predicted, geographic shifts in climate suitability for MPB have also occurred, allowing the beetle to expand its range into marginal and novel habitats that have historically remained unfavorable because of climatic barriers. Until recently, this expansion to the north and east across the Rocky Mountains has followed the distribution of its preferred host, the lodgepole pine, but the arrival of MPB in north-central Alberta places the leading edge of the epidemic at the species eastern limit. Here, species composition shifts from lodgepole pine to jack pine through a narrow hybrid zone where the two distributions overlap.

Over the past year, researchers from the University of Alberta have documented the first cases of successful MPB colonization in natural stands of both hybrid and pure jack pines, suggesting that this tree species may support and be subject to future MPB outbreaks. Given the vast distribution of jack pine across the continent from Alberta to Nova Scotia, this raises major concerns about the introduction of MPB to the boreal forest, and leaves ecologists facing unpredictable consequences as to how this interaction will unfold. While climate is only one component of a complex disturbance process, projected changes will likely continue to increase ecosystem vulnerability to temperature-dependent invasive pests like the MPB, in the boreal and other forests across North America. This progression poses a considerable threat to these resources and their management.

By Kathryn Hrinkevich, PICS UNBC fellow and PhD candidate, who has been researching historical MPB outbreak dynamics in north-central BC.

A winter of bio-energy at UNBC

UNBC's new biomass gasification system has been heating the Prince George campus since May 2011. The renewable energy system provides heat to core campus buildings and has reduced the use of fossil fuels by 86%. This \$15 million system funded by the federal and provincial governments runs on hog fuel (biomass) provided by Lakeland Mills, a family-owned sawmill in Prince George. In addition to being carbon-neutral and supporting climate action within the province, the new plant saves money: the cost of sawmill residue is only about 35% of the cost of natural gas.

Since fully operational, the biomass gasification plant has offset the use of more than 49,980 GJ of natural gas with a clean, renewable source of energy. This reduction of greenhouse gases is approximately equivalent to consuming 5815 barrels of oil, 104,166 home barbeque tanks of propane, or 33 tanker trucks of fuel.

Before the gasification system was built on campus, UNBC installed Canada's first university-owned wood-pellet heating system in the spring of 2009. With much higher energy efficiency than the previous fossil fuel-based heating system, this project has resulted in savings of an additional 140 tonnes CO₂e/year. UNBC's bio-energy projects are also creating an array of educational and interdisciplinary research opportunities of great value to forest-based communities across Canada.



The UNBC biomass plant gasifies sawmill residue to heat water that provides heat for the Prince George campus. Photo courtesy of UNBC.

Upcoming Events

The PICS UBC-SFU Public Lecture Series continued this winter with a joint lecture by Kirsten Zickfeld (SFU Geography) and Erica Frank (UBC School of Population and Public Health) on "Limit Climate Change and Stay Healthy." Our next lecture, "Shaping Communities as if Sustainability Mattered," will be presented by Drs. Mark Roseland (SFU Resources and Environmental Management) and Ron Kellett (UBC Architecture and Landscape Architecture). It will take place on March 28, 2012 at UBC Robson Square.

PICS and PCIC are off to the GLOBE 2012 Trade Fair from March 14 – 16, and will be sharing a booth to showcase the collaboration between the two organizations. Our booth will feature a TV showing the *Climate Insights 101* suite of products, and both PICS and PCIC representatives will be on hand to talk about the 'Spectrum of Climate Insights' that we jointly provide. View the full GLOBE program at 2012.globeseries.com.

The PICS-sponsored summit "Scaling-Up Civic Engagement: Mobilizing for Collective Action" takes place on Friday, March 16 at the Creekside Community Centre in Vancouver. At the event, researchers and social change leaders will gather to exchange ideas on how to scale up (and out) our social mobilization efforts. Keynote speakers include Dr. Susanne Moser and Dr. Tom Crompton. Look for the video recording on the PICS website in late March.

PICS is also pleased to host former marine biologist turned writer and filmmaker Dr. Randy Olson for a three-day visit in late March. The author of *Don't be such a Scientist: Talking Substance in the Age of Style* (2009), his work focuses on the challenge of communicating science to the general public, and the current attacks on mainstream science in fields such as evolution and climate science.

More information on upcoming events is available at pics.uvic.ca/events.php.

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