



Rapporteur's Report by Marshall Kern:
The First Richard Marceau Energy Symposium
A NEW LOOK AT CANADA'S ENERGY SYSTEM
Powering the Economy and Achieving Environmental Objectives
November 9, 2016 – Western Sarnia-Lambton Research Park

This report was prepared by Marshall Kern, rapporteur for The First Richard Marceau Energy Symposium. All presentations delivered at The First Richard Marceau Energy Symposium are available on the website of The Bowman Centre for Sustainable Energy at www.bowmancentre.ca.

Purpose

The First Richard Marceau Energy Symposium delivered positive results for its several purposes. First and foremost, we paid tribute and honour to our friend and mentor, an inspiration and supporter of our work for many years, the late Dr. Richard Marceau. We also presented status reports on key initiatives underway by Associates of The Bowman Centre for Sustainable Energy to our supporters in the Sarnia and Lambton County area. Finally, we used the time together to engage in discussions amongst the Associates to push ahead with project work toward Canada's Future; including a Canadian Interprovincial Technology and Research Authority (CITRA).

Agenda

The Agenda for The First Richard Marceau Energy Symposium was in flux, and growing, until a few days before the event. With the cooperation of all participants the final Agenda, as shared with all registrants and attendees, allowed us to meet our 3-fold purposes of the Symposium. A simplified Agenda follows:

Gary Locke – Moderator - Symposium Intent

Key-note Address –Eddy Isaacs - Energy Transformation, the Innovation Revolution and Big Projects

Peter Frise, Canadian Academy of Engineering – Tribute to Dr. Richard Marceau, and his big project work

Guy Van Uytven, Canadian Society of Senior Engineers – Energy Compass -2020 and beyond

Walter Petryschuk -Two Pillars of Canada's Energy System –Hydrocarbons and Electricity

Clement Bowman - Canada's Energy Future (Proposal to Canada's Premiers)

John Kramers – The ProGrid Selection, Evaluation and Ranking Methodology

Don Wood, Ed Brost, Axel Meisen - Big Project 1:

- **Hydrocarbons Beyond Combustion (LAMP₂₁)**
- **Bitumen Beyond Combustion: Fundamentals**

Guy Van Uytven – Big Project 2 – Canada West Hydro Development

Marshall Kern – Rapporteur's Report on the morning sessions

In the afternoon there were Breakout Discussions on the Two Big Projects

- a) **Hydrocarbons Beyond Combustion (LAMP₂₁)**
- b) **Canada West Hydro Development**

Rapporteur's Comments

Marshall Kern, Associate of The Bowman Centre for Sustainable Energy

Today saw action based on the inspiration of two remarkable men: Dr. Richard Marceau, and Dr. Clem Bowman.

This Energy Symposium also provided an update to the supporters of The Bowman Centre for Sustainable Energy. We have explained our actions taken on the opportunities available. We have explained our new look at Canada's Energy System. And we have demonstrated our sense of urgency. The Bowman Centre for Sustainable Energy recently issued a Newsletter, and will be updating our Website with new content based on the presentations and discussions today.

Through the presentations and questions in the morning sessions, I heard two themes: complexity, and convergence.

A course I teach for Nipissing University's School of Business addresses innovation. A student asked me to define complexity vis-à-vis innovation. I answered that a simple system has one input, no constraints, and an output that is certain. Complex systems have multiple inputs, many constraints, and multiple outputs that are uncertain. Canada's current energy system meets this description of being complex. Dr. Eddy Isaacs showed us Michael Porter's 4-Forces Model with relevance to energy systems, with the complexity of additional factors, and influencers, and determinants.

He also showed us a model from a climate change programme with 3 Pillars and 3 Foundations. And he added the complexity of opportunities at the interfaces of these pillars and foundations.

Dr. Walter Petryschuk was blunt about Canada's Energy System. Our current system is so complex that no one person can understand it. He very clearly emphasized that we are in a carbon-constrained energy system and need a strategic response to meet its constraints. He pointed out that it is complicated to achieve collaboration to get to the goal of Canada's Future in having an integrated energy system. It involves a team approach with a common goal through the cooperation of many federal and provincial ministries as well as a partnership with the private sector. Dealing with the acceptance of the implementation to reach the common goal would be the subject of much debate among various environmental groups, the public at large, and the many indigenous peoples.

Guy Van Uytven gave a review of the North-West Hydro Development opportunities. Even with the simplified description, this is a complex opportunity: it is spread over a large geography, and with long time-lines for execution. Still, I finally grasped that there are different complexities for peak power generation, than for base-load power generation.

Don Wood explained some decisions made by The Bowman Centre for Sustainable Energy regarding the SABER (Sarnia Advanced Bitumen Energy Refinery) project that were influenced by external uncertainties. He shared a simplified 'Mind-Map' of 67 ideas to move on to the next opportunity. This

was one purpose of the Symposium, to explain to supporters the new look at Canada's energy system and the decisions made within The Bowman Centre for Sustainable Energy.

Ed Brost brought us through a series of conceptual evaluations to arrive at the direction and scope of the LAMP₂₁ Project. Notable are the opportunities for collaboration and achieving greater marketplace value for the products of the project.

Dr. Axel Meisen described the status of work under the title of "Bitumen Beyond Combustion". He provided a list of the desired characteristics for opportunities to use bitumen for something other than energy products. He also shared an anecdote of BMW's current complex carbon fibre manufacturing process. Work is progressing on several opportunities.

The other theme I heard was that of convergence.

Guy Van Uytven shared work being done by the Canadian Society of Senior Engineers that was initiated several years ago by our friend and mentor, Dr. Richard Marceau, regarding a decision-making framework for energy projects. The framework is being applied for some large-scale energy systems by the CSSE. The Canadian Academy of Engineering 'Energy Pathways' project used an alternate evaluation process, and arrived at proposals moving in a similar direction. The initial scope of ideas proposed within The Bowman Centre for Sustainable Energy has been refined with data and an assessment methodology towards promotion of 'Big Projects'. And the Council of the Federation, of Canada's Premiers, understands the same thing: that there are a few big projects which are fundamental to achieving Canada's future sustainable energy system.

We are converging on a Canadian Energy System that is integrated, sustainable, incorporating Big Projects focused on Canada's competitive advantages in both hydrocarbons and electricity that delivers wealth and environmental benefits.

Finally, we have been reminded today of the urgency of the tasks at hand. Dr. Clem Bowman showed us a path to Canada's future by working with the Council of the Federation, Canada's Premiers, to launch a Canadian Interprovincial Technology and Research Authority (CITRA).

Now our task is to make this happen.

The Symposium also featured concurrent workshops to allow participants to discuss the two Big Projects. The following summaries of some of the discussions during the workshops were prepared by Marshall Kern.

Hydrocarbons Beyond Combustion (LAMP21)

Workshop Leader: Don Wood

Having explained the reasons in the morning presentations for taking a new look at the role of the proposed SABER (Sarnia Advanced Bitumen Energy Refinery) project as part of Canada's energy system, the afternoon workshop focus was on Alberta's 'Bitumen Beyond Combustion' discussions, and the business case for the LAMP₂₁ project of The Bowman Centre for Sustainable Energy.

The workshop participants reviewed ongoing discussions with First Nations. There was also an update on discussions that have taken place with the Ontario MOECC. A presentation regarding capabilities and interests of members of the Sarnia-Lambton Industrial Alliance was shared.

The workshop participants reinforced a number of the conclusions made to-date by the team working on LAMP₂₁. It was noted that an asphalt plant has much less equipment and fewer facilities than a conventional refinery. For example there are no hydrodesulphurization facilities, but there is likely to be a need for a flare system as a process-safety measure. It was noted that there are low concentrations of some valuable metals in the raw material, and it was suggested to explore whether these metals could be extracted as part of the process.

The business case for an asphalt plant needs to understand and address what long-term contracts exist in Ontario for the supply of asphalt. These may be a constraint for breaking into the current market. Or they may set the timing for the launch of a new asphalt plant to provide competition in the marketplace.

One of the downstream processes or modules being explored is the manufacture of carbon fibres. There is an opportunity for such a plant to have heat integration with the asphalt plant to optimize total energy demand and minimize greenhouse gas emissions.

It is known that there are a number of companies and organizations exploring manufacturing processes for carbon fibres, including: the Rocky Mountain Institute, Mitsubishi Rayon Carbon Fiber & Composites, Advanced Carbon Products, and the Oak Ridge National Laboratory Carbon Fibre Technology Facility. A suggestion was to explore collaboration with these organizations; possibly sending a sample of bitumen (or asphalt from bitumen) to our contacts with these organizations and have them tell us if it is suitable for their carbon fibre products.

The workshop participants noted that there is a considerable amount of research already done on carbon fibres to date; so a challenge to us is to determine if we are late getting into the game? We may not want to be involved with development of carbon fibres technology, and so focus on making a suitable feedstock for others to make carbon fibres. If this is so, then the price of that feedstock could be the determining factor in what propels our efforts regarding bitumen forward. On the other hand, current carbon fibre technologies are costly, energy intensive, and significant GHG emitters. To overcome these issues merits a look at new technologies.

The workshop was fortunate to have expertise in the group regarding the automotive sector. There is a challenge of producing carbon fibre parts that keep up with modern production lines. A carbon fibre part needs to be produced every 42 seconds in order for it to go in an average automobile produced in North

America. This cycle-time constraint may need to be addressed further up the value-chain at our planned point of production of carbon fibre.

The workshop participants also explored ideas other than those presented in the morning sessions. From the perspective of process technology, it was suggested to explore if it may be advantageous for other advanced materials production to start from vacuum tower bottoms than from whole bitumen. While this may add complexity to the LAMP₂₁ project description, it may also add significant value to the resource.

Prompted by the research already underway in Alberta, the workshop discussed some of the other materials markets for bitumen fractions. Industrial coatings, specialty adhesives, technical improvements in Oriented Strand Board (OSB) and similar composite construction materials, and organic release coatings for fertilizers, and bitumen clays as high-temperature refractory materials were listed for consideration.

Canada West Hydro Development Workshop

Workshop leader: Peter Smith

There are many large and small untapped opportunities for hydro development in Canada. For example, Alberta has almost 12,000 MW of hydro capacity but is not developing it due to a lack of any overall provincial planning authority.

There are two main points to be considered for hydro development in Canada. First is the site of a dam to convert the flow of water to electricity. Second is the need for transmission lines to move the electricity from the source of generation to the point of demand. There are opportunities and opponents to both of these points.

The opportunities for siting a dam or generating source are technical, and well known. It is well within current, demonstrated technology, to properly site and develop a dam or generating source, that can produce electricity for decades. The example of the Shawinigan 2 facility was shared. It has reliably produced electricity for 105 years.

The opportunities for setting the path of transmission lines involve more uncertainties. Canada, and particularly Quebec, is a leader in building and managing high-capacity transmission lines. There is an opportunity for federal support and direction to drive a national plan for a national transmission system. Other organizations and think-tanks have promoted a national electrical grid. These include:

- The Fraser Institute – A number of reports have been published on electricity transmission.
- The C.D. Howe Institute – In a report “National Priorities 2016: The Future of Canadian Energy Policy”, there is a call for enhancing inter-provincial electricity trade.

- The Canadian Society of Senior Engineers – “Energy Compass 2020” declares “Canada needs a nation-wide electrical grid, mainly for security and economic reasons, particularly with the growing probability of cyber attacks on electrical plants and control systems”.
- The Canadian Academy of Engineering – A series of reports by The Energy Pathways Project call for development of a national electricity grid.

Opponents to hydro development and electricity transmission lines appear to the workshop participants to be based in unreasonable fear, and concern for the current state of the local environment. Opponents also believe that the benefits accrue primarily elsewhere from those who are impacted by the development.

Workshop participants recognize we need to frame the discussion with identifiable opposition groups. We understand that people will do something for their own benefit. We need to understand what benefits accrue to those who oppose hydroelectric development. Our discussions need to happen at all levels of governance and awareness. Our discussions need to earn acceptance for, and action on, hydroelectric development projects.

One aspect of the discussion focused on the displacement of fossil fuels for electricity generation. Hydroelectric power can be used to displace coal, diesel fuel, and natural gas, as fuel sources for electric power plants. It was noted that hydroelectric power can meet both base load and peak demand situations. Development of hydro resources should be more acceptable to opponents and environmental groups when framed as an essential element in the fight against climate change.

Another aspect of the discussion is that electricity is a commodity. If we do not need the electrical power, we can sell it to other jurisdictions (such as the United States) where it may attract a premium price as “clean electricity” and it can be used to displace coal for electricity generation. Thus, the environmental benefits of displacing fossil fuels can occur locally, and across North America if we more completely tap into Canada’s hydro generating capacity and build a national electricity grid.

It was noted that there are timeline issues to be faced. Decisions to build infrastructure such as dams and transmission lines typically extend beyond the life of an elected government. And the benefits to Canada and the world for reducing greenhouse gas emissions over the life of the infrastructure will also be realized beyond the life of an elected government.

Marshall Kern holds degrees in biology and environmental studies from the University of Winnipeg and the University of Waterloo. He also earned an MBA from Heriot-Watt University (Edinburgh, Scotland). He completed a successful career with Dow Chemical including roles as regulatory compliance manager and the global leader for business non-financial risk management. He was honoured by Dow with the highest recognition for service in the Environment, Health and Safety department. Now Marshall exercises leadership as a corporate director, a member of the teaching faculty of Nipissing University School of Business, and an Associate of The Bowman Centre for Sustainable Energy.