Canadian Prairies Group
http://www.cpgce.org

NEWSLETTER

of Chartered Engineers

Summer 2013/Winter 2014

Institution of Civil Engineers
Liaison
Nigel Shrive

Institution of Mechanical Engineers
Liaison
Alastair Milne

The Institution of Engineering and Technology
Liaison
Ray Marsh

The Institution of Structural Engineers
Liaison
John Charrett

IChemE
Liaison
Alan Rhodes

Chairman's Notes Winter 2014

Dear members

I hope all is well with you and would like to thank members for their support over the last year – the attendance at technical meetings has been excellent, so your executive will continue to try and bring speakers on topical issues of general interest to the membership. The lowest attendance this year was 32 and reports on the talks are in the newsletter. We have a diverse set of subjects set up for next year, starting in February with a talk about the floods this spring and some of the consequences.

We are really pleased to have an exciting guest speaker for the Annual General Meeting on February 1st at Fort Calgary – Don Hladiuk on "Planetary Robotic Explorers". Humans have managed to put robotic explorers on various planets and asteroids, so Don will talk about them and the findings. Don is a geologist who has worked for ConocoPhillips for over twenty years, and who has a great interest in the Milky Way and its constituents. He has presented a program on CBC every month for the last 29 years talking about the latest discoveries in space science. In recognition of his extensive educational activities, he has had an asteroid named after him! There is more information on the website (www.cpgce.org – click on AGM, the top left button). Please let us know you will be attending – spouses, better halves, others, are welcome – the cost is $10 per person.

At the AGM, I will become past-president as Mo Jaffer takes on the role of Chairman. The executive has functioned very well this year and I would like to take this opportunity of thanking all members of the executive for their contributions to keeping the group functioning and searching and connecting for the sequence of interesting speakers we have enjoyed. I know Mo will benefit from and appreciate that level of commitment and support.

On behalf of your executive, I would wish all members and their families the very best over the holiday season, and we all look forward to seeing you in the New Year.

Nigel Shrive

IN THIS NEWSLETTER

2014 Annual General Meeting (AGM) and Dinner

Fort Calgary, 750 - 9th Avenue SE, Calgary, Alberta, T2G 5E1

Saturday 1st February 2014
Meet at 6:00pm for AGM at 6.30 pm
Buffet Dinner at 7.00 pm

RSVP CPGCE Secretary via
E-mail:Secretary on the website
or phone Tel.: 403 254 3315

Please confirm your attendance before 20th January 2014 and pay a nominal fee of $10.00 per person at the door

Our AGM after-dinner is Don Hladiuk

Don is a geologist by profession and a former President of the Calgary chapter of the Royal Astronomical Society of Canada. He has been on the CBC airwaves for over 29 years presenting the latest monthly space news. In recognition for his public education work in geology and astronomy with students, teachers and the general public, asteroid 73704 was named asteroid Hladiuk. Don will present "Planetary Robotic Explorers" – a look at the latest findings from current missions to other worlds plus explore some of the engineering challenges of landing and sampling other planetary bodies such as Mars, asteroids and comets.

Canadian Prairies Group of Chartered Engineers

AGM Agenda for
Saturday, February 1, 2014, 18.30 hrs.

1. Approval of Agenda
2. Apologies for Absence
3. Minutes of Previous Meeting
4. Matters Arising from Minutes
5. Approval of Minutes
6. Chairman's Report
7. Treasurer's Report
8. Secretary's Report
9. Scholarship Award
10. Election of Officers

Chairman	Mohamed Jaffer
Vice Chairman	*to be nominated*
Past Chairman	Nigel Shrive
Treasurer	Bob Enever
Secretary	Colin Pollard

Members

Adrian Dumbrava	Philip Doherty
Peter Giddy	Mia Jovic
Arun Kumar	Tom Martin
Rick Marshall	Bob Sparrow
Maina Waiguru	

Other new members to be nominated

11. Incoming Chairman's Remarks

Canadian Prairies Group of Chartered Engineers

Minutes of Annual General Meeting
January 26, 2013, 18.30 hrs.

Held at Fort Calgary, Calgary, Alberta, Canada

2012 Committee members present: T Arevalo, A Deazeley, A Dumbrava, R Enever, M Jaffer, A Kumar, C Pollard, T Martin, N Shrive, R Sparrow.

1 Approval of Agenda

The agenda was approved.

2 Apologies for Absence

Bob Orth.

3 Minutes of the last AGM (January, 2013)

Accepted as a true record.
Proposed A Deazeley
Seconded R Sparrow

4 Matters arising from previous minutes

None.

5 Chairman's Report

N Shrive presented a report covering the following subjects:

1. It had again been a busy year and attendance at technical meetings had remained good.
2. Thanks were extended to the Committee, Treasurer and Secretary for their work in the past year and in particular to Alan Deazeley who was standing down.

6 Treasurer's Report

R Enever presented a report:

6.1 Financial status is good and money has been received from London after protracted correspondence and form filling.

7 Secretary's Report

C Pollard presented a report covering the following subjects:

7.1 Nine committee meetings had been held in the past year. The principal subjects were the scholarship fund and technical meetings.

7.2 Correspondence with London had been sparse with no problem issues.

7.3 No Presidents of the sponsoring Institutions had visited in 2012.

7.4 Correspondence from members had been at a similar level to last year and primarily related to possible immigration to and work practices in Canada from UK based engineers mainly from mechanical and electrical engineers. Where I had not been able to provide assistance, the message had been passed on to the appropriate Institution representative in Calgary.

7.5. I would like to record my thanks to all on the Committee for assistance in performing the function of Secretary. It is made considerably less onerous by Adrian Dumbrava's handling of everything related to our scholarship, Arun Kumar's handling of the web site and Bob Enever producing the Newsletter. The support of the Chairman was also acknowledged.

8 Scholarship Fund Report

Adrian Dumbrava presented a report:

8.1 24 applications, up from 17 last year, for the Scholarship had been received.

8.2 The standard had varied with several very good applications.

8.3. Applications had been received from the University of Alberta, Calgary and Regina.

8.4 The winner of the Charles Dempsey Scholarship for 2012 was Ms Aquila Azizi a 5th year Environmental Systems Engineering student at the University of Regina. Ms Azizi was from Afghanistan and planned to return on completion of her studies.

9 Election of Committee for 2013

9.1 Om Malik officiated during the election of the Committee. Dr Malik, Derrick Harrison and Ray Marsh had been asked to form a Striking Committee to canvas possible candidates.

9.2 Nominations were requested from the members present and added to the Striking

Committee's list. The following were elected by member vote:

Chairman	Nigel Shrive
Vice Chairman	Mohamed Jaffer
Past Chairman	Vacant
Treasurer	Bob Enever
Secretary	Colin Pollard
Members	
	Teddy Arevalo
	Philip Doherty
	Adrian Dumbrava
	Peter Giddy
	Mia Jovic
	Arun Kumar
	Tom Martin
	Rick Marshall
	Bob Sparrow
	Maina Waiguru

10 Vote of Thanks

Om Malik proposed a vote of thanks to the Committee and this was endorsed by the members present. The Chairman acknowledged the thanks with gratitude.

Meeting adjourned at 18.45 hrs.

2012 CPGCE SCHOLARSHIP AWARD

Highlights of the 2012 CPGCE Chartered Engineers Award

CPGCE Executive Committee is proud to offer the Chartered Engineers Award to full time engineering students at universities and colleges of technology in the CPGCE region, Alberta and Saskatchewan, in order to sustain their education. The Scholarship Committee received a total of 24 applications from the following institutions: University of Calgary (10), University of Alberta (9), University of Regina (4) and SIAST Saskatchewan (1). Participants were from the following disciplines: Mechanical Engineering (10), Chemical Engineering (6), Systems Engineering (3), Civil Engineering (2), Engineering Physics (2) and Power Engineering (1). Based on year of studies: 2nd year (6), 3rd year (12), 4th year (3) and final years (6).

This year, the CPGCE Executive and Scholarship Committees developed an array of criteria putting emphasis on personal motivation and professional development. Participants submitted an essay with their: (1) reasons for wanting this award (evaluation weight: 50%); and (2) personal views on the role of Engineering in society (evaluation weight: 30%). The remaining 20%component of evaluation is based on academic results. The essays are to describe why they chose engineering studies, how the financial benefit of this award would help them to progress their studies; and their engineering experience, activities, and interests outside their academic studies.

The awarding committee had a very difficult task in selecting the winning application since all the submissions were of high standard. Like in previous years, the winner's name was announced during Annual General Meeting held on January 26, 2013. The winner of 2012 Chartered Engineers Award is Aqila Azizi, a 5th year student at University of Regina, enrolled in Bachelor of Applied Science, major: Environmental System Engineering.
Attached is an extract from her essay.

"Coming from a war-torn country, Afghanistan made me realize the importance of a good education. I was born and raised in Kabul, Afghanistan. Unfortunately, there are some places in the world where it is impossible to get basic education or simply get daily nutrients. I believe education is the key for a better future. I will be graduating next year and I have big dreams after graduation - to go back to Afghanistan and to bring environmental awareness. Although political conflict has taken majority of attention in Afghanistan; however, my goal is to shift the attention to immediate environmental issues. I dream to work with Afghanistan Environment to bring more awareness on greenhouse gas emission, renewable sources of energy, water treatment plant just to name a few."

"I have always been interested in innovation and design. I chose Environmental Engineering because I am passionate about our environment. I believe it is important to be actively involved in environmental issues as we enter the Green Era. I enjoy being in a faculty that challenges me. Every day is a new day full of knowledge. My research interest is water and wastewater treatment. Water is becoming the new oil and so it is important to find innovative systems that would optimize the efficiency of treatment plants. I also chose to be in engineering because it is uncommon for Afghan women to be in such a male dominated field. I want to bring awareness to my community that encourages women to pursue any profession regardless of gender tags. We should not be afraid of such occupation and I hope to empower women in third world countries to follow their dreams and fight for any political, social or cultural restrictions that may get in their way of pursuing knowledge."

The Charles Dempsey commemorative medal, engraved with the winner's name, and a cheque for $3000 were presented to Aqila Azizi on February 28th.

Every year, the CPGCE Scholarship Committee invites engineering students at universities and colleges of technology in the Prairies, Alberta and Saskatchewan, to submit their applications for the 2013 CPGCE Award and Scholarship until November 15, 2013. Specific details are shown at http://www.cpgce.org/Award.htm.

Aqila Azizi (in the middle) with members of the Scholarship Committee (from left to right) Bob Sparrow, Adrian Dumbrava, Alan Deazeley and Bob Enever

Adrian Dumbrava PhD PEng – On behalf of the CPGCE Scholarship Award Committee

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2014 SPRING TECHNICAL PROGRAMME

All Technical Presentations are held at the Danish Canadian Club, 727, 11th Ave. S.W., Calgary, AB at 7:00pm on the specified date.

Wednesday, 12th February 2014

The Flood of 2013, Effects on Structural and Electrical Infrastructure

Andre van Dijk, P Eng, MBA, VP System Operations, ENMAX Power Corp., and Nigel Shrive, P Eng, D.Phil. Professor, Civil Engineering, University of Calgary.

The floods of 2013 will be placed in perspective of the history of flooding in Calgary. The effects on buildings, bridges and electrical infrastructure will be discussed - what happened, the causes and consequences.

Wednesday, March 12, 2014

Using Low Grade Waste Process Heat in a SAGD Plant

Leo Flaman, P Eng,
S & L Generation Consulting Ltd.

Wednesday, April 9, 2014

Railway Safety

Dr. Chris Bunce
GM of Environment, CP rail

Wednesday, May 14, 2014

HVDC Engineering

Alberta Electric System Operator(AESO)

Presentation on the Western Alberta High Voltage DC Transmission Line

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Wednesday, June 11, 2014

Continuous Emission Monitoring Systems (CEMS)

Kurt J. Hansen, M.Sc., P.Eng.
President, Green Inc. Calgary

If you have suggestions for the Technical Programme contact the Technical Meeting Coordinators identified on the back page. Please monitor
http://www.cpgce.org/technical2014.htm
for updates to our Technical Programme.

Technical presentations in 2013

Wednesday, 13th February 2013

The Science of Climate Change - Two Perspectives

Dr. Neil Hutton, Past-President, Canadian Society of Petroleum Geologists, and
Dr. Shawn Marshall, Canada Research Chair in Climate Change, University of Calgary

The objective for the two presentations was to provide the science behind climate change, and whether there was anthropogenic influence or not.

Dr. Hutton presented first. He argued that the Intergovernmental Panel on Climate Change (IPCC) had not stuck with pure science in its reports and that there was no scientifically acceptable evidence that human activity had affected the climate.

He showed that current temperatures were lower than those that occurred in both the medieval warm period (see Figure 1), and the Roman warm period. Dr. Hutton presented similar data from several sources, for several regions around the world including Iceland, Alaska, Siberia, Central Asia and the Indo-Pacific.

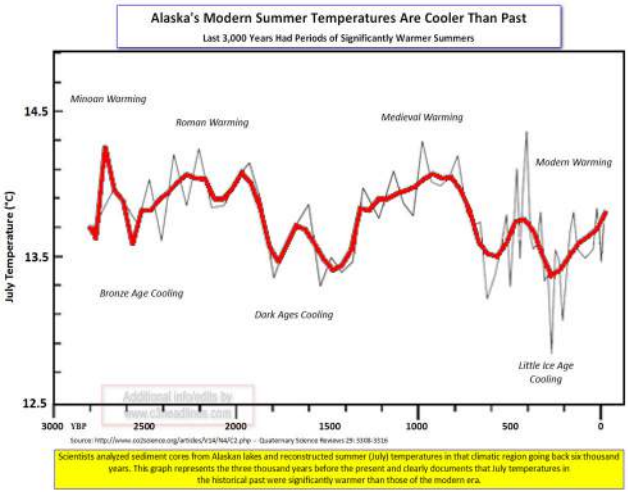


Figure 1. Mean Earth Temperature over the last 1000 years (from Dr Hutton's talk).

He pointed out that if one concentrated solely on the last 150 years or less, one could gain a very lop-sided view of climate change over the millennia. The earth's climate has always changed and there is no hard evidence that the current warming is anything other than a natural phenomenon.

There has been no recognition in the IPCC reports of the cyclic nature of Holocene climate variability that is a result of changes in solar output. The four hundred year record of sunspot cycles has a much stronger correlation with climate than CO_2, including its most active period in the last 50 years of 20th century.

The sun is now exhibiting a solar minimum not previously observed in two hundred years. Thus in his view, modern warming is consistent with previous Holocene warmings, although a

little cooler. Indeed, if one looked at the projections from the various IPCC reports, current temperatures were below their most conservative predictions.

Dr. Marshall also showed that the climate is changing, with warming in the northern hemisphere having considerable effect on Arctic ice and various glaciers, like those in Greenland. He looked at the energy balance for the earth as a whole. The earth absorbs radiated energy from the sun and loses energy through the re-emission of infrared (IR) radiation.

The balance of energy with respect to the planet involved three things – first, the energy supplied by the sun, which he agreed with Dr Hutton, changes depending on sunspots and other solar activity. How much of the sun's energy reaches the earth's surface depends on the earth's albedo (reflection coefficient). The more cloud, snow and ice cover the greater the albedo, resulting in lower energy absorption by the earth. The infrared radiation emitted by the earth has to travel out through the atmosphere, so the IR transmissivity of the atmosphere affects how much energy the earth loses. Carbon Dioxide reduces IR transmissivity and thus the planet retains energy.

The worst gas for blocking the earth's radiation is methane, but there is so little in the atmosphere, it is not a significant factor. Water vapour is a major influence because there is so much of it. The temperature of the earth is driven by three factors and one of them has to change to cause a change in the energy balance (Figure 2)

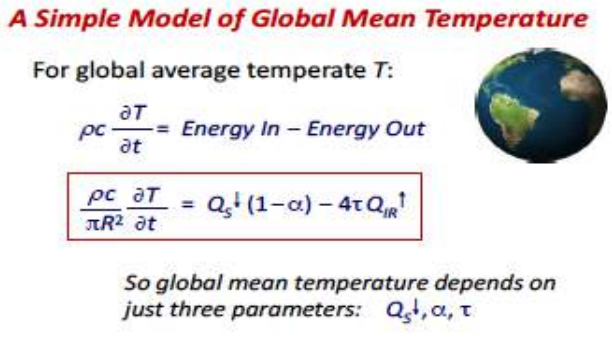


Figure 2. The energy balance that determines mean global temperature, Q_s is the energy from the sun, α is the albedo and τ is the atmospheric transmissivity (from Dr. Marshall's talk)

When one looks at the increase in global average temperature over the last century or so, the only thing that correlates with that change is the increase in CO_2 concentration, which would alter the IR transmissivity of the atmosphere. The sun's recent activity does not correlate directly, and there was nothing to indicate a change in albedo was occurring. Dr. Marshall cautioned that so many factors influence the average global temperature; one has to be careful of short-term fluctuations against longer term trends.

Both speakers expanded on their perspectives in the question and answer period, agreeing that the lack of rise in global temperature over the last fifteen years is just a fluctuation in a general trend. The speakers also agreed that the problem of climate change was complex with many factors influencing both short and long term trends.

Dr. Hutton described the work of Henrik Svensmark, a Danish astrophysicist, who designed an experiment to show that cosmic rays can facilitate the formation of cloud, an observation independently corroborated at CERN in a more sophisticated and complete study. Dr. Marshall commented that these were two of few studies and the influence of cosmic rays was poorly understood.

We may conclude that the Earth's climate appears potentially to be influenced by solar winds, the cosmic ray flux as well as greenhouse gas concentration. Modeling climate is not a simple task and there is much we have yet to learn.

As one member stated afterwards, the presenters were clearly very intelligent and knowledgeable, and made their points convincingly. However, the evidence presented neither proved nor disproved what were essentially two independent hypotheses on the cause of global warming – perhaps there is a combination of both going on!

Wednesday, 13th March 2013

Computer-aided Detection of Subtle Signs of Breast Cancer in Mammograms

Rangaraj M. Rangayyan, PhD

Professor with the Department of Electrical and Computer Engineering, and an Adjunct Professor of Surgery and Radiology, University of Calgary

Dr Rangayyan gave an excellent presentation on the development of the Computer-aided Detection of Subtle signs of Breast Cancer in Mammograms by his team at the University of Calgary. He made the presentation at two levels, one including all the mathematics of his image processing (which has not been included in this report) and the second at the layman's level.

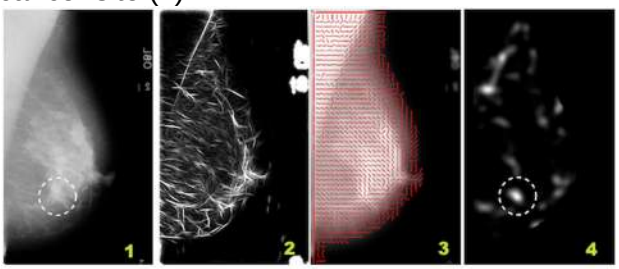
The focus of their research is on the third most common mammographic sign of nonpalpable (cannot be detected by hand) breast cancer. Most breast cancers are identified on screening mammography as either a breast mass or a focus of microcalcifications, Dr Rangayyan's work is focused on Architectural Distortion which can be missed during mammogram review.

The current process for breast cancer detection from x-ray images is for two radiologists to review the screen prints. The objective of this research is to provide a tool to support the radiologist and refine the mammogram review process to potentially one specialist and aided by the software review procedure.

The criteria for determining the occurrence of breast cancer by Architectural Distortion are:

- Normal architecture of breast is distorted
- No definite mass is visible
- Spiculations (the white fibrous lines in the breast mammogram) radiating from a point, see red square in adjacent mammogram
- Focal retraction or distortion at the edge of the parenchyma (milk ducts and glands)

The mammogram (1) is a low energy x-ray image of the breast and it is processed in a multistep procedure. Each of these stages is illustrated in the attached graphic. The computer-aided detection process commences with the extraction of the orientation of each spiculation using Gabor Filters represented by the white striations (2), analyze orientation using phase portraits, snapshots of the mammogram looking at a specific Gabor filter generated striation in relation to adjacent striations. (3), post process the phase portraits and detect potential Architectural Distortion cancer site (4).



The initial model was tested on 19 known cases of Architectural Distortion and 41 normal control mammograms. The sensitivity of the analysis was as follows, 84% success in detecting potential architectural distortion cancer sites with 4.5 false positives/image and with a higher sensitivity of 95% there is a consummate increase in false positives/image to 9.9. These early results demonstrated the feasibility of the computer-aided diagnostic. Much development is required to make it a viable tool.

Work has continued on refining the digital diagnostic processes. Each potential cancer location is noted as a detected Region of Interest (ROI), is either a false positive of true positive. The digitized mammogram is processed through the Gabor Filter and the resulting data further screened through five different parallel mathematical diagnostic trains. These are:

- Phase portrait analysis (Node values)
- Fractal Analysis (fractal Dimension)
- Analysis of Angular Spread of Power
- Statistical Analysis of Texture (Harlick)
- Structural Analysis of Texture

These mathematical tools refine the analysis by classifying data from the Gabor Filter output with metrics such as the intensity, length, distribution, angular spread etc. of the spiculations. These techniques are used because unlike the experienced eye of a radiologist which parallel processes the mammogram image as a two-dimensional "photograph", the digitized mammograms are computer processed as a series of data points and it is necessary rebuild the data into mathematical sets that can be analysed in an equivalent process to the human brain.

Dr Rangayyan's team is continuing to develop and refine the technology using historical mammograms from anonymous patients who developed breast cancer. The current model uses a combination of 86 points of analysis: spiculation features, 12; Harlick's and Laws's texture features and fractal dimension, 25; angular spread, entropy, 15; Harlick's measures with angle co-occurrence matrices, 28; statistical measures of angular dispersion and correlation, 6. The processing procedure uses selection with stepwise logistic regression and Bayesian classifier to minimize misclassification with leave-one-patient-out for validation. The current Computer-aided Detection has 80% sensitivity with 3.7 False Positives/patient. This roughly equates to four out of five Architectural Distortions being detected with up to four false ROI compared to an experienced radiologist. There is room for considerable improvement.

Future work for this image processing process is to continue development of a higher sensitivity with lower false-positive rates. The technology will be applied to direct digital mammograms and breast tomosynthesis images.

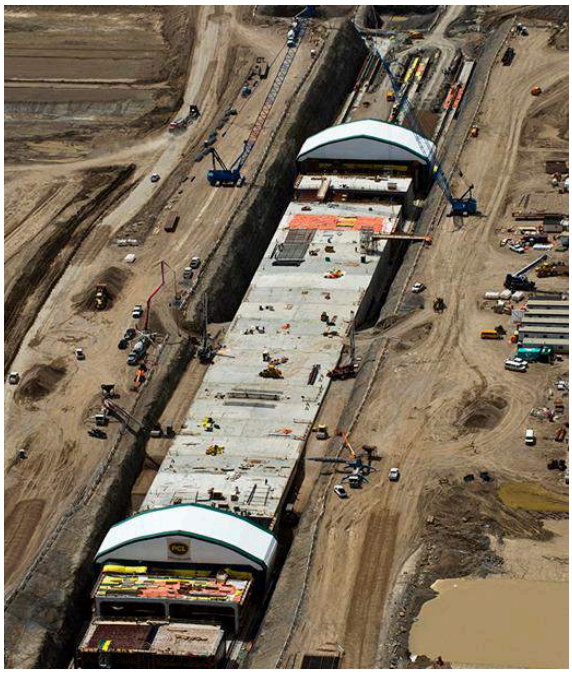
The presentation demonstrated how difficult it is to reproduce the analytical skills of the human eye and brain with a machine based system. There are many potential applications for the technology over and above Dr Rangayyan's team research objective of fully developing a proactive computer-aided breast cancer identification tool.

The presentation was well attended and generated many questions on mammogram imaging technology, focusing of mammography on specific age groups and other areas of research.

Wednesday, April 10, 2013

Calgary Airport Tunnel

Andrew Boucher, P Eng
Project Manager at CH2MHILL



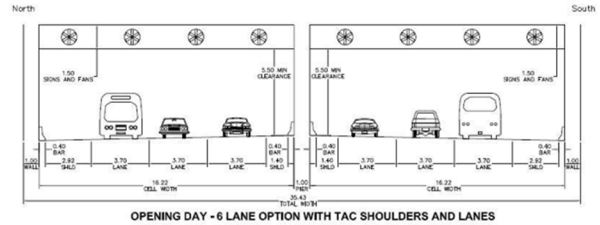
Aerial View of Tunnel Under

Andrew gave a very informative talk on the fast track project for the 620 m long cut and cover tunnel that runs under the new Calgary International Airport runway and links the Airport Trail from Barlow Trail to 36 Street NE. The tunnel is expected to be open to traffic in May 2014.

The City Council approved a budget of $294.8M for the airport tunnel project in February 2011 which consists of:

- Tunnel excavation (over 600,000m^3 earthwork).
- Underground utilities (over 2.5km of storm water drainage and water for firefighting).
- Tunnel Structure (approx. 58,000m^3 concrete and 12,000 tonnes of reinforcing steel).
- Life Safety System (communication/ surveillance, fire detection, emergency exit, ventilation, emergency power, traffic control).
- Roadworks (widening/upgrading of connecting roads).

After the lease agreement between the Calgary Airport Authority (CAA) and the City was signed in June 2011, excavation for the cut and cover tunnel started the following month. The lead consultant, CH2MHill issued design in 15 work packages. The first segment of the tunnel was poured in February 2012 and the tunnel structure was completed in the fall of 2012. The City turned over sections above the tunnel in stages; the main runway on August 2012; the taxiways on October 2012 and the east/west perimeter roads on June/ July 2013.



The tunnel is straight with two cells each 16.2m wide designed to accommodate two lanes in each direction with an option to add a primary Light Rail Transit (LRT) or a high occupancy vehicle (HOV) lane for each direction. In an 'ultimate' phase, the shoulder widths can be reduced to provide three lanes per direction plus a dedicated transit way. Initially it is estimated that the volume will only be about 5,000 vehicles/day (vpd) and over a twenty year horizon, the volume will grow to 27,000 vpd.

The typical cross section of the tunnel remained essentially the same from conceptual design. There are over 50 segments of up to 12.5m long. The end walls and the central wall are supported on 1m and 1.5m thick strip footings respectively. Four sets of steel forms on wheels were used to complete the concrete works in 8 months. Each tunnel section required 850m^3 of concrete delivered by 80 trucks in a 12-hour period. The tunnel has 13 movement joints each allowing 25mm movement, mainly from thermal variation.

The excavations were around 16.5m deep and 50m wide. The inconsistent soil / rock at the steep side slope posed difficulty during construction. Rock anchors and mesh were used to maintain slope stability and to allow safe work. Geologist (Thurber) regularly visited the work. Toe drains and a layer of gravel were provided for drainage to avoid hydrostatic load.

Piles were provided for the sections directly under the runway in order to address concern on the settlement of tunnel. Measurements have since indicated that settlement was limited to a few millimeters.

The American National Fire Protection Association (NFPA) codes and standards were adopted for the design of the tunnel, driven by the familiarity of the fire department with these codes.

Other components of the project include: control rooms at each end of the tunnel; gravity sewer; lift station serving as a surge tank and temporary storage for storm water; ventilation system using 8 groups of four 1.5m diameter reversible fans to extract smoke; fire/smoke detection systems; 600mm diameter water main; antenna cables to boost radio signals;

and UPS/redundant power supplies. The ventilation system is designed to ensure that one of the cells can be used as a fume free egress in case of fire. A live sprinkler system has not been implemented because of water freezing issues. Dry standpipes in the tunnel are charged by fire pumps located outside of the tunnel emergency.

In a fire steel rebar loses strength at high temperature. There is the added risk of explosive spalling from the vaporisation to steam, of water trapped in the concrete. As added protection the exposed concrete surface of the tunnel is coated with a fire retardant barrier.

A member of the audience asked what was the worst-case scenario expected for the tunnel, considered a high-risk environment. Andrew highlighted that brainstorming sessions were held with the stakeholders who included firefighters, security personnel, maintenance and operations departments. Vehicles carrying hazardous loads will not be allowed to use the tunnel. The tunnel is relatively short and response time from fire department is minimal.

Traffic accidents initially are not expected to cause significant issues, as volumes of traffic will be low. In future when higher volumes justify, a tow truck will be on standby.

Andrew revealed there are road sensors and weather stations to provide alert for de-icing. Conventional snowploughs will be used to keep the accesses clear.

Wednesday, May 8, 2013

Tailing Ponds

Emily Hicks, Robert Mayall and David Lloyd,
University of Calgary Graduates

Emily, Robert and David, recent graduates of the University of Calgary (U of C) consider themselves 'synthetic biological engineers'. They explained that synthetic biology is taking things apart and re-assembling the components to make something useful. One example cited was the use of yeast to produce synthetic version of Artemisinin, an anti-malarial drug to make it affordable to third world countries.

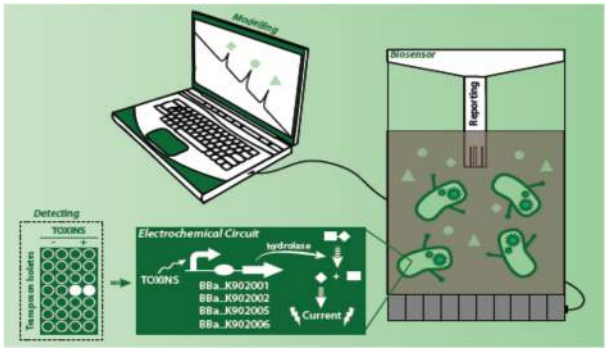
The trio was part of the U of C's team for the International Genetically Engineered Machine (iGEM) competition held at the Massachusetts Institute of Technology (MIT), Boston, USA in 2012. The team won five of eight possible awards at the American West regional competition; then went on to win the Best Human Practices award in the global finals at MIT, finishing as the only Canadian team in the top 16 teams from the 200 that took part worldwide. The teams were given a 'kit' of biological components at the beginning of summer to use with other new components of their own design to build biological systems that operate in living cells. The kit is an open source parts registry of standardized deoxyribonucleic acid (DNA) that researchers can use.

iGEM teams raise funds mainly through sponsors interested in their research; they develop their website and graphic arts for presentation and grow start up companies.

Basically iGEM 2012 Calgary aimed to develop a collection of toxin sensing and degrading organisms to bioremediate (detect and destroy) the toxins, turning them into useable hydrocarbons. Their research has been applied to the tailings ponds of northern Alberta's oil sands industry in which water are contaminated with toxic compounds from the oil extraction process. These compounds are corrosive and are major environmental and economic concern to Alberta and other areas.

Two components FRED and OSCAR were developed to achieve this 'detect' and 'destroy' project.

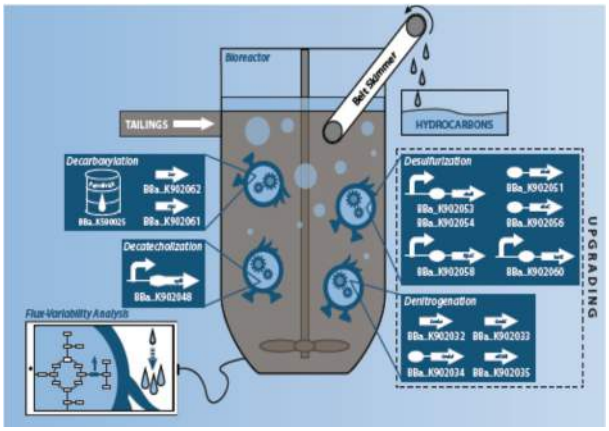
FRED (Field-Ready Electrochemical Detector) is an electrochemical biosensor capable of detecting a variety of different toxins such as naphthenic acids (NAs) within tailings ponds



FRED

samples. It is comprised of a sensing element (derived from a 'promoter' or toxin detecting screen), a reporter system (using electrochemical detection of enzymatic reaction) and software / hardware to perform / optimize the sampling. FRED can be applied to a range of other toxins.

OSCAR (Optimized System for Carboxylic Acid Remediation) is a system designed for

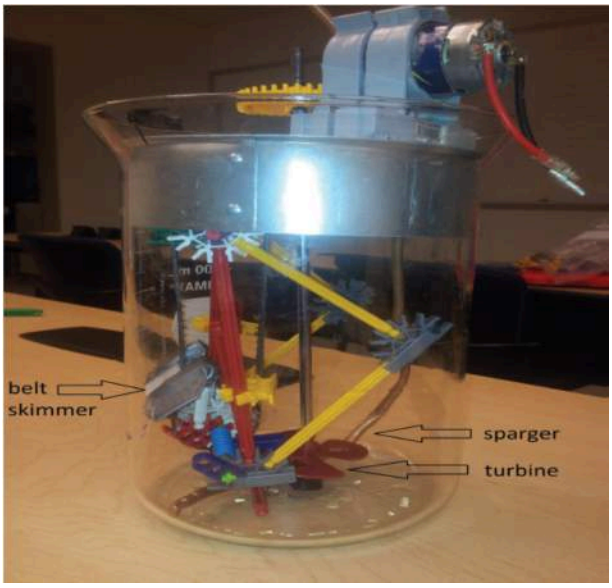


OSCAR

bioconverting toxins such as NAs into burnable hydrocarbons (fuel) through the use of a bioreactor system. Enzymatic pathways are used to cleave functional groups of carboxylic acid from the NAs; then break up the catechol (also a toxin in petroleum waste) and remove the sulfur and nitrogen from the ring structures. Flux variability analysis was developed to predict the optimal culture condition for the hydrocarbon production. A belt skimmer was added to the bioreactor to collect the hydrocarbons from a culture during the fuel production.

Another issue addressed was the problem in transporting the sample to the laboratory. A significant advantage of FRED is that it replaces the current sensing technology, which requires large expensive equipment.

The team has collaborated in a dialogue with the Oil Sands Leadership Initiative (OSLI) on addressing the industry's needs and on helping define the future direction for synthetic biology that OSLI recognized as useful in oil sands.



Bioreactor System

Aside from the team's research, the U Of C team has participated in outreach programmes such as Minds in Motions, Telus Spark Science Centre TEDxCalgary City 2.0 seminar and created their own video game LAB ESCAPE.

Following the team's success in the iGEM competition, the group is now exploring the potential for the commercialization of their work, in particular FRED. The biosensing market driven by public health and environmental protection concerns is an $8.9 billion market worldwide and is expected to grow to $18.9 billion by 2018. The speakers acknowledged their professors as well as the sponsors who supported their work. The talk sparked a lot of interest from the audience.

Wednesday, June 12, 2013

Lean Thinking

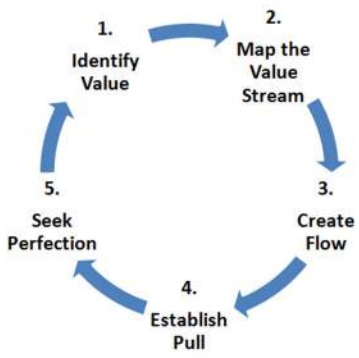
Carla Ciepliski P Eng, Consultant with Ternion Results
Jim Beswick P Eng, FMM, Consultant with Applied Performance

Carla and Jim are independent consultants with extensive industry experience. They support multi-sector industry needs by providing expertise on improved business, operational and manufacturing performance. Carla worked with Procter & Gamble's consumer packaged goods manufacturing then got involved with steel manufacturing, construction, food processing and not for profit organizations. Jim's industry experience was developed working with technology leaders such as Rolls Royce and Bombardier and then became a consultant servicing other sectors including the energy industry. Both Carla and Jim support provincial and national programmes to improve capability in areas of Continuous Improvement Methodology, Lean Thinking and Technology.

Lean Thinking is defined as creating more value for customers with fewer resources while improving quality and response time. The techniques are being used diversely and adapted to every sector and application in industry today.

The presentation explored universal Lean principles, some key techniques and ways to leverage these to tap a different level of innovation.

The Lean concept of continually reducing waste while preserving value has been practiced by the Japanese manufacturing industry (e.g. Toyota) for decades but it was not until the 1990s that the term 'lean thinking' was coined by Daniel Jones and James Womack. Although lean principle started with manufacturing, it had quickly spread to other industries including oil and gas, construction management, Alberta Health Services, the academia and even food production for non-profit organization such as Meals-on-Wheels.



5 Key Principles of Lean Thinking

Lean focuses on the 'value' that is often misunderstood. Value is what the customer is willing to pay for. In an example of a service that involves tightening nuts for a wheel, Jim explained that the customer does not care how long it takes for the workman to fetch the right tools but rather on the value of the tightening the nut.

In some cases, as much as 95% of the work is actually waste. In a Tim Hortons example, the value is the coffee or the 'double-double'. The quicker the coffee is poured in the cup, the better the value. Having a concierge to attend to customers would be an extreme 'waste'. It is important to understand what the customer is willing to pay for.

Types of Wastes

Jim enumerated examples of waste: transportation – unnecessary moving products;

excessive inventory (which deteriorates with age); unnecessary employee movement; waiting which is one of the major silent killers; over-production; and over-processing. Over production before they are required results in problems with: storage of unrequired inventory, insufficient raw material for other components, obstruction and quality issues. 'Polishing' or over-processing of products diverts resources from other necessary tasks.

Carla clarified that it is a greater waste for products to be waiting than people and equipment since it is the product the customer is paying for. It may be counter-intuitive but 'global' efficiency takes precedence to 'local' efficiency.

To illustrate the concept of waste, an example of a non-profit foundation in Edmonton was given. The complaint was that there were insufficient volunteer staff and that took twenty weeks from the time the process was initiated to its actual completion. The processing time was eventually reduced to six weeks and throughput increased threefold. The longest delay was the waiting time for background check. Improvements were made to filing system, computer systems and the handling of documents to achieve the reduction.

Similarly, Lean Thinking eliminated waste and reduced land permit processing time of a city administration office from 44 to 14 days.

The concept of waste reduction or Lean philosophy is applicable universally. With the correct concept of value and waste, Carla described the importance of creating conditions for smooth continual flow of processes in order to reduce time & defects. Each process output must correspond to the preceding process input. It is more efficient to finish one item before starting on the next. The item is 'pulled' or delivered when it is needed avoiding the worker being swamped.

Large companies have distinct departments. A typical example is a steel structure fabricator.

Client <> Sales<> Administration <> Engineering <> Production

A client defines the requirement to the sales person; the information is passed to the engineer to produce design, the design is returned to the client for review, and if accepted finally goes to manufacturing. If the output is not equal to the input, there will be re-work, waste of time and frustration.

Key points are: understand the process; remove boundaries; define the real value being delivered; discuss collaboratively and ensure more seamless information flow.

This challenges traditional organizations where the focus is often on the efficiency of each individual or the silos (departments) rather than optimizing the final output. This usually results in unnecessary costs, delays and possible fragmentation. The focus should be on the 'value' since this is what the customer is paying for. Local efficiency is important; however, global efficiency is more important. Processes must be well orchestrated. Flow and pull system was reviewed as key elements in the five steps of Lean Thinking. A system of local optimisations may not be the optimum system. Everyone can be very efficient but the overall result will not necessarily give the optimal output.

The audience took part in a demonstration of juggling between projects in order to illustrate the inefficiencies of multi-tasking, which is how most engineering is executed. Time required to tear green and white sets of papers vertically and then horizontally was measured. The errors made in the number of tears reflected quality. In the first exercise, one set of papers was torn before the second set. To simulate real world, where it is common to be working on several projects, the task was repeated but with second set of paper started after the first set was done half way. The result showed that the 'efficiency' dropped by 40% doing the same task.

A change in culture is required. Although the same principle based thinking is applicable, it has to be tailored for each organization. Carla gave examples of companies with the right attitude gaining substantial increase in 'global'

efficiency. She mentioned that when the number of concurrent active projects was reduced, wasted time in juggling between tasks was minimized leading to higher overall output.

It concluded that most improvement goes back to fundamental basics and it is important to get everyone engaged. There is a lot of potential in how people innovate and and interface with technology. Eighty percent of improvement arises from detailed changes in execution and not through costly modernisations. It is essential to maintain the big picture and to keep the workflow moving smoothly. Most ideas are common sense but some are counter-intuitive.

Value stream mapping is a technique used to eliminate waste and derive value. This helps the company become more holistic. Basically, a product / process flow is chosen; its current state is examined, the actually process (or what really happens) is observed, e.g. by following the file folder or the product; the best/worst times are recorded; quality issues are noted; wastes in the process identified; and then the processes are re-engineered. It is through objective observation where problems and wastes are exposed; and through honest debate, improvements are identified. This is similar to process mapping except that the focus is on the value and time. After this, a strategic plan is made to implement the desired improvements.

Another tool mentioned was Symbology. There are variations to the philosophy such as the Lean Six Sigma Blend and Lean Construction. The speakers recommended books on Lean Thinking by Womak and Jones for further reference.

The presentation generated a lot of interest in the audience. Questions and answers included discussions on Agile and Lean systems and the trade off between reducing multi-tasking and increase in resources. Examples in the IT industry were given as illustration.

Wednesday, September 11, 2013

Inherently Safer Design (ISD) – Safety is No Accident

Daniel Canning
Construction Director AMEC Americas

AMEC uses a range of tools to ensure their projects are safe. For client projects AMEC develop specific Human Factor Design Criteria taking into account:

- Client Standards
- Local Regulations (Alberta Building Code)
- International Standards ASTM F-1166, NORSOK S-002 and OGP Report 454, etc.

Examples of Poor Design

The following notes summarize the key tools that are implemented.

Inherently Safer Design (ISD)

- Address Health, Safety and Environmental (HSE) risks during the design phase of a facility, system or equipment. The HSE risks can be manifested at any stage of the project lifecycle. Specifically construction, operations, upgrade and retirement.
- Systematically and comprehensively identify and assess hazards and environmental challenges and their associated risk to People, Environment, Assets and Reputation for the project life cycle (PEAR).

Examine whether these hazards can be entirely avoided, or their magnitude can be mitigated by design. If this is not possible then appropriate and preferably engineered controls must be put in place to manage the residual risk.

As a minimum the following is expected:

- A project-specific Safety by Design Process Plan.
- Project goals towards safety and environmental protection.
- Findings of a structured project hazard assessment activity focused on identifying hazards that can occur during development and in-life operational phases, and must be addressed in the design phase.
- Evidence that the ISD principles have been applied to address the hazards that can occur during the project's development and in-life operational phases, specifically in construction and normal operations.
- Findings of a systematic review of the hazardous processes or activities, in order to assess the risks associated with these hazardous processes or activities. For a project involving a process facility a Hazard and Operability (HAZOP) study report is required.
- Evidence that all engineering actions raised during the Safety by Design process have been recorded, tracked and resolved.

Principles of Inherently Safe Design (ISD)

- **Eliminate** - remove hazardous materials, processes and activities.
- **Minimize** - use smaller quantities of hazardous substances, minimize the number of hazardous activities.
- **Substitute** - replace a hazardous material with one that is less hazardous, substitute a hazardous activity for one that is less hazardous.
- **Moderate –** minimize the impact of a release of hazardous material or energy, by changing the layout / configuration, adopting less hazardous operating conditions or a less hazardous form of a material, facilities, or by minimizing the number of people exposed.
- **Simplify -** design facilities in order to eliminate unnecessary complexity, thus minimizing the possibility of human errors.

Engineering for Construction Safety

- Understanding the health, safety and environmental hazards that can arise in the construction phase
- Evaluating how to achieve an Inherently Safer Design. The intent is to eliminate a construction hazard completely or reduce its magnitude sufficiently to eliminate the need for safety systems ("engineered controls") and procedures ("administrative controls"). Furthermore, this hazard elimination or reduction would be accomplished by means that were inherent in the process and thus permanent and inseparable from it.

Workshop Attendees

- Engineering for Construction Safety workshop facilitator.
- Plant layout discipline engineer
- Construction manager and/or construction/constructability discipline engineer, subject matter experts (SME's).
- Discipline engineer(s) from Health, Safety, Security and Environment (HSSE) and Technical Safety.
- Other discipline engineers appropriate to the scope of the Engineering for Construction Safety review. E.g. engineers from Process, Civil, Piping, Structural, Mechanical, Architectural, Instrumentation/Automation, Electrical and Commissioning.
- Client construction and operations representatives.
- Client HSSE and Technical Safety representative(s).
- Client engineering discipline representative(s), as appropriate.

Workshop Inputs

Input data to include:

- Design criteria
- Applicable legal and contractual requirements
- Applicable codes and standards
- Basis of design, project specifications, technical philosophies and other documents defining key technical premises and scope of work of project
- Environmental data
- 3-D model
- Construction site layout, general arrangement drawings, detailed drawings, output from 3-D model
- Transportation/traffic streams for heavy traffic and pedestrian/working staff to and on site
- Information on existing facilities/ equipment
- Construction site/logistics constraints
- CWP Methodology and build sequence (schedule)
- Building and construction methodology (e.g. in situ building, modularization, pre-fabrication, pre-assembly, piling methods).
- Available and anticipated temporary equipment/works.
- Relevant best industry practices
- Seasonal and environmental constraints.
- The date and place of the meeting and the attendees.
- The scope and objectives of the review
- A list of actions against specific individuals and target dates. Actions should clearly specify the action, identify the action party, action approvers and closeout date.
- A summary of recommendations and any exceptions, or confirmation that there is none.
- The completed Engineering for Construction Safety review worksheets.

Confirmation of HSSE risk reduction and delivery of a safer design that takes account of the construction works.

Wednesday, October 9, 2013

Pipeline Projects

Jim Hale, Explorer Energy Services Ltd

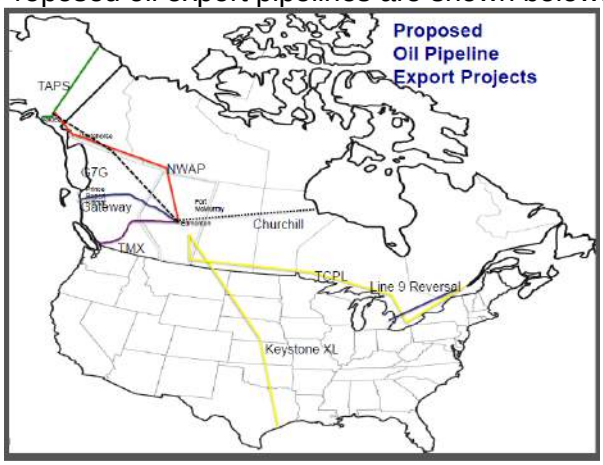
Jim has more than 25 years of experience in the energy industry. Prior to forming Explorer, Jim Hale worked for the NOVA group of companies where he held leadership positions in the areas of natural gas marketing.

The presentation provided a comprehensive overview of future "Big Inch Pipelines", 24in and larger in diameter and 100 kilometres or more long. These are used for transporting oil and gas resources from Alberta and British Columbia to various markets. Key features of these pipelines are:

- Long lead times, 6+ years
- Industry needs to work together to improve outcomes

- Canadian Government needs to facilitate and resolve First Nations' Land Claims
- Oil Sands producers need to be more active in promoting their environmental initiatives
- Not all proposed projects will be built.

Proposed oil export pipelines are shown below:



Enbridge Inc. and TransCanada Corporation have a total of 45 major pipeline projects in review or under development. Other projects are under consideration by Pembina, IPF, Keyara, NWA Pipelines, Spectra-BG, Pacific Trails and KinderMorgan-TMX.

Proposed pipeline expansions include:

- Northern Gateway, Enbridge Inc., 525 kbpd of exported oil sands bitumen, 193 kbpd imported diluents at Kitimat BC. Currently estimated as a less than 50/50 chance of being on stream by 2021.
- Keystone XL, TransCanada Corp, 850 kbpd to Texas Gulf Coast. Many believe there is a 50/50 chance of the project will be approved. If it is not approved it will have a significant impact on the Canadian economy as a whole.
- TCPL Energy East, TransCanada Corp, 1100 kbpd going to Quebec and possibly Saint John NB. Producers support the project; an existing gas pipeline will be converted for part of the route. Extending the pipeline from Montreal to Saint John will attract more opposition. US approval required to export US crude.
- Enbridge Mainline Expansion, Enbridge Inc. 1000 kbpd to US mid-west, Gulf Coast and possibly eastern seaboard. Real Canadian export capacity is only 120kbpd!
- Enbridge Line 9 Reversal, Enbridge Inc. 300 kbpd to Suncor`s Montreal refinery. Odds are that the reversal will be approved.
- NWA Pipeline, NWA Pipelines and major in-situ producers, 1000 kbpd diluted bitumen to Valdez Alaska. It appears that the Governments of Alberta, NWT, Yukon and Alaska will support the project. The port of Valdez has the capability to ship 2000 kbpd. This will require US Presidential approval.

Rail transport to Valdez Alaska is another option; proponent is G7G (Generating for 7 Generations). Volume is 1000 kbpd of oil. Promoters are currently looking for feasibility study funding. If the feasibility study is positive they will have First Nations's support. No mention of how the project will be financed! Likely investment cost $10-15 billion; existing transportation rates $20 per bbl for the 2400 km rail journey!

New bitumen pipeline capacity by Gateway, Trans Mountain TMX, Keystone XL, Energy East, Line 9 Reversal, and Enbridge+ Mainline add up to 1640 kbpd of dilbit capacity. Additional increases through to 2025 will require approximately 2400 kbpd of additional dilbit capacity. Using synthetic or light oil as diluent will require 17% more capacity.

The key risks presented were:

- Political
  - US government
  - BC government
  - Québec government
  - First Nations
- BC First Nations treaties need to be settled
- Economics
  - Product pricing low owing to low natural gas prices
  - High transportation tolls
  - Capital availability for producers and transporters

- Lack of industry cooperation
    - Unwillingness to share information
    - Lack of funding
    - Different processes
    - Too focussed on exploration
    - Competition
- Expansion of the railways $10-$15 billion in next 2-5 years, as well as pipeline and other oil and gas production facilities will cause shortages in construction manpower.
- Schedule differences between pipeline and production facilities construction.
- *Keystone XL:* all pipes already ordered and stockpiled since 2008 – what's holding it up?
- Obama – elected on a green platform, most of his supporters are environmentalists
- Large quantities of Shale Oil, 1000 kbpd, will be on stream by 2014.
- Earliest Obama decision on Keystone will be after November 2014 US midterm elections, 50/50 chance he'll approve.
- Not the case in Canada, BC and AB trying to resolve how to share out the dollars.
- Availability of construction manpower.

The next five to ten years will be a very interesting period to see how this benefits Canada, especially British Columbia and Alberta. Pipelines have very long lead times. The Canadian Government needs to solve First Nations land claims. Oil sands producers need to be more active in promoting environmental improvements and the benefits to Canada. Not all of the projects will be built.

Wednesday, November 13, 2013

Carbon Management

Mr. Gary Mackay
BP Canada

Carbon Dioxide ($C0_2$) is one of the greenhouse gases (GHGs) that are alleged to be responsible for an increase in the average global temperature resulting in climate change, ocean acidification and rising sea levels. Other GHGs include methane (CH_4), nitrous oxide (N_2O), Perfluorocarbons (PFCs), Hydroflourocarbons (HFCs) and Sulphur Hexafluoride (SF_6). Fossil fuels (coal, oil and gas) add GHG to the environment. There is global effort to reduce GHG emissions.

Gary presented an overview of the policy and regulatory framework that currently drive CO_2 emission reductions and discussed available mitigation and technology options.

Five main reasons were cited on why Carbon Management (CM) is important:

(1) Public perception of energy projects has created widespread non-governmental organization (NGO) and shareholder concerns. This could increase reputational risk resulting in license to operate issues.
(2) The timing and the type of policy determine the options and the cost of compliance, e.g. availability of market, technology mandates.
(3) Companies are beginning to engage in carbon management activities as a way to hedge long-term cost, e.g. carbon capture & storage (CCS) funding, low-carbon technology (alternative energy) investments.
(4) Evolution of global carbon regulation may influence Canadian policy, e.g. power sector mandates, European Union (EU) standards, lifecycle risk.
(5) Carbon financial exposure is material given great uncertainty with CO_2 policy and price futures. For oil sands companies, this could be in billions of dollars.

The top emitters of $C0_2$ in 2011 were China, USA, India, Russia and Japan. Canada at 9th place emitted over 700MT of the gas. The chief contributor, at 35%, is Alberta due to its heavy reliance on coal-fired plants for electricity generation, and its role as a significant supplier of energy to the United States.

Market-based emission trading has been introduced to address environmental problems. A limit or 'cap' is allocated or sold to firms in

the form of emission permits. The 'cap and trade' market allows buyers to pay a charge for pollution and the seller to be rewarded for reducing emission.

Although China produces a quarter of the world's $C0_2$, it has been doing a lot to rein its emission. It is now the biggest builder of wind farm and solar energy in the world. Pilot programs for cap and trade are underway in seven major cities. If successful it will be implemented nationwide by 2016.

Numerous countries have started or are shortly starting cap and trade programs, e.g. Australia, New Zealand, Europe, India, Japan and Korea. United States Environmental Protection Agency (USEPA) has legislated under the Clean Air Act that new coal power stations have to limit its emission to about 500 kg / MWh. With such low limit, no new coal plant could be built without CCS.

Gary described a few of the CM activities in Canada including:

- Some CCS projects, e.g. Quest CCS for permanent underground storage of CO_2 from the Scottford Upgrader in Fort Saskatchewan
- Canadian Oil Sands Innovation Alliance (COSIA) – promotes innovation in environmental performance in the oil sands
- Climate Change and Emissions Management Corporation (CCEMC) – establish / funds initiatives that reduce GHG emissions or improve our ability to adapt to climate change

An overview of Canada's Environmental Policy was given:

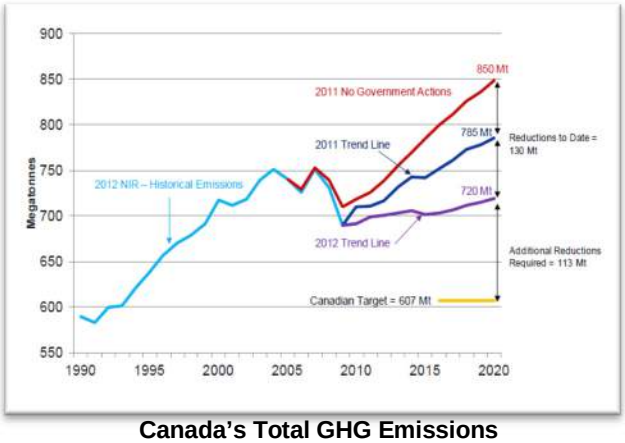
- Federal regulations on emission reductions from coal-fired generation have been finalized
- Alberta passed climate change legislation in 2007 requiring companies that emit over 100,000T of $C0_2$ to reduce their emissions by 2% annually to 12%. Failure to achieve this, a levy of $15/tonne/annum is imposed. This is to encourage development of more efficient oil sand processing techniques.
- Preliminary Alberta "40/40 plan" – means increasing the target reduction to 40% relative to the baseline and increase the technology fund levy to $40/tonne/annum. This translates to significant cost for oil companies some of which produce 10Mt annually.

There are various environmental policy activities in the international arena, including:

- CA/OR/ WA/BC sign agreement to align states/Province climate and clean energy policies
- Quebec and California have recently linked (harmonized and integrated) their cap and trade programs providing synergy in implementing advanced and comprehensive reduction programs. California is a leader in North America.
- USEPA is legislating life cycle fuel standards (well to wheels). This not only aims to lower overall GHG emission of fuel (from production, transportation and use) but also stimulate clean transportation technology.
- UN Climate Conference 11-23 November 2013 – Warsaw, Poland (COP) 19 is laying foundation for legally-binding agreement in 2015 that will govern how energy is used in all countries by 2020.
- Intergovernmental Panel on Climate change (IPCC) issued Climate Change 2013 report reiterated its conclusion that the warming of climate system is evident and it is "extremely likely" that human influence is the cause.

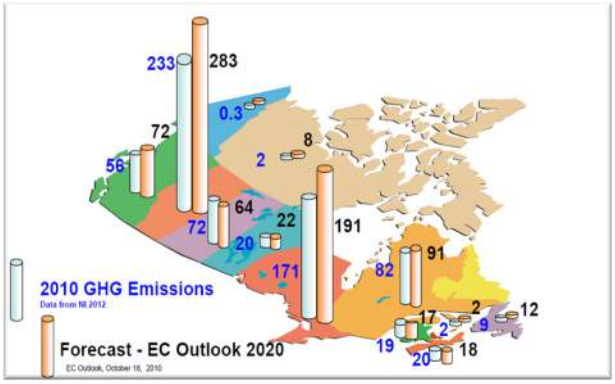
US and Europe are on track to meet target. Canada was committed in the Copenhagen Accord to reduce its total GHG emission by 17% below the 2005 level by 2020. From current projections, this will be extremely difficult with a deficiency of about 113Mt since programs have long lead / decision time.

It is projected that there will be about 28% reduction in per capita / per GDP emission; meaning more energy is being produced for export, i.e. emission by others.



Canada's Total GHG Emissions

GHG emission per capita is relatively constant. Being a cold country, Canadians consume a lot of energy for heating.

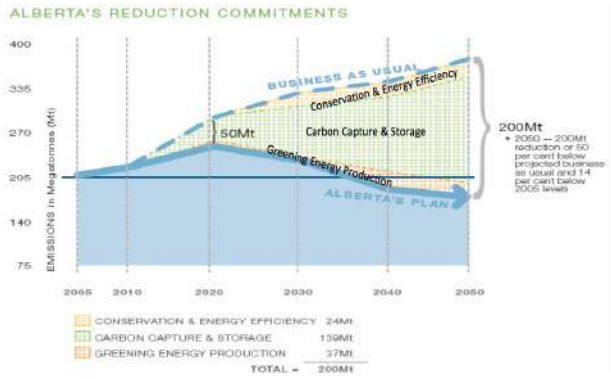


Provincial Emissions

Alberta is the leading emitter in Canada. By sector, transportation accounts for 24% of the emission followed closely by Oil and Gas at 23%. Electricity and heating of buildings are at 13% and 12%.

Oil sands $C0_2$ emissions will increase from 48MT in 2010 to 104MT in 2020, with emissions from mining production expected to double; and that from in situ production three-fold increase.

Alberta's 2008 Climate Change Strategy is committed to reducing emissions by 50MT by 2020 from business as usual and 200MT by 2050 (or 14% below 2005 levels). The 2020 target is difficult to achieve given significant emissions increases through oil sands development.



Alberta's Climate Change Strategy

CCS although very expensive is expected to play a significant role for Alberta in reducing emissions. CCS is considered to be a transition technology while alternative green energy production is increased.

Carbon offset projects include:

- Renewable energy such as wind farms, biomass energy and hydroelectric dams
- Energy efficiency projects, e.g. Cogeneration of electricity and useful heat
- Destruction of industrial/agricultural pollutants
- Destruction of landfill methane
- Reforestation.

Companies use 'marginal abatement cost' (MAC) curves to help decide on long term capital investment strategies to select options to reduce GHG emission. A flexible economic market is advocated to allow the bests options to be used for specific situations.

In summary, Canadian national and provincial carbon policy and price are rapidly evolving with businesses facing significant reputational and financial risk. Despite future uncertainty around carbon policy and price, businesses are increasingly recognizing that there is significant value in proactively addressing CO_2 emissions. Technology development is critical to reduce emission.

Questions were taken during the talk. At the end of the presentation, Gary stated that major power companies are actively developing CCS technologies.

The CPGCE Executive as of January 2013

Left to right: Tom Martin, Colin Pollard, Mohamed Jaffer, Bob Sparrow, Adrian Dumbrava, Arun Kumar, Robert Enever, Rick Marshall, Teddy Arevalo and Nigel Shrive.

The following members were proposed and duly elected to the executive committee at the Annual General Meeting held on January 26, 2013.

Executive Officers

Nigel Shrive	Ci	Chairman
Mohamed Jaffer	E	Vice Chairman
Colin Pollard	Ci/S	Secretary
Bob Enever	E	Treasurer

Executive Members

Arun Kumar	Mar	Web/Technical
Tom Martin	Ci	Deputy Treasurer
Adrian Dumbrava	Ch	Scholarship
Bob Sparrow	Ch	Scholarship
Philip Doherty	M	Technical
Mia Jovic	E	Technical
Rick Marshall	M	Technical
Peter Gibby	M	Technical
Teddy Arevalo	S	Newsletter
Maina Waiguru	Ci	Memberships