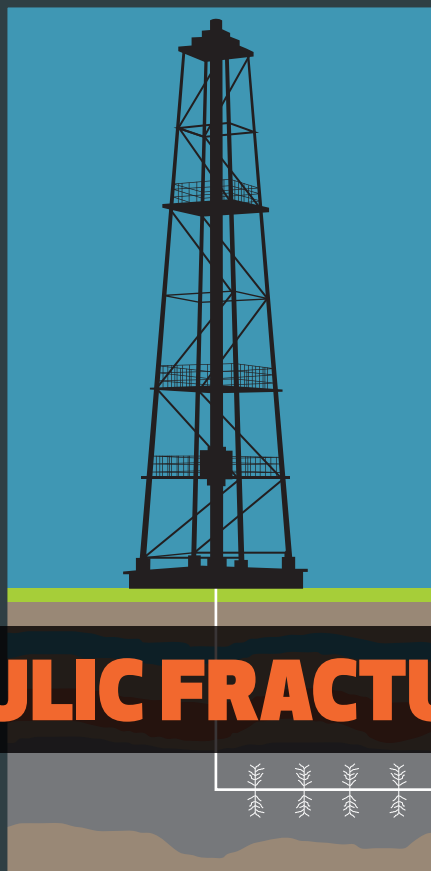


CONTEXT

Energy Examined.

FEATURE:

What's Being Done
About Induced
Seismicity?



THE HYDRAULIC FRACTURING ISSUE

O&G 101:

Water and
Hydraulic
Fracturing

**MESSAGE
FROM TIM:**

The Natural Gas
Opportunity

WHAT'S UP AT
CAPP, Q1

Q&A WITH THE NEB'S
PETER WATSON

ENERGY CITIZEN PROFILE:
MELANIE POPP



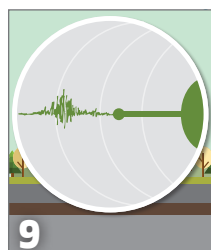
CANADA'S OIL & NATURAL GAS PRODUCERS

Publication Number: 2016-9202

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CONTEXT IS PRINTED ON 100 PER CENT POST-CONSUMER FIBRE, MANUFACTURED USING BIOGAS ENERGY



BY USING 484 KG OF RECYCLED MATERIAL WE SAVED:



9 TREES



33,149 LITRES OF WATER
95 DAYS OF WATER CONSUMPTION



406 KG OF WASTE
8 WASTE CONTAINERS



1,333 KG CO₂
8,969 KM DRIVEN



8 MMBTU
36,840 60W LIGHT BULBS FOR ONE HOUR



1.8 KG NO_x
EMISSIONS OF ONE TRUCK DURING 5 DAYS

CONTEXT

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MARKET ACCESS AND CANADA'S NATURAL GAS INDUSTRY



» In this issue of *Context* magazine, we discuss the critical importance of hydraulic fracturing, and the valuable work industry is doing in this area to ensure that we continue to operate at the highest safety and environmental standards. We also take a look at the current state of the natural gas industry, its benefits to our country, and its challenges going forward.

Canada has an abundance of economically accessible natural gas resources. We are currently the fifth largest producer of natural gas in the world, and we have a 300-year supply based on current technology and consumption levels. This represents an enormous export opportunity: one that can fuel jobs, economic growth and public revenues for Canadians for decades to come.

We already are a net exporter of natural gas—but we export to only one customer: the United States. This lack of market diversity presents a significant problem for Canadian producers, as our best customer has now become our biggest competitor.

Over the past ten years, advances in horizontal drilling and multi-stage hydraulic fracturing have enabled the United States to increase its natural gas production by 48 per cent (source: EIA). The U.S. is now the world's number one producer of natural gas. The result has been low prices in North America due to regional oversupply, and declining exports of Canadian natural gas, particularly into the eastern regions of the United States. In these areas, shorter transportation distances give American producers a decided cost advantage.

In addition, the United States is increasing its own exports—including into Ontario and Quebec, displacing natural gas from Western Canada.

When it comes to the development of LNG exports, we as a country have fallen behind the United States. The U.S. Federal Energy Regulatory Commission has approved five LNG export plant proposals, with the first cargoes already being shipped from the Sabine

Pass LNG project located on the U.S. Gulf Coast. With more than ten additional projects at various stages of review, the U.S. is poised to become a major exporter of LNG. While it is certainly positive to see LNG export capacity developed in the U.S., as any natural gas leaving the continent helps Canadian producers move their own resources, the world market has become more competitive.

Canadians recognize the opportunity represented by overseas LNG exports. Nineteen projects are being proposed along the B.C. West

We have an important opportunity—provided projects are approved and the necessary infrastructure built in a timely manner.

Coast, and Canada has decided advantages, including a shorter sailing distance to markets in Asia and a generally cooler climate (meaning less energy is required to liquefy natural gas). We have an important opportunity—provided projects are approved and the necessary infrastructure built in a timely manner.

A West Coast LNG industry would be backed by our robust upstream natural gas industry. This industry has the technical know-how and a proven track record for producing large volumes of natural gas using hydraulic fracturing in a manner that is safe, cost-effective and environmentally responsible. Combined with our reputation as a reliable trading partner that observes rule of law, and that possesses world-leading environmental regulations, we are well positioned to become a trusted and preferred supplier of LNG to customers in Asia.

Continued on next page »

The long-term benefits would be significant. Even a modest West Coast LNG industry, exporting about 30 million tonnes per year, would grow Canada's economy by an average of \$7.4 billion per year over the next 30 years, according to a Conference Board of Canada study. Increased economic activity from natural gas development and exports would increase national employment by an annual average of 65,000 jobs. Increased international trade would generate substantial new government revenues through royalties, taxes and land tenure payments.

The global impacts would be beneficial as well. Natural gas is the cleanest burning hydrocarbon. Exports into China, for example, would help displace the use of coal to generate electricity—resulting in lower levels of smog and decreased GHG emissions.

Market access for Canadian natural gas production is a CAPP priority for 2016. We are working along multiple fronts to achieve this priority: including advocacy initiatives to enhance support among the public, government and stakeholder groups, and outreach efforts to build stronger relationships with local communities and First Nations groups. CAPP also supports producers through our ongoing efforts to ensure clear and balanced fiscal and regulatory

LNG and Canada's Economy

A Canadian LNG industry exporting **30 MILLION TONNES PER YEAR** would grow Canada's economy by an average of **\$7.4 BILLION PER YEAR** for the next 30 years.

(Source: Conference Board of Canada)



environments for natural gas production in Alberta, British Columbia and Saskatchewan—with policies that maintain Canadian competitiveness versus producers in other countries.

Natural gas and LNG exports are a generational opportunity. CAPP is committed to ensuring that this opportunity is realized, to the benefit of our members and all Canadians. **C**

Tim McMillan
President and CEO
Canadian Association of Petroleum Producers

WELCOME NEW MEMBERS

Q1 2016

ASSOCIATES

Civeo Canada Inc.
Elbow River Marketing Ltd.
FWS Energy Ltd.
Greatario Covers Inc.
Hess Corporation
MNP LLP

PME Inc.
Trinity Industries Canada ULC
Vepica Ltd.
Western Canadian Spill Services Ltd.
WSP Canada Inc.



Visit www.capp.ca/about-us/membership to view our full list of members.

SAFETY 101: What's wrong with this picture?

Phillipe is a worker at a natural gas well site being completed using multi-stage hydraulic fracturing. He's chatting on his cell phone during his break. Is there anything wrong with what he's doing?

Visit
<http://bit.ly/1QR9s3H>
to view the answer.

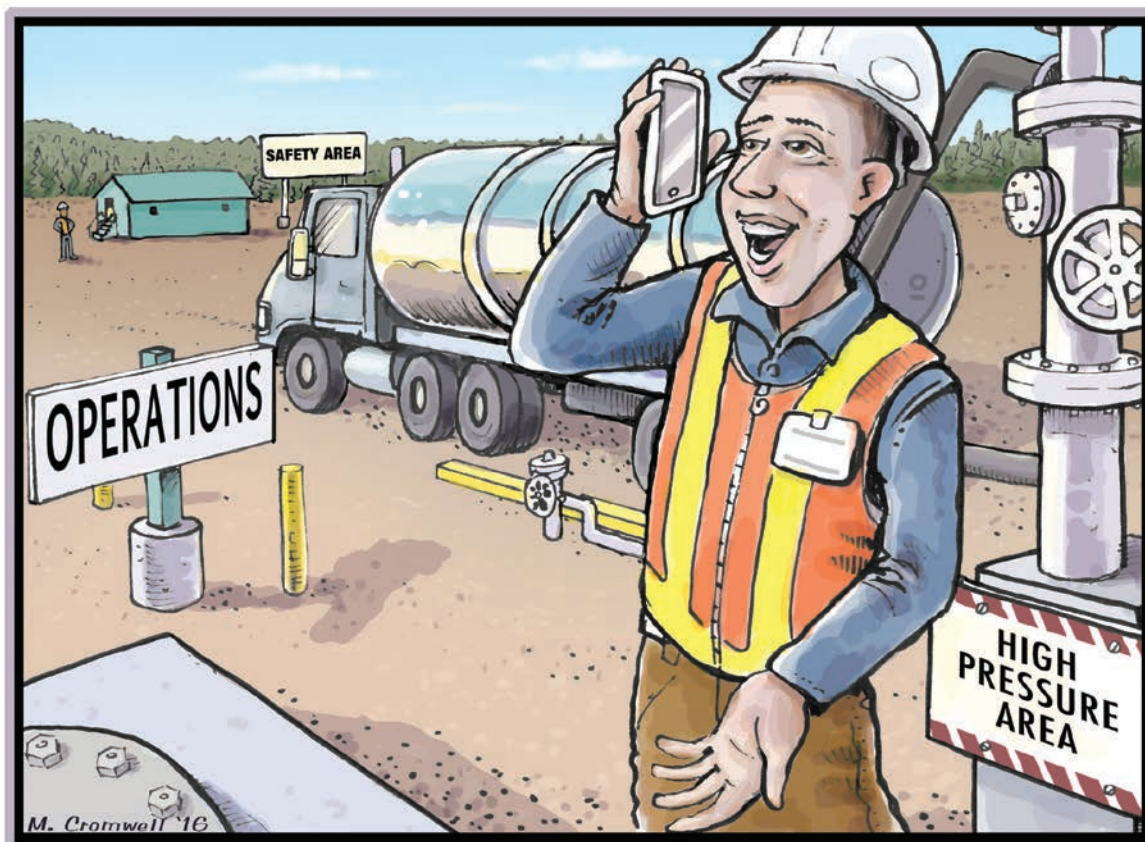


Illustration: Mark Cromwell

Our **biggest customer** is now our **greatest competitor**

THE STORY:

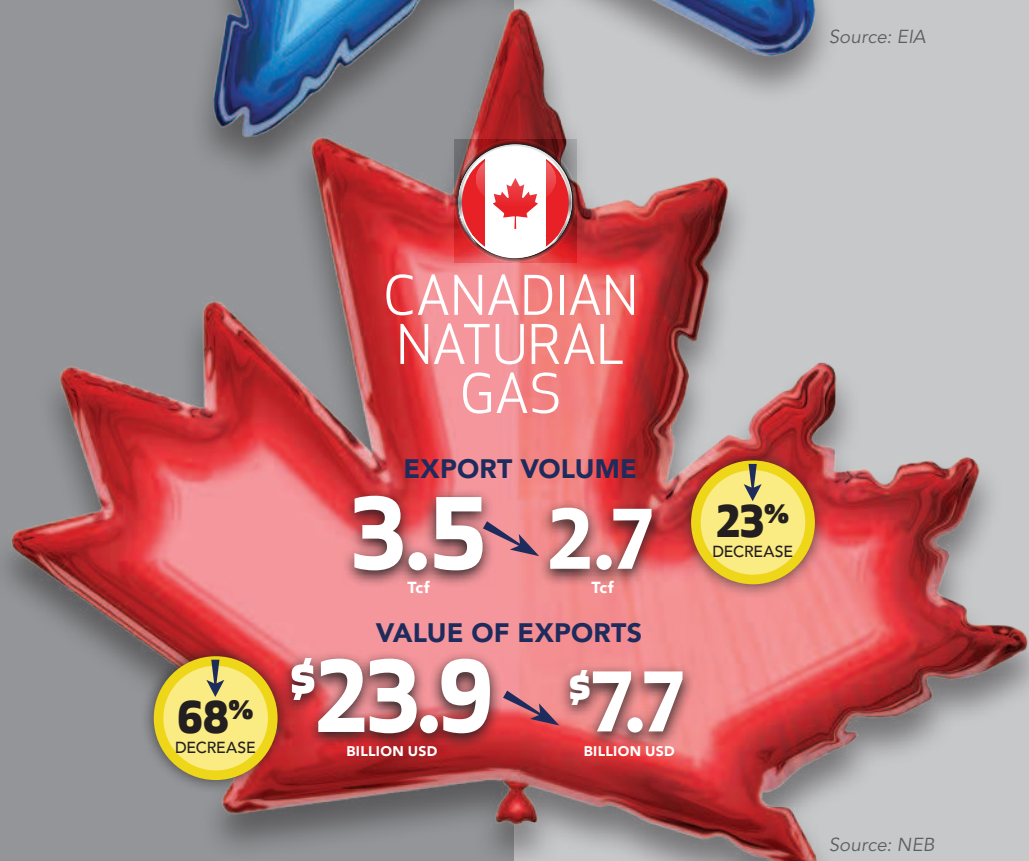
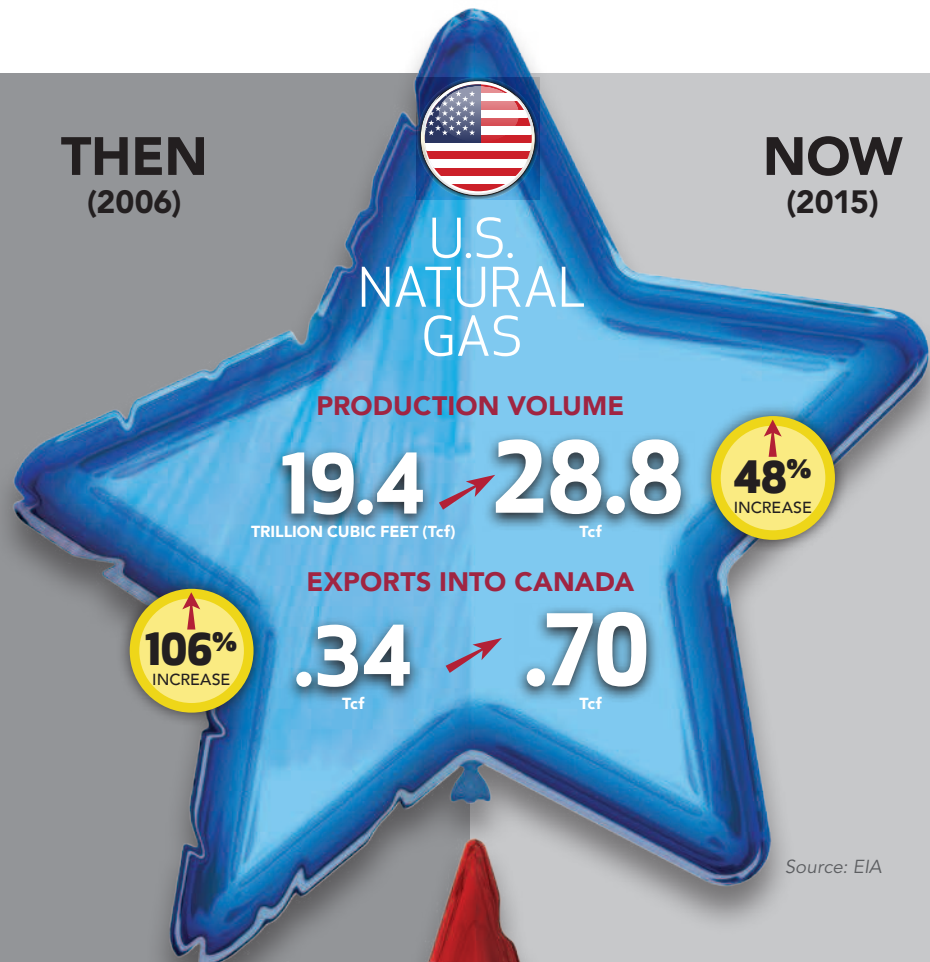
Canada exports natural gas to one customer: the United States. Over time, our best customer has become our biggest competitor. U.S. natural gas production has risen dramatically due to innovations in horizontal drilling and hydraulic fracturing, allowing the economic extraction of natural gas from low permeability formations like shale.

The result: Canadian exports into the U.S. are falling steadily. As well, the value of those exports has fallen due to low natural gas prices in North America, brought on by a persisting regional oversupply. Meanwhile, the U.S. is increasing exports into Quebec and Ontario, and is also starting to export LNG to markets overseas.

To maintain a robust natural gas industry, Canada must diversify its own markets—primarily via LNG exports to new customers overseas.

THEN
(2006)

NOW
(2015)



WHAT'S UP at CAPP

» NEW GOVERNMENT RELATIONS, ABORIGINAL ENGAGEMENT INITIATIVE, AND HELPING ON ROYALTY CALIBRATIONS, PLUS WE GO IN DEPTH ON MUNICIPAL COMPETITIVENESS.

New Governments: Opportunity and Relationship Building

It's been a busy past year in terms of elections across Canada, with new governments elected in Alberta, Newfoundland, Manitoba and federally.

"For an advocacy group like CAPP, change in government requires a lot of up-front work as we reach out to new ministers and deputy ministers to build relationships, respect and mutual trust. It takes time," says David Gowland, manager of Alberta operations at CAPP. "A key is to go in without an agenda; offering to provide insight and information," adds Gowland. "New ministers and their staff are often grateful for good factual information as they acclimatize to their new portfolios."

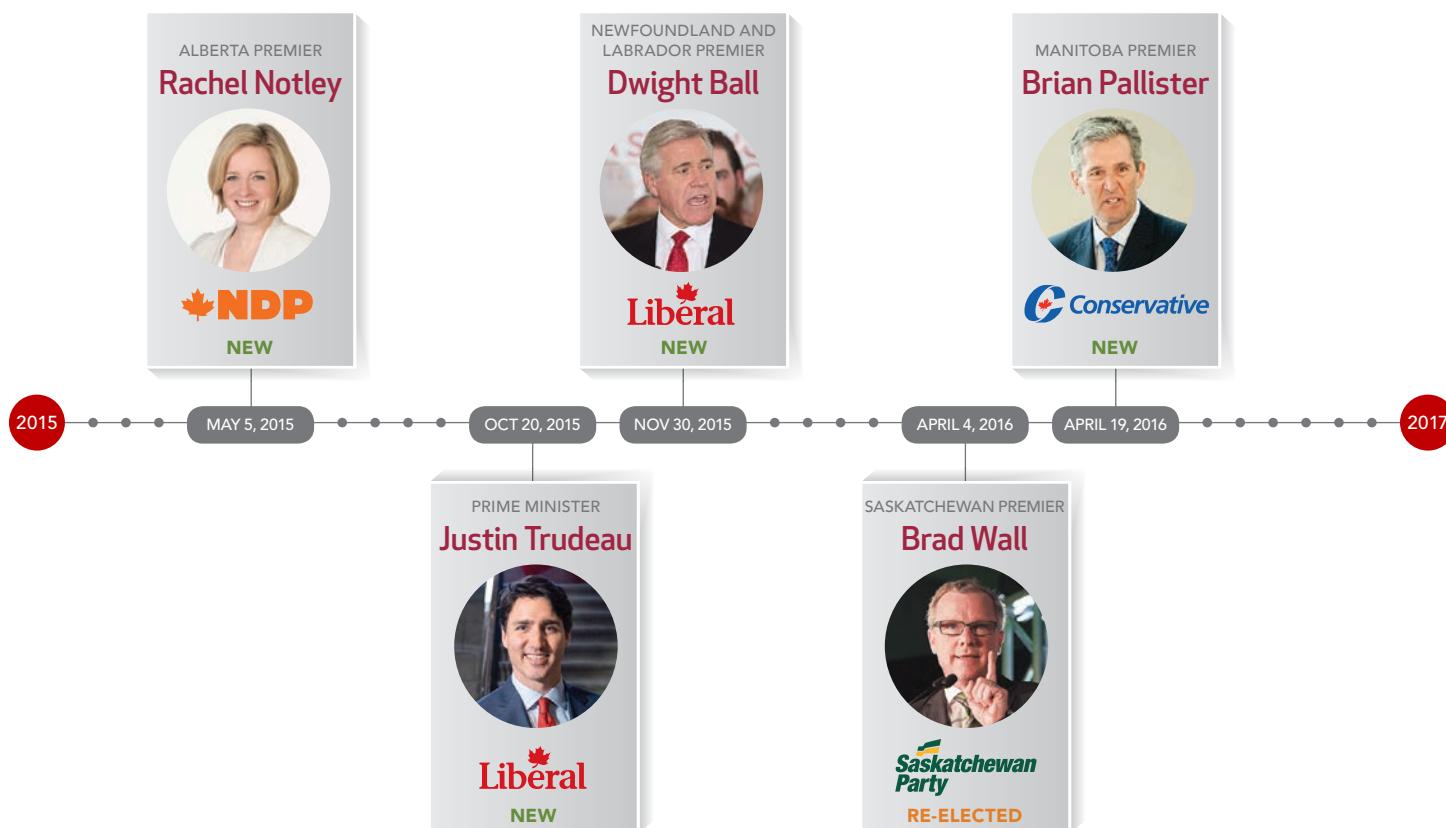
It may be necessary to begin providing feedback early on key policy proposals that could impact the industry. Examples include the federal government's proposed West Coast tanker ban, as well as

the recently concluded climate change review in Alberta. On the other hand, change also brings with it an opportunity to address ongoing challenges with a fresh perspective.

"We recently met with the new Newfoundland and Labrador government and had a good discussion about regulatory changes we've faced in recent years," says Paul Barnes, manager of Atlantic Canada and the Arctic at CAPP. "We identified how these changes have cumulatively added significant cost and/or uncertainty to offshore operators, resulting in a decline in industry's ability to compete globally."

"I think the government left the meeting with a better understanding of some of the competitiveness issues we face as an industry, and the knowledge that CAPP is ready to work constructively with the government to help create a long-term sustainable oil and gas industry for the province," says Barnes.

Photographs: (left to right) THE CANADIAN PRESS/Jeff McIntosh; THE CANADIAN PRESS/Justin Tang; THE CANADIAN PRESS/Michael Bell; THE CANADIAN PRESS/Mike Sudoma.



A Year of Changes, Continuity, in Government.



▲ Brian McGuigan, manager of Aboriginal policy at CAPP.

CAPP Launches Aboriginal Engagement Initiative

CAPP and senior industry representatives have begun a series of meetings with indigenous leaders in Alberta and B.C., held in the spirit of relationship building and constructive dialogue.

"The Aboriginal Engagement Initiative is an important priority for CAPP and our members," says Brian McGuigan, manager of Aboriginal policy at CAPP. "If we're to make progress on the many energy and resource issues that industry and indigenous groups both have a stake in, it's important we begin with real dialogue, and take the time needed to create meaningful relationships founded on mutual trust and understanding."

About 35 meetings have been held to date, with more to come.

"The initial round of meetings in Alberta has been very successful with some First Nations leaders reaching back to CAPP to continue dialogue on topics of mutual interest. We're now turning our focus to British Columbia," says McGuigan.

✉ For more information, contact Brian.McGuigan@capp.ca.



Credit: Matthew O'Connor

▲ Jackie Forrest of ARC Financial gave a keynote presentation at the CAPP Scotiabank Investment Symposium. She noted oil markets should "greatly improve" by the end of 2016.

Investment Symposium: Another Successful Year

The CAPP Scotiabank Investment Symposium concluded after two days of meetings in Toronto, April 12 to 13. The event connected representatives from more than 80 Canadian oil and gas companies with over 200 investors.

"It was another successful year for CAPP's annual investment event," says Brenda Jones, manager of communications at CAPP. "With over 600 one-on-one meetings, we enabled members looking to access much needed capital funds to connect directly with the investment community."

Jones adds, "Through media interviews and plenary presentations, the event also allowed us to raise industry issues of competitiveness and market access to audiences in central and eastern Canada. It's important for us to emphasize to Canadians who may be less familiar with the upstream oil and gas industry that these are issues that all Canadians have a stake in."



Save the Date

The 2017 CAPP Scotiabank Investment Symposium will be held April 11 to 12 in Toronto.

! Sponsorship opportunities are available: contact Colleen Houston, colleen.houston@capp.ca.

Royalty Review Calibration Update

The Alberta government released the results of its royalty calibration work on April 21. The announcement dealt with a number of technical issues related to the government's modernized royalty framework (MRF), including the finalized C* formula, the post-payout royalty rate curves for oil, gas and liquids, and the mature phase of the program.

"CAPP provided key financial and technical input," notes Jonathan Stringham, royalty and fiscal policy advisor at CAPP. "The government's goal was to keep the internal rate of return (IRR) neutral relative to the old regime, the Alberta

Royalty Framework (ARF), while at the same time generating comparable government royalty revenues for comparable levels of activity. This presented a complex challenge for both industry and government; however, through a collaborative calibration process, appropriate royalty rate price curves were developed that would provide comparable levels of investment in the province while providing comparable levels of Crown revenue."

"We were able to help the government find a solution that kept industry whole," says Stringham. "We're grateful that the government was open to feedback on these issues."

✉ For more information, contact Jonathan.Stringham@capp.ca.

MUNICIPAL COMPETITIVENESS IN ALBERTA:

Q&A WITH BEN BRUNNEN, MANAGER OF FISCAL AND ECONOMIC POLICY, ABOUT AN ISSUE THAT COSTS PRODUCERS \$1.1 BILLION A YEAR.



Ben Brunnen, manager of fiscal and economic policy at CAPP

Q: Why is CAPP concerned with the issue of municipal competitiveness in Alberta?

A: Municipal taxes are a significant cost burden to producers. We estimate municipal taxes represent \$1.1 billion in annual costs to CAPP members—making it the second highest cost factor, after royalties, that producers pay.

More concerning is that here in Alberta, property taxes in rural and specialized municipalities, which is where our members usually operate, have increased by \$60 million a year from 2010 to 2014—that's a seven per cent annual increase. Even before the economic downturn, we were concerned about how inflationary property taxes have become a major driver of rising operating costs for our members—as well as a disincentive for future oil and gas investment and exploration.

The new economic reality of severely depressed oil and natural gas prices, along with cumulative costs associated with last year's corporate tax increase and changes to the Alberta carbon levy, make the need to address this issue even more pressing.

Q: What's driving the escalation of municipal taxes on industry?

A: In Alberta, we're seeing rising local taxes that vary wildly from county to county. In some communities, industrial property taxes have doubled in the past decade.

Central to this issue are changes to how much properties are taxed—in particular, increases to non-residential-to-residential property tax ratios. A sustainable ratio is usually somewhere between 1.0 and 2.0. Throughout the province, however, non-residential tax rates have risen so rapidly that they are now, on average, nearly four times higher than residential rates in rural and specialized communities. That's an

increase of more than 100 per cent over the past decade.

Q: How does Alberta compare to other producing jurisdictions?

A: Oil and natural gas industry assets are valued five times higher in Alberta compared to British Columbia and Saskatchewan. As a result, at equivalent tax rates, property taxes are significantly higher in Alberta. We know that investment capital is mobile and these kinds of imbalances over time discourage investment.

"Property taxes have become a major driver of rising operating costs for our members."

Q: What is CAPP doing about this issue?

A: The Alberta government is in the process of modernizing its Municipal Government Act (MGA). This provides CAPP a unique opportunity. We have been and will continue to participate in consultations that are part of the MGA review process, highlighting issues of increasing property taxes, inconsistencies in assessment preparation and appeals, cumulative cost burden and cost imbalances relative to neighbouring jurisdictions.

We are also raising the profile of issues related to municipal competitiveness as part of our broader outreach program to

municipalities, business communities and local media.

Q: Are there specific changes you are looking for in the MGA review?

A: In the short term, we are proposing that the non-residential-to-residential property tax rate ratios be frozen. We are also proposing that Alberta assessments take into account declining construction and service costs when assessing the value of industrial properties.

Over the longer term, we are encouraging the provincial government to consider the creation of a centralized authority to govern how industry assets are valued and assessed. This is the approach used in most other Canadian provinces, and it helps ensure a fair outcome and consistent process.

We also will encourage the province and municipalities to re-introduce a link between non-residential and residential property tax rates so that the ratio stays between one and two.

Q: What should members look for on this issue? Can members help?

A: MGA draft legislation will be introduced this spring. There will be a period of public consultation on proposed amendments. All changes to the MGA are planned to be in place prior to the municipal elections to be held in October 2017.

Members can help by supporting favourable amendments during public feedback sessions, and reinforcing messages of competitiveness among stakeholders in communities where industry operates.



From 2010 to 2014, property taxes on industry rose by **\$60 MILLION A YEAR**—a 7 per cent annual increase.



WHAT'S BEING DONE ABOUT

INDUCED SEISMICITY?

RECENT SEISMIC EVENTS FELT BY SOME RESIDENTS OF FOX CREEK, ALBERTA, HAVE BROUGHT FRESH SCRUTINY TO THE RELATIONSHIP BETWEEN HYDRAULIC FRACTURING AND SEISMICITY. *CONTEXT* EXAMINES WHAT INDUSTRY AND REGULATORS ARE DOING IN RESPONSE.

By Andrew Mah

At 11:27 a.m. on Tuesday, January 12, 2016, a low rumble was felt by some residents of Fox Creek, Alberta. The town, a centre for natural gas production in the Duvernay formation, is located about 260 kilometres northwest of Edmonton. Roy Dell, the chief administrative officer for the town, was in a meeting at the time.

"Personally, I didn't feel the event," he says, "But others did. The mayor described it as the kind of shake you get when a truck drives by."

Seismic monitoring connected this seismic event, which had a local magnitude of 4.5 ML according to Natural Resources Canada, to a hydraulic fracturing operation just west of Fox Creek.

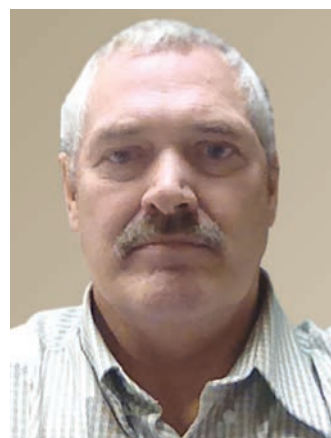
There were no injuries or property damage caused by the event, and in compliance with Alberta Energy Regulator (AER) regulations, the hydraulic fracturing operation was immediately shut down.

Dell notes that the event, the third in the area to measure greater than 4.0 ML over the past two years, has raised some concerns regarding induced seismicity among the 2,000 residents of the northern Alberta community. It has also generated media attention, bringing fresh scrutiny to the practice of hydraulic fracturing.

been positive, and that knowledge of the issues has grown with time.

"We're able to let residents know there's a great deal of research and collaboration going on right now among regulators, industry and experts in seismology into the phenomenon of induced seismicity. At the same time, we can reassure them that hydraulic fracturing is a technology that's been safely used in the Western Canadian Sedimentary Basin for almost 60 years without any reported instances of injury or property damage," Montgomery says.

Dell agrees that responsive engagement by industry is helpful: "It's very important. We are an oil and natural gas town, and people understand the risks associated with development—it's the livelihood of



Photograph: Courtesy Roy Dell

"Personally, I didn't feel the event. The mayor described it as the kind of shake you get when a truck drives by."

« Roy Dell, chief administrative officer, Town of Fox Creek

REACHING OUT TO THE COMMUNITY

"While rare, any time there's a seismic event felt at the surface that's related to hydraulic fracturing, that's something industry takes very seriously," says Chris Montgomery, CAPP's manager of exploration and production communications and engagement.

A necessary step, and a key part of Montgomery's job, is to reach out to local community members: to share knowledge and listen to concerns. He's visited the town of Fox Creek several times over the past few years, including soon after the January event. He's met with town council, residents and the town's business support network.

During these meetings, he presents the latest scientific and fact-based information on issues related to hydraulic fracturing, including induced seismicity. Montgomery notes that the responses have generally

the town. However, if there are incidents, I believe the townspeople should be notified quickly."

SEISMICITY AND HYDRAULIC FRACTURING

It is now generally accepted that hydraulic fracturing in certain areas can trigger induced seismicity. Hydraulic fracturing is, after all, the literal fracturing of layers of rock two kilometres or deeper below the earth's surface. (For a visual perspective, the height of Calgary's tallest building, The Bow, is 236 metres—that's one tenth the depth at which hydraulic fracturing occurs). The energy released through this process generates small tremors within rock layers very near the hydraulic fracturing, called microseismic events. Due to the great depth and small magnitude of these events (from <-3 ML to -1 ML),



What is Induced Seismicity?

Seismicity is the occurrence of earth shaking. Induced seismicity is when seismicity occurs as a result of human activities. A number of industrial activities have been connected with seismicity, including geothermal energy extraction, mining, dam building, wastewater disposal and hydraulic fracturing.

they are imperceptible at the surface. These events can only be detected by very sensitive seismic recording devices.

Once in a while, higher magnitude events of 3.0 ML and above can occur. At above 4.0 ML, seismic events begin to be felt at the surface, but typically cause no damage. These events are called anomalous (or irregular) induced seismicity because higher magnitude events are unusual in association with hydraulic fracturing. It's believed they occur when the hydraulic fracturing area coincides or connects with a naturally occurring, pre-existing buried geological fault line (a break in the rock layer), causing that fault to shift or slip.

Recent larger seismic events that have been linked to hydraulic fracturing in the Western Canadian Sedimentary Basin (WCSB) include three events in the Fox Creek region of the Duvernay, and one near Fort St. John in the Montney Formation in British Columbia.

CAUSES OF ANOMALOUS INDUCED SEISMICITY

David D'Amico is manager of geoscience—North American subsurface development at Repsol Oil & Gas Canada Inc. The 4.5 ML January 2016 event near Fox Creek has been associated with a Repsol hydraulic fracturing operation.

"In situations like these, the safety of the public and our workers is always our number one concern," says D'Amico. "As soon as we detected the event, we immediately ceased operations and reported the incident to the AER as required. We then began reaching out to area stakeholders, including community leaders in Fox Creek."

Photograph: Jason Dziver



"The safety of the public and our workers is always our number one concern."

« David D'Amico, manager of geoscience—North American subsurface development, Repsol Oil & Gas Canada, Inc.

D'Amico notes that while hydraulic fracturing is a proven technology, a number of factors may be at play in relation to these recent larger seismic events.

One factor is advances in hydraulic fracturing technology which allow for the pumping of water at higher rates and greater pressure using multiple stages. This creates more energy underground that can potentially trigger a seismic event.

A second factor is the overall increase during the past few years of the number of wells completed with hydraulic fracturing.

"While the risk of induced seismicity might remain very small for any given individual well, or within a certain area, the larger number of hydraulic fracturing operations spread over a larger regional footprint means you have a greater statistical probability to expose that risk," explains D'Amico.

A third factor is the unique features of the local geology, such as the existence of critically-stressed, pre-existing faults. The clustering of events near Fox Creek and a few other areas suggests this might be an important variable.

"There are some places, even within other parts of the same Duvernay play, where there is no seismicity strong enough for us to measure even with our sensitive induced seismicity monitoring," says D'Amico.

D'Amico further cautions that while the occurrence of several high-profile seismic events might give the impression that there's been a jump in induced seismicity, "it's still a very rare occurrence." Indeed, a recent publication [Atkinson et al, 2016] identified only 39 hydraulically fractured wells (0.03 per cent) correlated with >3.0 ML seismicity out of a total of 12,289

hydraulically fractured wells from 1985-2015 in the WCSB.

MITIGATING SEISMICITY: REGULATIONS

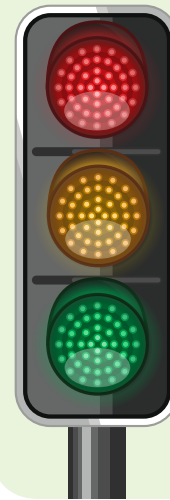
Regulators in British Columbia (B.C. Oil and Gas Commission) and Alberta (the AER) have introduced the requirement for continuous seismic monitoring during hydraulic fracturing operations in areas where seismicity is an issue. As well, both regulators have instituted a risk-based protocol requiring the reporting of all seismic events of 2.0 ML or greater, and an immediate suspension of operations if a 4.0 ML or greater event is detected.

"These regulations are in place to reduce the risk of seismicity associated with hydraulic fracturing operations," notes Ryan Bartlett, senior advisor of public affairs at the AER. "The requirements ensure the safe, orderly, and environmentally responsible development of energy resources while minimizing the risks to the public and environment."

"This should be a pretty significant study. The results will give us a better understanding of the geological conditions present in the subsurface."

Ryan Bartlett, senior advisor of public affairs at the AER »

AER Traffic Light System – Duvernay Zone, Fox Creek



- ≥ **4.0M_L**
cease operations, inform the AER
- ≥ **2.0M_L**
inform the AER, invoke response plan
- ≤ **2.0M_L**
no action required

Bartlett adds that the AER posts information about any event 4.0 ML or greater to its Compliance Dashboard available on their website.

The BC OGC has published two studies, one investigating seismicity in the Montney and the other in the Horn River Basin. The AER is currently working with industry and experts in seismology to better understand the factors causing the reported events in the Fox Creek area.

"We began a formal study in September 2015," notes Bartlett. He adds that the study is led by a team of experts from the AER's Alberta Geological Survey (AGS) branch. The team consulted with energy operators in the region, as well as seismology experts at Natural Resources Canada, the University of Alberta, University of Calgary, Western University and the BC OGC. An interim



Photograph: Jason Dziver

Photograph: Jason Dziver



"Industry's goal is to be able to shift from reacting to these events to predicting, minimizing and ultimately preventing felt-level seismicity from occurring."

« Leanne Laverick, external relations advisor, Shell

report is due out in May, with a final report arriving in November.

"This should be a pretty significant study," Bartlett notes. "The results will give us a better understanding both of the geological conditions present in the subsurface, and how hydraulic fracturing in the area contributes to induced seismicity."

"The goal is to use this knowledge to further refine our regulations to ensure public safety and environmental protection."

MITIGATING SEISMICITY: INDUSTRY LEADING RESEARCH

While regulators are quickly adapting to the issue of induced seismicity, industry is looking to lead the way in understanding the underlying science and what operational factors contribute to events. This has led to an unprecedented level of collaboration among the different companies operating in the WCSB.

"As an industry, we've been working together with academia and regulators to come up with a framework of operating guidelines and procedures," says Leanne Laverick, external relations advisor at Shell. Shell has operations in the Duvernay and is one of 12 companies participating on CAPP's Induced Seismicity Task Group, which has a mandate to "engage in deep sharing of industry best practices in mitigation and management of induced seismicity risk from hydraulic fracturing."

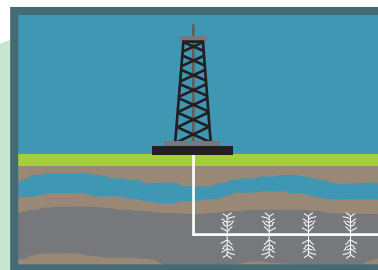
The key for D'Amico, who sits on both CAPP's Induced Seismicity Task Group, and an operators group specific to the Fox Creek region, is industry's willingness to share data with regulators, academics and each other—a level of sharing D'Amico calls "unprecedented in my career."

"Each operator has seismic monitoring arrays to monitor their own operations. By sharing this data, we can all get a more accurate representation of the location, depth and magnitude of seismic events throughout the region, as well as hydraulic fracturing operational factors like flow rate and fluid pressure occurring just prior to and during these events," says D'Amico. "This allows for a much more sophisticated and regionalized data analysis."

This data analysis includes work being done in cooperation between industry and academic researchers like David Eaton, a professor in the Department of Geoscience at the University of Calgary.

"Industry's been very supportive of working with us to gain a deeper scientific understanding of the mechanisms underlying induced seismic events," says Eaton. Professor Eaton is also the NSERC/Chevron Industrial Research Chair in

Microseismic Dynamics, and leads a team investigating regional differences in the geological response to fluid injection within North America.



Hydraulic Fracturing 101

Hydraulic fracturing involves pumping fluid (water with a small amount of additives) and sand (or another proppant) down a well at high pressure. The pressure causes the surrounding rock in the target formation deep underground to fracture.

When the pumping pressure is relieved, the water flows back up the well under the natural pressure of the formation, and leaves behind small particles of sand to prop open the cracks. This sand keeps the microfracture channels open and allows natural gas to escape and flow to the well where it is recovered.

Hydraulic fracturing has been used to enhance conventional natural gas production for over 60 years. Recent innovations using multiple stages in hydraulic fracturing, combined with horizontal drilling techniques, has allowed for the economic recovery of natural gas from tight or low permeability formations such as shale rock.



CAPP's Induced Seismicity Task Group

Apache Canada Ltd.
Athabasca Oil Corporation
Canadian Natural Resources Limited
Canbriam Energy Inc.
Chevron Canada Resources
ConocoPhillips Canada Resources Corp.
Encana Corporation
Husky Energy Inc.
Imperial Oil Resources
Nexen Energy ULC
Progress Energy Canada Ltd.
Repsol Oil & Gas Canada Inc.
Shell Canada Energy
Sinopec Canada
XTO Energy Inc.

"This research could help companies and regulators quantify the hazard potential for induced seismicity based on a site-specific geological model," he says.

Eaton's team is also studying the mapping of basement faults—a type of fault believed to be linked to induced seismic events. These faults do not always show up well in standard 3-D seismic images used by industry.

"We're thinking outside the box to develop some new techniques to delineate and map these fault systems," notes Eaton.

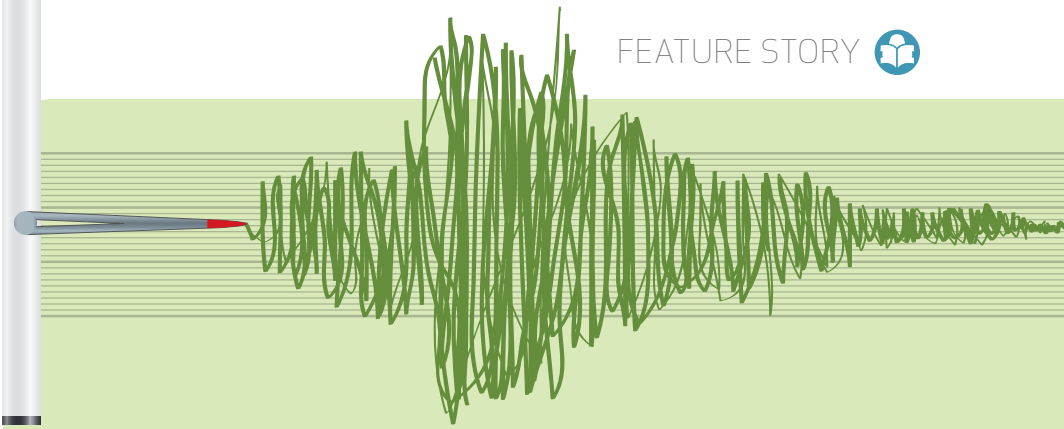
The goal for industry is to apply these kinds of new knowledge and tools in the field.

"It may be that we'll be able to identify precursor patterns that predict an imminent larger event," notes D'Amico. "With an enhanced understanding of the science and geology of induced seismicity, companies may also be able to optimize controllable factors like hydraulic flow rates and injection volume, wellbore placement and flowback procedures, all with the aim of reducing the chance of triggering larger seismic events."

The companies on the CAPP Induced Seismicity Task Group have taken a first step towards practical application of shared knowledge, collaborating on a shared practices document that enables each operator to gain insight on how others are currently handling the issue and what kind of successes they've had. Soon, they will translate findings from the AER study and other research into stronger mitigation measures incorporated directly into industry operational guidelines.

"As research and our understanding progresses, industry's goal is to be able to shift from reacting to these events to predicting, minimizing and ultimately preventing felt-level seismicity from occurring," says Laverick.

"Canada is recognized as a leader in developing natural gas from shale resources. Among our companies, regulators and researchers, we have the right expertise and leadership to also lead the way in terms of understanding the relationship between hydraulic fracturing and induced seismicity," adds Laverick, "Ultimately, we believe that hydraulic fracturing can continue to be done safely within the framework of science-based regulations and the use of shared industry best practices."



The Local Magnitude Scale

Also known as the Richter scale, this scale assigns a magnitude number to quantify the energy released by a seismic event. The scale is logarithmic, such that each whole number increase corresponds to an increase of about 31.6 times the energy (i.e., a magnitude 6 event would be about 900 times stronger than a magnitude 4 event).

MAGNITUDE	EFFECTS
Less than 3.5	Recorded on local seismographs, but generally not felt.
3.5 - 5.4	Often felt, but rarely cause damage
Under 6.0	At most slight damage to well-designed buildings. Can cause major damage to poorly constructed building over small regions.
6.1 - 6.9	Can cause damage to poorly constructed buildings and other structures in areas up to about 100 kilometers across where people live

Source: Natural Resources Canada

COMMUNITY VALUES

When Montgomery visits communities that are near industry operations throughout B.C. and Alberta, he has found that residents have two main categories of concerns. One is environmental safety—in particular, concerns about induced seismicity and water usage.

"They want to know that we take these issues seriously and that we're taking steps to minimize risk," says Montgomery.

The second concern is economic.

"People want to know that industry will still be around and what we're doing to protect jobs," says Montgomery. "It's a good opportunity for us to talk about the need for competitiveness and the importance of building an LNG industry to get natural gas to new markets overseas."

"People in these towns and communities are generally supportive and have a great willingness to engage on these issues," he adds.

Roy Dell, meanwhile, is hopeful that the regulator and industry can find solutions to

prevent these kinds of issues in the future. He would rather have the focus on Fox Creek be about something else.

Regarding the widespread media coverage of the January 2016 event, Dell says, "Are we proud of it? No, definitely not." Dell would rather emphasize the positive aspects of living in a robust, growing and economically strong oil and gas community.

"We'd like to attract more direct industry investments and have more families come here to live," he says, noting the town has recently upgraded its water infrastructure, purchased land for development and is building a multi-use facility with a swimming pool, field house and arena. "Fox Creek is a great place to live and work. We should write about that," he says.

For industry and regulators, the belief is that by becoming leaders in researching, understanding and mitigating induced seismicity, we can get to the point where induced seismic events are no longer an issue for the newspaper headlines. **C**

 AER seismic monitoring and reporting requirements: <http://bit.ly/1q9LCWF>

BC OGC seismic monitoring and reporting requirements: <http://bit.ly/1VQT07v>

CAPP industry operating practice for induced seismicity: <http://bit.ly/24Hfn0N>

About Peter Watson

Peter Watson was designated Chair and CEO of the National Energy Board of Canada on June 13, 2014. Prior to joining the NEB, he held various roles with the Alberta government including Deputy Minister of the Alberta Executive Council, Head of the Alberta Public Service, Deputy Minister for the Alberta Department of Energy, and Deputy Minister for the Alberta Department of Environment. Watson has a B.Sc. in Civil Engineering from the University of Alberta.



Regulating at the centre of Canada's energy debate

By David Coglon

Since stepping into his role with the National Energy Board (NEB), Peter Watson has made it his mission to revamp the 57-year-old federal agency. In his first year and half on the job, Watson and his team have reached out to hundreds of Canadians to get feedback on the NEB, established regional offices in Montreal and Vancouver, and taken steps to make industry information more accessible to the public. *Context* spoke to Watson to learn more about his work at the NEB.

Q: What would you say are the greatest challenges facing the NEB today?

A: There are three I'd highlight. First, we need to carry out our regulatory work at the NEB more transparently, so Canadians clearly understand what we do and how we do it. Second, we have to become better at forging relationships with people in communities. We make independent decisions as a federal regulator and people may not always be happy with those decisions, but they need to feel that they're being listened to and that our processes are fair. Finally, we have to continue to adapt to the changing needs of citizens. Not too long ago, few people would turn out to NEB hearings for project applications. That's changed. Canadians expect more, they're challenging more, and they're asking good questions about issues they care about. The NEB must continue to respond to their expectations.

Q: What is the NEB doing to address these challenges?

A: When I joined the NEB, one of the first things I did was launch our national engagement initiative. We spent more than six months crossing the country and talking to Canadians to listen to their

concerns and perspectives. The process was very instructive.

Some of the steps we've taken so far, as a result of this feedback, has been to require pipeline companies to post their emergency response plans online so the public better understands how industry and the regulator are prepared in the case of an emergency. We've also begun posting online inspection reports of the country's oil pipelines to provide more information to Canadians.

Q: What are your thoughts about the federal government's plan to modernize the NEB?

A: Ever since I arrived, we've been working on what I would say is an agenda of modernizing the NEB, starting with action to address our key challenges. So I look forward to working with the government on what they're going to be doing on this front as well. We're all trying to find the

right way to step up and improve the NEB to meet the needs of citizens today.

Q: The NEB's *Canada's Energy Future 2016 Report* forecasts continued growth for oil and gas production in Canada out to 2040. Can you elaborate on this?

A: The simple story is that, as our country continues to grow, it is energy that will continue to drive our economy. We're in a period right now that, because of the low price environment, we're waiting to see how commodity prices in the market balance out so that industry can have some certainty how and when it makes investments in the future. But there's no question that not just in Canada but across the globe that energy demand will continue to rise as populations increase and economies grow. And energy production will have to grow to meet this demand.

Q: How would new pipeline and LNG infrastructure impact Canada's GHG emission trends?

A: We've looked at various scenarios — like low and high oil and natural gas prices, and scenarios with or without pipelines and LNG facilities— and tracked anticipated energy production and demand in Canada. Our conclusion is the presence or absence of pipelines and LNG facilities will not make a material difference to our country's greenhouse gas emission trends. Because at the end of the day most of the emissions will arise through the consumption of the products. What will make a difference to future emissions will be the introduction of more aggressive policy frameworks around carbon pricing. We're starting to see these policy frameworks emerge in Canada. **C**

What is the National Energy Board?

The National Energy Board, or NEB, is responsible for regulating interprovincial and international pipelines, power lines, energy development and energy trade in the public interest. The NEB:

- is an arms-length agency that operates within a mandate set by the Canadian Parliament;
- regulates 73,000 km of pipelines;
- receives approximately 260 applications a year for pipeline and power-line related facilities and tolls.



Melanie's ENERGY STORY:


» Standing up for her profession and industry

ENERGY CITIZEN: Melanie Popp
RESIDENCE: Calgary, Alberta
JOB: Petroleum engineer

Melanie Popp is a petroleum engineer who has seen the ups and downs of Canada's oil and gas industry. She believes that now is the time for professionals in the industry to stand up for Canadian oil and gas.

using them. She also recognizes that energy security is a vital part of our daily lives. "I enjoy a warm home, and organic strawberries that need to get here from somewhere. Even mass transit systems or the plastics and rubber used

In addition to joining Canada's Energy Citizens (CEC), Popp is a member of the Society of Petroleum Engineers (SPE), where she's helping to organize an advocacy rally for young professionals called "Taking Action for Canada's Energy Industry." The rally occurs on May 19 at Local 522, and will bring together oil workers and supporters from various groups, including CEC, SPE, CAODC Oil Respect and Canada Action.

"We need to take a stand and step up for our industry. There's power through numbers. If enough people start having a united, strong voice in support of the energy industry, people will wake up," says Popp. 

"If enough people start having a united, strong voice in support of the energy industry, people will wake up."

Popp's 15-year career in oil and gas includes some notable firsts. She was part of the team that first used hydraulic fracturing to recover economic quantities of natural gas from the Barnett Shale in the early 2000s. She also worked with industry-leading coalbed methane producers to implement new technology for the extraction of gas from coals.

Born and raised in Saskatchewan to a farming family, Popp has a keen appreciation for the sustainability of the land. She believes in being environmentally responsible: relying on public transit and her bicycle for her transportation needs, while teaching her five-year-old son the importance of turning off the lights when not

to make my bicycle—that doesn't happen without oil and natural gas," she says.

Popp also thinks it doesn't make sense for parts of Canada to be importing oil from foreign sources when we have plentiful sources of responsibly produced oil here.

Laid off last fall from a Calgary-based oil and gas company, Popp has started doing some consulting work while seeking new employment. The experience has served to galvanize her commitment to oil and natural gas. "We have some really great, very smart people in this industry. It's also an amazing time of innovation and diversification," says Popp.

Join the Rally!

**Taking Action for
Canada's Energy Industry**

May 19, 2016 at Local 522 in Calgary.

More info and to register:
<http://bit.ly/1Tw1uun>




**CANADA'S
ENERGY CITIZENS**

Melanie is a proud member of the Canada's Energy Citizens community. Join her by signing up at energycitizens.ca.

**COSIA CORNER:
ELIMINATING ONE MILLION TONNES OF CO₂ A YEAR**

The Quest Carbon Capture and Storage project will capture and safely store more than one million tonnes of CO₂ each year from the Scotford Upgrader, located northeast of Edmonton, Alberta, and store it more than two kilometres underground. Shell Canada contributed Quest to the Canada's Oil Sands Innovation Alliance (COSIA), meaning this technology is being shared among the members of COSIA.

COSIA is an alliance of 13 oil sands producers, representing 90 per cent of production from the Canadian oil sands. These producers have shared 814 distinct technologies and innovations that cost almost \$1.3 billion to develop.

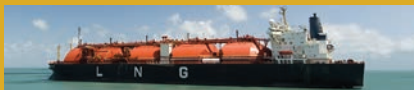
 Learn more at www.cosia.ca.



EnergyCitizens.ca

SHOW YOUR PRIDE

To access a free "I ♥ Canadian Energy" bumper sticker: contact Brad Tennant, 403-267-1163, brad.tennant@capp.ca.

**LNG
BY THE
NUMBERS**

600x


The reduction in volume achieved by cooling natural gas to -161 degrees Celsius to become a liquid. This reduction makes it economical to transport LNG by tankers to markets overseas.

46%


The expected increase in global demand for natural gas by 2040, driven primarily by rapidly expanding Asian economies.
(Source: IEA 2015)

65,000

The average increase in national employment created over 30 years by a modestly sized West Coast LNG industry exporting 30 million tonnes per year.
(Source: Conference Board of Canada)

 Learn more, download CAPP's Canada's Liquefied Natural Gas (LNG) Opportunity fact sheet: <http://bit.ly/1rtUibO>

LOOKING FOR MORE RESOURCES?

 Visit www.capp.ca/publications-and-statistics to download the latest CAPP publications, fact sheets, statistics and presentations.

**CANADA'S ENERGY CITIZENS TURNS 100,000**

The Canada's Energy Citizens community continues to grow. The grassroots movement of like-minded citizens joining to show support for Canada's oil and natural gas industry has surpassed several key milestones, including 100,000 likes for its Facebook page.

A year ago at this time, there were less than 10,000 Energy Citizens.

"The growth of the program has been amazing. As part of the Energy Citizen Nation, tens of thousands of Canadians belong to a supportive community where it's ok to publicly support our vital oil and natural gas industry," says Steve Rennick, manager of campaigns. "Energy Citizens are highly engaged and actively lobbying decision makers. They finally have a community and the tools they need so that their voices can be heard."

COMMUNITY GROWTH

As of April 25, 2016



160,886

Total number of Canada's Energy Citizens

101,792

Facebook Likes



2,768,138

Facebook Reach

156,134

Facebook Engagement

**ADVOCACY CAMPAIGNS**

42,000

Pipeline Pledges
(started in January)

Take the pledge:
www.supportcanadianpipelines.ca



5,300

LNG Pledges
(started April 12)

Take the pledge:
www.supportcanadiangas.ca



16,456

Emails to decision makers

"Now that the program has reached these important milestones, we will soon be conducting an Energy Citizens' Census so that we can learn more about our citizens and what they want from the program," says Rennick, "There's already an incredible amount of information you can access that will enable you to provide a balanced, factual perspective in the far too-often one-sided debate about our industry, either via the Facebook page or on www.energycitizens.ca."



Not a Canada's Energy Citizen? Join today at www.energycitizens.ca – and begin participating in the conversation at www.facebook.com/CanadasEnergyCitizens.

Oil and Gas 101: HYDRAULIC FRACTURING AND WATER USE

WATER USE

Hydraulic fracturing is a government-regulated technology used safely for more than 60 years to recover tight oil and natural gas trapped in deep underground rock. The process of hydraulic fracturing requires a mixture of water, sand and additives to be pumped down a well under high pressure to fracture the rock and release the hydrocarbon from a low permeability formation like shale. The amount of water needed varies depending on the specific geology of the target formation. The average water use for hydraulic fracturing natural gas wells in B.C. was about 13,000 cubic metres per well in 2014 (Source: BC OGC).

APPROACHES TO REDUCING FRESH WATER USE



Saline Groundwater

Deep saline groundwater is unsuitable for other uses such as human consumption or agriculture. Where practicable and appropriate, industry draws the water it needs from these sources.



Flowback and Produced Water

About 25 to 40 per cent of the water injected during hydraulic fracturing flows back up out of the well. This flowback can be reused for subsequent fracturing stages in the same well and/or other wells. Also, some reservoirs have water naturally present. This produced water can also be recovered and used for subsequent hydraulic fracturing events.



Reclaimed Municipal Wastewater

Some companies have made arrangements with municipalities to use municipal wastewater for their hydraulic fracturing operations. This saves the town costs associated with disposing the wastewater, while giving operators an alternative to fresh water.



Shared Infrastructure

By building pipelines to centralized storage facilities, companies can optimize water usage across multiple operations in a region. An example is Encana's Water Resource Hub near Dawson Creek, B.C.



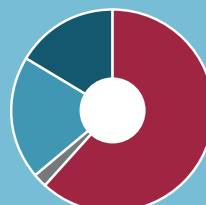
▲ The Encana Water Resource Hub near Dawson Creek, B.C.

ENSURING SUSTAINABILITY OF WATER WITHDRAWALS

The provincial governments and regulators in Alberta and B.C. have policies and regulations for allocating water and tracking actual use by the various sectors. For example, both provinces have robust regulations that require licences or approvals before surface water and groundwater can be withdrawn for industrial purposes. These regulations aim to maintain sustainable supplies of fresh water for future generations.

The graphs below show the different sources of water for hydraulic fracturing in B.C., and the percentage of water allocations for different uses in Alberta.

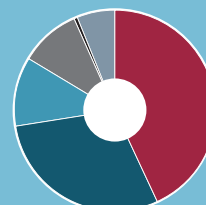
B.C. sources of water used for hydraulic fracturing (2014)



● Surface Water 61.7%
● Groundwater 2.3%
● Alternatives 19.8%
● Other 16.2%

Source: BC OGC

Alberta water allocations by sector (2014)



● Agriculture/Irrigation 43.1%
● Commercial 29.4%
● Municipal 11.3%
● Other Oil & Gas* 9.8%
● Hydraulic Fracturing 0.3%
● Other 6.1%

*Other Oil & Gas includes water-floods, gas plants, downstream refineries, drilling, construction, field offices, and oil sands.

Source: AER

- Water used by B.C.'s natural gas industry represents 0.004 per cent of the total average annual runoff in northeastern B.C. (BC OGC, 2014)
- In Alberta, just 0.3 per cent of provincial water allocations are for hydraulic fracturing operations—compared with 43.1 per cent for agricultural and irrigation uses (AER and AEP, 2014)
- CAPP has developed a set of industry-led guiding principles and operating practices to safeguard supplies.

DIG DEEPER

Fact book:

The Facts On: Canada's Natural Gas
<http://bit.ly/1OSTmHw>

Fact sheets:

- Water Use in Oil and Natural Gas Development in Alberta:
<http://bit.ly/1rElqnv>
- Water Use in Natural Gas Development in British Columbia:
<http://bit.ly/24IlqRC>
- Hydraulic Fracturing Guiding Principles and Operating Practices <http://bit.ly/23npqFN>



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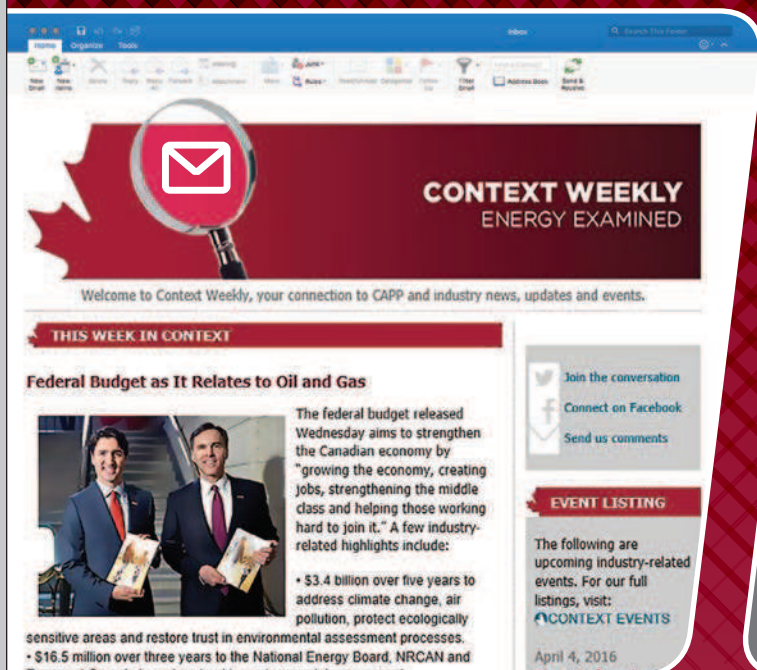
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working world

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NATIONAL POST

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all the pieces
in more ways
than ever before.