What is Old is New Again

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Total BOE Production out of Western Canada is at near Record Highs

Overall BOE production is being limited not by supply, but transportation and demand

Unconventionals and expansion of heavy oil production have dramatically increased oil and overall BOE production
Neighbouring Producers are Also Doing Well

Table 4.2 Natural Gas Trade by Country

<table>
<thead>
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<th>Year</th>
<th>Natural Gas Imports From Canada</th>
<th>Natural Gas Exports to Canada</th>
<th>Natural Gas Exports to Mexico</th>
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<td>2010</td>
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<td>0</td>
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Data source: U.S. Energy Information Administration
North American Basins

- In “The Natural Gas Industry” by Tussing and Barlow, adapted from Riva, 1983
History of Pipelines: Many, but not Enough

- **1950-53**: First section of the Interprovincial Pipe Line oil pipeline laid from Edmonton to Superior, Wisc., in 1953 it was extended to Sarnia, Ontario.
- **1953**: Trans Mountain Pipeline Company line completed from Edmonton to Vancouver.
- **1954**: The Alberta Gas Trunk Line Company Limited (AGTL), (now called NOVA Gas Transmission Ltd.) was created to build and operate a provincewide natural gas transportation system. In 1957, Alberta gas began to flow through the AGTL (NOVA) system.
- **1957**: First gas exported by the Westcoast Energy Inc. pipeline system through Vancouver to U.S. markets.
- **1958**: Construction of the TransCanada Pipelines system was completed from Alberta to eastern Canada.
- **1961**: The Pacific Gas Transmission pipeline is built to deliver Alberta gas to customers in the U.S. Pacific Northwest and California.
- **1962**: Line 10 of IPL
- **1976**: Line 9 of IPL
- **1985**: First permanent buried pipeline completed in the Canadian Arctic to carry light crude oil from Norman Wells to Alberta.
- **1997-2000**: Alliance pipeline
- **2008-2010**: Alberta Clipper constructed, which runs from Hardisty, Alberta, to Superior, Wisconsin, in the United States.
- **2010**: Southern Lights constructed
- **2010**: Line 65
Recent Pipeline Capacity

We are processing a decreasing proportion of our crude growth in take away capacity, but not nearly enough.
In the 1950s, the ERCB recommended the creation of a province-wide natural gas gathering system. It would be more efficient to develop a single gathering system than to let gathering systems evolve piecemeal. Such a system would eliminate the possibility of federal regulation of gas within the province.

- Protestors rush Louis St Laurent, June 7, 1957

- Paul Chiasson / THE CANADIAN PRESS
Canol Pipeline: in B&W and Color

- Finnie Family fonds, #427.

- DECEMBER 21, 2017
Crowds line up to watch pipeline debates in the House of Commons in June 1956. Duncan Cameron/Library and Archives Canada

1961 National Oil Policy: All refineries west of the Ottawa valley must use higher priced crude from western Canada.
Oh No! Oil is Cheap
Things Weren’t Better Then (in terms of growth)

Overall Economy

Business Fixed Capital

Housing
Secondary Economic Impacts
...Other Industries Catch Cold...

• Replace with up to date info
...and it Looks Ugly

The coloured floors are currently vacant
Oil Politics is Slippery: in B&W and Colour

• Calgary Herald May 18, 1974

• Calgary Herald: March 3, 2016:
Alberta Might Turn Off Oil Production

"The Mayor of Vancouver says he wants a carbon-free economy by 2040. Maybe we should help give him a carbon-free economy by 2020!"

- Jason Kenney, September 20, 2017

"British Columbia cannot replace that [fuel] supply from viable sources. It says that reductions in supply from Alberta will cause shortages in British Columbia and that the result could be increased prices, lack of supply and civil unrest in British Columbia."

- British Columbia v Alberta, 2019 ABQB 121, Feb. 22, 2019

Anti-oil, anti-pipeline BC NDP say they need Alberta oil!
Quebec Exceptionalism: in B&W and Colour

- John Collins - The Gazette 1964
Fracking: in B&W and Colour

During the fracturing process, fractures can be produced, allowing migration of native brine, fracturing fluid, and hydrocarbons from the oil or gas well to a nearby water well. When this happens, the water well can be permanently damaged and a new well must be drilled or an alternative source of drinking water found.

In 1982, Kaiser Gas Co. drilled a gas well on the property of Mr. James Parsons. The well was fractured using a typical fracturing fluid or gel. The residual fracturing fluid migrated into Mr. Parsons’ water well (which was drilled to a depth of 410 feet). According to an analysis by the West Virginia Environmental Health Services Lab of well water samples taken from the property, dark and light gelatinous material [fracturing fluid] was found, along with white fibers. (The gas well is located less than 1,000 feet from the water well.) The chief of the laboratory advised that the water well was contaminated and unfit for domestic use, and that an alternative source of domestic water had to be found. Analysis showed the water to contain high levels of fluoride, sodium, iron, and manganese. The water, according to DM officials, had a hydrocarbon odor, indicating the presence of gas. To date Mr. Parsons has not resumed use of the well as a domestic water source. [API] states that this damage resulted from a malfunction of the fracturing process. If the fractures are not limited to the producing formation, the oil and gas are lost from the reservoir and are unrecoverable.18 (WJ)19


Fracking OUR COMMUNITIES
ARE THE KIDS ALRIGHT?

MULTI-STAGE HORIZONTAL HYDRAULIC FRACTURING COMING TO AN OIL OR GAS WELL NEAR YOU

This type of “Fracking” has been used in Alberta for slightly over ten years.

THIS NEW TECHNOLOGY
• Has been banned in several countries and numerous smaller jurisdictions worldwide-is the subject of a
United Nations Global Environment Alert
• Has been implicated in serious human and animal health effects and increasingly frequent earthquakes
• Is the subject of multiple law suits in the U.S. and Canada regarding air and water contamination
• Is happening NOW in Rocky View

The National Farmers’ Union, The Alberta Surface Rights Group, The Council of Canadians and many more have asked for a moratorium.

AND YET, many more wells are planned for our County over the next year-over 40 more for the Loch End area alone - under regulations that were never meant to deal with this new process. Our air and water are not being tested for the many dangerous chemicals involved.

WHAT CAN YOU DO? BE INFORMED!

These websites can help: www.canadians.org/fracking • www.frackingcanada.ca
www.endocrinedisruption.com • www.ernaversuscanada.ca
THEN CALL YOUR LOCAL COUNCILLOR, YOUR MLA, YOUR MP
BE PART OF THE SOLUTION! Local contact – e-mail: causcco@gmail.com

• http://www.frackingcanada.ca/fracking-calgary/

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We Need Alternative Energy, Like Yesterday

- John Lane, 1973
You’re So Negative!

Please, I’m begging you, talk about ways to make money (and talk about liquids)
Let’s Sell Electricity

- **1955**: Edmonton Electric Lighting and Power Company’s Rossdale plant switches from coal to natural gas.
- **1980**: Medicine Hat replaces coal-fired steam units with Canada’s first gas turbine, combined cycle cogeneration system.

In 2018, gas generation provided 42% of net-to-grid power.
Our Neighbours Like to Sell Too

For exports, we’ll need cheap power, which will probably mean cheap gas. But it does help put a floor on how low gas prices can get as there’s still lots of coal that can be pushed out of generation. It is also a good adjunct to solar and wind generation.
Electricity: Saviour and Killer of Children
Key Canadian Unconventional Resource Plays

- Oilsands
- Montney
- Duvernay
The Montney is Becoming Canada’s Main Gas Supply, Especially in British Columbia

It is the largest (and growing) supply for gas in British Columbia

British Columbia is becoming a larger fraction of Canada’s gas supply
Development Requires the Right Mix of HC Products and Access to Infrastructure

This means that Montney development is, in general, moving to the northeast.

It also means that companies are looking for local areas of higher liquids along the main trend.

To a lesser extent, it means companies are targeting hz well landing depths.
Average Liquid Yields are Changing Over Time as Companies Develop New Areas

The average liquid yield of development of unconventional resources can change over time as development shifts to new areas.

More conventional fields often show more consistent field behaviour.
Average NGL Yields are Changing Over Time as Companies Develop New Areas
Overall NGL Production

Production of light NGLs is flat, but we've seen gas rates are up.

Overall yields are down, there is scope for higher recoveries... if the economics make sense.
Companies are Reconsidering Complex Phase Behaviour

Not only will the industry add in complex VLE behavior (as was done in the 1970s and 1980s) industry is adding in surficial chemistry and equilibria, to account for adsorption and solid/fluid interactions.
So we’re producing liquids, how are we not going to get screwed again on price?

As the basin is being developed we are seeing

Heavy oil:
1. Upgraded to light oil
2. Shipped elsewhere

Super-Light Oil:
1. Used for distillation feed
2. Used as diluent

NGLs: a growing volume
1. Sold at suppressed prices
2. Sold outside N.A.
3. Sold as feedstock

Gas:
1. Shipped to N.A. markets offering reasonable prices
2. Used for fuel (steam, electricity, etc)
3. Shipped outside N.A.
4. Injected?
History of Petrochemicals: the Kickoff...

- Proposed in 1974 by Premier Peter Lougheed in response to demand for Alberta oil by Ontario petrochemical industry – **didn’t want to ship petrochemical jobs to Sarnia**
  - Alberta had been investigating ethane based petrochemical manufacturing technology
  - The Lougheed government felt that Alberta should have its own petrochemical industry to diversify the economy

- **Initial Corporate Involvement**
  - Dow Chemical Canada
  - Alberta Gas Trunk Line
  - Alberta Gas Ethylene
  - Dome Petroleum

- **Construction Period**: 1976 – 1980

- **Startup of New Facilities**: September 1979

- **1979**: Alberta’s first ethylene plant was officially opened at Joffre. A second ethylene plant and a polyethylene plant began production in 1984.

In the 10-year period between **1973 and 1983**, the number of Albertans employed in the industry nearly doubled, while the value of shipments increased from $100 million to almost $2 billion annually.
It requires development in a “localized” areas already developed with populations that already directly understand the costs and benefits of such development. In a good way, it uses concepts of the social development crowd to target investment dollars in areas that want the investment and will fight for it.
History of Petrochemicals: Expansion and “Localization”

- Alberta Gas Trunk Line (AGTL)
  - Alberta natural gas extraction/straddle plant in Cochrane
  - Empress extraction/straddle plant
  - Alberta Ethane Gathering System (AEGS) – supplied ethane from Cochrane and Empress to AGE E-1 ethylene plant in Joffre

- Alberta Gas Ethylene (AGE) – Joffre
  - Alberta Gas Ethylene established by Alberta government and eventually became part of NOVA
  - E-1 Ethylene Plant (Ethane Cracker)
  - Ethylene Pipeline to Dow Fort Saskatchewan
  - Diamond Shamrock Alberta Gas (now Oxyvinyls) PVC - Scotford

- Ethane Feedstock Regulations
  - Alberta petrochemical industry had first call on all ethane feedstock
  - Supply and price of ethane feedstock guaranteed by Alberta government
  - Exports of ethane limited to amounts not required by Alberta petrochemical industry

- Dow Chemical Canada – Fort Saskatchewan
Oil Protesters: In B&W and Colour

A crowd protesting the federal government’s energy policies gathers outside Calgary’s Palliser Hotel: Glenbow Archives, NA-2864-25432d-43

Alberta Oil Lubricates Socialist Machine.

Canada Runs on Alberta Oil
“Localization” in Action
Awesome! Alberta will look like this.
Upstream and Downstream are Allies, not Friends 1/2

- Tom Pearson November 15, 2006
- “Alliance Pipeline was a watershed event, a paradigm shift for the Alberta Petrochemical Industry – equivalent to moving all Canadian auto manufacturing to Detroit or Canadian aircraft manufacturing to Boeing in Seattle”
- “Ten year property tax exemption on new manufacturing facilities – are routinely available in Texas and Louisiana”
  - But there goes tax revenue... so hard choices should be made
- “Export of Alberta oil sands bitumen to U.S. refineries or to the Far East for upgrading also guarantees the upgrader byproducts, including ethane, propane and butane, will not be available for the Alberta petrochemical industry”
  - Does that mean CanaPux are bad?
  - What about diversifying access to demand?
- These issues sound familiar... more then 10 years after the fact!
Upstream and Downstream are Allies, not Friends 2/2

• Tom Pearson November 15, 2006
• “No economic incentives exist to encourage extraction of more ethane in Alberta, either via deeper cuts at Empress and Cochrane or via new field extraction plants that have access to existing collection pipelines.”
• “High cost natural gas has made North American industry uncompetitive”
• “North American natural gas production forecast to be flat at best”

• Some things sound different now!
• 1974: The Natural Gas Price Protection Plan was introduced. The Public Utilities Board’s role in the plan, which was aimed towards sheltering Alberta consumers from increasing world market prices for natural gas, was set out in the Natural Gas Rebate Act. Under the Act, the Board was required to issue certificates qualifying utilities to receive provincial rebates.
History of Petrochemicals: Contraction

• 2001
  • $5 Billion 3000 km natural gas and liquids pipeline from NW Alberta to Chicago (Alberta gov’t. removed original ethane export restrictions)
  • Aux Sable Fractionator located 75 km SW of Chicago to extract liquids
  • Ships 1.3 – 1.5 BCF/day natural gas plus up to 80,000 BBL/day natural gas liquids consisting of ethane, propane, and butane (30,000 – 40,000 BBL/day ethane – ½ from NE B.C.) Ethane extracted at Aux Sable fractionator is sold to Equistar which produces ethylene and ethylene derivatives (export of manufacturing jobs to U.S.)
  • Ethane formerly supplied to Equistar from U. S. Gulf is now available to ethylene producers in Texas and Louisiana (Dow Chemical has
  While both the upstream and the petrochemicals industry want plenty of hydrocarbon production, one wants high prices and the other wants low.
  • Loss of 310 direct jobs & 620 indirect jobs
  • Alberta salary reduction of $75 million per year
  • Alberta income and property tax reduction of $10 million per year

• 2002
  • Dow Chemical 1968 Chlor-alkali plant shutdown
  • Loss of 35 direct jobs & 70 indirect jobs
  • Alberta salary reduction of $8.4 million per year
Oil Companies: In B&W and Colour

- Oliphant, Pat c1973

- http://www.frackingcanada.ca/fracking-calgary/
Oil Protesters: In B&W and Colour

Anti-pollution activists stage a protest parade through downtown Calgary, April 1970. : Glenbow Archives, NA-2864-5922

Macleans May 31, 2018
Gas Injection is a Great Paper Idea (Again)

- “Condensate Recovery By Cycling At Declining Pressure” 1967
- “Simulation of a Partial Pressure Maintenance Gas Cycling Project with a Compositional Model, Carson Creek Field, Alberta” 1970
- “Reservoir Performance Review Of Kaybob South Beaverhill Lake Cycling Schemes” 1973
- “Compositional Simulation to Develop an Optimum Gas Cycling Scheme At The Kaybob Beaverhill Lake C Pool, Alberta” 1979
- “Recovery of Retrograde Condensate from Naturally Fractured Gas-Condensate Reservoirs” 1984
- “An Experimental Study of Cyclic CO2 Injection to Improve Shale Oil Recovery” 2014
- “Enhanced oil recovery in shale reservoirs by gas injection” 2015
- “Huff ’n’ Puff Gas-Injection Pilot Improves Oil Recovery in the Eagle Ford” 2018
- “The Viability of Gas Injection EOR in Eagle Ford Shale Reservoirs” 2018
We Have a History of Gas and NGL Injection
Gas Injection Pilots are Underway (Again)

• “Field application of enhanced recovery in Canada dates from the North Pembina Cardium Unit hydrocarbon miscible pilot project in 1957-58. Fifty-one commercial projects are now operating, all of them hydrocarbon miscible floods in the Province of Alberta.”
  Barbara J. Howes, 1988

• “The Commission has reviewed the application dated November 26th, 2018 requesting an Innovative Technology pilot project for enhanced hydrocarbon liquid recovery from the Heritage field Montney A pool utilizing gas cycling.” OGC, January 2019
Cursory Field Analysis for Miscible

What type of decline is this?
Is this an optimistic forecast?
Is the estimate of incremental EOR performance optimistic?

Gas Injection Begins
Cursory Field Analysis for Shale IOR

- How many use harmonic extrapolations for multi-frac’d horizontal wells?
- Issues that affected analysis of EOR in conventional fields will “echo” analysis in unconventional fields
The outlier in growth is the United States.
Success is Never Guaranteed, Even for Others

And within the US the outlier is growth in the Permian… which requires permitting within a single jurisdiction (Texas) that also has access to tidewater, pipelines and rail.
The Path Forward Will Echo the Past

• The most distance resources are the hardest to exploit, as they were in late 40s, the late 70s

• NIMBYism exists in Alberta too... instead of social license think “localization”

• If the previous problem was unlocking heavy oil and tight gas, maybe the current problem is selling power and value added materials to distant markets
  • Plastics and specialty chemicals
  • Electricity, or other derived energy
  • These options work best with low feedstock price
Under Klein, Calgary continued with construction of the LRT system megaproject that had opened its first line in 1981, pushing through to completion of the northeast line in 1985, even as oil prices reached their lowest ebb. The city borrowed heavily to build this asset.
Oh No! Oil is Expensive!

• Bob Taylor: 1975

• “KAL” Economist Mar 13th 2008
The Takeaway

• We’ve been here before
• We’ve lived through this before
• **We have experience, both in terms of breadth and depth, that can and will be employed to keep value within the local and regional economy.**
• We’ll be fine

• Technical analysis remains important, even for plays in “manufacturing” mode
• So far, we don’t appear to need radically different models... though we will probably need to combine models in new ways.
• It still sucks and will for a while
Thank you

Questions?