National Energy Board
Office national de l'énergie

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Energy Brief

UNDERSTANDING CANADIAN SHALE GAS

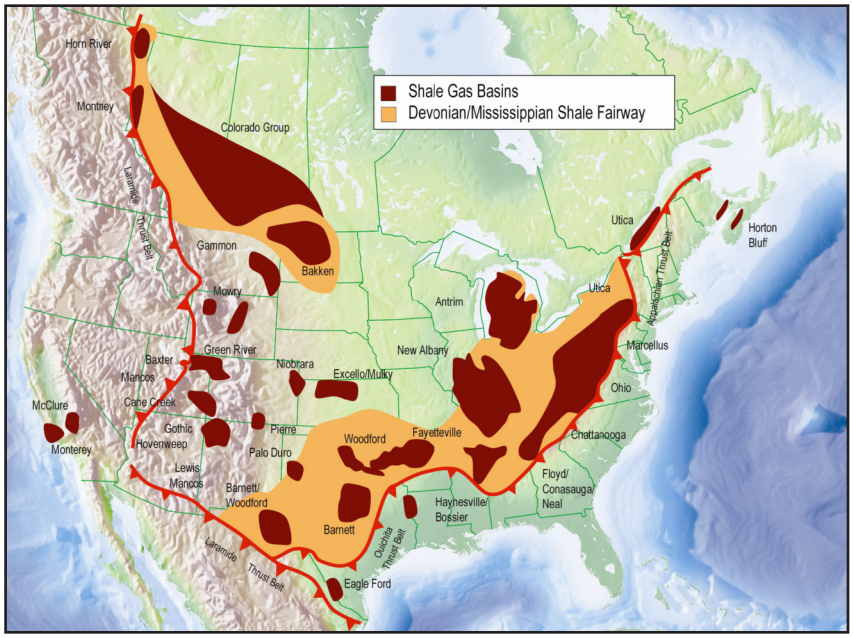
Shale gas is natural gas that is embedded in shale, a sedimentary rock that was originally deposited as clay and silt. Similar in appearance to a chalkboard slate, shale is the most common sedimentary rock on Earth. Shales are less permeable than concrete, so the natural gas cannot easily move through the rock and into a well. In fact, the gas is so tightly trapped within the shale, that in order for it to flow, it must pass through pore spaces that are 1,000 times smaller than those in a conventional sandstone reservoir.

Shale gas is one of a number of "unconventional" sources of natural gas, including coalbed methane and tight gas. Conventional natural gas is formed when methane molecules migrate from their original location to an area where they are trapped by an underground geological feature resulting in a higher concentration of methane molecules. These conventional sources are easier and cheaper to produce. However, the production from these accumulations is declining. In order to replace that production, the oil and gas industry is turning to fossil fuels that were previously thought of as too expensive and difficult to produce. New technologies, such as multi-stage hydraulic fracturing or "fraccing" in industry terms, combined with horizontal drilling, are making it easier and cheaper to produce shale gas.

Despite being difficult to drill, there is potentially 30 10^{12} cubic metres (1,000 trillion cubic feet) of shale gas in Canada if not more. Normally, only 20 per cent of the gas can be recovered, but this could grow with advancements in drilling and fracturing technology. It's important to remember however, that there is a lot of uncertainty around shale gas as the industry is still evaluating the resource.

In North America, there are several shale gas opportunities, shown in the map below. While the potential for Canadian shale gas production is still being evaluated, the principal Canadian shale gas plays are the Horn River Basin and Montney Shales in northeast British Columbia, the Colorado Group in Alberta and Saskatchewan, the Utica Shale in Quebec and the Horton Bluff Shale in New Brunswick and Nova Scotia.

Figure 1: Shale Gas Plays of North America



Source: Advanced Resources, SPE/Holditch Nov 2002 Hill 1991, Cain, 1994 Hart Publishing, 2008. Modified from Ziff Energy Group, 2008.

Drilling and Production

While producers have only been focusing on shale gas for the past few years, extracting hydrocarbons from shale is not new. In fact, natural gas has been produced from shale in the Appalachian Mountains since the late 1800s. Today, there are two primary technologies used to produce shale gas: horizontal drilling and multi-stage hydraulic fracturing.

Hydraulic fracturing, or "fraccing," in industry jargon, involves injecting fluid at a very high pressure into underground rock formations in order to fracture the rock. The fluid pumped down the well is loaded with granular material that helps prop open the fractures and allows the gas to escape the shale. The gas can then flow to the surface through a well. By drilling horizontal wells, where the drill bit is steered along a horizontal trajectory, the wellbore is exposed to as much of the shale reservoir as possible and may intersect more natural fractures.

The trade-off between horizontal wells and conventional vertical wells is increased access to the reservoir but at a higher cost. The technology and the extra time needed to drill horizontally or to fracture a well makes shale gas expensive to produce. Horizontal shale gas wells typically cost $5 to $10 million. Furthermore, shale gas producers generally only recover 20 per cent of the gas while in conventional reservoirs, more than 90 per cent of the gas is normally recovered.

Environmental Effects

There are some concerns about the effects shale gas drilling has on the watershed, land-use footprint and increase in carbon dioxide emissions, among other environmental issues. Drilling and hydraulically fracturing wells can be water-intensive procedures. In the U.S. where water is extensively used in hydraulic fracturing, producers developing the Barnett Shale in Texas used one per cent of all the water consumed in the Fort Worth basin in 2007. Water that has been used to fracture a shale gas well can contain chemicals and additives so it is never allowed to enter the watershed. Typically, it is disposed of by injecting it deep below the earth's surface into rock formations, which is a common practice in Western Canada and strictly regulated by provincial authorities. The land-use footprint of shale gas development is not expected to be much greater than conventional operations because advances in horizontal drilling allow for up to ten or more wells to be drilled from the same wellsite. While not all shale gas contains significant amounts of CO_2, the potential growth in carbon emissions from some shale gas is being addressed with proposals for carbon capture and sequestration. Still, it is very early to make any conclusions about how developing this resource will impact the environment.

Shale Gas in Canada

With the recent drop in Canadian conventional natural gas production, shale gas could allow Canada to meet its own need for natural gas well into the 21st century. ***Table 1*** summarizes Canadian shale gas plays that are currently being evaluated, including the:

- Montney Formation – The production of natural gas from horizontal shale gas wells in the Montney of northeast B.C. has risen from zero in 2005 to 10.7 10^6 cubic metres per day (376 million cubic feet per day) and is expected to continue rising. As of July 2009, 234 horizontal wells were producing from the Montney shale. Exploration companies have spent more than $2 billion since 2005 to acquire rights in the Montney Formation from the B.C. government.
- Horn River Basin - Wells in this basin in northeast British Columbia are prolific and produce an average initial flow rate of 230,000 cubic metres per day (8 million cubic feet per day) with the top wells ranking amongst the most productive drilled in Western Canada last year. Exploration companies have spent over $2 billion to acquire resource rights in this basin.
- Colorado Group - The Colorado Group of southern Alberta and Saskatchewan have been producing natural gas from shale for over 100 years. Because of poor rock conditions and the risk of caving in the wellbore, only vertical wells are planned in the Colorado shale.
- Utica Group - These shales, located between Montréal and Quebec City near the Appalachian Mountain front, have an increased potential for natural fractures. The potential for shale gas from the Utica Group is still in the early evaluation stages.
- Horton Bluff Group - While still in the early evaluation stage, two vertical wells drilled in New Brunswick have flowed 4,200 cubic metres per day (0.15 million cubic feet per day) after undergoing small fractures.

Table 1: Comparison of Canadian Gas Shales

	Horn River	Montney	Colorado	Utica	Horton Bluff
Depth (m)	2,500 to 3,000	1,700 to 4,000	300	500 to 3,300	1,120 to 2,000+
Thickness (m)	150	Up to 300	17 to 350	90 to 300	150+
Published estimate of natural gas (Tcf)*	144 to 600+	80 to 700	> 100	> 120	> 130
Horizontal well cost, including fractures (Million $Cdn)	7 to 10	5 to 8	0.35 (vertical only)	5 to 9	unknown

***Recoverable gas will be considerably less.**
These numbers come from a variety of sources, including exploration companies that selectively release information to the public.
The NEB has made no attempt to verify these numbers.

Natural Gas Infrastructure in Canada

Currently, there is not enough infrastructure in northeast B.C. to handle growth in shale gas production beyond the next few years. In 2008, the National Energy Board approved an application by Spectra Energy to build the South Peace Natural Gas Pipeline which would carry 6.2 10^6 cubic metres per day (220 million cubic feet per day) through the Montney area to Spectra's gas processing plant in Taylor, B.C. NOVA Gas Transmission Ltd. has also applied to the NEB to build the Groundbirch Pipeline in the same area, with a potential capacity of 28 10^6 cubic metres per day (1 billion cubic feet per day). The Utica shale gas play is adjacent to the Trans Québec & Maritimes Pipeline while potential shale gas from the Horton Bluff is close to the Maritimes & Northeast Pipeline.

Conclusion

While there is currently little significant production of shale gas, studies show there is potentially 30 10^{12} cubic metres (1,000 trillion cubic feet) of shale gas in Canada if not more. However, the economics of shale gas development is still uncertain. The industry will only invest in developing the resource if it is profitable, which means the price of gas from other sources, like LNG, will need to be higher than the cost of producing shale gas.