CANADA’S Natural Gas
**Natural Gas: Tomorrow’s Energy**

The world relies on all forms of energy – oil, natural gas, coal, hydro, nuclear and renewables. Global demand for energy is expected to increase 30% by 2040. As the world’s population and economies grow, so does the need for energy.

World demand for natural gas is expected to increase 45% by 2040, driven primarily by rapidly expanding Asian economies. Canada has enormous natural gas resources and our industry is well-regulated, technically advanced and is positioned to help meet global demand.

In Canada, we know resource development has an impact on the environment and we recognize the need to develop our natural gas in a way that is environmentally responsible. Canada’s natural gas industry is committed to improving environmental performance. We take action to manage our impacts through innovation and technology to improve our overall environmental performance. Innovative approaches to reduce emissions help Canada achieve global environmental commitments as the world transitions to a lower-carbon future.

The Canadian natural gas industry is poised to play an important role in the global energy mix, now and for decades to come.
GLOBAL ENERGY MIX
The world relies on an energy mix that includes all forms of energy – oil, natural gas, coal, hydro, nuclear and renewables. All forms of energy are needed to meet growing global demand. Canada can provide a safe and secure supply of energy.

1,225 TRILLION CUBIC FEET
Canada is the world’s fifth-largest producer of natural gas, with an estimated 1,225 trillion cubic feet (Tcf) of remaining natural gas resources.
Source: National Energy Board (NEB), 2017

From heating homes to generating electricity, currently natural gas meets about 35% of Canada’s energy needs.
Source: Statistics Canada, 2016

Given current domestic consumption, Canada has more than enough natural gas for at least 300 years.

TECHNOLOGY
Technology and innovation play a critical role in improving environmental performance in our resource development. Advances in recovery technology have unlocked shale and tight gas, increasing Canada’s overall natural gas supply.

CANADA’S ENERGY FUTURE
Natural gas is an affordable, reliable, versatile, abundant and cleaner-burning hydrocarbon.
Global demand for energy is expected to increase 30% by 2040 as both developed and emerging economies continue to grow and standards of living improve. 

Source: IEA, 2017

Global demand for natural gas is expected to increase 45% by 2040. 

Source IEA, 2017

Canada’s Natural gas supply and export

With strong production and an abundant resource, Canada’s natural gas industry delivers affordable and reliable natural gas to Canadians across the country.

Canada currently only exports natural gas to the United States. Although 2016 and 2017 saw an increase in natural gas exports to the U.S., there has been a steady decline in natural gas exports since 2007 as the U.S. has developed its domestic supply of natural gas. In fact, the United States is now a net exporter of natural gas for the first time in 60 years.

Source: Energy Information Agency, EIA, 2018

Canadian Natural gas production and exports to the U.S. (Bcf/d)
Canada is the fifth-largest producer of natural gas in the world.

NATURAL GAS
Natural gas is a naturally occurring hydrocarbon consisting primarily of methane. As natural gas flows out of the ground, it may also contain sulphur compounds, nitrogen, carbon dioxide, and other substances. These compounds are removed from the natural gas at processing plants.

FORMATION
Natural gas was formed millions of years ago as heat and pressure transformed decaying plant and animal matter buried in sedimentary rock layers. The gas is trapped under an impermeable layer of rock that prevents it from flowing to the surface.

PRODUCING LOCATIONS
Natural gas has been part of Canada’s energy mix since 1859 when it was first discovered in New Brunswick. Natural gas resources are located in British Columbia, Alberta, Saskatchewan, Ontario, Quebec, New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland and Labrador, the Northwest Territories and Yukon.

Today, natural gas production is mainly from the Western Canada Sedimentary Basin (WCSB) in British Columbia, Alberta, and Saskatchewan. Atlantic Canada is currently the only region producing natural gas offshore, from areas off the coast of Nova Scotia.
CANADA’S NATURAL GAS RESOURCE

NATURAL GAS PRODUCING REGIONS IN WESTERN CANADA
Source: NEB 2015

SHALE GAS, TIGHT GAS - Natural gas may be found in rock that is porous, but much of the remaining natural gas in Western Canada is trapped in less porous rock — in other words, the formation, which is often shale, is “tight.” Hydraulic fracturing is required to produce natural gas from such formations.

HYDRAULIC FRACTURING - Hydraulic fracturing pumps fluid — a mixture of sand, water and some additives — into the well at high pressure, causing the reservoir rock to crack and releasing the flow of natural gas.

Hydraulic fracturing has been safely used in resource development for more than 60 years.

COMPONENTS OF HYDRAULIC FRACTURING FLUID
Source: CAPP

Hydraulic fracturing fluids are comprised primarily of water and sand, and a small amount of additives.

RECOVERING NATURAL GAS
Natural gas is extracted from beneath the earth’s surface using a variety of methods. The method used depends on the geology of the region.

VERTICAL DRILLING - Vertical wells are drilled directly into porous geological formations that hold natural gas.

HORIZONTAL DRILLING - Horizontal drilling uses flexible drilling pipe and a steerable drill bit to bend a vertical well at a target depth and then drill horizontally. This technique allows the well to have better access to the natural gas.
CANADA’S NATURAL GAS RESOURCE

ABOUT HYDRAULIC FRACTURING REGULATIONS - The Canadian natural gas industry is highly regulated. While each province has its own regulations, all jurisdictions have laws to manage environmental impacts, to protect fresh water aquifers, and to ensure safe and responsible development. For example, public disclosure of fracturing fluid additives is mandatory in Alberta, B.C., the Northwest Territories and New Brunswick. (www.fracfocus.ca).

DEPTH OF RESOURCE – Natural gas reservoirs developed using hydraulic fracturing are found two to three kilometres below ground (2,000 to 3,000 metres). For comparison, the CN Tower in Toronto is about a half a kilometre tall (550 metres).

DEPTH OF FRESH WATER AQUIFERS - Fresh water aquifers are usually found at depths less than 300 metres. When natural gas wells are drilled through aquifers, multiple layers of steel casing are cemented into place to isolate the aquifer from the natural gas-bearing zone and all activity inside the wellbore. The protection of fresh water aquifers is strictly regulated by provincial governments.

SIZE AND EXTENT OF FRACTURING - A horizontal well is drilled into the geological zone containing the natural gas. These zones are typically many metres thick and extend hundreds of metres laterally. Like a three-dimensional spider web, fractures extend between 50 and 100 metres from the wellbore. The fractures are only a few millimetres wide, enough for a few grains of sand to prop them open. The fractures do not usually extend beyond the natural gas-bearing zone.

HORIZONTAL DRILLING AND HYDRAULIC FRACTURING SCHEMATIC
Source: CAPP
CANADA’S NATURAL GAS RESOURCE

HYDRAULIC FRACTURING – HOW IT WORKS

DRILLING THE WELL - A drilling rig is moved to the well site and the well is drilled to the required depth – 2,000 to 3,000 metres below the surface.

SURFACE CASING - Steel casing is inserted and cemented in place, creating a solid barrier between the well and any underground water sources.

INTERMEDIATE CASING - Intermediate casing extends even deeper, below any fresh water sources, and provides an additional layer to the production casing.

HORIZONTAL DRILLING - Horizontal drilling extends the well hundreds of metres into the formation to allow more natural gas to be extracted.

PERFORATING THE WELLBORE - The wellbore casing is perforated, creating cracks in the rock, which provide entry points for the natural gas to flow.

FRACTURING - A combination of water and sand with a small amount of additives is pumped down the well at high pressure. When the pressure is relieved, the water disburses or flows back into the well, leaving a thin layer of sand to prop open the cracks, allowing the natural gas to flow to the surface.

GUIDING PRINCIPLES FOR HYDRAULIC FRACTURING

Protecting water during sourcing, use and handling is a priority. Industry abides by all regulations governing hydraulic fracturing operations, and follows voluntary guiding principles and operating practices that address fracturing fluid additives disclosure, risk assessment and management, baseline groundwater testing, wellbore construction and quality assurance, water management, fluid management, and anomalous induced seismicity.

CAPP GUIDING PRINCIPLES FOR HYDRAULIC FRACTURING

Source: CAPP

1. We will safeguard the quality and quantity of regional surface and groundwater resources, through sound wellbore construction practices, sourcing fresh water alternatives where appropriate, and recycling water for reuse as much as practical.

2. We will measure and disclose our water use with the goal of continuing to reduce our effect on the environment.

3. We will support the development of fracturing fluid additives with the least environmental risks.

4. We will support the disclosure of fracturing fluid additives.

5. We will continue to advance, collaborate on and communicate technologies and best practices that reduce the potential environmental risks of hydraulic fracturing.
Natural gas is versatile — it is used to heat homes, cook food, generate electricity and as a chemical feedstock.

**USES**

**NATURAL GAS USE**

From heating homes to generating electricity, currently natural gas meets about 35% of Canada’s energy needs.

Source: Statistics Canada, 2016

Demand for natural gas in Canada is driven primarily by industrial and residential users. Canadians consumed 9.1 billion cubic feet per day (Bcf/d) of natural gas in 2017.

Source: CAPP

Demand for natural gas varies due to weather, economic growth, market conditions such as prices, regulatory changes, and infrastructure constraints. Currently, supply exceeds domestic demand, creating the opportunity for exports and Canadian jobs.

**NATURAL GAS USE BY SECTOR IN CANADA, 2017**

Source: Statistics Canada

- **Industrial**: 68%
- **Residential**: 18%
- **Commercial**: 15%
USES

INDUSTRIAL - Natural gas accounts for about 68% of the energy used in the industrial sector both as a heat source – for example, in making steel – and as a feedstock in the petrochemical industry.
Source: Statistics Canada

RESIDENTIAL – Millions of Canadian homes use natural gas to heat and cool their home, cook, and heat water. Canadians also enjoy the benefits of increasingly efficient natural gas furnaces and appliances.

COMMERCIAL - Natural gas use in Canada’s commercial sector closely follows residential use patterns. Schools, hotels, businesses, and restaurants use natural gas for space heating, water heating, cooking, and air conditioning.

ELECTRICITY GENERATION – In Canada, natural gas is also used for power generation. As electricity generated by natural gas can be delivered quickly on demand, natural gas is an excellent partner for intermittent renewable power sources such as wind and solar.

TRANSPORTATION – To help reduce fuel costs and lower vehicle emissions, heavy-duty fleet owners are switching to natural gas to fuel trucks and buses. Natural gas can reduce vehicle greenhouse gas (GHG) emissions by up to 25%
Source: Go With Natural Gas – a Canadian Industry-Government Collaboration

PRODUCTS
Raw natural gas is comprised mainly of methane, which is also the largest part of household natural gas. Natural gas also contains other hydrocarbons including ethane, propane, butanes and pentanes, collectively called natural gas liquids (NGLs).

COMPONENTS OF NATURAL GAS
Source: CAPP

раМethane
Ethane
Propane
Condensate
Nitrogen
Carbon Dioxide
Hydrogen Sulphide
Helium
In 2017, Canada produced 245,000 barrels per day (b/d) of ethane - more than any other NGL.  
Source: CAPP, 2018

Natural gas liquids are an important part of the Canadian energy mix. NGLs are used as inputs for petrochemical processes, as a fuel for heating and cooking, and blended into vehicle fuels.

### USES FOR NATURAL GAS LIQUIDS

Source: U.S. Energy Information Administration (EIA)

<table>
<thead>
<tr>
<th>NGL</th>
<th>APPLICATION</th>
<th>END USE PRODUCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethane</td>
<td>Plastics production; petrochemical feedstock</td>
<td>Plastic, anti-freeze, detergent</td>
</tr>
<tr>
<td>Propane</td>
<td>Residential and commercial heating; cooking fuel, petrochemical feedstock</td>
<td>Home heating, small stoves, barbecues</td>
</tr>
<tr>
<td>Butane</td>
<td>Petrochemical feedstock; blending with propane or gasoline</td>
<td>Synthetic rubber for tires, lighter fuel</td>
</tr>
<tr>
<td>Isobutane</td>
<td>Refinery feedstock; petrochemical feedstock</td>
<td>Alkylate for gasoline; aerosols, refrigerant</td>
</tr>
<tr>
<td>Pentane</td>
<td>Natural gasoline, agent for polystyrene foam</td>
<td>Gasoline, polystyrene, solvents</td>
</tr>
<tr>
<td>Pentanes Plus</td>
<td>Blended with vehicle fuel, used for bitumen production in oil sands</td>
<td>Gasoline, ethanol blends, oil sands processes</td>
</tr>
</tbody>
</table>

### ELECTRICAL GENERATION

As government policies move to restrict emissions, natural gas is a preferred source for electrical generation as it has fewer emissions than coal-generated electricity.

Natural gas-powered electricity is expected to increase its total share of electricity generation capacity to 22% by 2040.  
Source: NEB, 2017

### CANADA’S POWER GENERATION CAPACITY

Source: NEB: Canada’s Energy Future 2017

<table>
<thead>
<tr>
<th>Source</th>
<th>Hydro</th>
<th>Wind</th>
<th>Solar</th>
<th>Biomass</th>
<th>Uranium</th>
<th>Coal</th>
<th>Natural Gas</th>
<th>Oil</th>
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<tbody>
<tr>
<td>2016</td>
<td>55%</td>
<td>8%</td>
<td>1%</td>
<td>2%</td>
<td>10%</td>
<td>7%</td>
<td>15%</td>
<td>2%</td>
</tr>
<tr>
<td>2040</td>
<td>48%</td>
<td>14%</td>
<td>5%</td>
<td>2%</td>
<td>6%</td>
<td>1%</td>
<td>22%</td>
<td>2%</td>
</tr>
</tbody>
</table>
TRANSPORTING NATURAL GAS
An integrated pipeline network safely moves natural gas from the well to the customer.

The length of Canada’s natural gas and NGLs pipeline network extends 830,000 kilometres (km).
Source: Canadian Energy Pipelines Association

Pipelines within a province are regulated by the provincial government, while pipelines that cross provincial boundaries or the Canada-U.S. border are regulated federally by the National Energy Board (NEB). The NEB is responsible for about 73,000 km of pipeline, or roughly 10% of the Canadian total.

GATHERING AND FEEDER PIPELINES – Gathering lines move natural gas from wellheads to processing facilities, while feeder pipelines transport natural gas and NGLs from various facilities and storage tanks to transmission pipelines. These pipelines are mainly concentrated in the producing areas of Western Canada.

TRANSMISSION PIPELINES – These are the major conduits of the pipeline network, transporting natural gas within provinces and across provincial or international boundaries.

DISTRIBUTION PIPELINES – These are operated by local distribution companies or provincial co-operatives, to deliver natural gas to homes, businesses, industrial and commercial customers.

Canada’s natural gas pipeline network is extensive – more than 830,000 kilometres.
Pipelines range in diameter from 17 to 27 centimetres (cm) (6.5 to 10 inches). In Alberta, almost 70% of the pipelines licensed by the Alberta Energy Regulator (AER) have an interior diameter of less than 17 cm, or about the size of a coffee cup.

Source: CAPP

Pipeline performance is continuously improving. A common indicator of overall pipeline performance is the ratio of incidents per 1,000 km of pipeline length. In Alberta, over the past decade, this ratio declined from 2.08 to 0.98 incidents per 1,000 km.

Source: AER, 2018

In addition to following strict regulations, the upstream natural gas industry has developed best management practices to improve pipeline performance.

Since 2008 the number of pipeline incidents declined while the length of pipelines grew.

Pipeline Inspections
Frequent inspections ensure operators follow rules and regulations, and that any safety hazards are identified and addressed.

Smart “pigs” are used to push stagnant fluids, slush and buildup out of pipelines.
Getting Canada’s natural gas to new global markets is critical.

With advances in recovery technology that have unlocked shale and tight gas resources, Canada’s potential supplies of natural gas have grown significantly – more than enough to provide natural gas to Canadians for the next 300-plus years at current consumption levels.

However, due to limited pipeline capacity, Canada is challenged to move natural gas from Western Canada to eastern markets, into the United States, and to new global markets.
**MARKETS**

Traditional markets for western Canadian natural gas are changing; exports to the United States, Canada’s only export market, have decreased to 8.2 Bcf/d in 2017 from more than 10 Bcf/d in 2007. Exports are likely to decline due to the U.S.’s growing domestic natural gas industry. In eastern Canadian markets, natural gas from Western Canada competes against U.S. imports from producing areas such as New York and Pennsylvania. In 2017, Canada imported about 2.4 Bcf/d of natural gas from the United States.

*Source: CAPP*

**FOREIGN NATURAL GAS IMPORTS**

*Source: Statistics Canada*

In 2017, about 60 per cent of total Ontario natural gas consumption was imported from foreign sources.

**NEW MARKETS**

Canada’s natural gas industry is seeking new markets where natural gas can be exported overseas as liquefied natural gas (LNG). The need to find global customers, especially in Asia where demand for natural gas is growing, is crucial to Canada’s natural gas industry.

By 2040, global demand for natural gas is expected to increase 45%. India and China will need an additional 51 Bcf/d.

*Source: IEA* For context, in 2017 Canada produced about 15.0 Bcf/d.

*Source: CAPP, 2018* An LNG industry in Western Canada can play a key role in supplying this demand for clean, affordable, reliable energy. Atlantic Canada is exploring LNG opportunities.

**POTENTIAL NEW NATURAL GAS MARKETS**

*Source: Statistics Canada*
TRANSPORTING LNG
LNG shipping has a proven safety record. The world’s first LNG tanker shipped the product safely from Louisiana to the United Kingdom in 1959. Through 50-plus years of marine shipping experience, more than 135,000 LNG carrier voyages have taken place around the world without major accidents, safety problems, or security issues, either in port or at sea.

Source: Centre for Liquefied Natural Gas

LNG CARRIERS ARE DESIGNED FOR A HIGH DEGREE OF SAFETY BY:

- Separating LNG cargo tanks from the hull structure using thick insulation.
- Installing closed cargo systems for loading or discharging, to prevent vapour venting.
- Temperature and pressure monitoring.
- Gas detection and cargo tank liquid level indicators.

MARKETS

CANADA’S LNG OPPORTUNITY
When natural gas is cooled to -161° C it becomes a liquid.

Liquefaction reduces the volume of natural gas so it can be transported safely and efficiently by ship to overseas markets, where it is converted back to natural gas for various uses.

As the majority of Canada’s natural gas resources are in B.C. and Alberta, the best place to establish new LNG processing and shipping facilities is on Canada’s West Coast, which is also close to potential new markets in Southeast Asia, India and China.

20,000 JOBS ANNUALLY
Developing and exporting more LNG from Canada would not only help meet growing global energy demand with cleaner-burning natural gas, but would also provide benefits to Canada’s economy. For example, upstream activities supporting one LNG plant in B.C. exporting 2 Bcf/d would provide 20,000 direct, indirect and induced B.C. jobs, about $475 million in annual payments to the B.C. government, and add $3.7 billion to B.C.’s GDP (annual figures averaged over 10 years).

Source: CAPP, 2017

More broadly, royalties and taxes generated by LNG development would help fund health care, education, infrastructure and social services across Canada.
ECONOMIC BENEFITS

Natural gas development makes a strong contribution to Canada’s economy.

ECONOMY

The upstream natural gas industry contributes to Canada’s overall economic health through jobs, and taxes and royalties paid to provincial and federal governments. For the period 2017 to 2027, total Canadian GDP impact from the natural gas industry is estimated to be $422.5 billion.

Source: Canadian Energy Research Institute (CERI), 2017

INVESTMENT

Capital investment by the conventional (non-oil sands) oil and natural gas industry was $22.3 billion in 2016 and estimated to be about $32 billion in 2017.

Source: CAPP, 2018

JOBS

In addition to paying royalties and taxes, the natural gas industry is a major employer and creates jobs across Canada. All provinces – even those with no natural gas resource – benefit from jobs related to natural gas, such as natural gas distribution, pipelines, and construction services.

115,000 JOBS

Total employment from the upstream natural gas industry (direct, indirect, and induced employment) is forecast to grow from about 62,500 jobs across Canada in 2017 to about 115,000 jobs by 2027.

Source: CERI, 2017
ECONOMIC BENEFITS

INDIGENOUS COMMUNITIES
Canada’s natural gas industry continues to build positive and mutually-beneficial relationships with Indigenous communities. An example is the Kitimat LNG export facility planned to be built on First Nations land under a partnership with the Haisla First Nation. Industry understands the value of consulting with Indigenous communities at the earliest stages of project development to identify concerns and mitigate potential impacts in a proactive manner.

$55 MILLION
During June-December 2017, Canada’s conventional oil (non-oil sands) and natural gas operators made payments in the form of royalties, and socio-economic and community benefits in the amount of $55 million to Indigenous governments of Canada.

Source: CAPP, 2018

GOVERNMENT REVENUES
Royalties, taxes and other government revenues support health care, education, infrastructure construction, social services and other government programs. Government revenues ensure all Canadians benefit from responsible development of our resources.

Due to economic conditions, provincial and federal government revenues from the upstream oil and natural gas industry were unusually low in 2016 but are expected to rebound.

ALBERTA AND B.C. GOVERNMENT REVENUES FROM UPSTREAM OIL AND NATURAL GAS

<table>
<thead>
<tr>
<th>Year</th>
<th>Royalties</th>
<th>Land Sales</th>
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</thead>
<tbody>
<tr>
<td>2015</td>
<td>$3.1 billion</td>
<td>$294 million</td>
</tr>
<tr>
<td>2016</td>
<td>$2.3 billion</td>
<td>$152 million</td>
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</table>

*Excluding oil sands and offshore.

Source: CAPP, 2017

Over the period 2017 to 2027, tax revenues to the federal government from upstream natural gas development in Canada are forecast to be $39.1 billion, plus about $24.5 billion to provincial governments. On average, expected annual federal tax revenues will be $3.5 billion, plus $2.2 billion at the provincial level. B.C. and Alberta will generate the highest shares of both federal and provincial tax revenues.

Source: CERI, 2017
Canada’s natural gas producers are committed to reducing impacts on the environment.

**LAND**

Canada’s natural gas industry minimizes impacts on the land by avoiding sensitive habitat, using narrow seismic lines, low-impact pipeline methods, and other measures.

**MULTI-WELL PADS** — Advances in horizontal drilling and the use of multi-well drilling pads have greatly reduced the amount of land disturbed for drilling operations. Several horizontal wells drilled from a single pad can access a greater area of the reservoir from a smaller piece of land than vertical wells drilled from single-well pads. A 20-well drilling pad disturbs about 5% of the land required for an equal number of vertical drilling pads.

**HORIZONTAL VS. SINGLE-WELL DRILLING PADS**

Source: Encana

Several horizontal wells drilled from a multi-well pad (left), can access a greater area of the reservoir from a smaller piece of land than vertical wells drilled from single pads (right).
**ENVIRONMENT**

**Land**

**RECLAMATION** - Reclamation planning starts at the beginning of the project and physical reclamation proceeds when natural gas resources have been depleted. It generally takes five years for a well site to be reclaimed - from capping the well and removing equipment to cleaning up any contaminants, replacing soil and replanting vegetation.

**SEISMIC MONITORING IN B.C.** - To detect seismic events, Natural Resources Canada (NRCan) operates the Canadian National Seismograph Network, a network of seismograph stations across the country. As part of a research consortium, the natural gas industry provided funding to increase the number of stations in northeast B.C. from 9 to 11, to improve understanding and facilitate research.

*Source: Geoscience B.C., CAPP, BC Oil and Gas Commission (BCOGC) and NRCan*

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**INDUSTRY IN ACTION**

**WILDLIFE MANAGEMENT**

Under a memorandum of understanding between the B.C. government, CAPP, and other industry stakeholders, the oil and natural gas industry voluntarily contributed up to $10 million for caribou research in B.C. *Source: Government of British Columbia.* The industry is also participating in research and programs to improve caribou habitat and help increase caribou populations.

**RECLAMATION RESEARCH**

Companies conduct a myriad of research programs to improve the efficiency and effectiveness of their reclamation. For example, Canadian Natural Resources Limited is examining improved methods of soil salvage to retain the valuable characteristics of soil nutrients and structures, as well as seed and root stocks for revegetation. Encana is collaborating with several First Nations in B.C. to select the best native plant species for revegetation, and the company’s wetland reclamation project near Nordegg, Alberta now supports moose, elk, black and grizzly bears, wolves, deer and a number of waterfowl species.

*Source: Geoscience B.C., CAPP, BC Oil and Gas Commission (BCOGC) and NRCan*
ENVIRONMENT

Water

WATER
Using water responsibly and protecting water sources is a priority for industry.

WATER USE
Natural gas operations require water for hydraulic fracturing, well drilling and well completion. Natural gas processing plants also require water. Most water used for natural gas production is withdrawn from surface fresh water sources such as lakes, rivers and dugouts. Water used during drilling and production is licensed through the provincial regulator. Water withdrawals are reported to and monitored by the regulator to protect the integrity of the water system, especially during low flow periods or drought conditions.

The industry is working to reduce fresh water use by using alternative water sources including:

BRACKISH WATER – Water extracted from slightly saline aquifers can be treated and used.

SALINE GROUNDWATER – In some cases, treated water drawn from deep saline aquifers can be used for hydraulic fracturing.

FLOWBACK – Fracturing fluid that flows back to the wellbore after hydraulic fracturing is completed.

PRODUCED WATER – Water naturally present in the reservoir, that is recovered along with the hydrocarbon.

MUNICIPAL WASTE WATER – In some cases, municipal effluent can be treated and used in natural gas operations.

PROTECTION
Protecting water resources is a priority for Canada’s natural gas industry. Canadians place high value on the country’s fresh water resources and expect the industry to manage its use of water responsibly. Sound wellbore design and construction is critical to protecting groundwater. Each wellbore has layers of steel casing that are cemented in place to prevent any fluids from migrating from the wellbore to groundwater. Wellbore design is strictly controlled by provincial regulators and wellbore integrity can be evaluated at any point in the life of a well.

TRANSPORTATION
Moving fluids during resource development is done carefully so that surface water and groundwater sources are protected. Industry conforms to all regulations, including the federal Transportation of Dangerous Goods Act, when transporting fracturing fluids, produced water and flowback.
**ENVIRONMENT**

**Water**

**VOLUMES**
Well drilling and completion operations generally require 400 to 600 cubic metres of water. Water needed for hydraulic fracturing varies depending on the geology of the target rock formation, and may use up to 100,000 cubic metres – but the average is about 15,000 cubic metres.

*Source: BCOGC, 2018*

Fresh water is an important resource. Government and industry work together to ensure water is used responsibly. Provincial governments regulate how much water can be diverted from fresh water sources. In 2017, short-term water use approvals, and water licences related to oil and natural gas development, accounted for about 3.6 million cubic metres of water use, or 0.003% of total volume of mean annual runoff in B.C.

*Source: BCOGC, 2018*

**WATER USE IN OIL AND NATURAL GAS DEVELOPMENT, BRITISH COLUMBIA**

*Source: BCOGC, 2018*

- **120.6 BILLION CUBIC METRES** represents the average annual runoff replenished in northeast B.C.’s river basins.
- **0.003 PER CENT** represents the per cent of annual runoff reported withdrawn for water licences and short-term approvals in 2017.
- **34.1 MILLION CUBIC METRES** represents the total volume of water authorized for use under water licences and short-term approvals issued in 2017.

**TESTING & MONITORING**
Canada’s natural gas industry voluntarily follows CAPP’s operating practices to test water wells located within 250 metres of natural gas developments prior to drilling to establish pre-development groundwater conditions, and to establish a process to address any concerns with water well performance after development. Water testing may be undertaken for:

- Domestic wells;
- Natural springs;
- Water sources; and,
- Larger regional monitoring projects with the government and regulator.

Provincial governments monitor regional groundwater quantity and quality to help manage groundwater resources sustainably. For example, Alberta Environment and Parks manages a network of monitoring wells called the Groundwater Observation Well Network (GOWN). This network consists of more than 250 active monitoring wells, more than 40 of which are equipped with satellite devices that transmit near real-time data. Thirteen new observation wells were added in the unconventional oil and natural gas resource areas to extend groundwater monitoring to improve understanding of the effects of hydraulic fracturing on groundwater sources.
INDUSTRY IN ACTION

MUNICIPAL WASTEWATER USE
Shell Canada is reducing its overall fresh water footprint by using municipal wastewater as first priority water in its operations. In 2014, Shell and the Town of Fox Creek signed an agreement that allows Shell to use the town’s treated wastewater in its operations and in return, Shell funded the engineering and design to upgrade the town’s raw water facilities. This alternative source of water replaces the use of about 400,000 cubic metres of fresh water a year.

WATER HUB
Encana’s Water Resources Hub in the Montney natural gas region in northeastern B.C. will significantly reduce fresh water use in Encana’s hydraulic fracturing operations in the region, by accessing saline water that’s unfit for human or agricultural use from a subsurface aquifer. By tapping this otherwise unusable source, the hub will conserve an estimated 2.7 million cubic metres of fresh water over the next five years, plus avoiding 250,000 truck trips for transporting fluids.

ENVIRONMENT

Air
Natural gas is the cleanest-burning hydrocarbon – 40% cleaner than coal when used in electricity generation.
Source: ARC Energy and CAPP

NATURAL GAS IS A CLEAN ENERGY SOURCE

40%

UPSTREAM NATURAL GAS EMISSIONS
Canada’s natural gas industry recognizes that climate change is one of the great challenges facing the world. While natural gas is the cleanest-burning hydrocarbon, our industry does emit GHGs, including methane, through fuel combustion and other operational processes such as flaring. Natural gas production also emits particulate matter as a by-product of fuel combustion, operating engines for natural gas processing operations. Sulphur dioxide ($\text{SO}_2$) is also emitted from operations that produce and process raw natural gas containing hydrogen sulphide ($\text{H}_2\text{S}$).
ENVIRONMENT

Air

EMISSIONS
Canada, with less than 1% of the world’s population, generated less than 1.5% of global GHG emissions in 2016.


Of Canada’s emissions, conventional upstream oil and natural gas operations emit 11%, or about the same as emissions from all of Canada’s buildings combined. In 2016, GHG emissions from the conventional oil and natural gas industry totalled 79 megatonnes of carbon dioxide equivalent (CO₂e).

Source: Environment and Climate Change Canada, 2017

CANADA’S GHG EMISSIONS BY SECTOR, 2016

MONITORING & REPORTING
Canada’s natural gas industry monitors GHG emissions and reports each year as required. Reporting is done via Environment and Climate Change Canada’s Single Window system - a central web tool shared with provincial partners that streamlines national and provincial reporting.

MANAGING EMISSIONS
Regulations in British Columbia, Alberta and Saskatchewan have helped reduce upstream emissions and serve as models for other jurisdictions:

- British Columbia eliminated routine flaring in 2016. Since 2006, industry has reduced annual flare volumes by 23%.
  
  Source: BCOGC

- Alberta reduced natural gas flaring by 71.9% from 1996 to 2016.
  
  Source: AER, 2017

- Saskatchewan enforces regulations for reducing flaring, incinerating, or venting from oil and natural gas operations.
ENVIRONMENT

Air

METHANE

Methane, the largest component of natural gas, contributes to GHG emissions so reducing methane emissions is an important way to tackle climate change. Both Alberta and British Columbia are committed to reducing methane emissions by 45% from 2012 levels by 2025.

Methane is emitted from many sources:

• Fuel combustion from transportation;
• Extraction industries such as oil and natural gas, and coal mining;
• Industrial processes such as aluminum production
• Electricity generation;
• Wildfires and crop waste burning;
• Livestock; and,
• Landfills, liquid and solid waste.

“Fugitive emissions” from oil and natural gas operations come from small leaks from valves and other equipment used in drilling and production, and are unintentional. The industry has initiatives in place to reduce fugitive emissions. “Venting” is a controlled release of gases including methane, SO$_2$, H$_2$S, and other compounds, as part of natural gas processing. Regulations and industry best practices provide guidance to avoid venting when possible.

Between 1996 and 2016, Alberta reduced natural gas flaring by 71.9%.
Source: AER, 2017

NATURAL GAS GHG EMISSIONS REDUCTIONS

71.9%

GLOBAL METHANE EMISSIONS BY COUNTRY

- Canada 1.2%
- Mexico 1.5%
- United States 6.2%
- Russia 6.8%
- India 8.0%
- China 21.9%
- Other 54.3%

ENVIRONMENT

Air

MANAGING METHANE EMISSIONS
Canada’s natural gas industry recognizes the opportunity for improved performance on methane emissions. The industry has committed to reduce methane emissions by 45% by 2025. Through relationships with regulators, governments, and stakeholders, the industry can deliver action on climate change while realizing the economic benefits the sector brings to Canada’s economy.

TECHNOLOGY IS KEY
Technology is critical to reducing methane emissions from natural gas development and operations. This includes using solar panels for power and systems to capture vented gas, thus eliminating engine emissions, and redirecting gas to help fuel compressor engines. The industry is also partnering with the Petroleum Technology Alliance of Canada (PTAC) on a number of initiatives, including:

• Area methane detection using work trucks, to allow screening and triage of emission sources so operators and regulators can focus on emissions reduction plans.

• Advanced methane detection, analytics and mitigation to test technologies on major methane sources.

• A methane abatement tool that aggregates data and generates emissions reduction offsets in Western Canada.

END-USE EMISSIONS
Burning natural gas releases CO₂, nitrogen oxide, sulphur oxide and particulates. However, natural gas is the cleanest-burning of all hydrocarbons. That’s why natural gas can help to reduce global GHG emissions, especially when it’s used instead of coal, which produces more emissions.

Life cycle GHG emissions of natural gas from shale reservoirs are slightly higher than those of natural gas produced from more conventional sources.
Source: NRCan

However, comparisons of several studies of GHG life cycle emissions for natural gas produced using hydraulic fracturing indicate there is little difference between conventional natural gas production and natural gas produced using hydraulic fracturing.
Source: ICF Consulting, 2012
INDUSTRY IN ACTION

METHANE DETECTION

Shell Canada launched a methane detector pilot at one of its shale gas sites near Rocky Mountain House, Alberta. This pilot project is part of the Methane Detectors Challenge, a partnership between various governments, industry and environmental stakeholders, and technology developers, to test next-generation methane detection technologies. The initiative aims to enable better early detection and repair of methane leaks, and ultimately reduce emissions. The sensing system used in the pilot is a new technology that can continuously monitor methane emissions, unlike hand-held optical gas imaging cameras.
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gowithnaturalgas.ca

GOVERNMENT OF BRITISH COLUMBIA MINISTRY OF ENERGY, MINES & PETROLEUM RESOURCES
www2.gov.bc.ca

NATIONAL ENERGY BOARD (NEB)
neb-one.gc.ca

NATURAL RESOURCES CANADA
nrcan.gc.ca

NEW BRUNSWICK DEPARTMENT OF NATURAL RESOURCES
www2.gnb.ca

NOVA SCOTIA DEPARTMENT OF ENERGY
gov.ns.ca/energy/oil-gas

STATISTICS CANADA
statcan.gc.ca

U.S. ENERGY INFORMATION ADMINISTRATION (EIA)
eia.gov

UPDATES
The facts provided in this book are current as of July 2018.
A regularly updated version is available online at:
www.canadasnaturalgas.ca.

Discover Canada’s natural gas industry with social media:
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THE CANADIAN ASSOCIATION OF PETROLEUM PRODUCERS
capp.ca

The Canadian Association of Petroleum Producers (CAPP) represents companies, large and small, that explore for, develop and produce natural gas and crude oil throughout Canada. CAPP’s member companies produce about 80 per cent of Canada’s natural gas and crude oil. CAPP’s associate members provide a wide range of services that support the upstream crude oil and natural gas industry. Together CAPP’s members and associate members are an important part of a $110-billion-a-year national industry that provides essential energy products.

CAPP’s mission, on behalf of the Canadian upstream oil and natural gas industry, is to advocate for and enable economic competitiveness and safe, environmentally and socially responsible performance. Competitiveness, in North America and globally, is necessary so as to attract the capital necessary to grow production and expand markets to deliver value to the Canadian public and to our investors. Public confidence, from governments, Aboriginal Peoples, the public, stakeholders and the communities in which we operate, will be determined by our collective performance and the effectiveness of our communications and outreach.