

Pipeline Infrastructure

Abstract

Canada's crude oil and natural gas pipeline network extends 700 000 kilometres throughout Canada, except Prince Edward Island and Nunavut and is composed of pipelines and associated facilities. The vast concentration of pipelines is found in the Western Canada Sedimentary Basin (WCSB), where most petroleum exploration and production occurs.

The map shows three types of pipelines: transmission trunk lines, gathering system field lines and distribution lines. Gathering pipelines move crude oil and natural gas from wells to processing facilities. After processing, feeder lines carry the hydrocarbons to the major, long distance transmission lines. Transmission lines deliver product to small-diameter distribution pipelines, as well as industrial users, local distributors, refineries or connection pipelines to the United States.

Local distribution companies (LDCs) use distribution lines to deliver natural gas to homes and businesses. Crude oil transmission lines also transport natural gas liquids (NGLs) and other refined petroleum products, while natural gas transmission lines only transport natural gas. There are approximately 100 000 kilometres of transmission pipelines in Canada, 80 000 are natural gas pipelines and 23 000 crude oil pipelines.

There are seven regions in Canada where petroleum bearing sedimentary rocks laid down 560 million years ago possess fossil fuels - coal, crude oil or natural gas. These regions are often referred to as the seven hydrocarbon regions – Western Canada Sedimentary Basin, Atlantic Margin, Arctic Cratonic, Arctic Margin, Pacific Margin, Intermontane and Eastern Cratonic. The four 'other' sedimentary basins (see map) do not have significant reserves of fossil fuels (hydrocarbons). In the hydrocarbon regions of the sedimentary basins, crude oil is derived from marine plants and animals, mainly algae that have been heated at temperatures between 50 and 150 degrees Celsius for at least one million years. Natural gas is formed from both marine and terrestrial organic material at varying temperatures and pressures.

Most of Canada's crude oil is collected at Edmonton and transported on three major pipeline systems: Enbridge Pipelines Inc., Trans Mountain Pipe Line Company Ltd. and Express Pipeline. The last two pipeline companies are operated by Kinder Morgan Canada. Enbridge Pipelines Inc. is composed of approximately 3700 kilometres of pipeline from Edmonton to Sarnia, and transports about 270 000 cubic metres of crude oil a day. The Trans Mountain pipeline system (approximately 1150 kilometres) transports crude oil and refined products from Edmonton to terminals

and refineries in the greater Vancouver area via Kamloops and Burnaby, British Columbia. The Express Pipeline system transports crude oil from Hardisty, Alberta to Casper, Wyoming on 1236 kilometres of pipeline.

There are seven major natural gas pipeline companies in Canada: TransCanada Pipeline Ltd., Westcoast Energy Inc., Alliance Pipeline, TransGas Limited, Union Gas, TransQuebec and Maritimes Pipeline Inc., and Maritimes & Northwest Pipeline. These companies are the service providers for transportation of natural gas and sell their services to the owners of the natural gas, according to the terms of a pipeline tariff. These tariffs are a set of procedures a company follows in selecting which customer to serve or help to determine the building of new pipelines. Natural gas is stored in underground reservoirs to help balance seasonal demand fluctuations. There are large natural gas storage facilities in Alberta and Ontario.

Oil trunk pipelines are made from steel and are essentially tubes with diameters up to 120 centimetres, buried at a depth ranging from 1 to 2 metres. Pumps situated along the pipelines move oil at speeds of 4 to 8 kilometers per hour. Some pipelines, called multi-product pipelines, can transport different products in sequences (or batches) without mixing of products. Natural gas pipelines are made of carbon steel and vary in diameter from 51 millimetres to 1400 millimetres and move gas by pressure generated at compressor stations situated along the pipeline.

Both pipeline networks are composed of key structures or facilities that allow for the transportation of oil and natural gas through pipelines from the source to the distributor and ultimately the customer. These key infrastructure facilities are described below.

Refinery

There are sixteen refineries across Canada where crude oil is refined to produce a full slate of petroleum products such as gasoline. Refined petroleum is transmitted to the consumer by pipeline, ship, rail, truck or to storage at distribution terminals.

Upgrader

Upgraders use fractionation or chemical treatment of bitumen or heavy oil to increase its value. The minimum objective is to reduce the viscosity to allow shipment by pipeline.

Gas Processing Plant

Natural gas processing plants are used to purify the raw natural gas and remove such impurities as hydrogen sulphide. The processed natural gas is used as fuel by residential, commercial and industrial consumers.

Liquefied Petroleum Gas (LPG) Fractionators

Plant where refined crude oil is fractionated into its component parts to make methane, ethane, propane, butane, pentane and other lighter hydrocarbons. At normal temperatures LPG is a gas, but it can be cooled or subjected to pressure to facilitate storage and transportation.

Liquified Natural Gas (LNG) Terminal

LNG is natural gas that has been super chilled and converted to liquid form for ease of storage and transport. LNG import terminals regassify the LNG before the gas enters the pipeline network. The most advanced LNG import project is Irving/Repsol's Canaport project in New Brunswick. LNG imported at Canaport will serve the Maritimes and the US Northeast markets.

Meter Station

These stations measure the quality and volume of gas as it travels through the pipelines usually monitored from a central control system called the Supervisory Control and Data Acquisition (SCADA)

Pump Station

Station used to pump liquids (oil) by electric pumps and in remote areas they are diesel powered pumps, which vary in size depending upon type of pipeline, volume and type of product. In some cases three or more pumps may be located at one station. Pump stations have sensors which are connected to the SCADA.

Compressor Station

Station used to move gas by turbines through pipelines. The gas pipeline network is monitored at both compressor stations and at meter stations by the SCADA.

Farm Terminal

Terminal where one or more tanks are used as a temporary depot for oil storage from which oil is unloaded in tanks or withdrawn from them by pipeline as required to meet demand.

Storage Facilities

Storage facilities are used to store oil or natural gas for eventual distribution. Tanks can be found above ground while depleted oil and gas wells, salt caverns and other geological formations can be used for underground storage.

Interconnect Facility

Facility located where one pipeline system interconnects with another operator's pipeline system.

Natural Gas Marketing Hub

The location at which two or more transmission networks connect and where producers, traders, marketers, transmission companies and local distribution companies facilitate the movement and transfer of natural gas ownership.

Map Sources

Pipelines and Facilities

PennWell Corporation. 2006. This map includes information copyrighted by PennWell Corporation, 8000-823-6277. This information is provided on a best effort basis and PennWell Corporation does not guarantee its accuracy nor warrant its fitness for a particular purpose. Such information has been reprinted with the permission of PennWell.

Sedimentary Basins

Not all of the sedimentary basins depicted on the map conform to the strict definition of the term 'basin'. A sedimentary basin is a geographical feature which exhibits subsidence and consequent infilling by sedimentation. Some of the basins on the map are erosional remnants or outliers and others are defined by their physiographic or bathymetric extent rather than by their surface geology. Map compiled by G.D. Mossop, K.E. Wallace-Dudley, G.G. Smith and J. C. Harrison. Geological Survey of Canada. 2004. Map: Sedimentary Basins of Canada. Open File 4673. Scale 1:5 000 000.

References

Bott, D. Robert . 2004. Evolution of Canada's oil and gas industry. Canadian Centre for Energy Information.

Canada. Natural Resources Canada. 2000. Energy in Canada.

Canadian Energy Pipeline Association. 2008. Welcome to Pipelines 101 (http://www.cepa.com/pipeline101.aspx?page_guid=6F35823F-A318-499B-BAC0-CB5DDE396C42)

Petroleum Communication Foundation. 2000. Canada's Pipelines.

Related Web sites (1999 – 2009)

Federal Government

National Energy Board of Canada
<http://www.neb-one.gc.ca/clf-nsi/index.html>

Other

Centre for Energy
<http://www.centreforenergy.com/404.asp?404>; <http://www.centreforenergy.com/Silos/ET-CanEn01.asp>

Petroleum Communication Foundation
http://www.abheritage.ca/abresources/partners/part_pcf.html

