Moving Alaska gas from Canada to the Lower 48

By: Bill White, *Researcher/Writer, Office of the Federal Coordinator*

May 31, 2011

What would happen to Alaska's natural gas once it reaches the end of the proposed pipeline, 1,700 miles from Prudhoe Bay?

The gas would flow into a vast network of Canadian and U.S. pipelines assembled over the past 60 years.

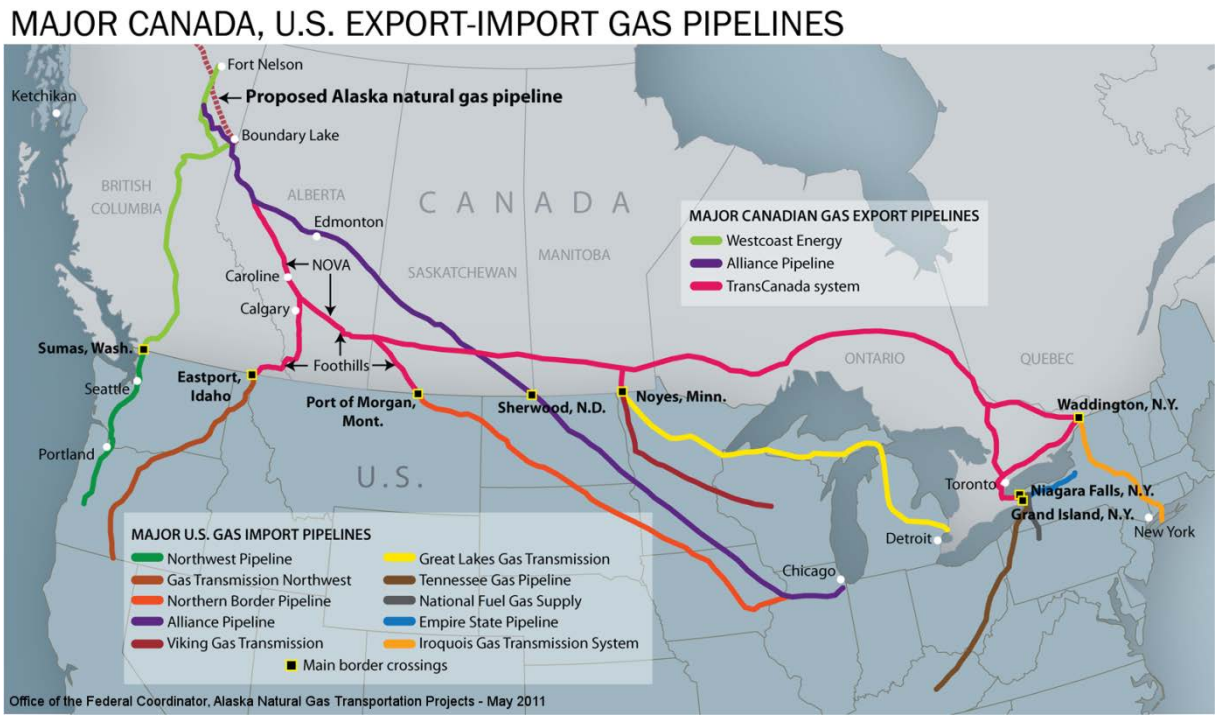
Some key components of that network were built or expanded in the early 1980s in anticipation of Alaska gas starting to flow back then. Those components went into service without Alaska gas and helped Canada double its natural gas exports to the United States in the 1980s, then double them again in the 1990s.

In all, the entire network today can move 15 billion to 20 billion cubic feet a day of natural gas, roughly three to four times the volume the Alaska pipeline would deliver to the British Columbia-Alberta border northwest of Edmonton.

Of course, the network still moves billions of cubic feet of gas daily. But the volume it handles has been declining, leaving room for Alaska gas, and even if the flow is relatively flush when the Alaska pipeline is finished, the network's capacity could be expanded. No longer is there serious talk of needing a pipeline stretching all the way from Prudhoe Bay to Chicago.

But why end the Alaska pipeline near the B.C.-Alberta border as opposed to somewhere else?

The answer is simple: Three major North American gas pipeline systems converge there, in the heart of some of Canada's hottest natural gas plays.



Expansive network of pipes

Once Alaska's gas reaches the North American pipeline network, it could be delivered to just about any major urban area in Canada or the United States, from Vancouver to Montreal, San Francisco to New York City.

Those three major pipeline systems connect to 10 big U.S. gas pipelines at eight major border crossings, from Sumas, Wash., to Waddington, N.Y. The U.S. lines link to a spider web of pipelines that flow natural gas north and south, east and west - wherever it's needed.

The proposed Alaska pipeline would carry as much as 4.5 billion cubic feet a day of natural gas toward Lower 48 household furnaces, power plants and petrochemical complexes. That's a volume equal to about **7 percent of current U.S. consumption**.

The biggest player in handling Alaska gas piped through Canada would be TransCanada Corp. of Calgary, Alberta. TransCanada is co-sponsor, with ExxonMobil, of the proposed Alaska pipeline. It also owns the biggest Canadian network of gas trunk lines, including one of the triumvirate of lines that converge near the B.C.-Alberta border. TransCanada also partly owns four of the 10 big U.S. pipelines.

The other two owners of major Canadian trunk lines are Enbridge Inc., also of Calgary, and Spectra Energy Corp. of Houston.

Before looking more closely at the pipeline systems that likely would receive Alaska gas, we'll first survey the western Canada natural gas industry, which has been in flux for several years.

The rise of Alberta gas

Western Canada produces well over 90 percent of that nation's natural gas.

But Canadian production peaked in 2002 and has sunk 13 percent since then - the numbers are even worse in Alberta. The **U.S. government projects** the production shrinkage north of the border will continue for perhaps another decade.

Canada produces far more gas than the nation can use internally. The **U.S. imported just over half of Canada's production last year**, an average of about 9 billion cubic feet a day, or bcf/d. About one-tenth of the natural gas that U.S. furnaces burn and U.S. industry consumes comes from Canada.

Meanwhile, Canadian gas exports to the United States are down - tumbling 13 percent since their peak in 2007, just before the Great Recession started.

Within these two facts - less production and fewer exports - lies a richer tale about what's happening in the Canadian gas patch.

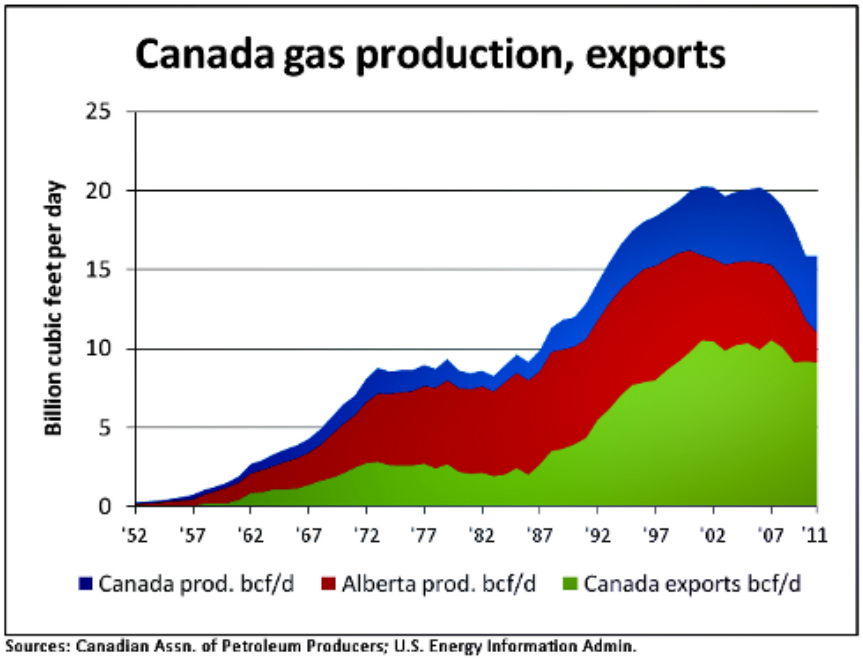
Canada's natural gas industry centers on the western province of Alberta, and its first growth spurt occurred in the 1950s and 1960s, roughly coinciding with development of Southcentral Alaska oil and gas fields, although the discoveries in Alberta were much larger.

In the 1950s, Canadians launched an ambitious plan to start building pipelines, storage sites, and gas liquids processing plants that could help the country become self-sufficient in energy. The plan stemmed from the major Alberta discoveries, a Canadian population boom and an acute lesson learned during World War II that the United States would supply itself with energy before shipping any north.

Construction of the Canadian Mainline, stretching from Alberta to eastern Canada, occurred in 1957-58. At 2,200 miles, it was the world's longest pipeline. The Canadian Mainline has been expanded many times since - although its capacity was reduced recently - and if Alaska gas flows into Canada, this likely would form a key channel for routing gas to the Lower 48.

As big as the infant Alberta natural gas industry was in the late 1950s, what came next was spectacular. The province's gas production rocketed in the 1960s, growing nearly fivefold and hitting 3.6 bcf/d by the decade's end.

Alberta gas production continued to soar each decade through the 1990s, with output peaking at 14.5 bcf/d in 2000. Through that period, 75 to 85 percent of Canadian gas production came from Alberta.



Sources: Canadian Assn. of Petroleum Producers; U.S. Energy Information Admin.

But, like Alaska's aging Prudhoe Bay oil field and its Cook Inlet gas fields, Alberta's conventional gas production has lost its pep. The province's gas output has plunged and now totals an estimated 11 bcf/d, a figure buttressed somewhat by flow from new shale and tight-gas plays in northwest Alberta.

Meanwhile, next door in northeast British Columbia, gas output is growing. Production has swollen from 2.2 bcf/d in 2000 to an estimated 4.1 bcf/d this year - nearly the same amount that Alaskans hope will flow from the North Slope.

Gas fever in British Columbia mirrors what's happening in the Lower 48: A new-found love affair with shale gas and other tight gas production (tight gas lies in relatively impermeable rock, such as shale). Coincidentally, British Columbia's shale and tight gas plays lie generally along the last miles the proposed Alaska pipeline to Alberta would traverse.

That bounty of natural gas in northwest Alberta and northeast British Columbia is why the three big western Canada pipeline systems gas converge there.

Shale woes

Shale gas has been a mixed blessing for Canada.

In Alberta and British Columbia, shale and other tight gas are propping up the region's production, offsetting some of the falling output from aging conventional fields.

Shale gas is eyed as a vital source of the region's jobs and resource wealth during the coming decades. It can help keep Canada self-sufficient in natural gas, and it can fuel the growing, but energy-intensive oil sands developments to the east in northern Alberta.

But the United States also has an abundant cache of shale gas in Texas, Louisiana, Pennsylvania and elsewhere.

As a result, the U.S. simply doesn't need to import so much Canadian gas. Lower 48 shale-gas output could grow from 9 bcf/d in 2009 to about 20 bcf/d in 2015, the U.S. Energy Information Administration forecasts. The EIA predicts other U.S. gas production will fall from about 48 bcf/d to about 42 bcf/d during that same period. (It should be noted that forecasting the future is tricky, and some analysts disagree with EIA on shale, other gas production, imports, etc.).

The rise of U.S. shale is displacing Canada gas imports.

The U.S. shale glut, with Alberta's aging conventional fields, helps explain why Canadian gas production has dropped 13 percent since peaking about a decade ago. But it's not the whole story.

Another factor is that growing supplies of Lower 48 shale gas have depressed natural gas prices for now. This has made drilling for Canadian gas less attractive. Less drilling typically means less production.

"While in previous years natural gas targets accounted for almost 80 per cent of new wells drilled in Canada, this percentage has been declining since 2006," **Canada's National Energy Board says in a new report**. "In 2010, only 40 percent of wells that were drilled targeted natural gas, and this is not expected to change until at least 2013. Moreover, new production has not been able to offset the drop in output from existing wells, and a gradual decrease in natural gas deliverability is expected between 2011 and 2013."

Another reason for falling Canadian exports is construction of major new U.S. pipelines - particularly those moving gas east and west from the Rockies. These pipes are carrying domestic gas to U.S. markets that Canada once targeted.

All of these factors have combined to open up space on gas pipelines crossing the border from Canada to the United States.

Canadian pipelines can channel 15 to 20 bcf/d of gas to the United States. Last year they averaged about 9 bcf/d. (Pipelines always will carry less on average than their capacity because gas demand fluctuates during the year based on weather. For example, a 2 bcf/d pipeline might carry an average of 1 bcf/d for the full year, but during the coldest days of January it might

carry 1.5 bcf/d. In this case, the pipeline's spare capacity in January is 500 million cubic feet a day, not the year's average spare capacity of 1 bcf/d.)

Of the 10 major import trunk lines, all but one of them are carrying less gas than at their peaks. The declines from their peak flows range from 12 percent to 79 percent.

The Canadian export pipelines

As was said, three main pipeline systems route gas to the Lower 48 from the Alberta-British Columbia region.

Here is a snapshot of those systems.

TransCanada

TransCanada Corp. is by far the largest player in moving natural gas within Canada. It also owns some of the U.S. system that picks up gas at the border.

Within Alberta alone, TransCanada operates about 15,000 miles of pipeline. The company says it gathers two-thirds of western Canada gas production.

TransCanada owns pipelines under its own name and under the names of wholly or partly owned subsidiaries in both Canada and the United States.

Its **NOVA Gas Transmission Ltd.** subsidiary runs the Alberta pipeline network, including the TransCanada trunk line that could pick up Alaska gas near the border with British Columbia.

FOOTHILLS (WESTERN LEG)
Owner: TransCanada Corp., Calgary
Export capacity: About 3 billion cubic feet a day (bcf/d)
Route: Via NOVA Gas Transmission – British Columbia and Alberta to Kingsgate, B.C./Eastport, Idaho
Gas destination in U.S.: Pacific Northwest, California, Nevada

NOVA would deliver Alaska gas to two other TransCanada-owned systems - Foothills and the Canadian Mainline - which would take the gas to the U.S. border.

The **Foothills** pipes were initially laid in the early 1980s from Caroline, Alberta, northwest of Calgary, down to the U.S. border. This was the piece of the 1970s-planned Alaska gas pipeline system actually built. Instead of flowing Alaska gas, the 771 miles of Foothills pipes today deliver Alberta and British Columbia gas to the Lower 48.

FOOTHILLS (EASTERN LEG)
Owner: TransCanada Corp., Calgary
Export capacity: About 2.4 bcf/d
Route: Via NOVA Gas Transmission – British Columbia and Alberta to Monchy, Saskatchewan/Port of Morgan, Mont.
Gas destination in U.S.: Midwest

Foothills-piped gas crosses the border at two locations: Eastport, Idaho, and Port of Morgan, Mont. The ultimate destinations are California and the Chicago area. The Idaho leg of Foothills' system can carry up to 3 bcf/d of gas, and the Montana leg about 2.4 bcf/d. Both have spare capacity today.

CANADIAN MAINLINE
Owner: TransCanada Corp., Calgary
Capacity: About 6.5 bcf/d
Route: Alberta-Saskatchewan to Quebec, with off-takes along the way
Gas destination in U.S.: Midwest and East (and southern Ontario)

The **Canadian Mainline** is the gas-distribution backbone of Canada. It runs from the Alberta-Saskatchewan border to the Quebec-Vermont border. It provides gas to central and eastern Canadian cities.

Gas comes off the Mainline at numerous border crossings. The biggest are at Noyes, Minn., and three New York state locations: Niagara Falls, Grand Island and Waddington.

The mainline has been carrying less and less gas. Its capacity is 6.5 bcf/d, but its flow has been ranging from about 3.5 to 5 bcf/d, depending on the day and season. The flow is down 59 percent in the past 10 years.

In recent years, TransCanada retired some of its unused Mainline gas capacity so that one of the parallel pipes that comprises the Mainline can carry oil instead. That 537-mile pipe became part of the company's Keystone pipeline that last year started delivering Alberta oil to Lower 48 refineries.

Spectra Energy

Spectra's British Columbia pipeline network stretches from Fort Nelson to Sumas, Wash.

WESTCOAST ENERGY INC.
Owner: Spectra Energy Corp., Houston
Export capacity: About 1.7 bcf/d
Route: Northeast British Columbia to Huntingdon, B.C./Sumas, Wash.
Gas destination in U.S.: Seattle, Portland, Pacific Northwest

The company owns 17,000 miles of transmission pipeline in the eastern United States. In 2002, it bought **Westcoast Energy** and that company's British Columbia pipelines.

Westcoast started laying its pipelines in the 1960s. As with the Foothills system, Westcoast was expected to pick up gas from the 1970s-era Alaska gas pipeline project that never was built. Besides serving British Columbia towns, Westcoast-carried gas is a key source of energy for Seattle and Portland.

Westcoast can deliver about 1.7 bcf/d of gas to the United States, but it averaged about half that last year. Its export volume peaked at about 1.1 bcf/d on average in 1999.

Alliance Pipeline

ALLIANCE
Owners: Enbridge Income Fund, Calgary; Veresen Inc., Calgary
Capacity: About 1.9 bcf/d
Route: British Columbia and Alberta to Northgate, Saskatchewan/Sherwood, N.D.
Gas destination in U.S.: Midwest

Alberta gas producers partnered in building the 1,855-mile-long **Alliance** line to near Chicago in the 1990s. In part, they wanted an alternative to TransCanada's system.

Pipeline company Enbridge Inc. now is a major owner of Alliance, with Veresen Inc., a Calgary energy company. Enbridge and Veresen own the Alliance line on both sides of the border

The Alliance pipe can carry about 1.9 bcf/d of gas. Alliance been running full or nearly full since startup just over a decade ago, in part because the long-term contracts signed by its original shippers haven't expired yet.

The U.S. import pipelines

Ten major U.S. pipelines pick up gas at eight border crossings.

Here's a snapshot of those lines.

From Sumas, Wash.

NORTHWEST PIPELINE
Owner: The Williams Companies, Tulsa, Okla.
Import capacity: About 1.7 bcf/d
Route: Sumas, Wash., to Oregon
Gas destination in U.S.: Seattle, Portland, Pacific Northwest

The 3,900-mile **Northwest Pipeline** network runs through the Pacific Northwest and Rockies, carrying gas in all directions from producers to consumers.

The section most relevant for Alaska gas extends from Sumas, at the border, south down the I-5 corridor past Seattle and Portland.

This pipeline has a 1.7 bcf/d capacity, and it has been carrying well under that flow for many years.

The Williams Companies of Tulsa, a major gas pipeline business, owns Northwest.

From Eastport, Idaho

GAS TRANSMISSION NORTHWEST
Owners: TransCanada Corp., Calgary; TC Pipelines, Omaha, Neb. (TransCanada owns one-third share of TC Pipelines)
Import capacity: About 3 bcf/d
Route: Eastport, Idaho, to Oregon-California border
Gas destination in U.S.: Pacific Northwest, California, Nevada

Gas Transmission Northwest runs the 1,351-mile pipeline system through northern Idaho, southeast Washington and central Oregon to the California border. There it links into the California gas pipeline system.

Gas Transmission can deliver about two-thirds of its 3 bcf/d capacity to California. Last year its average daily volume was 1.9 bcf/d.

TransCanada is majority owner of Gas Transmission. The pipeline picks up gas from one of TransCanada's Foothills pipelines.

From Port of Morgan, Mont.

NORTHERN BORDER PIPELINE
Owners: TC Pipelines, Omaha, Neb.; ONEOK Partners, Tulsa, Okla.
Import capacity: About 2.4 bcf/d

Route: Port of Morgan, Mont., to Chicago area
Gas destination in U.S.: Midwest

Northern Border Pipeline Co. takes gas from the eastern leg of the Foothills system. TransCanada is a minority owner of Northern Border.

This 1,398-mile pipeline system can carry 2.4 bcf/d southeast to suburban Chicago. Along the way, it picks up gas from the Bakken shale-gas play in North Dakota.

As the cross-border volumes have softened in recent years, Bakken gas has become more important. One of the pipeline owners, ONEOK Partners, said Bakken gas provided 12 percent of the pipeline's gathered volume last year, a number it expects to grow to 40 percent by 2013. Northern Border also should pick up gas from the new Bison pipeline, which starts in the U.S. Rockies. Bison is one of the new U.S. pipelines expected to take market share from Canadian exporters.

Northern Border's volume of imported gas is down 13 percent from its 1999 peak.

From Sherwood, N.D.

ALLIANCE
Owners: Enbridge Income Fund, Calgary; Veresen Inc., Calgary
Capacity: About 1.9 bcf/d
Route: Sherwood, N.D., to Chicago area
Gas destination in U.S.: Midwest

The **Alliance Pipeline** crosses the border at Sherwood. See the Alliance discussion above in the Canadian pipelines section.

From Noyes, Minn.

Two pipeline companies pick up gas from TransCanada at Noyes.

GREAT LAKES GAS TRANSMISSION
Owners: TransCanada Corp., Calgary, Alberta; TC Pipelines, Omaha, Neb.
Import capacity: About 2.5 bcf/d
Route: Noyes, Minn., to St. Clair, Mich.
Gas destination in U.S.: Wisconsin and Michigan (and Ontario)

The bigger is **Great Lakes Gas Transmission**. Its route runs south of Lake Superior then through the heart of Michigan, ending north of Detroit. Much of its gas then goes back into Canada.

The Great Lakes pipeline capacity is 2.5 bcf/d. TransCanada is majority owner.

VIKING GAS TRANSMISSION
Owner: ONEOK Partners, Tulsa, Okla.
Import capacity: About 500 million cubic feet a day (mmcf/d)
Route: Noyes, Minn., to central Wisconsin
Gas destination in U.S.: Minnesota, Wisconsin

The other pipeline at Noyes is **Viking Gas Transmission**, owned by ONEOK Partners, which also has a piece of the Northern Border line to the west.

Viking's capacity is 500 million cubic feet a day of gas, but its average daily volume is about half of that.

Some Viking-carried gas gets used in the Minneapolis-St. Paul area. But much of the volume is delivered to another gas pipeline system in central Wisconsin called ANR. TransCanada bought ANR in 2007.

From the Niagara Falls area

NATIONAL FUEL GAS SUPPLY CO.
Owner: National Fuel Gas Supply Co., Williamsville, N.Y.
Capacity: About 400 mmcf/d (from Empire Pipeline)
Route: Niagara Falls area to western New York, Pennsylvania
Gas destination in U.S.: Eastern U.S.

TransCanada delivers gas to two border crossings here: at Niagara Falls and at Grand Island, N.Y.

Volumes have been falling at these two locations, and they are the smallest of the major pipeline border crossings.

Three U.S. pipelines pick up gas in the Niagara Falls area.

EMPIRE PIPELINE
Owner: National Fuel Gas Supply Co., Williamsville, N.Y.
Import capacity: About 650 mmcf/d
Route: Niagara Falls area to western New York
Gas destination in U.S.: New York State

National Fuel Gas Supply Co. carries gas into Pennsylvania, the heart of the Marcellus shale-gas play.

National Fuel also owns one of the import pipelines here: Empire Pipeline. The Empire line runs for 157 miles through western New York state, making deliveries to local gas utilities and power plants. Empire also can send gas south to other East Coast interstate pipelines. In May 2011, Empire got Federal Energy Regulatory Commission approval to expand the pipeline and reverse its flow so that it can carry U.S. export gas to Canada.

TENNESSEE GAS PIPELINE CO.
Owner: El Paso Corp., Houston
Import capacity: About 1.3 bcf/d
Route: Niagara Falls area to western New York
Gas destination in U.S.: New York State

Tennessee Gas Pipeline Co. owns the third import pipeline here. Tennessee is one of several major interstate pipeline systems that transportation giant El Paso Corp. owns. It can flow gas from Texas, Louisiana or Niagara Falls into the Midwest and Southeast.

From Waddington, N.Y.

This is the eastern-most big export hub on the Canadian Mainline.

IROQUOIS GAS TRANSMISSION SYSTEM
Owners: TransCanada Corp., Calgary; Dominion Resources Inc., Richmond, Va.; National Grid, Great Britain; New Jersey Resources, Wall, N.J.; Iberdrola USA, New Gloucester, Maine.
Import capacity: About 1.2 bcf/d
Route: Waddington, N.Y., to New York City
Gas destination in U.S.: New York, New England

Iroquois Gas Transmission System pipes gas south to Connecticut, Long Island and New York City.

The pipeline's capacity is 1.2 bcf/d, and last year it carried about half of that volume from Waddington on an average day. Its volume has been falling since 2007.

TransCanada holds a 44.5 percent interest in Iroquois, the largest share among the five owners.

Expanding the pipeline capacities

It's too soon to speculate about what expansions, if any, would be needed for this collection of 13 Canadian and U.S. pipelines to handle Alaska's gas if a pipeline from Prudhoe Bay is built.

But if the system does need to be enlarged, the simplest, quickest and cheapest way to do so is by adding compressor stations on the existing pipelines.

Many of these pipeline systems already have been expanded this way over the years. The preliminary design of the Alaska gas pipeline would accommodate an expansion from 4.5 bcf/d to 5.9 bcf/d by adding compression.

Compression moves gas through the pipe. More compression moves more gas.

But adding compressors has its limits.

Pipeline capacities are generally limited by the pipe's diameter and by its maximum allowable operating pressure, or MAOP.

The larger the diameter, the larger the capacity.

A larger MAOP also allows more capacity. MAOP is generally a function of the pipe steel grade and wall thickness. Some pipelines are designed from the start to maximize their MAOP. Others are designed with expansion in mind, with spare MAOP built in.

Once the MAOP is maxed out, an additional pipeline would be needed, often referred to as looping the line. Sometimes, only a swath of the overall pipeline is maxed out, and looping is needed only for that part of the line.