NORTH AMERICA'S FOSSIL FUEL BOOM: MORE RISK FOR WATER?

Surge in oil and gas production has seen more spills that are harming water supplies

By Brett Walton, Circle of Blue

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Until two years ago, when the National Wildlife Federation pointed out their presence, the twin oil pipelines beneath the fast-flowing channel that connects Lake Michigan to Lake Huron were like nearly every other piece of North America's energy transport network. The 61-year-old steel pipelines, owned and managed apparently without incident by Enbridge Inc., a Canadian pipeline operator, attracted virtually no attention from citizens or Michigan's state government.

Those days are over. A remarkable and unexpected surge in continental production of oil and natural gas is reshaping domestic and global energy markets, dropping prices for gasoline, raising employment in the energy and manufacturing sectors, and prompting civic concerns about the risks to water, land, and communities.

The North American fossil fuel boom also is directing more attention than ever before to the management, safety, and disruptive changes in the pipeline and rail transport systems that ship oil and gas to market.

The continent's new energy reserves in Alberta and Saskatchewan in Canada, and in the Dakotas, Montana, Colorado, Texas, and the East are located in areas not always well connected to the conventional markets, refineries, and customers developed in 20th century, or to the growing 21st century roster of terminals under construction for exporting fuels.

Oil and gas, in effect, need more ways to get to market. Energy companies are engaged in a continental campaign to fashion build infrastructure to match the new geography and the new supply.

Piece by piece the energy industry is assembling an expanded circulatory system for moving oil and natural gas, but without a systematic national plan for developing these energy corridors in a way that minimizes risk. The route of the Keystone XL pipeline, which would link Alberta to the Texas Gulf and is the focus of national protest, crosses a sensitive aquifer in Nebraska that citizens and the state's governor want to protect. Over the last two years, trains carrying oil from Canada and the Dakotas have exploded in Aliceville, Alabama; Casselton, North Dakota; and Lac-Mégantic, Quebec, causing loss of life and property. In 2010, a pipeline carrying oil to a refinery in Detroit from the tar sands region of Alberta ruptured in southern Michigan, spilling nearly 850,000 gallons of sticky crude into the Kalamazoo River. And the National Wildlife Federation called the Mackinac Straits pipelines a "sunken hazard," prompting activist campaigns in communities from across the Great Lakes region to remove or reinforce the lines.

"Our big frustration is that, to a high degree, the planning of how to get the oil from point A to point B, is left up to the pipeline and energy companies," Carl Weimer, executive director of the Pipeline Safety Trust, an advocacy group in Bellingham, Washington, told Circle of Blue. "On the East Coast, for example, you see multiple companies trying to develop lines going to the same location. There doesn't seem to be any federal government oversight, no agency asking if two lines are appropriate in this location, or four. Because of this, more communities are affected by construction."

MAMMOTH NEW TRANSPORT CAPACITY

The scale of pipeline construction is astounding. Industry analysts forecast that an average of nearly $50 billion annually, $540 billion in total, will be spent by 2025 to create pipeline and rail networks that connect natural gas reserves in British Columbia and Pennsylvania and oil fields in Alberta, North Dakota, and Texas to refineries, processing plants, and coastal export facilities. Older pipelines are being enlarged and the direction of flow is being reversed to accommodate the unexpected bounty of hydrocarbons. Where pipeline capacity is insufficient, rail transport of crude oil—a more expensive and, in some ways, riskier alternative—has ballooned.

Construction crews are hustling to keep pace with demand for product. As many as 28,968 kilometers (18,000 miles) of new, expanded, or refurbished crude oil pipeline—enough to circle the Earths and then some—will be put in the ground in Canada and the United States by 2018, according to IHS Global, a consultancy. Jeff Wright, director of the Office of Energy Projects at the Federal Energy Regulatory Commission, the U.S. regulator for natural gas networks, says that a "tsunami of new pipelines" is imminent; growth is already occurring. Since the boom began in 2008, the U.S. crude oil system has expanded by 20 percent. Some 3,448 miles of crude oil pipeline were added to the U.S. system in 2013, increasing its length by 6 percent,

according to federal government data. The country's railroads are seeing comparable growth. Analysts estimate a two-year production backlog for new rail tanker cars designed with stricter safety standards.

"[The map] has been reshaped entirely," Ken Medlock, an energy economist at Rice University's Baker Institute, told Circle of Blue. "Most people 10 to 20 years ago would have told you that energy infrastructure would be developed to move product from the coast in, because we'd become an increasing importer of both crude oil and natural gas. And today you're actually seeing the exact opposite begin to emerge. We're going from the middle of the country to the coast and trying to find ways to export."

As the broadest expansion in decades of fuel transport capacity unfolds in Canada and the United States, the public is becoming increasingly aware of the potential for leaks, fires, water contamination, and concerned about how well pipelines and rail transit are being designed and operated. Line 5, which crosses the Straits of Mackinac in Michigan, is one of many dozens of pipelines, both old and new, from British Columbia to New England, that are being looked at in a new light.

According to Tom Miesner, a 35-year veteran of the pipeline business and principal of the consulting firm Pipeline Knowledge & Development, the challenge for the pipeline industry is twofold: the outward growth of cities, which brings more people closer to pipelines that were located in fields or forests when originally built, and the pipeline's proximity to water sources, where the environmental damages from a spill and the cost of cleanup are significant.

"For crude oil pipelines, the highest risk is where you have people and water because that is usually where the consequences of a release are greatest," Miesner explained.

A New Era of Oil and Gas

Construction of oil and natural gas pipelines in Canada and the United States has been swift and disruptive, with investment increasing 60 percent since 2010, to $89 billion in 2013, according to IHS. "By 2015, just a year from now, the landscape of major U.S. crude oil pipelines will have almost no resemblance to the picture that existed in 2005," IHS asserted in a December 2013 report.

The record levels of spending for pipeline construction are designed to keep pace with the increased growth in fossil fuel production. For the time being, the mismatch between production and transport capacity is growing wider and more apparent.

Since 2009, U.S. natural gas production rose 22 percent while crude oil production jumped 67 percent, according to the Energy Information Administration. In the same time, production of heavy crudes in Canada, including the tar sands, increased 70 percent, according to Canada's National Energy Board. President Obama's chief economic advisor compares the rise in U.S. oil production to discovering a new Iraq at home.

In oil and gas patches without adequate pipeline infrastructure, rail transport has grown exponentially. In just two years, exports of oil from Alberta to the United States by rail have shot up 813 percent. Rail shipment of crude oil within the United States is nearly off the charts, a 3,654 percent increase since 2009.

Opponents of the Keystone XL pipeline, the most visible of the proposed delivery routes, believe that stopping the project will help prevent the tar sands, one of the world's most expensive and dirtiest sources of oil, from being developed.

That logic, though, is being turned on its head by rail transport. Oil is not waiting for new pipelines, notes Medlock, the energy economist. It is hitching a ride southward on the rails.

"If you put the clamps on one part of the market, the capital will find a way to facilitate development if there's really an opportunity there," Medlock said. "And that's exactly what's happening."

In the Bakken oil fields of North Dakota, for example, the million-barrel-per-day production is now nearly double the region's pipeline capacity. The 450,000 barrels per day that cannot fit into a pipeline are being shunted to a growing fleet of rail terminals and then out onto the tracks in 100-car trains.

Meanwhile, new rail terminals to unload the trains and new tracks to run on are proposed for riverside and maritime locations from California and Washington to New York. Increases in rail traffic are creating congestion where they cut through towns and cities. More oil by rail means less space to move a record grain harvest in the Midwest to market.

"It's not an either/or proposal—to ship or not to ship oil," Mark Barteau, professor of chemical engineering at the University of Michigan, told Circle of Blue. "What you're going to do without pipeline capacity is transport fuels by less desirable means."

A GAME OF RISK

By "less desirable," Barteau means moving oil by rail. The rise of rail—as well as the expansion of older pipelines—raises questions of risk and of inadequate infrastructure, points underscored by several high-profile accidents recently involving oil trains and old pipes.

Risk itself is often misunderstood, or at least not understood by the general public in the way technical experts define the term. Those who analyze risk see it as a combination of two variables: both the likelihood of an accident and its consequences. The chances of any given pipeline breaking are small, but the risk is still significant if the rupture happens in a suburban neighborhood or under Lake Michigan.

Risks vary depending on circumstances. Crude oil pipelines pose a greater risk to sources of water than natural gas lines because of the cost of cleanup of liquid fuels. Though none of the experts interviewed for this story could provide data comparing rail spills to pipeline spills—a lack of which is a problem for nearly all pipeline risk calculations—they agreed that rail transit results in more accidents than pipelines but smaller volumes spilled.

Two recent accidents underscore the risks of rail. Ten months ago, a train carrying Bakken oil hit a derailed grain train in North Dakota and crashed, letting loose 396,000 gallons (1.5 million liters) of oil onto the prairie. In July 2013, an explosion following the derailment of a train carrying volatile oil from the Bakken killed 47 people in Lac-Mégantic, Quebec, and spilled at least 26,400 gallons (100,000 liters) of oil into the Chaudière River.

In both cases, the trains were using an older model of tank car that is easily punctured in an accident. Federal regulators in Canada and the United States have recommended phasing out the old cars, but a complete turnover in stock will take years. The U.S. regulator for oil and gas transport, the Pipeline and Hazardous Materials Safety Administration, proposed a two-year timetable, but industry representatives are asking for at least seven years to transition to safer models.

Pipeline spills, which are less frequent than rail accidents but often result in larger releases, can pose an even greater environmental risk to waterways. The worst was the 2010 spill of 845,000 gallons (3.2 million liters) of diluted bitumen into Michigan's Kalamazoo River, a spill that grew larger when the Enbridge operations staff misinterpreted emergency signals and failed to shut down the line. The heavy oil dropped to the river bed, where it is more difficult to remove. Transporting diluted bitumen by pipeline poses a higher risk to water than other forms of oil because it sinks. Cleanup costs have passed $1 billion. The National Academy of Sciences subsequently began to study the consequences of diluted bitumen spills.

In other cases, soft regulation has led to spills. An Exxon pipeline across the Yellowstone River in Montana ruptured in July 2011, spilling roughly 47,250 gallons (179,000 liters) of oil and causing $135 million in property damages. Investigators

found that flood waters had scoured the river bed and exposed the metal pipe that had been initially buried 4-feet deep, as required by federal regulations for pipelines crossing rivers. Pipeline operators, however, are not required to maintain that depth of cover over the lifetime of the pipe, even though rivers are dynamic earth-movers and exposure to debris in open currents can led to a collision and rupture.

Older pipelines are also a concern. Half the pipelines in the United States were built more than 50 years ago. A March 2013 spill in Arkansas, for instance, came from a pipeline roughly 60 years old, a case that federal regulators are still investigating. Michigan's U.S. Senate delegation has questioned, along with state officials, the safety of the 61-year-old Line 5 through the Straits of Mackinac because the consequences of a spill to the northern Michigan economy would be enormous. Enbridge increased the amount of oil running through the pipeline by 10 percent last year.

Age does not necessarily pose a greater risk. As long as they are properly maintained, older pipelines can operate without incident for decades—as is the case with Line 5, which has never leaked, according to Enbridge. But newer pipelines have the advantages of technological progress. They are made of better materials, are manufactured under tighter tolerances, and have better protection against corrosion, noted Barteau, who chaired a National Academy of Sciences committee on the pipeline transportation of diluted bitumen. But, as with any part of life, there are still risks.

"Pipelines are certainly not perfect," Barteau explained. "They do leak. Sometimes detection of leaks does not occur immediately, and there is human error in operating them, like in Marshall, Michigan [where the Kalamazoo River spill occurred]. So we need to improve the system at all points, not just by putting tougher materials into the ground."

Yet spending money on tougher materials does matter, Barteau said.

"The basic problem in this country is that we don't want to pay for infrastructure," he lamented. "We can't keep putting pressure on what we have until it turns to rust and dust."

Determining the condition of the nation's pipelines, however, is not so easy. For one, important data are missing. Reliable statistics on the number of minor leaks and near failures—cracks that should have been detected before reaching such a state of disrepair—are not available, said Oliver Moghissi, director of the Materials and Technology Center at DNV GL, an energy consulting firm.

Pipeline companies are supposed to keep detailed records of inspections, defects, and maintenance, but they are not required to keep such records for all pipelines, nor are they required to submit records to regulators, said Weimer of the Pipeline Safety Trust.

The data that are reported reveal divergent trends. For example, the number of significant incidents for hazardous liquid pipelines—a category that includes spills that result in death, hospitalization, fire, or damages above $50,000—declined for two decades only to rise again in the last five years.
"Everyone is scratching their heads," Weimer said, referring to the increase in accidents. "Is it aging infrastructure? A matter of too many pipelines built too fast? We have no conclusion."

LOCAL CONCERNS

The perception of risk is magnified for communities in the path of rail lines and pipelines, argues Moghissi, because the communities are often not in control of the decision to build the project, a decision that is made at higher levels of government.

But local governments are increasingly using the few tools at their disposal. New policies and regulations pop up almost daily as local and state governments struggle to yoke an industry pushing pell-mell for more production and more lines to carry it to market. The Appellate Court in New York, for instance, ruled in July that local governments can block hydraulic fracturing for

natural gas under home rule land-use regulations, while the city council in Vancouver, Washington, passed a resolution opposing an oil terminal at a nearby port on the Columbia River that would handle 360,000 barrels per day from rail cars—almost half the capacity of the proposed Keystone XL pipeline.

In Michigan, state government regulators also are responding to public pressure on Line 5. Opened in 1953 as part of an oil network that skirts the Great Lakes, the pipes under the Straits of Mackinac were moving light crude across Michigan in the 1970s when the United States became the world's top oil producer.

The oil continued to flow through the line during three decades of decline, as U.S. production fell to half its peak. Now North America is again the world's center of oil and natural gas growth, and communities see the lines under the Mackinac Straits as a threat to the waters.

Aware that a spill in the Straits of Mackinac would setback a thriving fishing industry and tarnish one of the state's top tourist destinations, the Michigan Department of Environmental Quality (DEQ) earlier this year requested from Enbridge operation and maintenance records for Line 5, as well as information about the composition of its oil deliveries.

"Even though we don't have regulatory authority over the pipeline, we have a constitutional duty to protect Michigan's natural resources," Brad Wurfel, Michigan DEQ spokesman, told Circle of Blue. A state task force is reviewing the documents and will offer recommendations by March 2015 for responding to a spill.

Land and water advocacy groups argue that a task force, while an encouraging first step, alone is insufficient. FLOW, an organization based in Traverse City, Michigan, that supports protection of natural resources for public use, is part of a coalition of like-minded groups that want the state to assess the potential harm from a Line 5 spill and exercise greater oversight over the pipeline.

"As things stand, Enbridge holds all the cards," Liz Kirkwood, FLOW's executive director, told Circle of Blue. "We want to open up the process and get the state to evaluate the pipeline and make decisions in full disclosure." Those decisions, Kirkwood said, could range from restrictions on the type of fuel carried in the pipeline to a decommissioning and re-routing.

FLOW will present its public-trust argument to the task force in December. For now, the state is poring over the substantial amount of information Enbridge turned over, said Wurfel, who asserted that the department is "feeling more confident" about the condition of the pipeline than before. Still, the department wants to prepare for the worst.

"We have to assume that somewhere down the road a spill is going to happen," Wurfel said.

SIDEBAR: ECONOMY

The energy boom has produced winners and losers. While Europe and other rich-world countries flounder, cheap oil and gas has helped lift U.S. economic growth, adding 0.2 percentage points to national output and 133,000 oil and gas jobs in three years, according to the Obama administration.

Those figures do not account for the spillover effects that lower energy prices can stimulate in local economies, related industries, and for individual consumers. A paper prepared for the Federal Reserve Bank shows that the drop in natural gas prices increased U.S. manufacturing output by 3 percent on average and as much as 30 percent for heavy energy users such as the chemical industry. Anecdotal evidence shows that the boom has revived energy-intensive manufacturing in formerly moribund towns in the Ohio River Valley.

For boomtown communities, the effects are mixed. Though new energy development has cut the unemployment rate and driven up wages, it also increases the cost of goods and services. Congestion and air pollution have a deleterious effect on the quality of life. Economists at the University of Georgia and Oklahoma State

University found that many studies emphasize short-term employment benefits over long-term environmental degradation that hurts industries such as agriculture or tourism.

SIDEBAR: COASTAL CONCERNS IN BRITISH COLUMBIA

Two pipelines from Alberta to the forested and craggy coast of British Columbia have stirred opposition from towns located at the end of the pipes.

On June 17, the Canadian government approved the $8 billion Northern Gateway pipeline, which would end in Kitimat, a town of 9,000 located halfway up the province's coast on the Douglas Channel, a busy industrial waterway where orcas and humpback whales travel. The project still must clear significant legal hurdles. At least 10 lawsuits have been filed against it, and more are expected.

The other project is a $5.4 billion expansion of the Trans Mountain pipeline, which terminates in Burnaby, a Vancouver suburb of 223,000 people. Kinder Morgan, the developer, wants to add a parallel pipe to the original line, built in 1953. The Canadian government will issue a ruling by January 2016.

The Kitimat council voted to oppose the Northern Gateway project after the town's residents voted in April against the pipeline, 58 percent to 42 percent. The town is a hub for northern British Columbia's mining industry and is home to both an aluminum smelter and two proposed liquefied natural gas terminals. Industry is well-established in Kitimat, but the community does not want the increased oil tanker traffic in the Douglas Channel.

"The possibility of a tanker failure is remote, I think, but it is one of the things that turned the council in opposition," Joanne Monaghan, mayor of Kitimat, told Circle of Blue. "We're not opposed to pipelines, but we don't want our water polluted."

Murray Minchin was one of those who voted no. A member of Douglas Channel Watch, an anti-pipeline group, Minchin has lived in Kitimat for 50 years. He worries about what would happen if the diluted bitumen that the pipeline will carry gets into the channel.

"A spill is too huge a risk for us to bear," he said. "We have wild rivers running into a wild ocean. Where else do you have that?"

Down the coast in Burnaby, officials have similar concerns about the Trans Mountain expansion. Today, six oil tankers per month enter the Westridge marine terminal to load petroleum products from the Trans Mountain pipeline. According to Kinder Morgan, as many as 34 tankers per month will weave past downtown Vancouver and into the terminal when the expansion is complete.

Derek Corrigan, mayor of Burnaby, wonders if oversight will erode over time. Even now, Kinder Morgan is not required to have a detailed emergency plan in place before the government blesses the expansion.

A plan with how to deal with a spill or what to do in case of a major fire at the storage tanks—located on a forested city hillside between a neighborhood, a golf course, and Simon Fraser University—can come later as a condition of the government's approval, Alastair Lucas, a University of Calgary law professor, told Circle of Blue.

Burnaby already experienced one spill from Trans Mountain. In July 2007, a construction crew pierced a segment of the pipeline located in a residential neighborhood, spilling 62,000 gallons (234,000 liters) that flowed through streets and storm drains, eventually reaching the waters of Burrard Inlet.

Because of safety concerns raised in public consultations, Kinder Morgan will change the pipeline's route through Burnaby, tunneling through a mountain to avoid a cluster of homes.

Though many in town feel that because of the Canadian government's support of the fossil fuel industry, approval of the expansion is inevitable;

Corrigan, a former lawyer, will continue to argue against the pipeline.

"I think people feel like it's a done deal," Corrigan told Circle of Blue. "But how we feel and how we should act are two different things. We still have to diligently pursue the arguments we're making because we owe that to our citizens."

Brett Walton is a reporting for Circle of Blue writing about agriculture, energy, and the politics and economics of water in the United States. Brett also writes the Federal Water Tap, Circle of Blue's weekly digest of U.S. government water news. In 2014, the Society of Environmental Journalists awarded Brett 3rd place in the SEJ annual awards competition for beat reporting in a small market (Western water issues). He can be reached at: brett@circleofblue.org.

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Cover Photo: *The Mackinac Bridge crosses the Straits of Mackinac, a narrow channel that connects Lake Michigan and Lake Huron. Just west of the bridge, submerged beneath the Straits, are the twin Line 5 oil pipelines, operated by Enbridge, a Canadian energy transport company. The 61-year-old pipelines have become a rallying point for environmental groups concerned about the risks of oil spills to freshwater resources.*

Photo Credit*: Carl Ganter, Circle of Blue*