



Economic, environmental, and safety impacts of transporting oil and gas in the U.S.

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Access to cheap and reliable energy is vital to the continued growth of the U.S. economy. In today's energy market, oil and gas are both relatively cheap and reliable energy sources. The efficient transportation of these products ensures that Americans are able to fuel their day-to-day lives. The United States transports large amounts of oil and gas over long distances to help meet the energy needs of its citizens. In 2017, petroleum production in the United States is nearing 15 million barrels per day and is projected to climb to 18.6 million by 2040.¹ Transporting these products in the most efficient and safest manner allows domestic energy production to flourish and provides U.S. consumers with access to affordable energy.

There are four main methods of transporting oil and gas in the United States: pipeline, rail, boat, and road transportation by truck. In this report we analyze the three inland transportation methods' economic impact, safety record, and effect on the environment, and look to determine which of the three deliver oil and gas to consumers most cost-effectively.

Pipeline is the most commonly used method for transporting oil and gas. About 70 percent of all domestically produced petroleum products is transported by pipeline.² There are currently 2.4 million miles of natural gas pipelines and 190,000 miles of liquid petroleum pipelines throughout the United States.³

Transportation by rail is the most commonly used alternative to pipeline transportation. Since the domestic oil boom in the mid-2000s, the use of rail to transport crude oil and natural gas has increased dramatically. In 2008, 7 million barrels of oil were delivered by rail. By 2013, that number increased to 262 million.⁴ Although that number decreased slightly in recent years, the competitive advantages offered by rail, particularly its access to remote regions, will likely make it a viable transportation method for years to come.

Although pipeline and rail are generally used to transport oil and gas long distances, truck transportation is commonly used to move smaller quantities of oil and gas over shorter distances. Despite the fact that trucks have limited holding capacity, they help move oil and gas from production sites to pipelines and other long-distances transportation infrastructure, and across areas where pipeline or rail infrastructure does not exist. An average truck holds about 200 barrels of oil, about one-third of the capacity of the average railcar.⁵

All three forms of transportation play a role in moving oil and gas efficiently, but each has its unique trade-offs in terms of economics, environmental impacts, and safety.

Economics: Pipeline, Rail, and Truck

Domestic pipeline construction benefits both workers and the U.S. economy as a whole. From 2015 to 2016, pipeline construction and operation resulted in a \$31.8 billion increase in labor income as well as a \$46.9 billion contribution to GDP.⁶ A pipeline like the proposed Keystone XL can move nearly 700,000 barrels of oil per day, benefitting producers, refineries, and consumers alike.⁷

Pipelines are large projects, and have high upfront costs. It can also take significant time and money to obtain necessary permits. According to the Oil and Gas Journal, the estimated construction cost of pipelines in 2013 was \$6.57 million per mile.⁸ Even after construction is completed, pipelines can be costly to maintain. A report by the National Association of Manufacturers estimates the annual maintenance and operation cost of a pipeline to be around

1 United States Energy Information Agency. (2016). *ELA projects rise in U.S. crude oil and other liquid fuels production beyond 2017*. Washington, D.C: Author. Retrieved from: www.eia.gov

2 Furchtgott-Roth, Pipelines are Safest for Transportation of Oil and Gas. (2013, Jun 23). *Manhattan Institute*. Retrieved from: www.manhattan-institute.org

3 American Petroleum Institute. (2017). *Pipelines*. Washington, D.C. Retrieved from: www.api.org.

4 Conca, J. (2014, April 26). Pick Your Poison For Crude--Pipeline, Rail, Truck or Boat. *Forbes*. Retrieved from: <https://www.forbes.com/sites/jamesconca/2014/04/26/pick-your-poison-for-crude-pipeline-rail-truck-or-boat/#41b3064c17ac>

5 Conca, J. Pick Your Poison for Crude--Pipeline, Rail, Truck or Boat.

6 National Association of Manufacturers. (2016). *America's Oil Pipelines--Fueling Manufacturing Jobs and Growth*. Retrieved from: <http://www.nam.org/Issues/Energy-and-Environment/Crude-Oil-Pipeline-One-Pager.pdf>

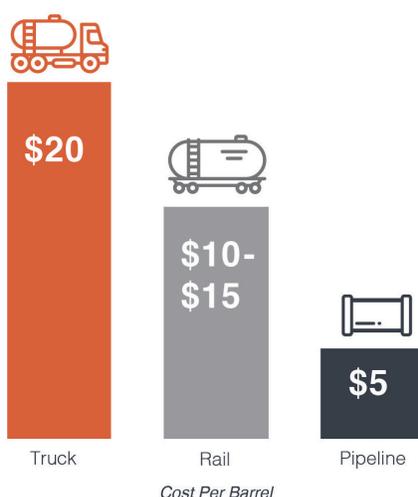
7 State Impact: Texas. (2015). *What is the Keystone XL Pipeline?* National Public Radio. Retrieved from: <https://stateimpact.npr.org/texas/tag/keystone-xl-pipeline/>

8 Smith, Christopher E. (2014, Sept. 14). Crude Oil Pipeline Growth, Revenues Surge; Construction Costs Mount. *Oil and Gas Journal*. Retrieved from: <http://www.ogj.com/articles/print/volume-112/issue-9/special-report-pipeline-economics/crude-oil-pipeline-growth-revenues-surge-construction-costs-mount.html>

\$135,000--\$175,000 per mile, depending on the size of the pipeline.⁹ In spite of these high upfront costs, there are currently over 30,000 miles of pipeline either under construction or planned in North America.¹⁰ This suggests that, despite their high upfront costs, pipelines are considered a worthwhile investment. Pipelines also require much less human capital than the other two methods of transportation, and are more efficient at moving product over large distances.

Transporting oil and gas by pipeline is generally cheaper than transporting it by rail or truck. On average, it costs about \$5 per barrel to transport oil and gas by pipeline compared to \$10-\$15 a barrel for rail and \$20 a barrel by truck.¹¹ These alternatives, however, offer their own advantages. Rail is faster than pipeline at transporting oil and gas across large distances. Rail can transport oil from the remote Bakken field region in North Dakota to the Gulf coast in anywhere from five to seven days, whereas oil transported by pipeline takes about forty days to travel the same distance.¹²

How Much Does It Cost?



Many of these remote regions could potentially be accessed by pipeline. Because of the time and effort it takes to get a pipeline project permitted, however, some oil transporters have begun using existing rail infrastructure in these areas to move their oil. Because the rail capacity in these regions is already mostly in place, many drilling companies need only construct a railroad terminal in order to ship their product. The price of these rail terminals, however, is also considerable. In 2013, TORQ Transloading Incorporated planned an oil loading rail terminal that would cost \$100 million.¹³ In 2014, Enbridge planned to construct an oil loading facility that was projected to cost upwards of \$150 million.¹⁴

9 O'Neil, B., Hopkins, P. & Gressley, J. (2016, February). The Economic Impact of Crude Oil Pipeline Construction and Operation. *National Association of Manufacturers*. Retrieved from: <http://www.nam.org/Issues/Energy-and-Environment/Crude-Oil-Pipeline-Impact-Study.pdf>

10 Pipeline and Gas Journal. (2017). P&GJ's 2017 Worldwide Construction Report. *Pipeline and Gas Journal*, 244, 1. Retrieved from: <https://pgjonline.com/2017/01/03/pgjs-2017-worldwide-pipeline-construction-report/>

11 Congressional Research Service. (2014). *U.S. Rail Transportation of Crude Oil: Background and Issues for Congress*. Retrieved from: <https://fas.org/sgp/crs/misc/R43390.pdf>; Hiller, J. 2013, July 28. Crude oil will continue rolling by train. *Houston Chronicle*. Retrieved from: <http://fuelfix.com/blog/2013/07/28/crude-oil-will-continue-rolling-by-train/>

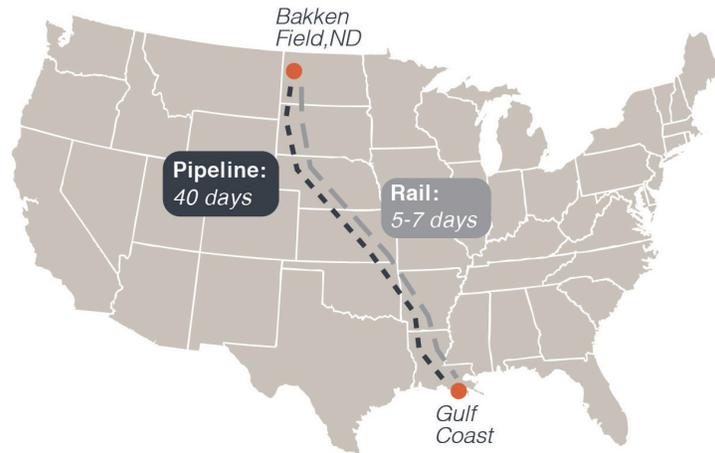
12 Batheja, A. (2014, April 12). Rail Transport of Crude Oil Increases as Pipeline Falls Short. *The New York Times*. Retrieved from: https://www.nytimes.com/2014/04/13/us/rail-transport-of-crude-oil-increases-as-pipeline-falls-short.html?_r=0; It should be noted that because active pipelines are always full of inventory, oil can be delivered to a customer almost immediately. This does, however, require the shipper to maintain a large amount of crude inventory.

13 Market News. (2013, August 14). TORQ to build 168,000 bpd Western Canada crude-by-rail terminal. *Reuters*. Retrieved from: <http://www.reuters.com/article/canada-crude-rail-idUSL2N0GF0Z520130814>

14 George-Kosh, David. (2014, August 01). Enbridge Plans U.S. Rail Loading Facility for Crude. *The Wall Street Journal*. Retrieved from: <https://www.wsj.com/articles/enbridge-plans-u-s-rail-loading-facility-for-crude-1406908778>

Rail is also constrained in terms of holding capacity. Trains have a limited holding capacity compared to pipelines. In 2013, the peak year for oil transportation by rail, trains moved a total of 262 million barrels of crude. In contrast, pipelines moved over 15 billion barrels of oil in that same year.¹⁵

How Long Does It Take?



Even with their speed advantage over pipeline, rail's limited capacity constrains the amount of product that can be moved. The limited carrying capacity of trains also congests rail infrastructure, limiting the transport of other products by rail.

Because road transportation is generally used to transport oil and gas shorter distances, it is hard to compare the economics of road transportation with other modes of transportation in a meaningful way.

Safety: Pipeline, Rail, and Truck

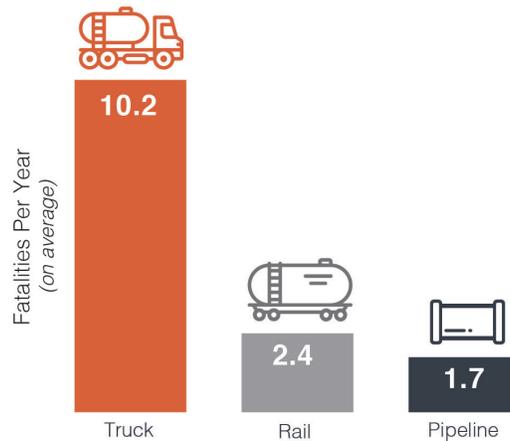
Many arguments against pipelines are centered on the possible danger they pose to human health and safety. Publicized accidents like the 2010 natural gas pipeline rupture in San Bruno, California that killed eight people understandably generate public wariness about further construction of pipeline.¹⁶ However, when compared with both train and truck transportation, pipeline is actually the safest method of transporting oil and gas. Oil and gas transportation by pipeline resulted in 1.7 fatalities to operators, personnel, and the general public per year in the United States. Rail transportation resulted in 2.4 fatalities and transportation by truck killed 10.2 people per year. Kenneth Green, an expert on crude-oil transportation at the Fraser Institute observed, "on an apples-to-apples basis, pipelines have less accidents [...] and cause less harm to human health than do railcars moving comparable amounts of oil and gas."¹⁷

¹⁵ Conca, J. (2014, April 26). Pick Your Poison For Crude--Pipeline, Rail, Truck or Boat. *Forbes*. Retrieved from: <https://www.forbes.com/sites/jamesconca/2014/04/26/pick-your-poison-for-crude-pipeline-rail-truck-or-boat/#41b3064c17ac>; Association of Oil Pipelines. (2013). Pipelines Transport Billions of Barrels of Petroleum Products Each Year. Association of Oil Pipelines. Retrieved from: <http://www.aopl.org/pipeline-basics/about-pipelines/>

¹⁶ Wald, Matthew L. (2011, August 30). Mismanagement Blamed for Bay Area Gas Disaster. *The New York Times*. Retrieved from: www.nytimes.com

¹⁷ Molinski, Dan. (2015, Sept. 13). How to Transport Oil More Safely. *The Wall Street Journal*. Retrieved from: <https://www.wsj.com/articles/how-to-transport-oil-more-safely-1442197722?mg=prod/accounts-wsj>

Safety Comparisons



To further illustrate the relative safety of transportation of oil and gas by pipeline, Green cited a statistic published by the National Weather Service that showed Americans are 75% more likely to be killed by lightning than they are in an incident related to an oil or gas pipeline.¹⁸

Environmental Impacts: Pipeline, Rail, and Truck

Despite increased safety regulations and technological advances that make spill and leak prevention much easier, oil and gas spills are inevitable. The Kalamazoo River spill in 2010, the spill on the Pegasus pipeline in 2013, and the Quebec train disaster in 2013 all contributed to recent public concerns about the environmental impacts of oil and gas.¹⁹

The U.S. Department of Transportation reports that there are about 280 “significant” pipeline spills each year.²⁰ A significant spill is defined as one where: there is either a fatality or injury requiring hospitalization, the spill causes over \$50,000 in damages, there are highly volatile liquid spills of at least 5 barrels or other liquid releases of 50 barrels or more, or there are liquid releases that result in an unintentional fire or explosion.²¹

In 2013, The United States Energy Information Administration reported that pipelines delivered over 7 million barrels of refinable product a day. Pipelines spill an average of 269 barrels for every million tons moved per mile per year.²² The vast majority of pipeline spills, however, occur in a facility rather than in actual line pipe.²³ These facilities are well-equipped to contain spills quickly and as such, pipeline spills boast a high product-recovery rate, the metric the Pipeline and Hazardous Materials Administration uses to measure the ease with which spilled materials can be cleaned up. On average, forty percent of all oil spilled by pipeline is recoverable.²⁴

18 Furchtgott-Roth, Green. (2013, October). Intermodal Safety in the Transport of Oil. *The Fraser Institute*. Retrieved from: <https://www.fraserinstitute.org/sites/default/files/intermodal-safety-in-the-transport-of-oil-rev3.pdf>

19 The Associated Press. (2010, July 28). Michigan: 800,000 Gallons of Oil Spill After Pipe Breaks. *The New York Times*. Retrieved from: <http://www.nytimes.com/2011/08/31/science/earth/31pipeline.html?ref=topics>; Frosch, Dan. (2013, April 02). Pipeline Spills Stir New Criticism of Keystone Plan. *The New York Times*. Retrieved from: <http://www.nytimes.com/2013/04/03/us/pipeline-spills-stir-new-criticism-of-keystone-proposal.html>; Conca, J. (2014, April 26). Pick Your Poison For Crude--Pipeline, Rail, Truck or Boat. *Forbes*. Retrieved from: <https://www.forbes.com/sites/jamesconca/2014/04/26/pick-your-poison-for-crude-pipeline-rail-truck-or-boat/#41b3064c17ac>

20 Conca, J. Pick Your Poison for Crude--Pipeline, Rail, Truck, or Boat.

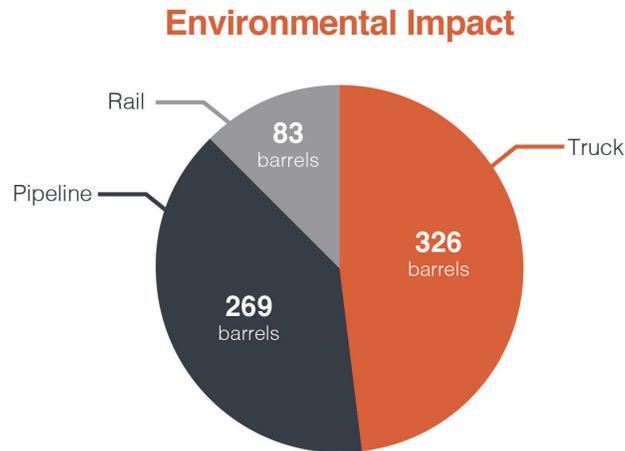
21 Pipeline and Hazardous Materials Safety Administration. (2016). *Distribution, Transmission & Gathering, LNG, and Liquid Accident and Incident Data*. US Department of Transportation. Retrieved from: www.phmsa.dot.gov

22 Furchtgott-Roth, Green. (2013, October). Intermodal Safety in the Transport of Oil. *The Fraser Institute*. Retrieved from: <https://www.fraserinstitute.org/sites/default/files/intermodal-safety-in-the-transport-of-oil-rev3.pdf>; Numbers in this paper were originally reported in gallons, but were converted to barrels using the conversion 1 liquid gallon = 0.0238 oil barrels.

23 Green, Kenneth P., T. Jackson. (2015, August). Safety in the Transport of Oil and Gas: Pipelines or Rail? *The Fraser Institute*. Retrieved from: <https://www.fraserinstitute.org/sites/default/files/safety-in-the-transportation-of-oil-and-gas-pipelines-or-rail-rev2.pdf>

24 Furchtgott-Roth, Green. (2013, October). Intermodal Safety in the Transport of Oil. *The Fraser Institute*. Retrieved from: <https://www.fraserinstitute.org/sites/default/files/intermodal-safety-in-the-transport-of-oil-rev3.pdf>

From 1975 to 2012 rail spilled a *total* of 800,000 barrels of oil. Since the use of rail for oil transportation increased in the mid-2000s, however, the amount of oil spilled by rail has skyrocketed. In 2013 alone, 1.5 million barrels of domestically produced oil were spilled.²⁵ Despite this recent increase in the amount spilled, railroads spill fewer gallons than trucks or pipelines per million tons moved every mile. Rail spills, on average, only 83 barrels per million tons moved per mile a year.²⁶



Barrels spilled per million tons moved every mile.

In terms of barrels spilled per year, transporting oil and gas by truck is the worst method of transportation. Trucks spilled more oil and gas than both rail and pipeline, averaging around 326 barrels per million tons moved every mile.²⁷ Road transportation is also closer to the general public. While pipelines and railways typically pass through rural areas with limited populations, oil trucks often pass through densely populated areas where spills and accidents have greater potential for human fatality and injury.

Although pipeline spills do occur, they are rare in relation to the massive quantity of product they move per year. When the amount transported is considered, transportation by pipeline is 4.5 times less likely to result in a spill than transport by rail.²⁸

Conclusion

Participants in recent protests such as those against the Dakota Access Pipeline and Keystone XL argue that pipelines are bad for the environment and bad for people. Access to cheap and reliable energy, however, is essential to modern life. Domestic oil and gas production provides access to abundant, affordable, and reliable energy, helping to meet demand from American consumers. This oil and gas must be transported from where it is produced to where it can be refined and ultimately consumed. As this brief has noted, all forms of transportation require unique trade-offs. Pipelines in particular have advantages in terms of safety, efficiency, and low environmental impacts. Pipelines, rail, and trucks all play valuable roles in moving oil and gas safely and efficiently. Policymakers deciding how to regulate the transportation of oil and gas should allow the market to determine which forms of transportation can most effectively meet consumer needs.

²⁵ Conca, J. (2014, April 26). Pick Your Poison For Crude--Pipeline, Rail, Truck or Boat. *Forbes*. Retrieved from: <https://www.forbes.com/sites/jamesconca/2014/04/26/pick-your-poison-for-crude-pipeline-rail-truck-or-boat/#41b3064c17ac>; it should be noted that much of this increase in spill can most likely be attributed to increased domestic energy production.

²⁶ Furchtgott-Roth, Green. (2013, October). Intermodal Safety in the Transport of Oil. *The Fraser Institute*. Retrieved from: <https://www.fraserinstitute.org/sites/default/files/intermodal-safety-in-the-transport-of-oil-rev3.pdf>

²⁷ Furchtgott-Roth, Green. Intermodal Safety in the Transport of Oil.

²⁸ Green, Kenneth P., T. Jackson. (2015, August). Safety in the Transport of Oil and Gas: Pipelines or Rail? The Fraser Institute. Retrieved from: <https://www.fraserinstitute.org/sites/default/files/safety-in-the-transportation-of-oil-and-gas-pipelines-or-rail-rev2.pdf>