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**Author**

***Matthew Craig, MBA***

***D. Larry Crumbley***[[1]](#footnote-2)\*

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This article focuses on the pipeline industry (SIC 4610 and NAICS 486000 codes) and the necessity for improvements in the U.S. pipeline infrastructure. Specifically, the paper discusses the history of ***oil*** and gas pipelines in the U.S., the regulatory bodies that govern these pipelines, and on public and environment safety involving the pipeline industry.

**Early Pipeline History of the *Oil* Industry**

There are several historians and sources that claim pipelines were first used by the Chinese with usage dating back to 500 BC. These pipelines are said to have been made of bamboo and were used to transport natural gas from brine wells (“History of Pipelines”). Pipeline technologies saw great advancement throughout the centuries, and in the Nineteenth Century the need for extensive ***oil*** pipelines became apparent. The first commercial ***oil*** well in the U.S. was drilled in 1859, by “Colonel” Edwin Drake in Titusville, Pennsylvania. In the beginning, ***oil*** was transported from the wellhead to rail stations by horses and wagons or barges (if the well was located near a river).

The individuals responsible for the initial transportation of ***oil*** by wagons were known as Teamsters (“The History of Pipelines”). With ***oil*** production continuing to grow and prosper, there was a high demand for the transportation services of Teamsters. This demand allowed Teamsters to exploit the market, and charge high fees for their services because of the lack of alternative modes of transportation. Due to the high volatility of ***oil*** prices, suppliers experienced troubling times and production even had to stop in some cases because of the high prices being charged by Teamsters to deliver ***oil*** to rail stations. It was not uncommon for the cost to transport ***oil*** five miles by Teamsters to be more expensive than the cost to transport the ***oil*** by rail from Pennsylvania to New York (Pees, 2004). This high price for transportation proved to be the main reason to develop alternative modes of transportation from the wellhead to rail stations.

Historian Samuel T. Pees along with several other historians give credit to clever individuals such as Samuel Duncan ***Kerns***, Evans W. Shippen, and Heman Janes as being some of the first to consider using pipelines as a means to transport ***oil***. As production continued to increase with more wells being drilled, modes of transportation became a more frequent topic. With several successful wells being drilled in deeper parts of the wilderness with rougher terrain, the traditional methods of transportation were becoming increasingly inefficient due to rising prices from the Teamsters.

Initially, several pipeline plans experienced resistance and were not provided with the necessary resources needed to be successful. Teamsters along with other groups saw pipelines as a threat to their jobs and their way of life (Pees, 2004). However, the resistance did not prevent the development of pipelines to transport ***oil***. Throughout the first half of the decade in 1860, there were several attempts to build pipelines from the well to rail stations. While most of these pipelines experienced mechanical failures or were destroyed by Teamsters, groundwork was laid for the components required to build a successful pipeline. In 1865, what is considered the first major successful pipeline was built by Samuel Van Syckel (Pees, 2004). The Van Syckel pipeline was approximately five miles long and was made out of iron pipe. Once complete, the pipeline was responsible for the delivery of close to 2,500 barrels of ***oil*** per day (Pees, 2004). The Van Syckel success was the beginning of the end for the Teamsters.

The next decade saw a major spike in the amount of pipelines being constructed to handle the growing demand for the transportation of ***oil*** wells to rail stations. As pipelines became the primary mode of transporting ***oil*** from the well to rail stations, the monopoly Teamsters had on the transportation of ***oil*** dissipated. However, this monopoly was soon to be replaced by another one: J. D. Rockefeller and Standard ***Oil***.[[2]](#footnote-3)1 In nearly a decade starting in 1870, Rockefeller acquired petroleum refineries until Standard ***Oil*** controlled roughly 90% of the U.S. refining capacity. At this time pipelines were still limited to transporting ***oil*** from wells to rail stations. Once at rail stations, ***oil*** was transported by the railroad companies to various refineries. With a limited number of participants, the railroad industry faced serious internal competition resulting in rate wars.

Analysis done by Elizabeth Granitz and Benjamin Klein explains the monopolization of railroad transportation by Standard ***Oil***.[[3]](#footnote-4)2 Rockefeller and Standard ***Oil***’s successful monopolization of railroad transit generated massive profits for the company. The profits continued to grow, and it seemed as if Standard ***Oil*** had positioned themselves as the dominant figure in the industry for the foreseeable future with no way of losing control.

Standard ***Oil*** successfully positioned itself as the primary market participant in the refining industry, and simultaneously controlled the railroad monopoly due to its refining capabilities. The cartel that had formed between Standard and the railroad companies made it impossible for a competitor to enter the market, unless, the new market entrant introduced an alternative means for transporting ***oil*** to refineries. Pipelines were being used to transport the ***oil*** from the well to rail stations, but a few entrepreneurs began to think about using pipelines to transport ***oil*** for longer distances in the late 1870s. These ideas were put to test when the Tidewater Pipe-Line Company was created on November 13, 1878 (Hartman, 2009). The plan was to build a long distance pipeline in order for individual refiners to bypass the railroad cartel that was headed by Standard, who wanted to maintain its market power.

The Tidewater Pipeline was a major development for use of pipelines in the ***oil*** industry. The implementation of pipelines had already once made a dramatic change in the industry by revolutionizing the transportation of ***oil*** from wells to rail stations. Now pipelines presented an opportunity for a low-cost, efficient means of transporting ***oil*** long distances. The railroad companies along with Standard saw the Tidewater Pipeline as a major threat to the massive profits they were making through the cartel they had formed. Despite all the prevention efforts exhausted by Standard and the railroad companies, the 109 mile long Tidewater Pipeline was constructed and the valves were opened on May 28, 1879 (Hartman, 2009).

The technological advancements used to successfully construct the Tidewater Pipeline sparked the construction of Standard ***Oils***’ own pipeline network. Rockefeller realized that an extensive pipeline network was the main threat to overthrow the transportation monopoly he had successfully created. In order to eliminate this threat, Standard positioned itself to have full control of the alternative to rail transit (Granitz and Klein, 1996). For the remainder of the Nineteenth Century, Standard continued to strong arm new market entrants out because of the transportation monopoly he had established through the railroad cartel and the introduction of an extensive pipeline network. Over the next few decades, Standard would face many difficulties in maintaining its monopolistic control of the industry. The continuous discovery of new ***oil*** fields in different regions of the country allowed for new market participants to enter and continue the development and advancement of more pipeline networks in the different regions.

Transporting ***oil*** and refined products longer distances allowed for greater efficiencies, but longer pipelines being built resulted in higher pressure in those pipelines. Thus, larger and longer pipelines leaks were common and a problem that needed to be resolved. In the 1920s, builders began to weld joints together to contain the high pressure and prevent leaks (“Pipeline,” 2015). Moving through the Twentieth Century, several technological advancements allowed the construction and functionality of pipelines to greatly improve. There were several advancements that extended the useful life of pipelines’ such as “pigs” which are used to clean the interior of pipes. Cathodic protection was used to prevent corrosion, and the implementation of computer systems allowed for more advanced communication from the fields to the offices and an increase in the ability to detect leaks (“Pipeline,” 2015).

**Need For Regulations**

Efficient transportation of ***oil*** and various refined products is essential to maintaining the economy of the U.S. and the world. Pipelines have proven to be the most efficient way to transport these goods over long distances. It is essential to properly monitor and maintain the pipelines responsible for the transportation of the necessary, yet hazardous materials. Today regulations regarding pipelines and the transportation of these potentially hazardous materials are typically centered on public and environmental safety.

The first discussion of regulation efforts of the ***oil*** industry were first introduced by the Interstate Commerce Act of 1887. The Interstate Commerce Act was passed in 1887 and this Act created the Interstate Commerce Commission, and the Act was meant to dissolve the railroad monopolies by enforcing set guidelines on how business would be conducted (Act of February 4, 1887). This Act was the first Federal regulation effort and only applied to railroads, focusing on “just and reasonable” rate changes (Act of February 4, 1887).

Overall, the Interstate Commerce Act of 1887 was not effective in accomplishing its goal because the Interstate Commerce Commission did not have enough power to enforce the guidelines established under the Act. The next legislation that was passed was the Sherman Antitrust Act of 1890. While the Interstate Commerce Act targeted only railroad monopolies, the Sherman Antitrust Act was the first legislation passed by Congress to eliminate all trusts and prevent monopolies from forming. Two major components of the Sherman Antitrust Act were the outlawing of any combination that would restrain trade between states or foreign nations, and the second making it illegal to attempt to monopolize any part of trade in the U.S. (“Sherman Antitrust Act,” 2015). Prior to the Sherman Antitrust Act, several states had passed their own laws to fight against monopolies and trusts, but they were only allowed to deal with intrastate trade. The passing of the Sherman Antitrust Act was backed by the power of Congress and had the ability to regulate interstate commerce along with intrastate.

Facing similar problems to the Interstate Commerce Act, initially the Sherman Antitrust Act was not enforced with a great deal of success in the early years after being passed. Those opposed to the act voiced that there were not clear definitions of what constituted trade among states (“Sherman Antitrust Act,” 2015). Additionally, the terms monopoly and trust were not clearly defined making it difficult to enforce the regulations set by the Sherman Antitrust Act.

During the first decade of the Twentieth Century Theodore Roosevelt fought relentlessly against monopolies and trusts. In 1904, Roosevelts’ perseverance led to the first successful case against a railroad holding company. Even with the ruling finding the Northern Securities Company in violation of the Sherman Antitrust Act, there were still monopolies controlling industries throughout the U.S. In an attempt to strengthen the regulatory power of the federal government, the Hepburn Act was passed in 1906. The Hepburn Act was strongly endorsed by Theodore Roosevelt and was focused on increasing regulation on all railways engaged in interstate commerce. Main points of the Hepburn Act included increasing the size and powers of the Interstate Commerce Commission by increasing the budget and amount of staff. The Interstate Commerce Commission was also given the power to establish maximum railway rates to lessen the power of railroad monopolies and Standard ***Oil***.

The Hepburn Act required that all railroad companies and carriers to adopt formalized and uniform accounting procedures. Another key point of the Hepburn Act was broadening the jurisdiction of the Interstate Commerce Commission to all common carriers, which included any business that transported information or goods for a fee (“Hepburn Act,” 2015). The Hepburn Act was a critical milestone in Roosevelts’ fight against monopolies and trusts. Through the provisions of the Hepburn Act, pipelines now fell under the jurisdiction of the Interstate Commerce Commission. In 1911, that Supreme Court found Standard ***Oil*** in violation of the Sherman Antitrust Act. After being found guilty of violating the Sherman Antitrust Act, Standard ***Oil*** was forced to dissolve into over 30 new companies. Many of the companies formed from the break-up of Standard ***Oil*** still rank as some of the most powerful ***oil*** companies in the world today.

With the break-up of Standard ***Oil***, the ***oil*** industry was finally able to act as a competitive market. Throughout the next several decades the use and need for ***oil*** and several other refined products grew exponentially. The growing need for ***oil*** and refined products drove the development of a vast pipeline infrastructure connecting the U.S. allowing for an efficient means of transportation. Since several laws and regulations that focused on preventing trade restriction had been passed in the early part of the Twentieth Century, the focus of regulation shifted towards pipeline safety.

Two of the early acts that established the federal role in pipeline safety were The Natural Gas Pipeline Safety Act of 1968 and the Hazardous Liquid Pipeline Act of 1979 (Service, 2012). The Transportation Secretary was given primary authority to regulate interstate pipeline safety including design, construction, operation and maintenance, and spill response planning (Service, 2012). The Department of Transportation administers pipeline regulations through the Office of Pipeline Safety within the Pipelines and Hazardous Materials Safety Administration (Service, 2012). The PHMSA pipeline safety program is funded through user fees determined on a per mile basis. Through these fees, the Office of Pipeline Safety is funded to staff more than 200 employees located in several major cities including Washington, DC, Atlanta, Houston, and others (Service, 2012).

The Pipelines and Hazardous Materials Safety Administration (PHMSA) through the Office of Pipeline Safety implemented safety standards for the transportation of ***oil*** through pipelines. The agency strives for compliance from pipeline operators by conducting inspections of management systems, procedures, processes, conducting physical inspections of facilities, investigating safety incidents, and communicating with pipeline operators (Service, 2012). The expectations for pipeline operators set by the PHMSA are broadcasted through several mediums. There are a wide variety of actions the PHMSA can take to enforce the regulations that have been set. Some of these include corrective action orders and civil penalties to make sure operators are held responsible for any safety violations and to prevent any future safety problems (Service, 2012). Civil penalties encourage pipeline operators to follow the safety regulations set in place. If operators do not follow these regulations they can face penalties costing them millions of dollars.

With several pipelines located near major cities, water sources, or other areas considered to be “high consequence areas,” the Pipelines and Hazardous Materials Safety Administration has increased the implementation of “integrity management programs” since 1997 (Service, 2012). These integrity management programs require continuous evaluation of pipeline conditions, assessment of any risks to the pipeline, inspections, and data analysis. In early 2001 integrity management programs were mandatory for most ***oil*** pipeline operators with at least 500 miles of regulated pipeline (Service, 2012). With the PHMSA and its Office of Pipeline Safety implementing and enforcing regulations for safe use of pipelines, the necessity for pipeline security protocols became apparent immediately following the devastating terrorists attacks that happened on September 11, 2001.

In November of 2001, the Aviation and Transportation Security Act was signed by President Bush, which established the Transportation Security Administration within the Department of Transportation (Service, 2012). Nearly a year later, President Bush signed the Homeland Security Act of 2002 which created the Department of Homeland Security. The act passed in 2002 also transferred the Transportation Security Administration to the Department of Homeland Security, and classifies the Department of Homeland Security as the lead agency for pipeline security and works with the Department of Transportation to regulate the transportation of hazardous materials (Service, 2012). Over the next several years, several other acts were passed in an effort to improve the security and safety programs for pipelines.

To strengthen the power of federal pipeline safety programs, President Bush signed the Pipeline Safety Improvement Act on December 12, 2002. A key aspect of this act was the interagency committee, which included the Department of Transportation, the Environmental Protection Agency, the Bureau of Land Management, the Federal Energy Regulatory Commission, and a few other agencies. This committee was to perform coordinated reviews and permitting of pipeline repairs (Service, 2012). Four years later, President Bush signed the Pipeline Inspection, Protection, Enforcement and Safety Act of 2006. This act focused of pipeline damage prevention, integrity management, corrosion control, and enforcement transparency (Service, 2012). Two key components from this act were the “call before you dig” 811 telephone number, and mandating review of federal pipeline safety regulations related to internal corrosion control (Service, 2012). The table on the next page describes several pipeline security initiatives that have occurred since 2003.

**Figure 1**

The initiatives listed in the table on the previous page are part of a continued effort to ensure the pipeline infrastructure of the U.S. is protected. This protection is very important to maintain a stable economy because over 75% of the U.S. crude ***oil*** along with approximately 60% of refined products is transported through roughly 170,000 miles of transmission pipeline (Service, 2012). This pipeline network has close to 200 interstate pipelines that make up almost 80% of the total pipeline mileage (Service, 2012). There are pipeline safety and security responsibilities that fall outside of the jurisdiction of the Pipelines and Hazardous Materials Safety Administration and the Transportation Security Administration.

The Federal Energy Regulatory Commission (FERC) also plays a role in pipeline safety regulations.[[4]](#footnote-5)3 Key responsibilities of the FERC consists of regulating the transportation of ***oil*** by pipeline in interstate commerce, administer accounting and financial reporting regulations and conduct of regulated companies, regulate the transmission and sale of natural gas for resale in interstate commerce, approve the siting and abandonment of interstate natural gas pipelines and storage facilities, and enforce the regulatory requirements set by the Commission through civil penalties. Overall, the responsibility of FERC is to regulate the practices of ***oil*** pipeline companies in interstate transportation to ensure that reasonable rates are established for transporting petroleum (Hollis, 2011). There are a great deal of government agencies that regulate pipeline safety and security. These agencies are responsible to ensure that the extensive pipeline infrastructure is protected and to uphold the ***oil*** pipeline companies to appropriate and acceptable business practices.

**Some Current Information**

Current information about pipelines can be found in these magazines:

* Pipeline and Gas Journal, (monthly), worldwide coverage.

1. Midstream Business (since Jan. 2011), merged with Pipeline and Gas Technology.
2. Right of Way magazine, international, bimonthly.
3. Pipeline: ***Oil*** & Gas Magazine, international, monthly.
4. Pipeline News, monthly.
5. ***Oil*** & Gas Journal, weekly.

There are more than 2.6 million miles of pipelines in the U.S., as the map below shows:

For example, Wikipedia lists these major U.S. interstate natural gas pipelines (which does not include minor interstate and offshore pipelines):

* Algonquin Gas Transmission

1. Alliance Pipeline
2. ANR Pipeline Company—formerly Michigan Wisconsin
3. Bluegrass Pipeline (proposed)
4. CenterPoint Energy Gas Transmission Company
5. Centerpoint Energy - Mississippi River—formerly, Mississippi River Transmission
6. Colorado Interstate Gas Company
7. Columbia Gas Transmission Corporation
8. Columbia Gulf Transmission Company
9. Devon Energy
10. Dominion Transmission, Inc. (formerly Consolidated Gas Transmission)
11. East Tennessee Pipeline
12. El Paso Exploration & Production
13. El Paso Natural Gas Company
14. Enbridge
15. Florida Gas Transmission Company
16. Gas Transmission Northwest Corporation—formerly Pacific Gas Transmission
17. Great Lakes Transmission
18. Gulf South Pipeline—formerly, United Gas Pipeline Company
19. ***Kern*** River Pipeline
20. Natural Gas Pipeline Company Of America
21. Kinder Morgan Interstate Gas Transmission LLC—owned by Kinder Morgan Energy Partners, formerly Kansas Nebraska and KN Energy
22. Magellan Midstream
23. Maritimes and Northeast Pipeline
24. Midwestern Gas Transmission Company
25. National Fuel Gas Supply Corporation
26. Northern Border Pipeline Company
27. Northern Natural Pipeline
28. Northwest Pipeline Corporation
29. Panhandle Eastern Pipe Line Company, LP
30. Portland Natural Gas Transmission System
31. Questar Pipeline Company
32. Rockies Express Pipeline
33. Ruby Pipeline
34. Southern Trails Pipeline
35. Southern Natural Gas Company
36. Southern Star Central Gas Pipeline, Inc
37. Suncor Energy
38. Tennessee Gas Pipeline Company
39. Texas Eastern Transmission Pipeline
40. Texas Gas Pipe Line Corporation
41. Texas Gas Transmission, LLC
42. Texas-Ohio Pipeline
43. Trailblazer Pipeline Company
44. Transcontinental Pipeline
45. Transwestern Pipeline Company, LLC
46. Trunkline Pipeline
47. Viking Gas Transmission Company
48. Williston Basin Pipeline
49. Williams Companies

Below on April 27, 2012, were the 20 largest market-cap U.S. pipeline master limited partnerships (MLP) (QVM Group LLC). A MLP is a limited partnership that is publicly traded on an exchange under I.R.C. Section 7704. This business form has the benefit of limited partnership treatment with the liquidity of a publicly traded entity.

1. Enterprise Products Partners L.P.
2. Kinder Morgan Energy Partners, L.P.
3. Plains All American Pipeline, L.P.
4. Energy Transfer Partners, L.P.
5. Magellan Midstream Partners, L.P.
6. ONEOK Partners, L.P.
7. Energy Transfer Equity, L.P.
8. Enbridge Energy Partners, L.P.
9. MarkWest Energy Partners, L.P.
10. Williams Partners L.P.
11. Buckeye Partners, L.P.
12. El Paso Pipeline Partners, L.P.
13. NuStar Energy L.P.
14. Regency Energy Partners LP.
15. Targa Resources Partners LP.
16. Sunoco Logistics Partners L.P.
17. Copano Energy, L.L.C.
18. Boardwalk Pipeline Partners, LP.
19. Western Gas Partners, LP.
20. Genesis Energy, L.P.

**Still Need for Improvement**

While there are several agencies involved in the regulation of pipeline safety and security, there is still a need to improve these agencies and their efforts to improve pipeline safety. The domestic boom in crude production has been accompanied by an increase in the amount of crude ***oil*** and petroleum products transported through transmission pipelines and an increase in the number of pipeline miles. A report conducted by the Association of ***Oil*** Pipe Lines and the American Petroleum Institute shows the growth in the number of barrels delivered and the growth in the amount of pipeline miles. The 2015 report showed that liquid pipelines stretch over 199,000 miles across the U.S. in 2014 (an increase of 3.5% over 2013). Crude ***oil*** pipeline mileage grew more than 5,000 miles in 2014 (a 9.1% increase over 2013). These pipelines delivered 9.3 billion barrels of crude ***oil*** across the U.S. in 2014 (nearly one billion barrels or 11.6% increase over 2013). However, the fall of crude ***oil*** prices during 2014 and 2015 has resulted in a slowdown in U.S. crude production growth (“U.S. Liquids Pipeline Usage & Mileage Report.” 2015). On December 21, 2015, West Texas Intermediate fell below $35, and Brent went under $37.

With such a large pipeline infrastructure, ***oil*** pipeline companies must act appropriately and follow the regulations that are set in place to ensure that the transmission of hazardous liquids such as crude and other refined products is done as safe as possible to prevent disastrous events that affect both public and environmental safety. Although petroleum products reach their designation safely 99.999% of the time, over the past two decades there have been a number of accidents that indicate a need to further develop pipeline regulation to increase activity related to pipeline safety. These accidents include the gas pipeline explosion in Washington that happened in 1999, the 2006 leak in the North Slope of Alaska caused by corroded pipelines (releasing over 200,000 gallons of crude ***oil***), and more recently the pipeline spill in 2010 that released over 800,000 gallons of crude ***oil*** into the Kalamazoo River (Service, 2012).

All of these accidents along with several others are prime examples why ***oil*** pipeline companies need to increase the level of pipeline safety measures set in place. A pipeline leak in 2010 shows why companies should increase the amount of resources allocated to pipeline monitoring and maintenance. The pipeline leak responsible for releasing over 800,000 gallons of crude ***oil*** into the Kalamazoo River was Enbridge Energy’s $6 billion pipeline (Mitchell, 2015). Enbridge was held responsible for the spill and was required to complete clean-up tasks ordered by the U.S. EPA. Enbridge finally completed the required efforts in the fall of 2014, with the removal of ***oil*** and several other environmental efforts the total amount spent by Enbridge totaled to more than $1.2 billion (Mitchell, 2015). Included in the $1.2 billion was any state and federal fines, and property damage caused by the spill. Under order of the Environmental Protection Agency (EPA), Enbridge is required to monitor the river through 2016 with the supervision of the Michigan Department of Environmental Quality (Mitchell, 2015). The Kalamazoo River spill is one of many examples proving that ***oil*** pipeline companies should feel obligated to improve their efforts made to monitor pipelines in order to prevent spills, leaks, or any other potentially devastating accidents from occurring.

Companies should continue to invest in new technologies that monitor pipelines such as pigs and more advance computer systems that can better communicate the conditions inside the pipeline. There also can be an increase in the frequency of inspections to detect corrosion more quickly. In addition to ***oil*** pipelines increasing the amount of resources allocated to pipeline monitoring and maintenance, there are several key policy issues under consideration. Issues to be mentioned are those focused on staffing resources for pipeline safety and security. There have been proposals to increase the number of staff for pipeline safety, specifically increase the number of inspectors staffed by the PHMSA. Figure 2 below shows the actual vs. anticipated pipeline safety staff from 1994 to 2009:

**Figure 2**

As can be seen from the figure above, there is a significant difference in the number of staff budgeted for the year before and the actual number of staff employed. There are several reasons for the difference between actual vs. anticipated. A key reason is the fact that the number of qualified inspectors is limited and those who are highly qualified are sought after by pipeline companies for their own safety programs (Service, 2012). These numbers indicate that along with investing in technologies to improve the monitoring and maintenance of pipelines, there needs to be an investment in labor capital to increase the number of qualified inspectors to match the growth of pipeline miles and amount of liquids transported.

**Conclusion**

Overall, the U.S. economy is extremely dependent on the efficient and extensive pipeline infrastructure responsible for the safe transportation of ***oil*** and several other refined products throughout the nation. Since the importance of pipelines in the ***oil*** industry was recognized there has been continued growth in the industry, growth in the number of pipeline miles, barrels of liquids transported, and regulations governing the industry. With proper regulations the pipeline industry can continue to grow and ensure the safe and efficient transportation of ***oil*** and other refined products. Whether the regulations are focused on preventing trade restrictions by promoting a competitive market, security protocols, or safe practices of pipeline companies to ensure public and environmental safety, all ***oil*** companies have an obligation to work alongside the federal government to continue to make the use of pipelines the most efficient and safest way to transport the ***oil*** and other refined products our country is so dependent on. Pipeline companies need to increase the amount of resources devoted to pipeline safety because of accidents such as Enbridge’s spill into the Kalamazoo River resulting in $1.2 billion in clean-up efforts. Companies can learn from these accidents and continue to improve their safety procedures and departments.

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1. \*The authors are, respectively, MBA student and Emeritus Professor at Louisiana State University. [↑](#footnote-ref-2)
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