

Oil and gas incidents in the United States: impact on energy companies and prices

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WORK IN PROGRESS

**Columbia
University
April 20th 2016**

Chaire The Economics of Natural Gas
Université Paris-Dauphine

Outline

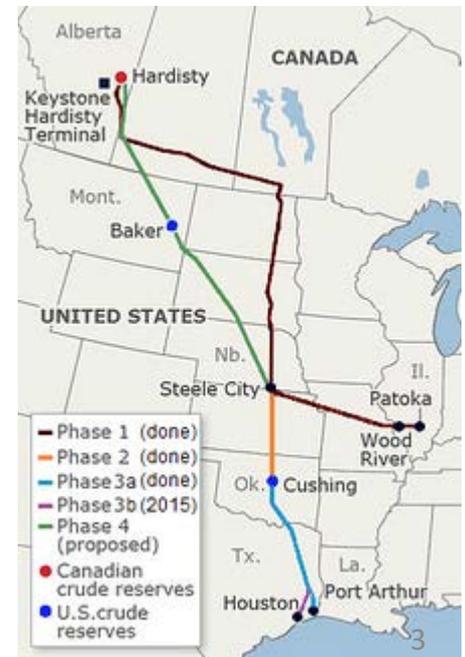


- Pipeline incidents: the context
- Pipeline safety regulation
- Incidents, safety, oil and gas firms market value: is there a link?
- Data, methodology, results (Exxon and ANR case study)
- Further steps and ongoing work

Pipeline economics:

the context

- Oil and gas production increase in the US should call for infrastructure building
- Environmental and safety issues are more and more constraining
 - Long debate over the « Transcanada ANR XL Pipeline » actually blockated
 - Risk of oil spills, air and water pollution, CO2 emissions.



Pipeline are safe

but incidents occur (I)

- **ExxonMobil to pay \$5 million to government over Mayflower oil spill April 22, 2015**

ExxonMobil pipeline rupture in Mayflower, Arkansas, April 1, 2013 (Reuters)



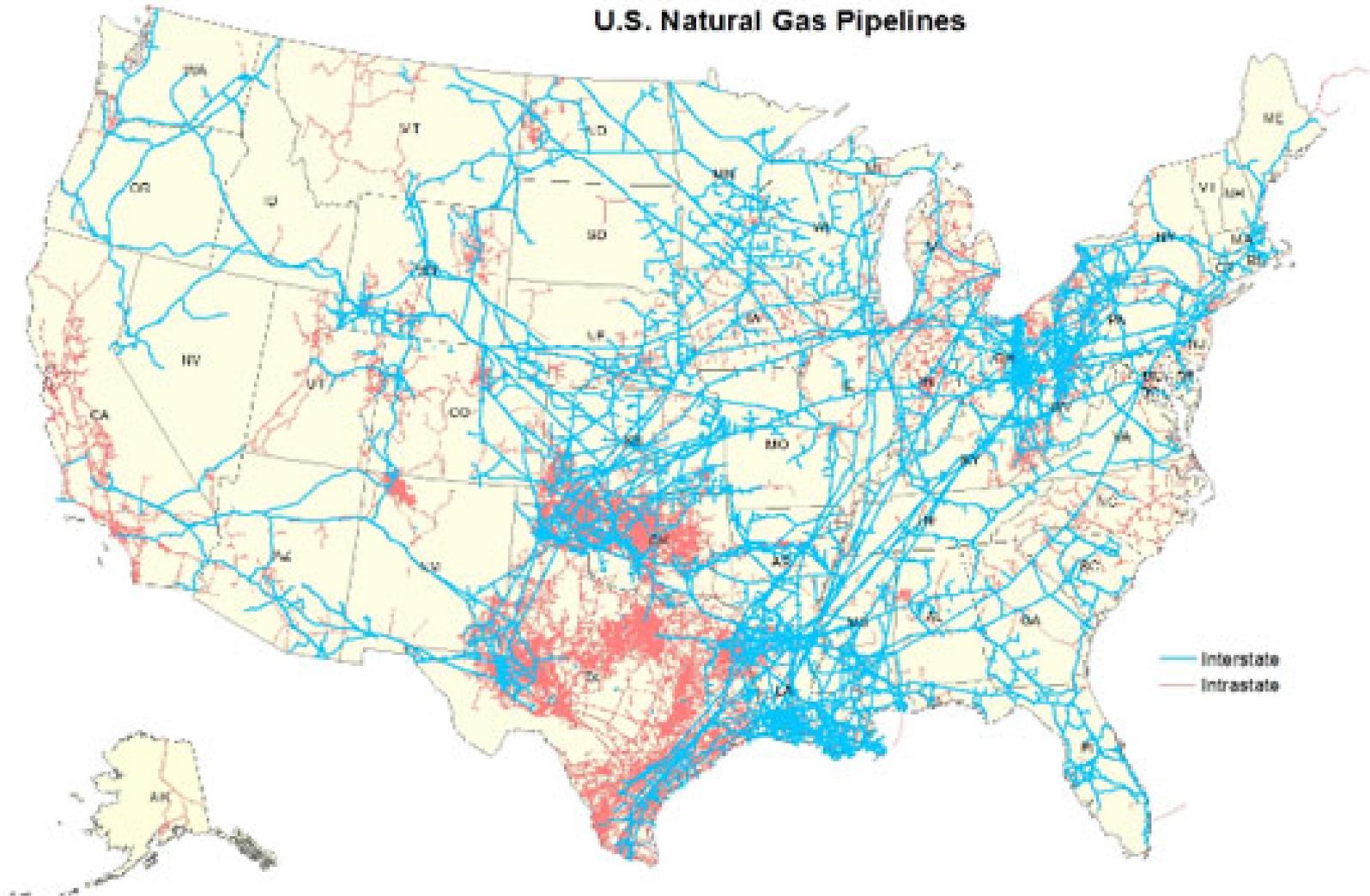
Pipeline are safe

but incidents occur (II)

- The **2013 Mayflower oil spill** occurred on March 29, 2013, when an [ExxonMobil](#) pipeline carrying [Canadian Wabasca heavy crude](#) from the [Athabasca oil sands](#) ruptured in [Mayflower, Arkansas](#), about 25 miles northwest of [Little Rock](#).
- Approximately 12,000 barrels (1,900 m³) of [oil](#) mixed with water had been recovered by March 31. Twenty-two homes were evacuated.
- The [United States Environmental Protection Agency](#) (EPA) classified the leak as a *major spill*. A reported 5,000–7,000 barrels of crude were spilled

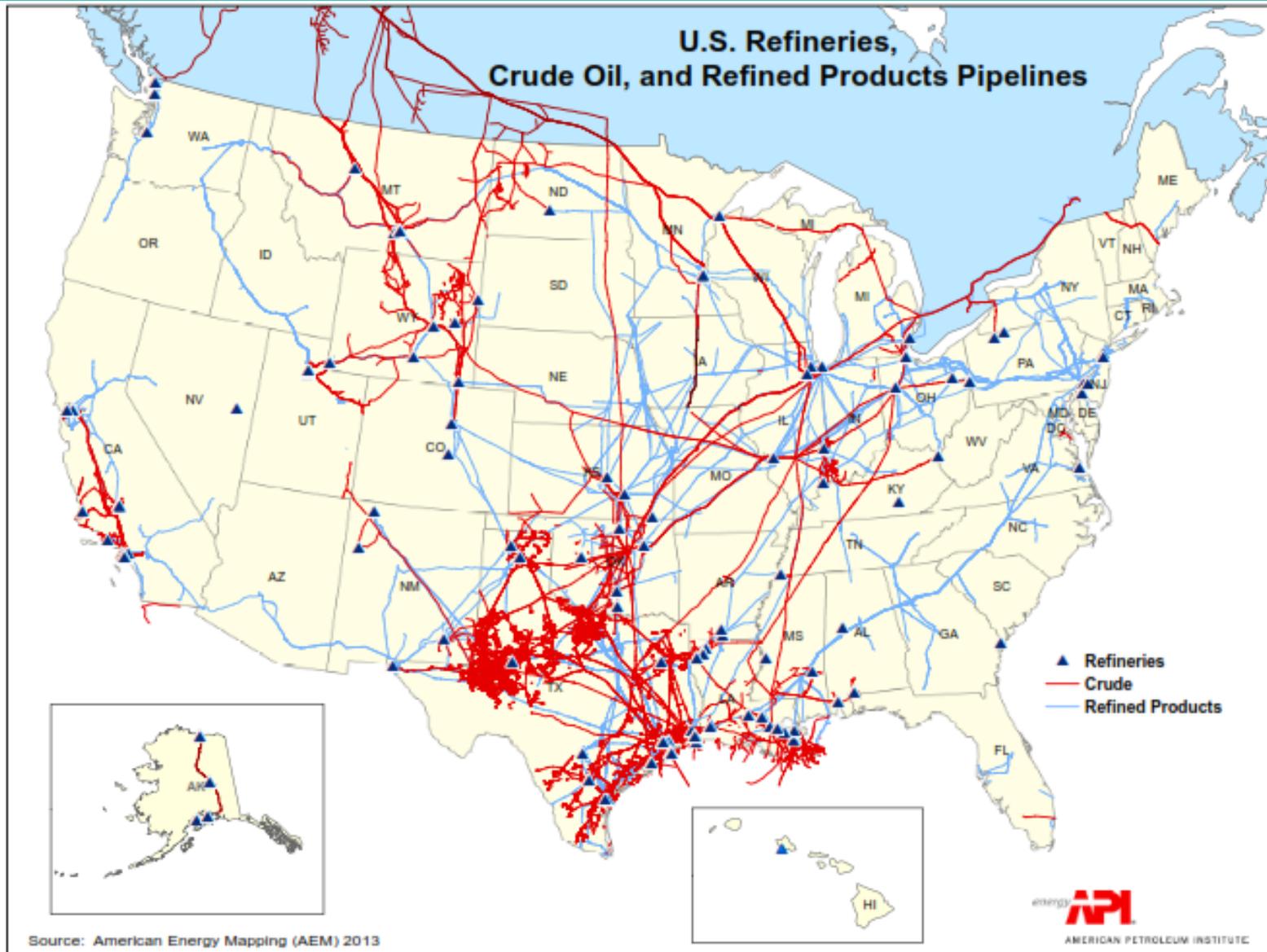
The infrastructure-Gas

U.S. Natural Gas Pipelines



Source: American Energy Mapping (AEM) 2013

The infrastructure-Oil



Safety Regulation: An Overview



Safety Regulation: In Practice

PHMSA (The U.S. Department of Transportation's Pipelines and Hazardous Materials Safety Administration)

States may issue regulations over intrastate pipelines if they are consistent with federal regulations. These state pipeline safety agencies are usually members of the National Association of Pipeline Safety Representatives (**NAPSR**).

The **National Transportation Safety Board (NTSB)** investigates some pipeline incidents and issues reports and recommendations to regulators, companies, and industry groups.

Research Question

**Which is the impact of incidents
on stock market value
of gas and oil firms?**





Literature Review (I)

- Based on the efficient market approach study the impact of incidents on equity value...
 - Capelle-Blancard & Laguna, 2010. JEEM
 - Stock market reaction to industrial disasters: 64 explosions in chemical plants and refineries worldwide in 1990-2005 belonging to 38 firms
 - Petrochemical firms experience a drop in their market value of 1.3% over 2 days immediately following the disaster.
 - Each casualty corresponds to a loss in market value of \$164 million and a toxic release to a loss of \$1 billion.
 - Borenstein & Zimmerman, 1998. AER
 - Stock market reaction to airplane incidents.



Literature Review (II)

- Technical literature
 - Restepo et al. 2009. *Int J Of Critical Infrastructure Protection*
 - Data on 1582 incidents related to hazardous liquid pipelines for the period 2002–2005 are analyzed.
 - Logistic regression modeling is used to determine what factors are associated with nonzero product loss cost, nonzero property damage cost and nonzero cleanup and recovery costs.
 - The results of these models are then used to construct illustrative scenarios for hazardous liquid pipeline incidents.
 - Furchtgott-Roth, 2013. *Stanford Working Paper*.
 - A review of safety and incident statistics provided by the U.S. Department of Transportation for the extensive network of existing U.S. pipelines show that, in addition to enjoying a substantial cost advantage, pipelines result in fewer spillage incidents and personal injuries than road and rail.

Methodology

- Event study under the market model approach:
 1. Using a window of 194 days prior to each incident (precisely [-199,-4]) we estimate the expected return of each company as a constant plus a slope times the NYSE return.
 2. We calculate the abnormal returns (AR) as the difference between actual returns and the returns calculated in 1 for an estimation window of [-4,+10].
 3. We calculate the cumulative abnormal returns (CAR).
 - The abnormal returns can be interpreted as resulting losses for which the firm was not insured.

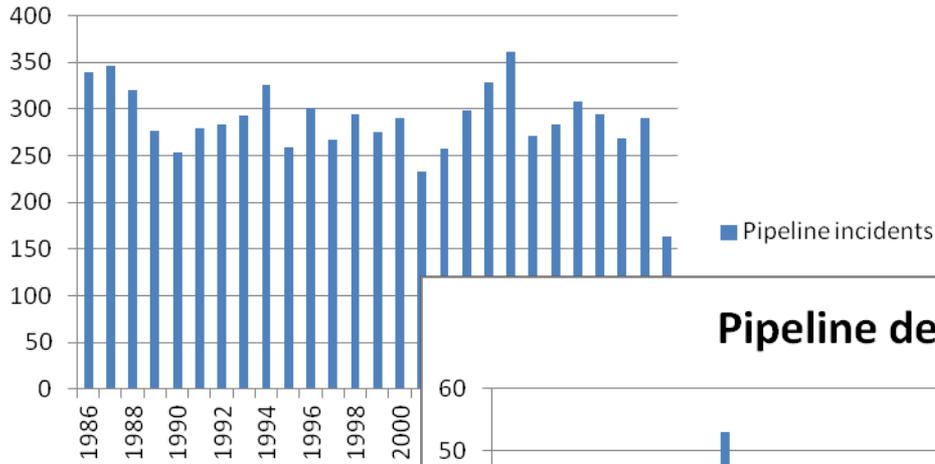
$$R_{it} = \alpha_i + \beta_i R_{mt} + e_{it}$$

$$AR_{it} = R_{it} - \bar{\alpha}_i + \bar{\beta}_i R_{mt}$$

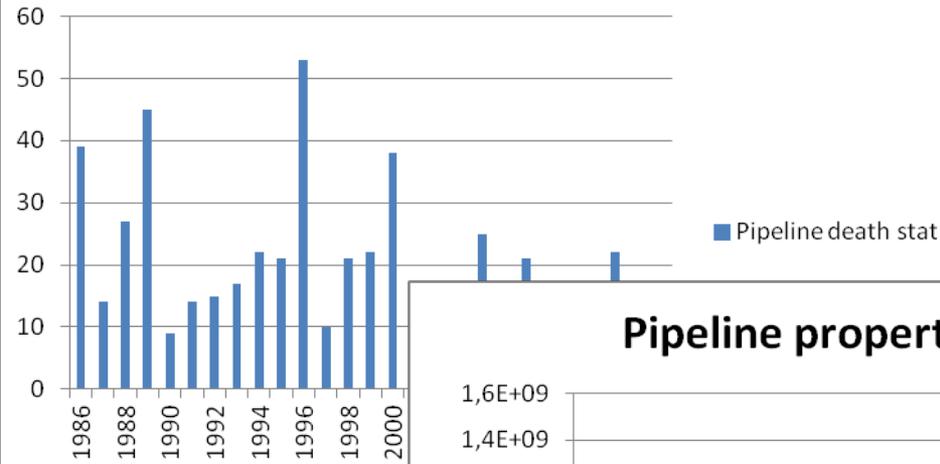
Data

- Unique database of 7517 incidents on oil and gas pipeline in the USA from January 1st., 1986 to August 31st, 2012.
 - For each incident we identify the cause, the value of damage, injured and fatalities as well as the age of the pipeline involved and the company that owns it.
 - We cross reference the previous database with equity value of the companies involved.

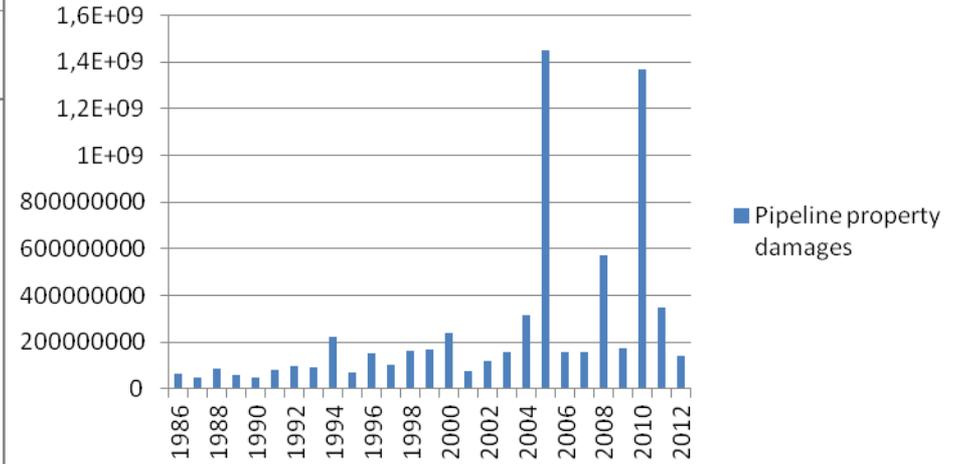
Pipeline incidents



Pipeline death stat



Pipeline property damages



Incidents: examples

	Incidents	Fatalities	Injuries	Total barrel lost	Property Damage	Av. Fatalities Rate
Texas	1669	78	371	1214640	668000000	5%
Louisiana	590	20	96	271318	1420000000	3%
California	573	43	198	17411	725000000	8%

Most frequent enterprise present and percentage of accidents

- Texas **ExxonMobil Pipeline Co. (7%)**
- Louisiana Tennessee Gas Pipeline Co (13%)
- California Pacific Gas & Electric Co (26%)

Incidents for two main firms

	ExxonMobil Pipeline Co.	ANR Pipeline Co.
type	Oil pipelines/Hazardous liquid	Gas Distribution; Gas Transmission or gathering
avg number of incident per year	7	3
avg damage cost per year	1054167	742445
avg injuries per year	0,03846	0
avg fatalities per year	0,00549	0,025
avg barrel lost per year	752	0
most frequent cause	Miscellaneous cause	Internal corrosion
most frequent states	Texas	Louisiana
date of the oldest pipeline installed	1917	1983
date of the most recent pipeline installed	2009	2008
incident with highest cost	07/01/2000	09/16/2008
state with highest cost	Montana	Louisiana
highest damage cost	135000000	8250000
incident with highest fatalities	09/07/2000	02/21/1988; 12/19/2006
highest number of fatalities	1	1
state with highest fatalities	Texas	Illinois; Michigan
incident with highest injuries	04/07/1986; 08/31/1992; 07/01/2000	0
highest injuries	2	0
state with highest injuries	California; Louisiana; Texas	0
highest number of barrel lost	20027	0
incident with highest barrel lost	02/13/1990	0
state with highest barrel lost	Texas	0

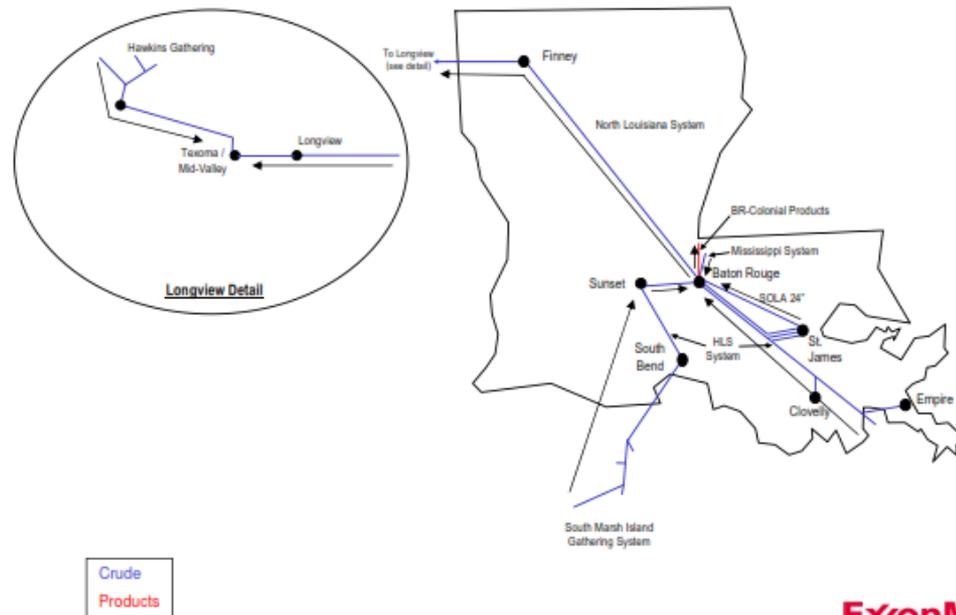
ExxonMobil Pipeline



- ExxonMobil Pipeline Company
 - transports over 2.7 million barrels per day of crude oil, refined products, liquefied petroleum gases, natural gas liquids and chemical feedstocks through 8,000 miles of operated pipeline.
 - operates 23 distribution terminals in the US which distribute gasoline, diesel fuel, heating oil, aviation fuel, kerosene and other refined products. ExxonMobil Pipeline Company also operates three salt dome storage facilities.
 - has a strong commitment to safety and environmental protection

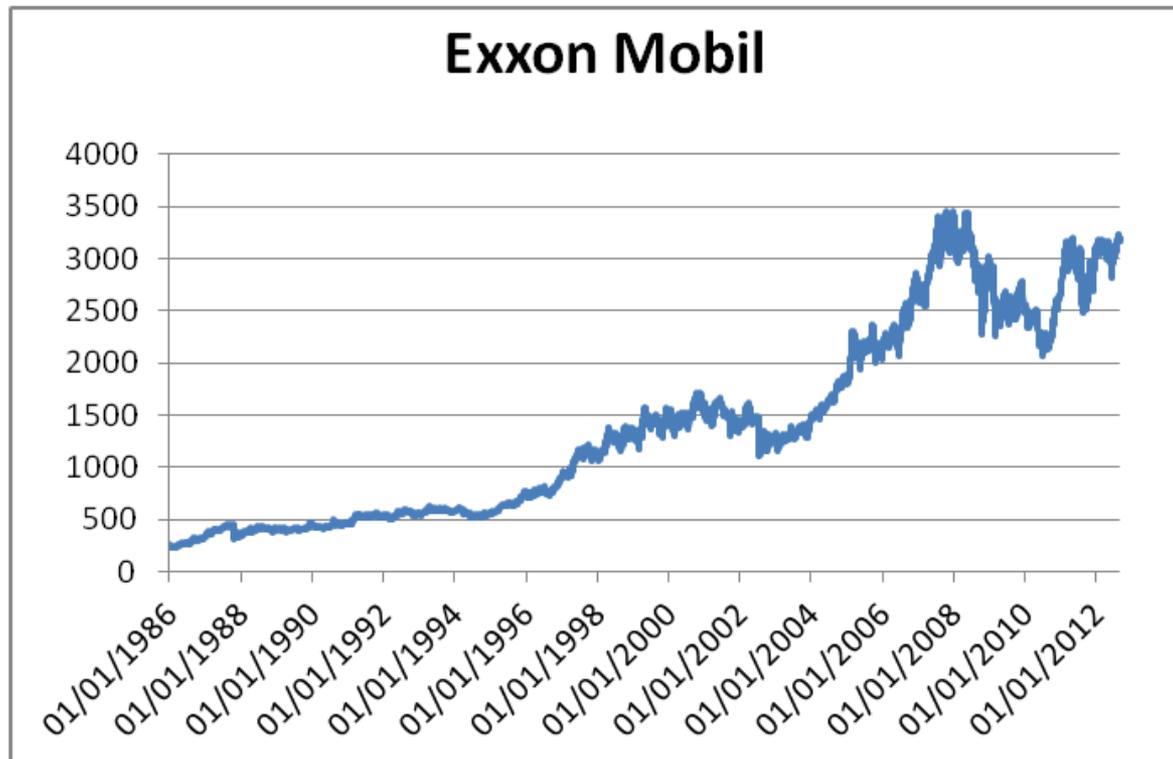
ExxonMobil Pipeline

- Operates in many US States-higher density network in the Midwest and Southeast



ExxonMobil Pipeline

Stock Market Value



ANR Pipeline

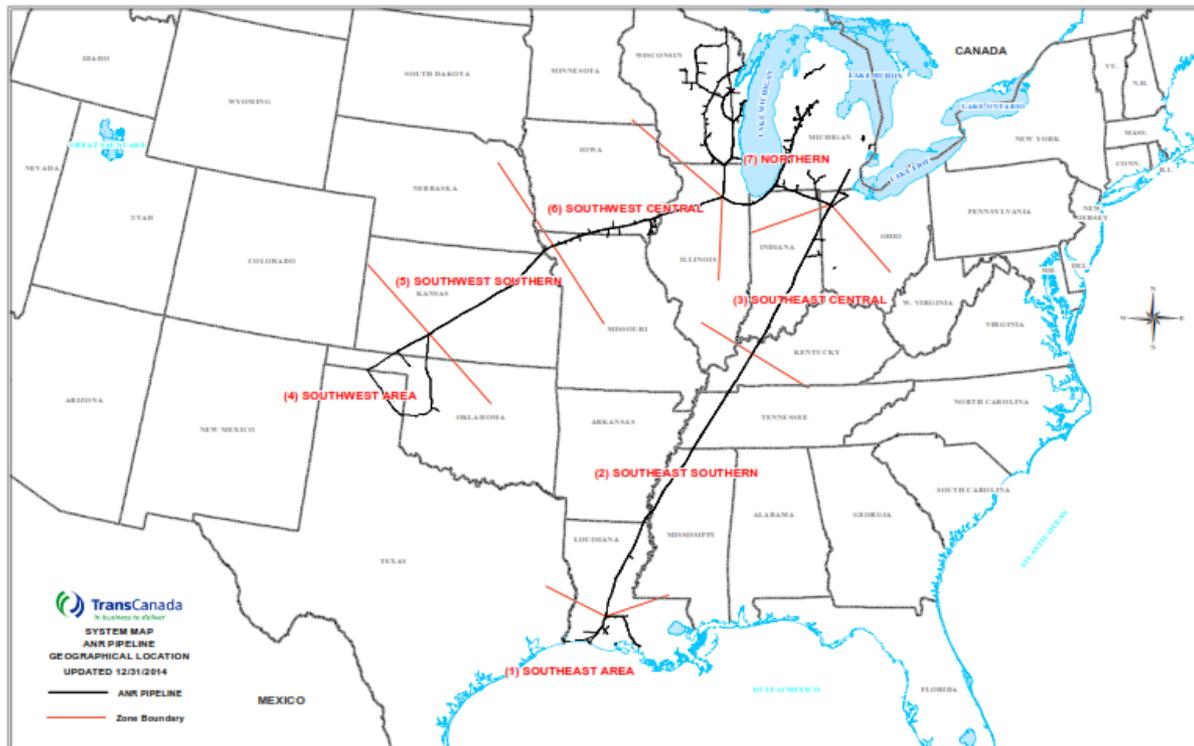


- ANR Pipeline Company

- From its founding as the Michigan-Wisconsin Pipe Line Company in 1945 to being a member of the TransCanada family of companies in 2007, ANR operates one of the largest interstate natural gas pipeline systems in the United States.
- With 15,128 kilometres (9,400 miles) of pipeline, ANR connects markets in Wisconsin, Michigan, Illinois and Ohio with supply in Texas, Oklahoma and the Gulf of Mexico.
- The ANR System is part of TransCanada's network of 60,000 km (37,000 miles) of wholly owned and 7,900 km (4,900 miles) of partially owned pipelines connecting major supply basins with major markets all across North America.

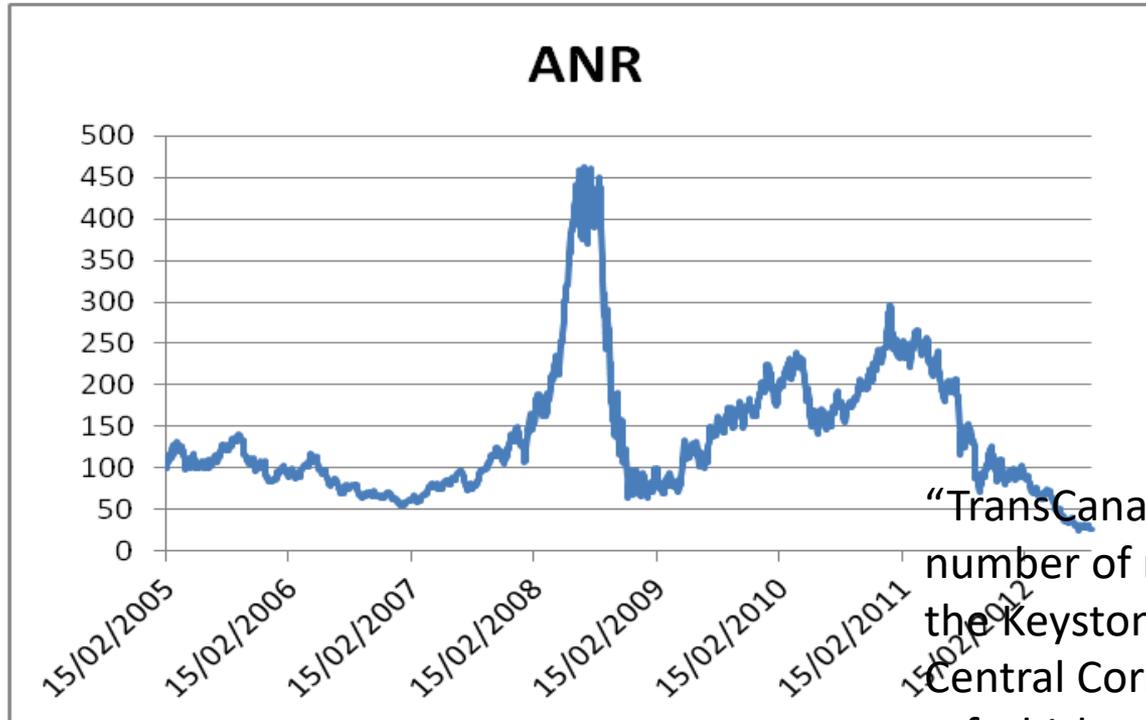
ANR Pipeline

- Operates North to Centersouth



ANR Pipeline

Stock Market Value



“TransCanada made significant progress on a number of major projects in 2008, including the Keystone oil pipeline system, the North Central Corridor expansion, the Bruce Power refurbishment, and three large-scale, gas-fired power plants. In 2009, we expect to invest approximately \$6 billion in these and other capital projects”

Incidents: examples

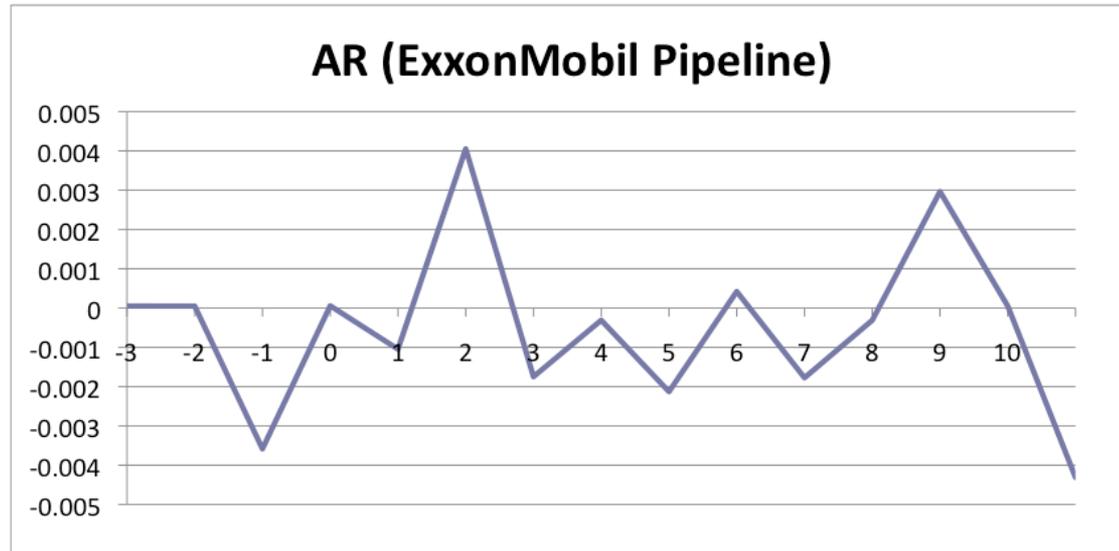
ExxonMobil Pipeline Co.

event dates	Feb. 13, 1990	Sept. 7, 2000	July 1, 2011
state	Texas	Texas	Montana
fatalities	0	1	0
injuries	0	2	0
barrel lost	20027	6800	1509
damage	227.000	38.200	135.000.000
cause	External corrosion	Third Party Excavation Damage	Heavy Rains/Floods

ANR Pipeline Co.

event dates	May 31, 2002	Sept. 16, 2008	Dec. 19, 2006
state	Louisiana	Louisiana	Michigan
fatalities	0	0	1
injuries	0	0	0
barrel lost	0	0	0
damage	2.450.000	8.250.000	1.920.000
cause	Incorrect Operation	Heavy Rains/Floods	Third Party Excavation Damage

Results: Exxon Mobile's 13th February 1990



Feb. 13, 1990

Texas

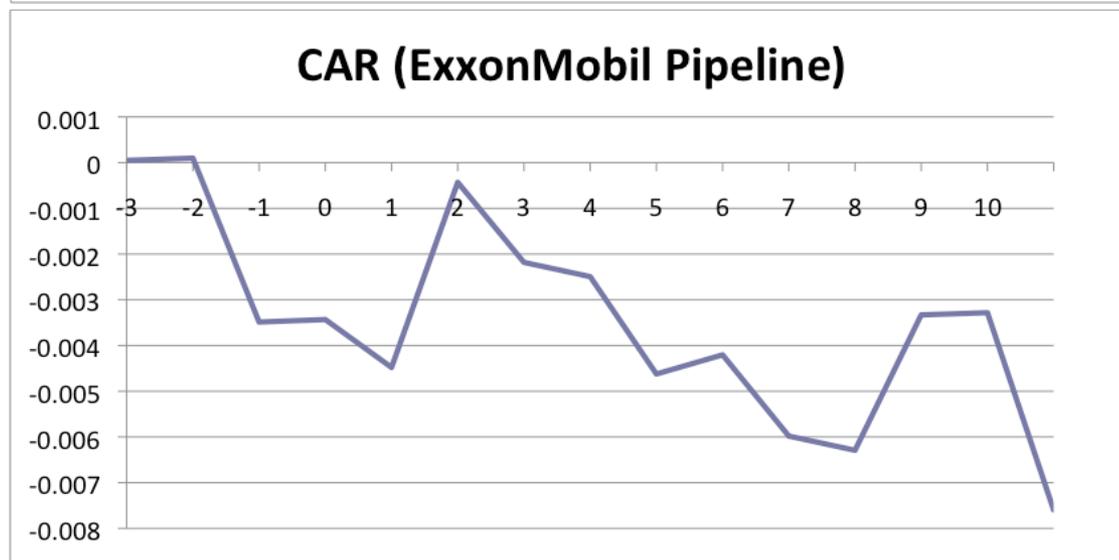
0

0

20027

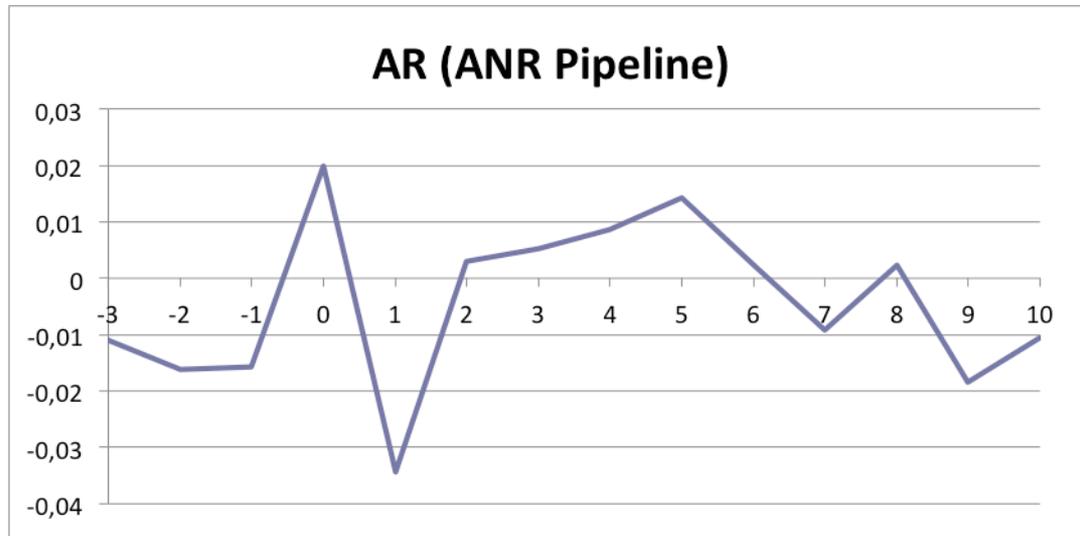
227000

External corrosion



Not the most costly but many barrels lost.
As from the 2nd day following the incident the CAR becomes negative.

Results: ANR 31st May, 2002



May 31, 2002

Louisiana

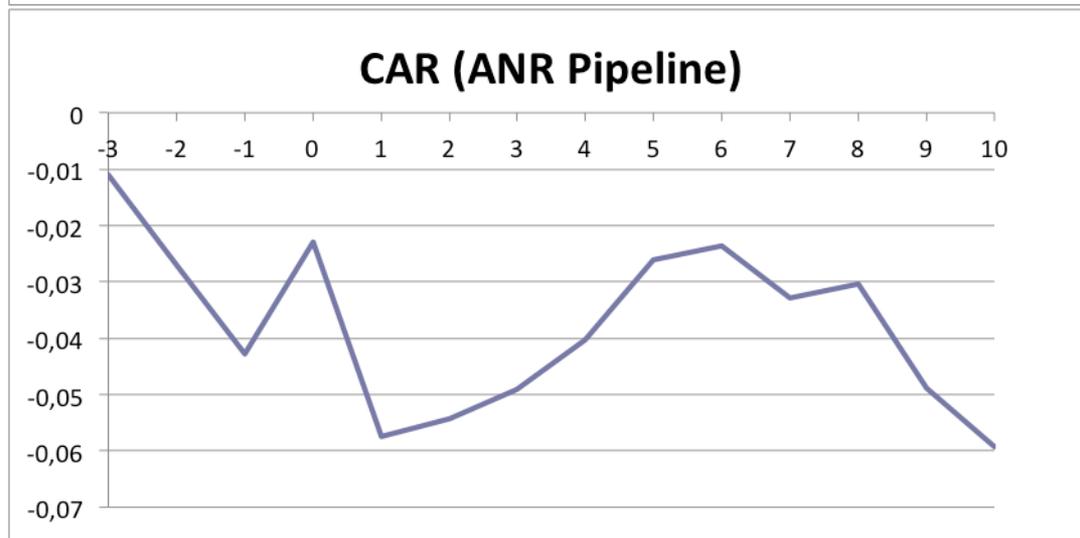
0

0

0

2.450.000

Incorrect Operation



No barrels loss but huge damage cost due to explosion. The AR becomes negative the day after and as the CAR shows there is no recuperation afterwards.

Events with deaths but no impact: Exxon Mobile's 13th February 1990

Sept. 7, 2000

Texas

1

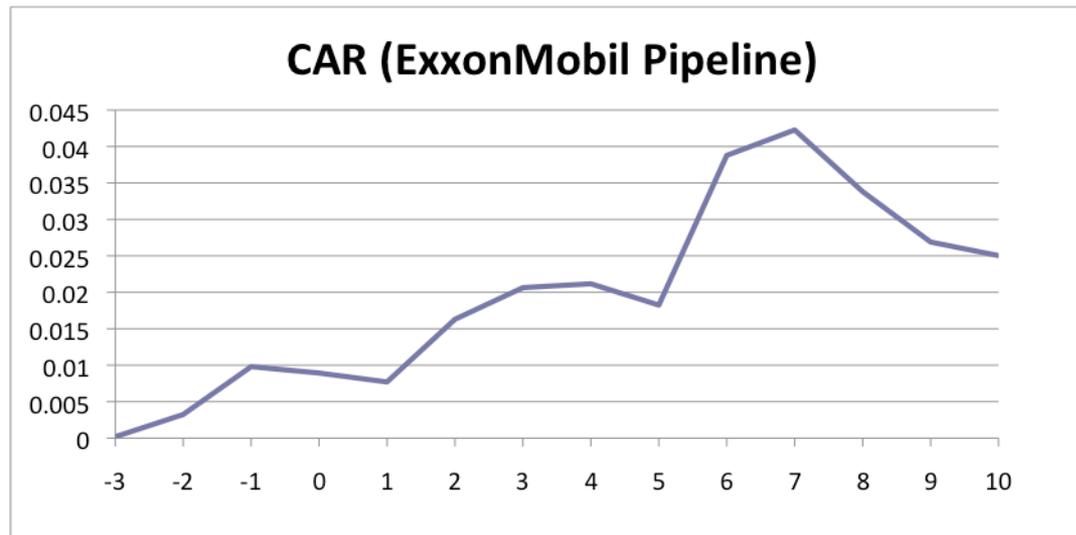
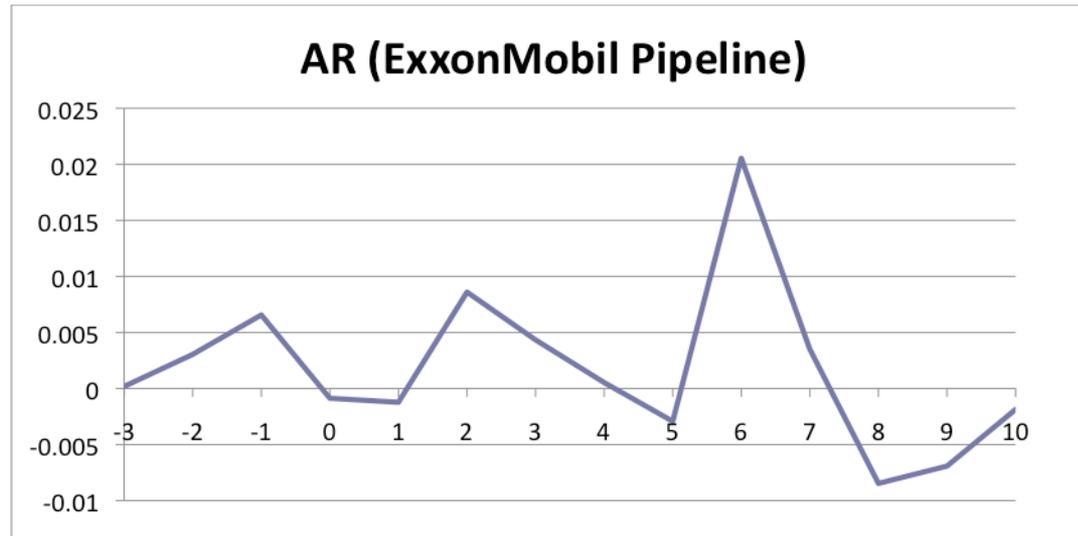
2

6800

38200

Third Party Excavation
Damage

No
impact.



Ongoing work

- 1) Event study with rolling windows: accidents effect may overlap
- 2) Multivariate regressions to relate cross-sectional differences in the loss incurred (measured by CAR and stakeholder loss (SL) for a certain +t) to the incidents features such as:
 - Total number of fatalities and injured (human damage)
 - Number of barrels lost (for oil firms only)
 - Dummy equal to 1 if there is an explosion
 - reputational variable accounting for number of previous incidents
 - Dummy to account for regulatory changes (so far year 2000 identified).
 - Regional and time dummies

$$SL_{i,[0,+t]} = CAR_{i,[0,+t]} MV_{i,-1}$$

Concluding Remarks

- Pipelines are the safest way to transport oil and gas but incidents occur in any case provoking significant equity loss for the firms involved.
 - The heterogeneity of such incidents implies that some may have no such impact and the reasons for such a difference is yet to be explored (opposite to efficient market hypothesis).
 - Lessons can be learnt from exploring the impact of regulation in the previous relationship as well as the regional market response.

Further steps

1. Interaction between changes in safety regulation after the occurrence of incidents and the impact that the expectations regarding this may have on equity value:
 - Controls regarding regulatory changes.
2. Impact on zonal energy prices:
 - Residential and Industrial use gas prices (monthly)
 - Gasoline (refinery) gas prices (monthly)
 - Import/export/stock (yearly)



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THANK YOU

ALL SUGGESTIONS ARE WELCOME

Safety Regulation: In Practice

PHMSA (The U.S. Department of Transportation's Pipelines and Hazardous Materials Safety Administration):

- issues pipeline safety regulations addressing construction, operation and maintenance
- inspects pipeline operators, and enforces against violations of pipeline safety laws and regulations.
- regulates interstate and intrastate hazardous liquids transmission pipelines, except that approves some state agencies to exercise interstate inspection authority and/or intrastate inspection and enforcement authority.
- regulates gathering pipelines greater than 6 5/8" diameter in all "non-rural" areas and rural areas within a quarter-mile of an "unusually sensitive area" and operating above a certain pressure.
 - Unusually sensitive areas are determined and include drinking water sources and ecological resources unusually sensitive to environmental damage from a liquids release.
 - Other gathering lines can be regulated by states or the Interior Department.

States may issue regulations over intrastate pipelines if they are consistent with federal regulations. These state pipeline safety agencies are usually members of the National Association of Pipeline Safety Representatives (**NAPSR**).

The National Transportation Safety Board (**NTSB**) investigates some pipeline incidents and issues reports and recommendations to regulators, companies, and industry groups.