Balancing Natural Gas Pipeline Safety with Economic Goals

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Executive Summary

Over the past two years, we have seen an abnormal number of gas-pipeline accidents. Gas-pipeline-related deaths, for example, more than doubled between 2009 and 2010. In response to these events, federal safety regulators and state utility commissions have expressed concerns over the integrity of local distribution systems. A primary concern is the age of old cast-iron and bare-steel pipes. Many of these pipes are several decades old and are susceptible to breaks or leaks. Aging gas pipes in particular have triggered a robust debate about the future safety of our pipeline system.

Federal safety regulators and others have articulated the importance of state utility commissions' giving utilities a reasonable opportunity to recover their costs for maintaining a safe pipeline system. They echoed this view at, among other places, the National Pipeline Safety Forum, hosted by the U.S. Department of Transportation in April 2011.

At the March 2011 hearing of the National Transportation Safety Board on San Bruno (California), a question arose as to whether a single entity, such as a state utility commission, should have responsibility for both pipeline safety and ratemaking. Some speakers alleged a possible inherent conflict that could compromise safety. As this paper discusses, divorcing safety from economics can lead to distorted decisions on safety and ratemaking. Safety regulators, who are not charged with the responsibility of considering economic factors, may de-emphasize the cost component while an economic regulator may not appreciate the importance of safety. Placing both elements under one regulatory umbrella may yield a better balance of these primary aspects of regulation. With a few exceptions, state utility commissions currently assume both functions.

This paper identifies four potential problems that confront state utility commissions when they address safety matters:

- A suboptimal level of safety (either excessive or deficient safety)
- Excessive costs for a given level of safety
- Poor utility incentives for safety activities
- An imbalance between safety and other regulatory objectives (e.g., those related to ratemaking)

This last problem can lead utilities to (a) underinvest in safety because regulation does not allow them a reasonable opportunity to earn their cost of return or precludes timely recovery of costs, or (b) overspend on safety activities because of inadequate regulatory oversight of costs or undue emphasis on safety relative to utility costs and rates. Specifically, utilities and their regulators might be overly risk averse regarding safety problems relative to society's risk aversion. The implication is that society would prefer to reallocate some of the money spent on safety to other activities offering greater benefits.

This paper highlights the responsibility of state utility commissions to assure the public that utilities perform at a high level in various dimensions, including economic efficiency, reliability, and safety. Safety is a prominent goal, but only one of several goals that commissions attempt to advance. Sometimes these goals conflict, requiring commissions to weigh their relative importance and make trade-offs that best serve the public interest.

One situation in which people make trade-offs involves buying a car. Most people do not buy a Hummer or Volvo, even though these makes might be the safest vehicles. We consider several attributes of a car before deciding on a particular make and model. Most people compromise safety for other attributes like fuel economy, maintenance costs, and appearance. They essentially balance the different attributes when deciding on a car that they prefer overall. Similarly, state utility commissions weigh different objectives in deciding on a specific matter that best advances the public interest. This balancing means that commissions are willing to "trade" some objectives in return for others. Achieving safety at any cost is not compatible with a balanced approach. One way to look at costs is that they represent lost opportunities to allocate funds to other activities. These activities have social benefits that might exceed the benefits gained from additional safety.

A perceived conflict exists between safety and "just and reasonable" rates. An example is achieving a certain level of safety at excessive cost or through "exorbitant" rate increases. State utility regulators are in the best position to balance safety and ratemaking goals, frequently confronting them with a difficult challenge.

One rule that utility regulators can consider is the following: Ensure that utilities make their pipes safe by spending prudently and efficiently. Another regulatory goal, reliable service, is complementary with safety. A pipeline incident would likely shut down at least part of the gas utility's operation. Thus, one benefit of improved safety would be more reliable utility service. Another benefit from improved pipeline safety—from pipeline replacement, for instance—is lower maintenance and operating costs. Overall, efforts directed at improving safety can have a payoff that goes beyond making pipelines merely safer.

Safety has a cost that utility commissions should take into account when evaluating a utility's proposal to invest in or spend on safety-related activities. Commissions must not only judge the justification for these costs in improving safety but also assess whether the underlying actions are least cost. The first justification requires a cost-benefit-type review, while the second justification applies a cost-effectiveness rule.

This paper addresses actions that state utility commissions may take to improve their policies on gas pipeline safety:

- State utility regulators are committed to pipeline safety, in many instances going beyond federal regulations.

- Gas utilities spend about $7 billion annually on safety. Regulators can help them spend that money more wisely.
- Good utility regulation requires balancing safety with other objectives, including just and reasonable rates.
- The fundamental economic criterion for evaluating any safety-improving activity is whether it increases social net benefits.
- Federal regulations required utilities to begin developing a distribution integrity management program (DIMP) by August 2, 2011.
- Criticisms that a single agency is regulating both utility rates and safety seem to overlook the importance and difficulty of balancing societal objectives.
- The socially optimal level of safety is less than "perfect."
- Gas utilities can overspend on safety from a societal perspective.
- State utility regulators should carefully evaluate accelerated pipeline replacement.
- A major determinant of the optimal level of safety is society's risk aversion regarding incidents.
- A utility's incentive for safety depends on several factors.

Appendix A lists the normal activities of safety regulators in fulfilling their duties, subject to federal and state regulations. Appendix B contains several questions that state utility regulators can ask both themselves and utilities in fulfilling their obligation to balance safety and other regulatory objectives.

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Balancing Natural Gas Pipeline Safety with Economic Goals

> *While much has been done in the wake of San Bruno and other pipeline incidents, much more state and federal action is underway. And now is the time. We all—industry, regulators, one-call operators, and stakeholders—must redouble our efforts to ensure that we are giving our very best effort to protect the people we serve. I know that if we all focus at one time and with the same level of determination, working together to heighten our commitment to ensure a concentrated proactive effort, we can and will be successful in protecting the people we serve from future catastrophic pipeline incidents. We owe it to them. This is what keeps me up at night.*[1]

Over the past two years we have seen an abnormal number of gas-pipeline accidents. Gas-pipeline-related deaths, for example, more than doubled between 2009 and 2010. In responding to these events, federal safety regulators and state utility commissions have expressed concerns over the integrity of local distribution systems.[2] A primary concern is the age of old cast-iron and bare-steel pipes. Many of these pipes are several decades old and are susceptible to breaks or leaks. Aging gas pipes in particular have triggered a robust debate about the current and future safety of our pipeline system.

Federal safety regulators and others have articulated the importance of state utility commissions giving utilities a reasonable opportunity to recover their costs for maintaining a safe pipeline system. They echoed this view at, among other places, the National Pipeline Safety Forum, hosted by the U.S. Department of Transportation (DOT) in April 2011.[3] At the hearing of the National Transportation Safety Board (NTSB) on the San Bruno (California) incident, some participants expressed concern at the idea of a single entity's—namely, a state utility commission's—having dual responsibility for the rates and safety of a utility.[4] One advocate for public safety raised the possibility of an inherent conflict that could compromise safety:

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[1] Chairman Collette D. Honorable, "What's Keeping Me Up at Night? Pipeline Safety," *NRRI Monthly Essay*, November 2011.

[2] "Integrity" means the ability to keep flowing natural gas within the confines of the pipes. A leak or rupture can cause gas to leave a pipeline, inflicting serious damage. Ruptures are more likely to occur on high-pressure transmission pipes than on low-pressure distribution pipes. Distribution incidents typically start with a leak.

[3] *See* the proceedings of the forum at http://opsweb.phmsa.dot.gov/pipelineforum/docs/Webpage%20Lead%20Final.pdf. DOT held the forum in response to the series of pipeline explosions that occurred in 2010.

[4] As described in the Executive Summary of the NTSB's final report on the San Bruno incident:

> I realize that commissions are concerned with safety, but it seems that their focus is on providing just and reasonable rates. If a board member needs to make a choice on a rate increase, is there an inherent conflict with having to spend more on safety when there are short-term pressures or pressures due to law? *The question is not intended to ask about the good will of any member but to [inquire] whether there is an inherent conflict for commissioners to approve spending on safety initiatives, which are long-term investments, due to short-term pressures.*[5] [Emphasis added]

This statement questions whether state utility regulators would jeopardize public safety for the sake of holding down rates in the short term. To the contrary, experience has shown that state utility regulators consider safety a top priority. Most states have safety regulations that go beyond federal requirements. The two issues that state utility regulators consider most important in overseeing the natural gas sector are (1) that distribution lines are adequately safe to minimize the chances of incidents and (2) that gas supplies are always available to customers when they need it, especially during the winter months. Rates have primary importance as well, but history has shown that state utility regulators are unwilling to jeopardize safe or reliable service just to keep rates down.

> On September 9, 2010, [at] about 6:11 p.m. Pacific daylight time, a 30-inch-diameter segment of an intrastate natural gas transmission pipeline known as Line 132, owned and operated by the Pacific Gas and Electric Company (PG&E), ruptured in a residential area in San Bruno, California. The rupture occurred at mile point 39.28 of Line 132, at the intersection of Earl Avenue and Glenview Drive. The rupture produced a crater about 72 feet long by 26 feet wide. The section of pipe that ruptured, which was about 28 feet long and weighed about 3,000 pounds, was found 100 feet south of the crater. PG&E estimated that 47.6 million standard cubic feet of natural gas was released. The released natural gas ignited, resulting in a fire that destroyed 38 homes and damaged 70. Eight people were killed, many were injured, and many more were evacuated from the area. (*See* Pipeline Accident Report: PAR-11-01.)

The NTSB made several findings: that PG&E's integrity management program was "deficient and ineffective"; that PG&E's pipeline installation failed to comply with "accepted industry quality control and welding standards in 1956"; that federal and state regulatory oversight was inadequate; and that PG&E had "no comprehensive procedures for responding to a large-scale emergency." The California Public Utilities Commission (CPUC) has responded to the NTSB recommendations by taking various actions. *See* California Public Utilities Commission, *CPUC Implementation Status of NTSB and Independent Review Panel Pipeline Safety Recommendations Overview*, January 2012.

[5] Rick Kessler (Vice President, Pipeline Safety Trust), *Proceedings from the National Pipeline Safety Forum*, April 18, 2011, 9; emphasis added.

I. Basic Things to Know about Safety

A. What is pipeline safety?

"Pipeline safety" refers to a publicly acceptable condition state in which society is secured from incidents that lead to explosions or fires. Safety is strictly a physical concept, devoid of any economic connotation. A safe pipeline system is one that reasonably protects the public from incidents. For a pipeline, the probability of an incident is small, but the consequences of an incident can be substantial. Society often overestimates the risk from such events, placing undue emphasis on the possible serious consequences and insufficient attention on the events' extremely low probability. A significant component of safety is "pipeline integrity," which is the ability of a pipeline to prevent natural gas from escaping and causing deaths, injuries, and property damage. There are other components such as qualified personnel, adequate maintenance, robust emergency response, odorization, design, and testing.

Safety relates directly to risk. Specifically, it represents the inverse of risk. Risk itself is a measure of the probability and severity of an incident. Pipelines are, therefore, more safe when the expected social cost of incidents is lower. Safety-related activities either reduce the probability of an incident or reduce the damage done by an incident. Emergency evacuations and public awareness would fall in the second category; more thorough inspections and monitoring, leak surveys, and pipe replacements would fall in the first.

Many engineers contend that pipeline design should have the goal of *zero significant incidents*. If a pipeline is constructed, operated, and maintained according to its design, it should then operate without posing a safety risk to the public. For example, pipelines should have adequate strength and wall thickness to withstand the design's maximum operating pressure. Violations of these conditions include faulty material and welding, untrained personnel, lax monitoring and inspection, and poor maintenance practices. The job of safety regulators is to make sure that these violations do not occur, or that if they do the utility corrects these problems in the shortest possible time. Several states, for example, issue corrective-action orders, which require the utility to make specific safety-related improvements.

B. Different utility actions affect safety

A utility's "safety culture" should entail a holistic approach directed at minimizing incidents and their consequences. It represents an accumulation of all utility actions that directly or indirectly relate to safety. This approach involves a combination of investments, prudent operating practices, inspections and monitoring, and personnel training. Some actions are substitutable for others in achieving a targeted level of safety.

Overall, a utility's safety culture derives from the totality of its practices and policies in response to regulatory, economic, and legal pressures. Without these pressures, utilities will likely underspend on safety activities.[6]

The American Gas Association says the following about safety culture:

> A positive safety culture begins with the organization's top leaders. Management must emphasize and demonstrate that the safety of employees, customers, the public and our pipeline systems is a value that is paramount. All decisions must take into account the importance of safety. For example, production, cost, and schedule goals should be developed, communicated and implemented in a way that demonstrates that employee, customer, public and pipeline safety is an overriding priority.[7]

Another document, authored by Resources for the Future, lists features characterizing a firm with a positive safety culture:

> The literature emphasizes that safety culture must be advocated by upper management. Consider a few specific policies and procedures that are adopted at firms with a strong safety culture: redundancy; compensation schemes, including bonuses, that emphasize safety performance; hiring appropriately trained individuals and providing continual on-the-job training; and regular analysis of how changes affect safety (i.e., management of change).[8]

Utilities alone cannot control the safety of their systems. Past incidents have had different causes, some of which lie outside the control of the utility. The PHMSA lists eight categories of threats to pipeline safety:[9] (1) corrosion, (2) natural forces, (3) excavation damage, (4) other outside-force damage, (5) welding materials, (6) equipment failure, (7) incorrect operation, and (8) other concerns.[10] Responses from a survey by the American Gas Foundation

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[6] One major reason is that the utility would perceive its benefits from safety as below those that society would receive. In other words, the social benefits would exceed the private benefits. Analysts refer to this condition as an "agency problem." Good safety regulation would create incentives for the utility that would align its interests with the public interest. One alternative is to set penalties at a level that would discourage utilities from violating regulations.

[7] *See* http://www.aga.org/our-issues/safety/Documents/AGA%20Safety%20Culture%20Statement_Feb%202011.pdf.

[8] Mark A. Cohen et al., *Deepwater Drilling: Law, Policy, and Economics of Firm Organization and Safety*, RFF DP 10-65, January 2011, 15.

[9] Threats are events that can lead to the unplanned release of natural gas.

[10] To the extent that incidents are stochastic (i.e., random or by chance), a utility might exert less effort on safety activities while blaming an incident on bad luck. The utility would argue that because it cannot be held responsible, it would be unfair for the regulator to impose a fine or penalty.

identified the following five items as having the greatest effect on safety: (1) cathodic protection of steel pipes, (2) leak surveys, (3) operator-training programs, (4) implementation of one-call systems, and (5) pipe-replacement programs.[11]

For most gas utilities, the greatest risks come from excavation damage, the corrosion of bare steel, and joint leaks and cracks on cast-iron pipes. Excavation is the leading cause of deaths and injuries from pipeline incidents.[12] Leakage is also a serious problem for distribution pipes. One sensible strategy for utilities is to spend money on those categories over which they have some control, either in preventing an incident or mitigating its consequences. Utilities, for example, can help mitigate excavation damage by making the public more aware of the dangers of digging without first contacting the gas utility to locate pipes. Another action may be to fine heavily contractors and others who do not contact the utility. Because of multiple threats to safety, utilities need to take a multifaceted approach, as no single action by itself can achieve satisfactory results.

C. Safety costs money

Safety has an economic cost that utilities incur and recover from their customers. Natural gas utilities and pipelines spend about $7 billion annually on safety activities.[13] These costs include: (1) personnel costs for safety-related training, routine operations, the handling of emergencies, and the hiring of safety experts; (2) capital costs for replacing cast-iron and bare-steel pipes, new technologies for inspection, and integrity-management programs;[14] (3) operating costs for maintenance and repairs, leak surveys, and control-room management; and (4) education expenses for public awareness and dissemination of information to customers and

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[11] See American Gas Foundation, *Safety Performance and Integrity of the Natural Gas Distribution Infrastructure*, January 2005, at http://www.gasfoundation.org/ResearchStudies/CompleteStudy.pdf.

[12] *See* ibid.

[13] See the AGA website at http://www.aga.org/our-issues/safety/Pages/default.aspx.

[14] As expressed in a paper by the Gas Technology Institute:

> Safety-related technologies to be created or enhanced include those to reduce or eliminate damage, improve leak detection and location, and detect unauthorized access or changes in condition that may require immediate response. The development and use of advanced global positioning and geographic information systems in conjunction with mobile and/or hand-held devices is another safety related area of technology advancement that complements all aspects of field construction, operations and maintenance.

Gas Technology Institute, "Natural Gas in a Smart Energy Future," GTI-11/0001, January 2011, 17 at http://media.godashboard.com/gti/Natural_Gas_in_a_Smart_Energy_Future_01-26-2011.pdf.

excavators. Hydrostatic pressure testing is one action that is expensive but often used in inspecting pipes.[15]

The safety level of a utility depends on the resources devoted to safety-related activities, as well as managerial allocation of those resources. Costs hinge on the incentive of the utility to use the right mix and level of resources. How much should a utility spend on safety? The theoretical answer is that the utility should achieve the socially optimal level of safety at least cost. The socially optimal level is difficult to determine. Besides, it falls outside the domain of utilities to determine. Utilities do, however, have control over the costs they expend to achieve the safety levels compatible with federal and state regulations.

II. Federal-State Partnership

A. Brief history

The federal government regulates natural gas pipeline safety under different laws and regulations. The Natural Gas Pipeline Safety Act of 1968 first authorized DOT to develop minimum safety standards for pipeline transportation. Over the years, newly enacted statutory and regulatory requirements helped increase the safety of natural gas pipelines, in addition to expanding the scope of safety regulations.[16]

DOT's Pipeline and Hazardous Materials Safety Administration (PHMSA) is responsible for enforcing regulations pertaining to pipeline safety.[17] PHMSA's mission is "to protect people and the environment from the risks inherent in transportation of hazardous materials—by pipeline and other modes of transportation."[18] Federal safety regulations apply to all interstate and distribution pipelines in the country, including those that are not under the purview of economic regulators.

Two objectives of federal pipeline safety regulations are: (1) to assure safety in the design, construction,[19] inspection, testing, operation, and maintenance of pipeline facilities; and,

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[15] This procedure involves filling a section of pipe with water at a pressure much higher than that at which the pipe will ever operate with natural gas. The inspector monitors the pipe for several hours. Failure to pass the test will result in repair or retesting. Besides its high cost, hydrostatic testing requires pipelines to be out of service for some time and fails to detect some small defects that may cause serious problems later.

[16] The federal rules governing pipeline safety are included in Title 49 of the Code of Federal Regulations (CFR), Parts 190-199.

[17] For an overview of DOT activities on pipeline safety, *see* http://phmsa.dot.gov/pipeline.

[18] *See* http://phmsa.dot.gov/about/mission.

[19] Safety regulation includes, for example, inspecting construction materials' or pipe materials' strength, as well as any necessary welding.

(2) to set out parameters for administering the pipeline-safety program. Annually, PHMSA evaluates the state pipeline safety programs. Most state programs enforce standards included in their gas-pipeline safety codes.

State public utility commissions partner with DOT to comply with pipeline safety regulations. The states are responsible for virtually all gas-distribution pipelines, gas-gathering pipelines, and intrastate pipelines, assuming that their safety programs receive federal certification or they enter into an agreement with DOT. A major activity of state safety regulators is to conduct frequent inspections of pipeline facilities and utilities' records. They inspect, for example, pipeline construction, pipe corrosion, leak surveys, and damage prevention. Another major activity is conducting, and helping to coordinate, investigations of major safety incidents.

Federal pipeline statutes provide for exclusive federal authority to regulate the safety of interstate pipelines. DOT, however, may (and generally does) authorize a state to act as its agent. Federal regulators also provide comprehensive and up-to-date training programs for state regulators, partially finance state programs, and annually evaluate state regulators through field inspections, records and financial audits, and progress-report reviews.

The mission and duties of one state commission—the Public Utilities Commission of Ohio (PUCO)—exemplify those articulated in most other states:

> The PUCO is committed to ensuring the safe, reliable, and environmentally sound operation of Ohio's natural gas pipeline system. PUCO investigators inspect each natural gas pipeline system in the state at least once every two years and review records and procedures implemented by utilities. When violations are detected, the PUCO orders corrective action and may assess fines and other penalties to ensure that Ohio's natural gas pipeline systems continue to deliver natural gas safely and reliably.[20]

The federal/state partnership helps assure nationwide uniformity of the pipeline safety program. The states must enforce at least the federal regulations. As articulated by the National Association of Pipeline Safety Representatives (NAPSR), which is the national association representing state pipeline safety inspectors:

> The general responsibilities of a pipeline inspector include inspection of: safety records, facilities, construction, integrity management programs, other programs and investigation of accidents. As noted, most states go beyond the federal requirements and perform additional kinds of oversight. The goal of the state

[20] See http://www.puco.ohio.gov/puco/index.cfm/consumer-information/consumer-topics/natural-gas-pipeline safety-in-ohio.

> pipeline safety programs is to ensure the overall safety of the pipeline system for people, property, and the environment in their regions.[21]

The NAPSR report highlighted the fact that most states' regulations are stricter than federal regulations. The largest number of initiatives exceeding federal requirements for pipelines have centered on the functions of operation, maintenance, and record keeping.[22] State regulations take into account local conditions and other factors that affect pipeline-safety risk in developing more stringent state safety regulations.[23]

The Pipeline Inspection, Protection, Enforcement, and Safety Act of 2006 (PIPES Act of 2006) expanded the federal pipeline safety program.[24] It represented an important piece of legislation that helped improve pipeline safety. The Act included major mandates that the natural gas industry is currently working with PHMSA to implement. The Act contains four core provisions that aim to improve distribution pipeline safety: (1) further emphasis on excavation damage prevention, (2) development and implementation of distribution integrity-management programs, (3) increased use of excess-flow valves, and (4) development of regulations regarding control-room management. It also authorized PHMSA to reimburse states for up to 80 percent of their safety-program costs as partners in enforcing federal regulations.[25]

B. Distribution Integrity Management Program (DIMP)

As of August 2, 2011, federal regulations require gas utilities to develop a distribution integrity management program (DIMP). Integrity management focuses on the allocation of utility resources to the areas of greatest risk. PHMSA considers DIMP an effective means for reducing the number of pipeline incidents. One benefit comes from mitigating and preventing problems prior to inspection. The utility can gather evidence showing where repairs, for example, were not effectively performed in the past. As expressed on PHMSA's website:

> The Pipeline Integrity, Protection, Enforcement, and Safety Act of 2006 (PIPES) mandated that PHMSA prescribe minimum standards for integrity management programs for distribution pipelines. The law provided for PHMSA to require

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[21] *See* National Association of Pipeline Safety Representatives, *Compendium of State Pipeline Safety Requirements and Initiatives Providing Increased Public Safety Levels Compared to Code of Federal Regulations*, September 30, 2011, 7, at http://napsr.org/Compendium%20FINAL%20NAPSR%20Oct%2028%202011%20First%20EditionR%20.pdf.

[22] Ibid., 10.

[23] Ibid., 10.

[24] *See* PIPES Act of 2006 at http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=109_cong_public_laws&docid=f:publ468.109.pdf.

[25] The actual percentage has been much less.

> operators of distribution pipelines to continually identify and assess risks on their distribution lines, to remediate conditions that present a potential threat to pipeline integrity, and to monitor program effectiveness. Instead of imposing additional prescriptive requirements for integrity management, PHMSA concluded that a requirement for operator-specific programs to manage pipeline system integrity would be more effective given the diversity in distribution systems and the threats to which they may be exposed.[26]

This formalized program requires gas utilities to identify, assess, and prioritize safety risks on a system-wide basis. DIMP requires a gas utility to take seven major steps: (1) develop and implement a written integrity management plan; (2) acquire knowledge of the distribution system;[27] (3) identify existing and potential threats; (4) analyze, assess, and prioritize risks; (5) mitigate risk by identifying and implementing safety actions; (6) measure, monitor, and evaluate performance; and (7) report the results. Risk assessment, for example, is a systematic method for determining the probability and consequences of pipeline incidents, such as deaths, injuries, and property damage. It asks the questions: What can go wrong? What is the likelihood that something would go wrong? What are the consequences? Risk management, in contrast, asks the questions: What can a utility do, and what options does it have? What trade-offs does a utility face in terms of costs, benefits, and risks?

Safety inspectors will have three broad tasks for enforcing DIMP: (1) review the plan, (2) monitor execution of the plan, and (3) evaluate *ex post* the effectiveness of the plan. This information should foster more cost-effective measures in mitigating safety risks. Specifically, DIMP can help utilities rank actions on the basis of cost and effectiveness in achieving a tolerable risk level for their entire gas distribution system. Cost-effectiveness requires that the last dollar spent in different safety activities have the same effect on safety as the first. This condition results in diminishing returns, by which the incremental effect on safety for each dollar spent falls as the utility spends more money on safety. Cost-effectiveness relates to the question: How can we gain the "most bang for the buck"?

As early as 2005, NARUC passed a resolution in support of DIMP. The resolution encourages

> states, the Federal Office of Pipeline Safety, gas distribution pipeline operators, and other stakeholders to develop an approach to distribution integrity management that uses risk-based, technically sound and cost-effective measures, which reflect that stakeholders are: knowledgeable of the infrastructure; can identify threats against their systems; and can take appropriate measures to reduce the risk of system failures while balancing the needs to ensure continued safe

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[26] See http://primis.phmsa.dot.gov/dimp/docsf/faq.pdf

[27] Formally knowing the risk aspects of its distribution system should enable a utility more effectively to manage its assets by having a better understanding of the cause and effect of safety problems.

operation, reliable service, and the implications of any increased financial demands on the consumer.[28]

C. New federal legislation

New federal legislation signed into law on January 3, 2012 addressed several problems for which parties reached consensus.[29] The law, among other things:

- Imposes higher penalties for operators that violate regulations; [30]
- Provides an additional incentive for states to remove current one-call exemptions by requiring all entities that excavate around pipelines to call a hotline before they dig; [31]
- Requires automatic and remote-controlled shut-off valves on new pipelines;
- Requires the Secretary of Transportation to evaluate the effectiveness of expanding pipeline-integrity management and leak-detection requirements; and
- Increases the budget for additional federal pipeline inspectors.

III. An Economic Perspective on Pipeline Safety

A. "Perfect safety" is a poor policy goal

From an economic perspective, utilities can have overly safe pipelines. The view that "we can't compromise on safety" ignores the fact that safety carries a cost that policymakers should compare with the benefits. Some readers might find this statement provocative, but it reflects the reality that lowering safety can produce a net gain to society. Generally, as safety increases, the incremental cost increases but the marginal benefit decreases. For example, at low

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[28] National Association of Regulatory Utility Commissioners, *Resolution on Distribution Integrity Management*, adopted on February 16, 2005, 2 at http://www.naruc.org/Resolutions/distributionintegritymgmt_w05.pdf.

[29] SNL Energy, "Obama Signs Pipeline Safety Legislation," *Daily Gas Report*, January 5, 2012, 2. The legislation—the Pipeline Safety, Regulatory Certainty, and Job Creation Act—reauthorizes federal pipeline safety programs through fiscal year 2015. *See* the text of the signed legislation at http://www.pipelinelaw.com/files/Uploads/Documents/PipelineLaw/HR_2845_signed_into_law_1.3.12.pdf.

[30] Specifically, the legislation doubles the maximum fines that pipeline operators face for safety violations.

[31] "One-call" refers to parties' calling a toll-free number prior to digging. It is a federal law to call unless a party receives an exemption.

levels of safety the utility could increase safety at a lower incremental cost than at higher levels. The assumption is that the utility would pursue the most efficient actions at each point in time.[32] As they undertake additional actions, these actions' effect on safety continuously decreases. There is some level of safety beyond which the additional benefits are less than the additional costs. Thus, society can have too much safety.[33]

Because safety has a cost, a utility should limit the amount of money spent on safety. To say that a pipeline is "safe enough" might be a good rule for utilities to apply. The phrase "safe enough" implies that even though the utility can spend more money on safety, the benefits would be marginal. From a cost-benefit perspective, the social value of more safety would fall short of the additional cost. It might be hard for some readers to imagine that a utility could have pipelines that are too safe, but, as discussed earlier in this paper, the opportunity cost of expending more resources on safety can exceed the benefits. As an example, if society spends an additional $10 million on safety, the reduction in the expected number of incidents and their consequences might be minimal. That is, marginal benefits would fall well short of $10 million. If, instead, the utility spent the $10 million on improving its internal operating efficiencies, the net benefit might be positive, or at least less negative than spending the money on additional safety.

A goal of "perfect safety" implies intolerance of any risk. The regulator may find disagreeable any pipeline incident that results in death or injury. The utility would not have to make trade-offs, as safety would dominate all other objectives and cost would not become a factor. One problem with this strategy is that the utility would spend money on mitigating "negligible risk" that most likely would fail a cost-benefit test.[34] As an example, the utility could spend $20 million on reducing the "last ounce" of risk, with incremental benefits valued at much less. One situation in which people make trade-offs involves buying a car. Most people do not buy a Hummer or Volvo, even though these makes might be the safest vehicles. They consider several attributes of a car before deciding on a particular one. Most people compromise safety for other attributes, such as fuel economy, maintenance costs, and appearance. We essentially balance the different attributes in deciding on a car that overall we prefer. Similarly, state utility commissions weigh different objectives in deciding on a specific matter that best advances the public interest. This balancing means that commissions are willing to "trade" some objectives in return for others. Achieving safety at any cost is not compatible with a balanced approach. One way to look at costs is that they represent lost opportunities to allocate money to other activities that might have greater societal benefits.

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[32] If this condition does not hold, the utility could have a lower marginal cost for safety at higher levels.

[33] There is no empirical evidence showing that this condition exits for gas pipelines.

[34] A cost-benefit test places primary importance on economic efficiency while deemphasizing equity and political factors. Policymakers should, therefore, supplement the information from a cost-benefit analysis with other considerations that affect the public interest.

One common interpretation of a safe pipeline is that the probability of an incident is small. A small probability does not preclude the possibility of an incident that has serious consequences. When an operator says that its pipelines are "safe," it is not clear what he means. It is wrong to think that the pipelines are guaranteed against possible future incidents.

In almost everything in life, including pipelines, the probability of an undesirable outcome is greater than zero. Even walking out the door has a nonzero risk. We all accept some level of risk. Rational people and organizations manage risks to maximize their well-being. Their actions then require that they weigh reducing risk against the additional cost or the impeding of other objectives.[35] They implicitly perform a cost-benefit calculation to determine how much risk they are willing to bear. In virtually all situations, the optimal risk is greater than zero. Where it would be possible to reduce the probability to zero, the costs would inevitably be prohibitive. Think of the effort and cost required to make something perfectly safe, much safer or even marginally safer than what it is currently. Demanding a risk-free pipeline system—if that state is even practicable—does not recognize the cost trade-offs that would make such a goal irrational.

Overall, the level of pipeline safety requires judgment in which the utility weighs the risk versus the costs. Although a utility has to abide by federal and state regulations, it has discretion on how to satisfy those regulations and how much money to spend.

B. Acceptable risk

As mentioned above, one indicator of adequate safety is that "pipelines are safe enough." One interpretation of this condition is that an acceptable but nonzero probability exists that an incident will occur. Safety below this level would be considered unacceptable either because implicitly the probability of an incident is too high or because the pipeline operator could better mitigate the potential consequences of incidents.[36] The operator, for example, could address the latter concern by designing a better emergency-response strategy. Because utilities are subject to both federal and state regulations, the minimum level of safety should reflect compliance with these regulations.

Public perception is essential in judging whether pipelines are safe. Unless the public has confidence that pipelines are safe, more effort needs to be put forth. Although safety is an objective and probabilistic matter for analysts, public acceptability depends on personal and social value judgments. Especially after an incident, public officials and utilities should inform the public that pipelines are safe and that the incident resulted from an isolated event. One

[35] These other objectives include reliability, equity, economic efficiency, and advancement of social objectives.

[36] The Army Corp of Engineers assesses the safety of levees, classifying some as unacceptable. To the Corp, "unacceptable" does not necessarily mean unsafe under most conditions; it suggests only a non-minimal risk of failure under extreme flooding. See "With Levees Rated 'Unacceptable,' Officials along the Mississippi Fight Back," *The New York Times,* February 5, 2012, 13.

critical piece of information for safety experts is whether the root causes are isolated events or systemic in nature; for example, an incident may represent an isolated event that occurred at a particular location, but it is not an isolated event when it occurs at multiple locations nationwide and across different time periods.[37]

From a purely economic perspective, it is hard to say whether current safety levels are too low or too high. Because quantification of the social benefits from safety is subject to a high degree of imprecision, policymakers should concentrate their efforts on ensuring that the politically acceptable level of safety is achieved most cost-effectively. Because safety regulations allow utilities flexibility in their actions, state utility regulators should ensure that utility customers are not paying excessively for safety levels complying with those regulations.

C. Optimal and cost-effective safety

The fundamental economic criterion for evaluating any safety-improving activity is whether it increases social net benefits. A sound public policy on safety would apply the same standard. Although regulators can easily measure the costs, they will find measuring the benefits much more challenging. One such benefit relates to the value placed on a human life, which is controversial and difficult to measure. Analysts find it difficult to measure how a safety initiative would improve overall safety, let alone the dollar value of any improvement.

1. Cost-effectiveness

In the absence of measuring benefits, the cost-effectiveness rule becomes important for how utilities make decisions on safety.[38] Because resources are scarce, utilities should allocate them most productively. Specifically, they should allocate each resource on the margin to those activities that would most improve safety. With resource constraints, utilities should equate the effectiveness of the last dollar spent on each safety activity. They should prioritize their activities so that as they spend more money on safety they achieve declining returns.[39]

Under this cost-effectiveness rule, the utility compares the costs of alternative approaches to maintain the existing level of safety or improve safety by a specified level.[40] It would then

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[37] I thank Randy Knepper for this thought.

[38] A cost-beneficial action is not a sufficient condition to undertake an action. Because a utility has a limited budget, it should only choose those cost-beneficial actions that are most cost-effective.

[39] Although perhaps not that pertinent for gas pipelines, more cost-effective safety might come from increased attention placed on the role of consumer or worker behavior than on technology. Studies have shown, for example, that the behavior of mechanical-device operators is much more frequently responsible for accidents than the device itself.

[40] Because safety regulations as designed allow utilities flexibility in their actions, regulators should review whether the selected actions are the most cost-effective.

select those alternatives that have the lowest costs.[41] Cost-effectiveness has the effect of saving lives or reducing injuries and property damage for a given amount of dollars spent on safety activities. As an illustration, suppose that a utility has $100 million to spend on one of two actions to improve safety.[42] Assume that a study shows that one action would be expected to save 200 lives and the other action to save 50 lives. As a matter of cost-effectiveness, the utility should undertake the first action: It spends $500,000 per expected life saved, while the second action would spend $2 million per expected life saved. Clearly, the first action is preferable from a cost-effectiveness perspective. Whether a utility should spend $100 million on safety is not as obvious. If evidence shows, for example, that the expected value of a life saved is $300,000, then society is spending $100 million to receive a benefit of $60 million ($300,000 · 200), which would fail a cost-benefit test. On the other hand, if the expected value of a life saved is, say, $3 million, then spending the $100 million would clearly be cost-beneficial.

2. Challenges with command-and-control regulation

Studies have shown that the largest source of waste from health, safety, and environmental regulations is the inability to achieve cost-effective outcomes because of detailed command-and-control rules.[43] These rules mandate certain technologies and actions that serve to drive up the cost of meeting regulatory goals. Because technology-based standards mandate a specific technology, they ignore other options that might be cost-effective for a subgroup of utilities. On the positive side, technology mandates might be justified in combating a high risk against which the specified technologies are known to work well, while the effectiveness of alternative actions is suspect. The regulator would prescribe, for example, specific technologies and actions and then check to see if utilities are in compliance.[44]

Less waste and more cost-effective behavior can result from performance-based regulations that set "outcome" targets instead of technological and other mandates that prescribe

[41] While eliminating some waste of resources, cost-effectiveness does not assure that existing levels of safety or safety regulations are optimal. Given safety regulations or safety targets, cost-effectiveness merely results in the lowest cost. "Lowest cost" means that society is using its lowest-valued resources to meet existing regulations or prescribed targets.

[42] Unlike a cost-benefit test, cost-effectiveness specifies a fixed amount of dollars as a goal or target. Although this amount is considered, in some rough way, desirable, it does not represent the optimal level of money that society should spend on safety in the sense of producing the highest net benefits.

[43] *See*, for example, Clifford Winston, *Government Failure versus Market Failure: Microeconomics Policy Research and Government Performance* (Washington, D.C.: AEI-Brookings Joint Center for Regulatory Studies, 2006).

[44] In past years, federal safety regulators assumed responsibility mainly by requiring pipeline operators to comply with uniform minimum standards. More recently, regulators have turned to a more risk-based approach—pipeline and distribution-system integrity-management programs that give utilities added flexibility in their actions, for instance.

specific actions. Even though performance-based regulation would not mandate the adoption of certain technologies, it should encourage utilities to deploy new and other "best practice" technologies when they are economical and more effective than alternate technologies. These technologies can help utilities prevent and detect problems, as well as repair pipes that pose a safety threat. [45]

By giving firms flexibility in achieving a target and assuming that they achieve these targets at different costs, the total costs for safety-related activities would tend to be lower.[46] A performance-based approach, as one illustration, would look at public awareness of potential safety problems without requiring utilities to take specific actions. It would also examine: (1) the number of incidents and their trends over time, (2) repairs of leaks that a utility would report, (3) the number of corrosion leaks per mile, and (4) the percentage of pipes replaced over a specified time. Regulators should first identify what they wish to accomplish. Then they need to set performance metrics to determine whether actual outcomes agree with the objectives. As three illustrations, if the objective is:

- To reduce leaks, an appropriate metric is leaks per mile;
- To reduce incidents resulting from maintenance failures, an appropriate metric is the percentage of work orders completed on time; and
- To reduce pipe damage from excavations, an appropriate metric is lines that are correctly located.

Take the example in which a person is contemplating purchasing a fire extinguisher for his house. Assume that the fire extinguisher costs $100 and has the capability to put out a kitchen fire. Assume also that the probability of a fire is 0.1 percent and that the fire extinguisher expects to avoid fire damage in the amount of $50,000. The expected benefit from the fire extinguisher is therefore $50 (0.001 · $50,000), which is half the fire extinguisher's cost.[47] It appears that the person should not purchase the fire extinguisher: Spending $100 for

[45] For a sample of new technologies enhancing safety in the natural gas industry, *see* Ron Edelstein, "Pipeline Safety Technology Needs," presentation at the NARUC Summer Committee Meetings, July 18, 2011 at http://www.narucmeetings.org/Presentations/NARUC%20Pipeline%20Safety%200711%20GTI.pdf.

[46] Government intervention in safety matters fall into one of three broad categories: (a) a "Big Brother" approach in which strict standards prevent consumers or firms from exercising any choices—sometimes referred to as "benign paternalism," (b) a performance-based approach in which consumers or firms can choose among different actions as long as they meet prespecified "outcome" targets; and (c) a "kind mother" approach in which the government gives consumers or firms accurate and easy-to-understand information to help them make better decisions.

[47] The fire extinguisher improves safety not by reducing the probability of a fire but by reducing damage in the event of a fire. Actually, it may increase the probability of a fire by making the person less careful in preventing a fire because he has the extinguisher to mitigate fire damage. A similar example is people tending to drive more safely when they do not have car insurance, or people tending to drive less

an expected benefit of $50 seems irrational. But if the person is risk averse, assigning a high value to avoiding a loss of $50,000, it might seem more sensible for the person to purchase the fire extinguisher. When we buy insurance, for example, our premiums can be much higher than the expected benefits. We buy the insurance because we want to avoid a large loss that could jeopardize our financial well-being.

A more relevant point is that buying a fire extinguisher might not be cost-effective. The person could buy fire alarms or take other actions that would reduce the risk from fire at lower cost. Given a fixed amount of money dedicated to risk reduction, a rational person would allocate it to achieving the greatest reduction. Like a gas utility, the person can spend her money either to reduce the probability of an accident or mitigate the consequences of accidents that occur. Under a command-and-control regime, the government would require all households to have fire extinguishers. The outcome would be non-optimal: Some households would value the fire extinguisher less than the costs—they would exhibit little risk averseness toward a fire, for instance; other households would find cheaper alternatives to a fire extinguisher in reducing the risk from a fire—they might purchase several fire alarms or a new furnace that is safer than their current furnace.

Determining how much a utility should spend on pipeline safety should involve recognizing the small probability of an incident as well as the possibility for substantial consequences. Loss of life, injuries, and property damage can have huge costs. Because of this possibility, some readers might believe that society cannot overspend on safety. But with a small probability of incidents, a rational response would place a limit on spending that is linked to the expected benefits.

3. Risk aversion and financial exposure

Both utilities and utility regulators—assuming they are risk averse—would be willing to improve safety beyond the level where incremental costs equal expected benefits. We can also assume that society is risk averse toward pipeline incidents that can have serious consequences. Because of risk aversion, we should assume that utilities spend more on safety than on the expected benefits. The degree of risk aversion exhibited by utilities and regulators is arguably greater than that of society. Decisions by these two groups can then result in safety-related activities and expenditures that are beyond those that society would prefer. As an example, utilities' and regulators' view of adequate safety might focus on a highly improbable worst-case

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cautiously when they wear seat belts. *See*, for example, Sam Peltzman, "The Effects of Automobile Safety Regulation," *Journal of Political Economy*, vol. 83 (August 1975): 677-725. These examples relate to what analysts call "moral hazard," in which the "insured" (the homeowner and the driver) may be less cautious because "insurance" (the fire extinguisher and the seat belts) provides a safety net against an accident. These examples illustrate the fact that actual safety relies on consumer behavior and opportunity cost. A regulation or action that aims to improve safety can end up decreasing safety because of unintended consequences. For gas pipelines, if a regulation mandates the adoption of a certain safety technology, the money spent to satisfy this requirement might have improved overall safety more if the utility had the discretion to allocate that money to some other activity.

scenario rather than on the more realistic expected outcome (which corresponds to mean risk values or the most likely outcome). Their actions may then seem conservative, and even irrational, reflecting a highly risk-averse disposition toward pipeline incidents. [48]

Another factor affecting the willingness of parties to improve safety is the extent to which one absorbs the cost of an accident. In our previous example, if the person had no insurance against a fire, he would be more inclined to buy a fire extinguisher. Parallel to this logic, the greater a utility's financial exposure to pipeline incidents, the greater its incentive to avoid an incident.[49] Financial exposure, in turn, depends on the insurance that the utility purchased for such events, its legal liability,[50] and whether the utility and safety regulators believed that the utility was at fault for an incident. The last factor could result in the regulators' penalizing the utility.

D. Utilities have multiple incentives for ensuring safety

1. Incentive

Because a serious incident can cause financial problems for a utility in addition to damaging its reputation, it may have a strong incentive to avoid incidents. Overall, a utility would probably shirk less on safety than would unregulated firms operating in a highly competitive environment. For both financial and nonfinancial reasons, a utility would likely go to great lengths to avoid an incident. As long as the utility can with high certainty and in a timely manner recover its costs for safety, it should have little reason not to maintain a high level of safety. Incidents jeopardize the goodwill that a utility has with the public and its regulators, in addition to inviting lawsuits with a potentially crippling effect on a utility's finances.

A difficult question for utility regulators is whether shareholders should bear the financial brunt of a pipeline incident not attributable to utility negligence. The answer would likely affect how utilities perceive safety and their efforts to maintain it. A moral-hazard[51] outcome can occur when a utility suffers little consequence from an incident, as its management and owners then have less incentive to engage in safety activities to avoid an incident. If instead the utility is held strictly liable for incidents and is unable to pass through costs to its customers and any insurance

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[48] Specifically, both utilities and regulators would be disposed to err on the side of too much safety to avoid an incident that would incur a substantial negative public reaction. As noted later in this paper, one possible example is excessive pipeline replacement in the near term.

[49] A utility might have reasons other than financial to maintain a high level of safety. It might, for example, perceive a high cost from the loss in goodwill if an incident occurs.

[50] With unlimited liability, for example, utility shareholders will want managers to have a strong safety culture that minimizes the chances of a major pipeline incident.

[51] "Moral hazard" refers to a situation in which people or organizations will tend to take excessive risks when they do not have to bear the consequences.

deductions, it would have a greater incentive to prevent incidents. This policy, however, may conflict with "fairness" standards that state utility regulators establish.

2. Disincentive

On the other hand, the utility might compromise safety because of financial considerations. When a utility earns a higher profit from spending less money on safety or suffers little profit decline from an incident, it might find slacking on safety irresistible. A utility might also be in a budget-cutting mode that compromises safety. Other reasons for inadequate safety are a lax safety culture within the utility and negligence on the part of utility management. Negligence can lead to operating errors, poor record keeping, malfunctioning equipment, subpar damage prevention, and lack of an emergency-response strategy.

Utilities may underinvest in safety for other reasons, including limited liability and subsidized insurance, in addition to ineffective regulatory oversight and enforcement.[52] A fundamental question is whether gas utilities have adequate incentives to minimize harm to third parties. Third parties include residents, businesses, and others who would suffer property damage or injury from a pipeline incident. The objective of safety regulations is to compensate for deficient control of externalities (i.e., spillover effects) by utilities that compromises or imperils safety. In other words, because a utility may not bear the full cost of a pipeline incident, it may devote less effort toward safety activities than what is socially preferred.

IV. Recommendations for Safety and Utility Regulators

Safety regulations are premised on the market's failure to produce the socially optimal level of safety. In other words, government intervention may be justified if the private market fails to produce the socially preferable outcome. This perspective derives from welfare economics, which emphasizes an economically efficient outcome. Economic efficiency requires the utility's incentive for safety to align with the public interest, which in turn means the social costs from a pipeline incident are fully internalized by the utility. Economic efficiency takes into account (a) the cost to society from satisfying the demands of utility consumers (i.e., productive efficiency) and (b) the value that consumers place on utility service (i.e., allocative efficiency). The keys to achieving economic efficiency are to set rates based on marginal-cost principles and to give utilities strong incentives to operate and invest efficiently. Economic efficiency helps to avoid resource waste from both consumption and production. Economic efficiency involves maximizing total net economic value, while fairness involves the distribution of net value among producers and consumers. Another way to look at the two concepts is that what matters to economic efficiency is maximizing the size of the pie, while fairness cares about the slicing of the pie. Ratemaking, as an example, involves treating these two concepts interdependently, because maximizing the size of the pie requires efficient pricing for consumers, which therefore encompasses slicing the pie at the same time.

[52] For example, most utilities have insurance for pipeline incidents. Their customers generally pay the premiums, and, in the event of an incident, they may have to pay the deductible as well.

Safety regulations attempt to control externalities—i.e., spillovers from normal business activities—that compromise or imperil safety. The market, for instance, might not take into account (1) the third-party effects of an incident or (2) inadequacy of information available to individuals or firms, which would prevent them from making informed decisions. A third rationale for government intervention comes from what analysts call the "agency problem." The incentives of the utility's owners to have a strong safety culture might not coincide with the managers'. Managers might not find it in their interest to spend time on promoting safety within the utility, while the shareholders would desire a strong safety culture to avoid costly lawsuits and other financial repercussions from a pipeline incident. In other words, for various reasons, the utility's managers might not act in the best interest of shareholders.

A last possible problem justifying government intervention is irrationality on the part of a market participant. Consumers might underestimate the probability of a certain event, resulting in their spending deficiently on safety. If the market contains any of the four problems, safety regulations become tenable.

Even though a market failure might exist, good regulation requires regulators to choose optimally among different alternatives available to them. Safety regulators should ask the fundamental question: What is the most effective and efficient way to compensate for a market failure that jeopardizes safety? Command-and-control regulations with detailed rules, as discussed earlier, would almost always violate this condition.

Achieving optimal safety rules poses a special challenge when regulators make decisions based on the input of different stakeholders with varying and sometimes conflicting interests. Stakeholders at PHMSA rulemaking proceedings include (a) local and state governments, (b) federal and state utility regulators, (c) public-interest groups, (d) the public, (e) trade associations, (f) federal safety regulators, and (g) pipeline operators. The main factor for decision making may well be the consensus of stakeholders, not the findings of any empirical or theoretical analysis.

A. Cost-effective actions

One problem occurs when a utility achieves a targeted safety level at a cost higher than what is most efficient. As an example, if a utility wants to improve safety, it should look at different options and select those with the lowest cost. Failing to take the least-cost action can violate the prudence standard.[53] In addition, it always means that utility customers are paying more for safety than they should. As an example, because pipe replacement is expensive, other approaches to improving safety might be more economical and yet improve safety to comparable levels. Safety regulations should include follow-up information on the effectiveness of specific actions in addressing threats underlying the regulations themselves.

[53] Under most legal interpretations, the prudence test requires only reasonableness under the circumstances at the time that a utility made a decision or undertook an action; the test excludes consideration of later facts or what some analysts call "second-guessing."

A regulation that mandates the installation of excess-flow valves (EFVs) represents what analysts refer to as a command-and-control, technology-based form of regulation.[54] Empirical studies have found command-and-control regulations to result in wasteful costs because they preclude the possibility of applying less costly options for individual firms that could attain a comparable objective (e.g., a specified improvement in safety). The overall safety of a gas distribution system depends on myriad actions, one of which could include the installation of EFVs. Other actions conceivably could be taken more cheaply than by installing EFVs and yet obtain the same or a higher safety level for a gas-distribution system.[55] By assessing various safety actions and identifying those that are most effective and cheapest, say, within a DIMP, the utility would achieve a cost-effective result.

B. Enforcement

Notwithstanding safety regulations, no matter how strict they might be, a firm may skirt them when enforcement is lax. Safety regulators apply different enforcement procedures. As expressed in a NAPSR report:

> Enforcement actions vary from state to state, but generally, when a safety violation is discovered during an inspection, the state inspector will submit a report of the findings for follow-up actions. Depending on the state's laws, the agency will determine the severity of the violation and the next course of action.[56]

Economics tells us that compliance with a law or regulation is more likely if the cost of compliance to a firm is less than the expected penalties from noncompliance.[57] If penalties for

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[54] An EFV is a device that restricts the flow of gas in a customer's service line when a severe rupture in the line occurs. Most breaks are caused by excavation and vehicular accidents. By restricting gas flow, an EFV may help to prevent deaths, injuries, and property damage. Back in the early 2000s, whether gas utilities should install EFVs was a major topic in the debate over the safety of local gas distribution systems. *See* Ken Costello, *Treatment of Excess Flow Valves by State Public Utility Commissions*, NRRI 05-07, July 2005.

[55] Although justification can exist for government intervention with regard to EFVs, it may not necessarily be in the form of a command-and-control mandate. When a customer makes a decision regarding whether or not to install an EFV on her service line, she takes into account the potential effects on her, including property damage and loss of life or injury, but probably not the consequences for her neighbors. In other words, by not considering the effects of an incident on her neighbors, the customer will underestimate the aggregate societal benefits from purchasing an EFV. As another reason for government intervention, customers may not have good information on the benefits of an EFV. The end result is that, from a societal perspective, utility customers would tend to under-purchase EFVs.

[56] National Association of Pipeline Safety Representatives, *Compendium of State Pipeline Safety Requirements and Initiatives Providing Increased Public Safety Levels Compared to Code of Federal Regulations*, 6.

[57] When a firm expects to spend substantial sums of money to satisfy a regulation, safety-related or otherwise, regulators should not assume that it would take the necessary actions to achieve compliance.

noncompliance are low, unless the probability of detecting infractions is high, firms would have little incentive to comply with a law or regulation.[58] Fines for violations should exceed the expected damage from an incident to the extent that the probability of detection is less than one.[59] An alternative approach for motivating utilities to operate safely is to impose an "incident tax." Utilities would have the leeway to select the most cost-effective actions to prevent incidents, for which they could pay a high tax.[60] As a condition, they should not be able to recover from their customers any taxes paid.

States might want to review their methods for determining fines. A review might lead to revised methods that assess higher and more appropriate fines for violations of pipeline safety codes.

C. Balancing safety with ratemaking goals

State utility regulators face pressure to approve safety actions and allow utilities to recover their costs. Federal authorities might exert this pressure. It becomes difficult for state utility regulators to resist it; they might face criticism if an incident occurs later. Utility regulators, however, owe their customers a thorough review of the utility's proposed actions to improve safety and how they would recover their costs. State statutes require most utility regulators to undertake this duty. Federal safety regulators tend to slight the cost and rate implications, as they understandably place most of their emphasis on safety.

Safety regulations require utility regulators to allow utility spending for maintaining minimum safety standards; but state legislative and judicial mandates restrict them to allow "just and reasonable" rates for gas utilities. These mandates reflect standard legal requirements imposed by court interpretations of statutes and the Constitution. Although interpreted differently by state utility regulators, "just and reasonable" rates typically include two broad features: (1) They reflect the costs of an efficient or prudent utility, and (2) they allow the

[58] In 2004, the U.S. Government Accountability Office issued a report critical of the federal safety regulator, the Office of Pipeline Safety, for imposing small fines and collecting only a portion of those fines. See U.S. Government Accountability Office, *Pipeline Safety: Management of the Office of Pipeline Safety's Enforcement Program Needs Further Strengthening*, GAO-04-801, July 2004 at http://www.gao.gov/assets/250/243540.pdf.

[59] Some state safety regulators do not initially fine a utility when they detect a violation. The utility has an opportunity first to mitigate the problem.

[60] One issue would be the size of the tax. It could correspond to the value placed on the loss of human life, injuries, and property damage; or on some multiple of the losses. If the tax is too low, from a societal perspective utilities would tend to have a deficient incentive to prevent an incident. They might decide, for example, that it is more profitable to forgo expenditures on safety and risk paying a tax for an incident.

efficient or prudent utility a reasonable opportunity to earn a return sufficient to attract new capital.[61]

1. Ratemaking and cost-recovery principles

Ratemaking requires that regulators take into account statutes and legal rules, economic principles, precedent, and the trade-offs among different regulatory objectives. Regulators need to judge (1) what objectives ratemaking should achieve, (2) the relative import of each objective, and (3) their willingness to impede certain objectives to advance others (e.g., the loss of economic efficiency from "fairer" rates). Good ratemaking also requires unbiased analysis and making information accessible to regulators in reaching a decision that advances the public interest.

To emphasize, ratemaking decisions typically have conflicting consequences. That is, the selected ratemaking method advances some particular regulatory objectives while impeding others. The classic example is marginal cost pricing. (Marginal cost pricing sets price equal to the cost to the utility of the last unit of service.) This pricing rule promotes economic efficiency by providing consumers with proper price signals while, some observers would argue, clashing with the objectives of equity and gradualism.

a. Prudent and reasonable costs

One defensible regulatory objective is "adequate safety at reasonable cost." It coincides with the requirement of "just and reasonable" rates to prevent customers from paying for costs that the utility could have avoided with efficient or prudent management. Regulators attempt to protect customers from excessive utility costs by scrutinizing those costs.

In the context of this paper, regulators would need to review a utility's safety actions. Prudent costs reflect cost-effective actions (as defined earlier). A more desirable standard would be to align costs with benefits. But because utilities have to abide by safety regulations—even those that do not pass a cost-benefit test—utility regulators cannot expect them to satisfy this standard. When safety regulations are prescriptive—mandating certain technologies, for instance—utility regulators should expect utilities to take some actions that would fail a cost-effectiveness test as well. The fault, of course, does not lie with utilities.

b. Fair cost recovery for the utility

Fair cost recovery[62] prevents severe cash-flow problems for the utility while also protecting customers against excessive costs. Some ratemaking mechanisms, such as an

[61] The second feature permits the utility an opportunity to recover the costs (including its cost of debt and equity) incorporated into the rates approved by the regulator in the last rate case. A regulator generally sets rates so that a utility has an *opportunity* to earn a fair or reasonable rate of return for shareholders, assuming efficient and economical management; but the regulator does not guarantee that return. A frequent area of contention in rate cases is the interpretation of the term "opportunity."

infrastructure surcharge,[63] achieve the first outcome while violating the second in the absence of a thorough regulatory review of costs. Good regulation would allow utilities a reasonable opportunity to earn their authorized rate of return, as long as they were prudent. If utilities have to spend money because of safety regulations, and they spend this money prudently, they should be able to recover all of their costs in a manner that avoids severe financial problems. For example, if the utility regulator previously approved "safety" investments, such as pipe replacements, and determined that the utility managed them prudently, it should allow the utility to earn an adequate rate of return on those investments. On the other hand, when a utility is not prudent, it would be unfair to its customers if it were allowed to recover all of its costs. In both instances, "just and reasonable" rates would require these regulatory actions.

c. No rate shock

State utility regulators are more favorably disposed toward new rates if the methods used to determine them have some historical coherence. Especially troublesome are new rates that increase unexpectedly and are well above previous rates for particular classes of customers. Allowing a utility to recover the costs for an expensive safety-improving project, such as a pipeline replacement program, on an annual basis outside of a general rate case can help lessen any dramatic one-time rate increase that could otherwise occur. Particularly during hard economic times, a gradual increase in rates might be more politically palatable.

d. The right incentives

In an ideal world, utilities would be motivated to achieve the right level of safety at least cost. "The right level" means safety that accounts for the marginal benefits and marginal costs at the level where they are equal. This condition requires that utilities be held accountable for incidents, especially those within their control.

e. Public acceptability

This principle refers to how utility customers, the public, and political actors will respond to higher rates related to safety improvements. Utility regulators like to avoid negative public

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[62] "Cost recovery" refers to the timing and methodology used for the inclusion of allowable costs in rates.

[63] Infrastructure surcharges come under different labels—for example, capital expenditure tariff tracker (Rhode Island), utility enhancement infrastructure rider (Michigan, New Jersey), accelerated main-replacement program (Indiana, Kentucky), infrastructure replacement rate surcharge (Georgia, Kansas, Missouri, Nebraska) interim rate adjustments/rate-stabilization tariff (Texas, Virginia), main-replacement program rider (Arkansas), and cast-iron bare-steel replacement program (New Hampshire). A general definition of surcharges is that they represent an adjustment to the customer bill that raises rates by a specified amount for a limited time. *See* Paul Roberti, "Regulatory Efforts to Enhance Pipeline Safety," presentation at the AGA Reauthorization and Transmission Pipeline Design, Construction and Operations Workshop, February 29, 2012, 8.

reactions to their decisions, as this places them in an unfavorable light and is more likely to trigger legislative intervention. Public acceptability should result in minimal customer complaints, legislative intervention, and negative media publicity. If the utility can justify expenditures on safety activities—claiming that necessary risk reduction requires an aggressive pipeline-replacement program, for instance—its customers will be more accepting of any rate increase. Utility regulators should not view public acceptability as something necessarily outside the control of the ratemaking process. How the public reacts to a particular rate increase would depend, for example, on efforts to educate customers on the justification for the increase.

f. Promotion of a specified goal

The utility regulator might feel strongly about mitigating the probability of pipeline incidents and their consequences. In achieving this goal, the regulator might want to approve a special tariff or a nontraditional treatment of the costs, such as a tracker or rider in which the utility could recover "safety" expenditures outside of a rate case.

g. Balancing of conflicting objectives

The proper balancing would result in cost considerations not jeopardizing safety, or in prompt cost recovery that coexists with prudent utility behavior or the most cost-effective actions.

2. The example of accelerated pipeline replacement

A primary concern is the age of old cast-iron or bare-steel pipes, many of which are susceptible to breaks or leaks.[64] Many of these pipes are several decades old and are either cast iron or bare steel. Cast-iron and bare-steel pipes account for a disproportional percentage of leaks.[65] The replacement of old pipes is a costly endeavor. One estimate is that replacing all

[64] Cast-iron pipes were installed into the 1940s and still make up about 3 percent of all distribution pipelines. Small-diameter pipes are susceptible to breaks under extreme weather conditions from earth movements. Bare-steel pipes were mostly installed between 1940 and 1970. These pipes are more tolerant of bending than cast-iron pipes but are susceptible to corrosion because of the lack of coating or cathodic protection. After 1970, regulations required coating and cathodic protection. Bare-steel comprises about one percent of the distribution system. Early plastic pipes can crack under bending stress. Plastic pipes are also susceptible to immediate failure under a severe impact.

[65] In Pennsylvania, for example, bare-steel and cast-iron pipes together account for only 5 percent of distribution pipes (in terms of miles), but they bear 95 percent of the leaks. Pennsylvania gas utilities expect to spend $13 billion over the next 20 years for pipe replacements. *See* Paul Metro, "Pennsylvania Natural Gas Summit—PUC Jurisdiction," Pennsylvania Natural Gas Summit, November 18, 2009 at http://www.puc.state.pa.us/transport/gassafe/pdf/Presentation-NG_Summit111809.pdf. In Ohio, the four largest gas utilities have together budgeted around $6.3 billion to their accelerated pipeline-replacement programs. *See* Cheryl Roberto, "Pipeline Safety Program: Ohio Highlights," presentation at the Annual NARUC Meeting, November 15, 2011 at http://www.narucmeetings.org/Presentations/Roberto_SafetyFirst_Tuesday.pdf.

pre-1960 pipes in the U.S. would cost around $150 billion, or $2,100 per customer.[66] This amount seems politically unpalatable, especially in these hard economic times.[67]

Although we have seen a downward trend in pipeline accidents over the past several years, the age and other features of existing gas pipes have raised legitimate questions about the future safety of our pipeline system. Safety experts contend that decisions to repair, rehabilitate, or replace pipe should depend on different factors in addition to age. These factors include: (a) the operating history of the pipeline, (b) pipeline protection against corrosion, (c) materials used during pipeline construction, (d) pipeline construction methods, and (e) soil movement around the pipeline and other environmental conditions.[68] Pipeline safety experts refer to the term "fitness for service" as a more broadly based standard for determining appropriate actions. This standard relies on operating history, as well as inspection and testing results.

Several state regulators are asking whether gas utilities should accelerate their replacement of old cast iron and bare-steel pipes.[69] PHMSA is encouraging state regulators to accelerate pipe replacement:

> Pipeline infrastructure replacement programs for gas distribution systems exist in nearly 30 states. Some state public utility commissions have used their traditional ratemaking authority to approve these programs, the terms and conditions of which are established under a generally applicable statutory provision. Other state public utility commissions have specific authority to approve such programs. The terms, conditions, and cost recovery mechanisms of these programs vary by statute. Whether as part of the traditional ratemaking process or in a separate proceeding, PHMSA is encouraging the states to accelerate the remediation of high-risk gas pipeline infrastructure.[70]

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[66] *See* Rocco D'Alessandro, "Pipeline Safety: Planning for a Safer Future," NARUC 122nd Annual Conference, November 2010, 9.

[67] The expectation of low wholesale natural gas prices over the next few years may, however, make the high cost of replacement more politically palatable.

[68] *See* Rocco D'Alessandro, "Pipeline Safety: Planning for a Safer Future," 12.

[69] Even new pipelines have risks. Their overall risk depends on operator qualifications, construction procedures and materials, and the number and thoroughness of inspections.

[70] U.S Department of Transportation, Pipeline and Hazardous Materials Safety Administration, *White Paper on State Pipeline Infrastructure Replacement Programs*, December 2011,1 at http://opsweb.phmsa.dot.gov/pipelineforum/docs/PHMSA%20111011-002%20NARUC.pdf. PHMSA specifically wants state regulators to consider having utilities accelerate pipe replacements for certain pipes. They include cast-iron gas mains, plastic pipes manufactured from the 1960s through the early 1980s, bare-steel pipes without cathodic protection or coating, and older pipes.

PHMSA is even offering to assist state regulators who are seeking to establish or improve programs for the repair, rehabilitation, and replacement of high risk pipeline infrastructure. Such assistance could include offering testimony at legislative hearings or in state proceedings, providing technical expertise in identifying high-risk pipeline infrastructure, and ensuring that state pipeline safety regulators are effectively implementing the integrity management requirements for natural gas transmission and distribution lines.[71]

Utilities will eventually have to replace their old pipes.[72] The question is whether they should replace them at a faster pace than they have done historically. One observer contended that "the best method to insure the integrity of the system is to have an effective replacement program to eliminate [the most hazardous] leaks as the system is replaced, as opposed to fixing each joint that is weeping one at a time."[73] Federal safety regulators can order pipe replacement only under the condition of an "imminent hazard." In their eyes, pipelines only have to be "fit for service." A consensus is that state regulators should seriously look at accelerating pipeline replacement, especially for old pipes that may pose an immediate danger. Waiting too long could result in any replacement's becoming a response to an emergency situation rather than a reasonably deliberate action.

a. Reviewing the cost-effectiveness

Assume that a utility proposes to spend large amounts of money on accelerated pipeline replacement over the next ten years. It should then demonstrate to the utility regulator that the strategy is: (1) cost-effective in improving safety at the lowest cost and (2) needed to address an imminent threat to safety.[74] Steps that the utility can take to determine the cost-effectiveness, or the expected costs and benefits, of accelerated pipeline replacement are as follows:[75]

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[71] Ibid., 17.

[72] In some programs, replacements involve bare-steel mains, cast-iron mains, pre-1971 coated-steel mains and services, certain first-generation plastic pipes, and isolated bare-steel services.

[73] *See* the comments of Sue Fleck, Vice President, Engineering, National Grid representing the AGA in the *Proceedings from the National Pipeline Safety Forum*, hosted by the U.S. Department of Transportation, April 2011, 18.

[74] In regulatory jargon, the utility should demonstrate that its pipeline replacement plan is "prudent and reasonable."

[75] The reference case from which to calculate the benefits and costs is a strategy that spreads out replacements over more years based on historical experience. For a presentation on quantifying the benefits and costs of accelerated pipeline replacement, *see* Frontier Economics, "Evaluating the Gas Mains Replacement Programme—Preliminary Findings," prepared for the Capex Working Group, November 15, 2010 at http://www.ofgem.gov.uk/Networks/GasDistr/RIIO-GD1/WorkingGroups/Documents1/Frontier%20repex.pdf. For the particular case examined by Frontier Economics, the net benefits from accelerated pipeline replacement were negative for several scenarios.

- *Determine whether current leak rates require accelerated pipeline replacement:* Are alternatives to accelerated pipe replacement inadequate to address the problem at hand, even though they are less expensive? Alternative actions can include pipe repair or pipe replacement at a slower pace.

- *If feasible, estimate the expected reduction in deaths, injuries, and property damage from accelerated pipeline replacement:* Do federal or state safety regulators have historical information on the reduced risk from accelerated pipeline replacement relative to a reference-case pipeline replacement?

- *If feasible, calculate the reliability and environmental benefits from accelerated pipeline replacement:* What exactly are these benefits? How can the utility measure them?

- *Calculate the opportunity costs of accelerated replacement:* Could the money the utility dedicated to accelerated replacement be better allocated to reduce risk by other actions? In other words, could these actions reduce risk more than the lower risk from accelerated replacement? Which options are most cost-effective given the monies available for safety actions? What other utility actions would reduce safety risk, and what are their costs? Because pipeline replacement is extremely expensive, can a utility spread it out over more years without jeopardizing safety?

- *Calculate the lower operating costs that would result from fewer leaks and lower maintenance costs:* How should utility customers receive the benefits from these cost savings?[76]

- *Identify pipe segments that are at the greatest risk and demand immediate attention*: What is the threat in the absence of immediate action? To what extent would a non-accelerated replacement program pose risk to the pipeline system? Do the results from a risk analysis show the urgency of replacing "at risk" pipes over an accelerated time frame?

The study estimated that replacing 25 percent of the pipes most at risk removes 60 percent of the system-wide risk. This outcome suggests declining returns from additional dollars spent on pipeline replacement.

[76] One study calculated that the largest benefit from accelerated pipeline replacement derives from reduced gas losses, which has both an economic and an environmental dimension. The latter benefit includes a reduction in the amount of greenhouse gas emissions. S*ee* Frontier Economics, "Evaluating the Gas Mains Replacement Programme—Preliminary Findings," 8.

- *Calculate the investment costs and compare with reference-case investment costs:* Accounting for inflation and discount rates, what would be the present-value cost of an accelerated program relative to a program based on historical replacement trends?[77]

- *Calculate the annual budget for accelerated pipeline replacement:* How precise are the budget numbers? Should the utility have a contingency budget for unexpected events?

- *Calculate the net benefits from accelerating pipeline replacement:* What are the total costs and benefits of accelerating pipeline replacement relative to a plan based on historical trends?

b. Appropriate cost recovery for investments

One justification for infrastructure surcharges is that investments in refurbishing or replacing aging pipelines (e.g., cast-iron and bare-steel pipes) do not generate additional revenues for the utility.[78] Surcharges can offer utilities the following advantages: (1) shortening the time lag between the incurrence of a cost and its recovery in rates (i.e., curtailing regulatory lag), (2) increasing cost-recovery certainty, and (3) lessening regulatory scrutiny of costs. Utilities like infrastructure surcharges because they allow cost recovery without a general rate case.[79] Overall, surcharges lower a utility's financial risk by stabilizing its earnings and cash flow.

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[77] One would expect that for accelerated pipeline replacement, investment costs in present-value dollars (assuming that the discount rate is greater than the construction-cost inflation rate) would be higher than under the reference case. *See* Frontier Economics, "Evaluating the Gas Mains Replacement Programme—Preliminary Findings," 19.

[78] Examples of two states with infrastructures surcharges are Ohio and Rhode Island. *See* Cheryl Roberto, "Pipeline Safety Program: Ohio Highlights," presentation at the Annual NARUC Meeting, at http://www.narucmeetings.org/Presentations/Roberto_SafetyFirst_Tuesday.pdf; and Paul Roberti, "Regulatory Efforts to Enhance Pipeline Safety: The Rhode Island Experience," presentation at the Annual NARUC Meeting, November 15, 2011, at http://www.narucmeetings.org/Presentations/Roberti_SafetyFirst_Tuesday.pdf.

[79] Pipe replacement should reduce a utility's operating costs from fewer leaks that waste gas and from lower maintenance costs. Any surcharge should subtract these cost savings from the amount charged to customers. Such an adjustment is particularly important when a utility is unlikely to file a rate case for a number of years. One gas utility estimated that its proposed accelerated pipeline-replacement program, relative to a "slower pace" program, would reduce operation and maintenance costs by $244 million during the period 2011–2059. The accelerated program would reduce the amount of leak repairs, leak surveys, leak rechecks, emergency responses, regulator station inspection and maintenance, vault survey and maintenance, lost gas, and inside safety inspections. *See* Illinois Commerce Commission, *Proposed General Increase in Natural Gas Rates (Tariffs Filed on February 25, 2009)*, Order, Docket

An important incentive for cost efficiency on the part of regulated utilities is the threat of cost disallowance from retrospective review. To the extent that infrastructure surcharges reduce the effectiveness of these reviews, further erosion of incentives for cost management occurs. With less regulatory oversight and auditing, which often accompany rate cases, a utility might have less concern over its costs. Regulators have long recognized the importance of retrospective reviews in motivating a utility to control costs. Many regulatory experts view retrospective reviews as dissuading a utility from poor decisions with the threat of a penalty—making the utility more diligent and careful in its planning and operations, for instance.

PHMSA favors surcharges because it wants utilities to replace their old pipes in the shortest possible time. Surcharges for safety expenditures can diminish any disincentive that utilities might otherwise have to invest in safety. Particularly when a utility is able to defend large investments in safety, prompt cost recovery can be appropriate.[80] Surcharges permit the utility an opportunity to recover substantial costs (including costs of debt and equity) incurred since the last rate case. A regulator generally sets rates so that a utility has an opportunity to earn a fair or reasonable rate of return for shareholders, assuming efficient and economical management, but the regulator does not guarantee that return. A frequent area of contention in rate cases is the interpretation of the term "opportunity." A highly expensive investment that generates no additional revenues for the utility would seem to be a good candidate for special cost-recovery treatment. Waiting to recover costs through a litigated rate case could place the utility in financial jeopardy.[81]

From an earlier discussion, the utility should first convince the utility regulator that the investments are preferable, from a cost-benefit or cost-effectiveness perspective, to alternate actions. As NARUC president David Wright recently expressed in an interview with the natural gas industry:

Nos. 09-0166 and 09-0167, January 21, 2010, 134 at http://www.icc.illinois.gov/docket/files.aspx?no=09-0166&docId=145807.

[80] Another large investment might involve replacing manual values with automatic shut-off valves. On a nationwide scale, the cost could be as much as $12 billion. (*See* Christina Sames, American Gas Association, National Transportation Safety Board Hearing, March 3, 2011.) Some industry people have argued that automated valves would have marginal benefits because most of the damage caused by a pipeline explosion occurs within 30 seconds. On the other hand, when a utility spends several hours looking for shut-off valves while gas is "blowing" out of a ruptured pipe, the possibility exists for hours of fire and massive property damage. I thank Bob Harding for this last point.

[81] The term "financial jeopardy" has different interpretations. This state, no matter how it is defined, has the potential to harm customers as well as the utility shareholders. It could, for example, cause (a) the deferment of needed capital investments to prevent unsafe pipelines and unreliable service, (b) the lowering of the utility's credit rating, and (c) an increase in the utility's cost of capital. The time period over which these effects would harm utility shareholders generally would be more immediate than that for the harm to customers.

> The best way we can expedite natural gas infrastructure replacement programs is for us to have a dialogue with everyone involved. Safety is job number one, and we will do all we can to provide the industry with the resources it needs to ensure the safety of its systems. It is incumbent upon the industry, however, to be proactive and tell us what problems exist and where the problems are. Regulators can't act unless we have a request in front of us, and your requests must demonstrate, in an open and transparent process, what you need and why. We know we have an aging infrastructure problem, and we rely on you to give us the specifics.[82]

The economic justification for accelerated pipeline replacement prevents customers from paying for costs that the utility could have avoided with a more efficient or prudent choice. Regulators attempt to protect customers from excessive utility costs in general by scrutinizing a utility's costs in a rate case or by applying an incentive mechanism (with explicit rewards and penalties) that motivates a utility to act efficiently. Ratemaking practices can affect the propensity of a utility to act efficiently. Cost riders (such as an infrastructure surcharge), especially when they preclude certain costs from undergoing a thorough review by the regulator,[83] can weaken a utility's incentive to control those costs, all else being equal.[84]

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[82] American Gas Association, "Go, Team!" *American Gas*, February 2012, 22.

[83] The utility may also have an incentive for "mission creep," whereby it would shift costs not related to safety activities to a rider such as an infrastructure surcharge. The motivation for the utility is get more prompt and certain recovery of these costs.

[84] *See*, for example, Ken Costello, *How Should Regulators View Cost Trackers?* NRRI 09-13, September 2009, at http://nrri.org/pubs/gas/NRRI_cost_trackers_sept09-13.pdf. Cost riders for which relevant costs do not undergo a thorough review by the regulator can weaken a utility's incentive to control those costs, all else being equal. They can also diminish the effect of regulatory lag on a utility's cost performance. Alternatives to an infrastructure surcharge are deferred accounting and tracker accounts. Each accounting procedure preserves the cost-recovery issue until the utility files its next rate case. As one state commission has expressed about deferred accounting:

> Deferred accounting is a valuable regulatory tool used primarily to hold utilities harmless when they incur out-of-test-year expenses that, because of their nature or size, should be eligible for possible rate recovery as a matter of public policy. Traditionally, deferred accounting has been reserved for costs that are unusual, unforeseeable, and large enough to have a significant impact on the utility's financial condition. Deferred accounting has also sometimes been permitted when utilities have incurred sizeable expenses to meet important public policy mandates. (*Minnesota Public Utilities Commission, Order Granting Deferred Accounting Treatment Subject to Conditions and Reporting Requirements*, G-002/M-10-422, January 12, 2011, 1.)

Several state utility regulators have approved surcharges for accelerated pipeline replacement.[85] A common rationale is that they would:

- Avoid cash-flow problems and other financial risks for utilities incurred from undertaking large investments to assure a safe pipeline system;
- Reduce the number of full rate cases;[86]
- Mitigate short-term high rate increases (i.e., rate shock);
- Allow utility regulators to periodically (e.g., annually) review the prudence of a project;
- Promote intergenerational equity; [87]
- Eliminate any disincentive that a utility would otherwise have to replace pipelines at an accelerated pace; and
- Promote safety by encouraging replacement of pipelines at high risk.

D. Why a single regulatory agency can better balance safety and economic goals

Criticisms about a single regulatory agency's regulating both utility rates and safety seem to overlook the importance and difficulty of balancing societal objectives. An argument made in this paper is that balancing goals becomes easier when one agency regulates both rates and safety. State utility regulators have to abide by federal safety regulations[88]—federal regulations, in other words, set a floor—but federal regulations pay little attention to (although they do not completely ignore) the ratemaking goals of state utility regulation. A safety regulator divorced

[85] *See* U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration, *White Paper on State Pipeline Infrastructure Replacement Programs*; and American Gas Association, "Infrastructure Cost Recovery Update," Natural Gas Rate Round-Up, January 2012. The last publication noted that "currently, more than 40 utilities in 19 states serving 20 million residential natural gas customers are using full or limited special rate mechanisms to recover their replacement infrastructure investments, and 6 utilities have such mechanisms pending in 3 other states [p. 1]." Incidentally, the Federal Energy Regulatory Commission has no special rate treatment for safety activities by interstate pipelines.

[86] Rate cases absorb substantial staff resources and time, diverting those scarce resources from other commission activities.

[87] The apparent reason is that current customers would be beneficiaries, so they should start paying for the pipe replacements as soon as possible.

[88] As noted earlier, most states have safety regulations that are more stringent than federal regulations.

from cost-recovery authority—that is, removed from the responsibility of determining how utilities will recover the costs—will tend to overemphasize safety relative to ratemaking goals. In other words, federal safety regulators, who are responsible and politically accountable for pipeline safety, will tend to be highly risk averse toward incidents, enacting regulations that mostly ignore their economic effects. A likely consequence is an overly safe pipeline system.

A single regulator would be better positioned to strike the balance between competing goals needed to achieve a socially optimal outcome. These goals are primarily a safe pipeline and "just and reasonable" rates. The regulator can assign greater importance to safety relative to ratemaking goals and still achieve a balanced outcome that is in the public interest. Even if one disagrees that policymakers should make trade-offs between these goals—that safety is too important to compromise, for instance—one should at least strive to achieve a given level of safety at least cost. Because federal regulations have increasingly allowed utilities discretion in their safety activities, regulatory oversight becomes important for assuring utility customers that they are not overpaying for safety.[89]

The main point conveyed here is that state utility regulators are the only agency that has a vested interest in considering both safety and the cost of safety to those who pay for it. This balancing requires utility regulators to ensure not only that utilities operate safely but also that they provide safety at a reasonable cost that reflects prudent and efficient action. While utility regulators have a strong commitment to safety,[90] they also have an obligation to assure utility customers that they do not pay more for utility service than is necessary. It is this responsibility of state utility regulators that makes their work so challenging and singular. The public holds them accountable for excessive rates and deficient safety. Overall, the preferred institutional arrangement would seem to call for a single agency—a state utility regulator subject to a federal floor on safety regulations—with jurisdiction over safety and ratemaking matters that allows it to harmonize and balance symmetrically different social objectives, which sometimes conflict. It is this harmony and balance that can best advance the public interest and justify single-agency authority over both the safety and economic functions of utilities.

When two regulators have authority over utility activities, the responsibilities of each should be clearly defined to avoid duplication, jurisdictional uncertainty, and turf battles. Because safety standards directly affect utilities' costs and rates, state utility regulators should assume an advisory role in developing federal safety regulations.

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[89] If, instead, federal regulations were predominately command-in-control in nature, utilities would have less discretion, and prudence reviews would be less demanding and important.

[90] It is hard to question the commitment of states to pipeline safety because most of them, as mentioned earlier, have stricter safety regulations than the federal regulations. This situation implies that states are willing to have utility customers pay higher rates in return for greater safety.

V. Conclusion

This paper highlights the responsibility of state utility regulators to assure the public that utilities perform at a high level in various dimensions, including economic efficiency, reliability, and safety. Safety is a prominent goal, but only one of several goals that regulators attempt to advance. Sometimes these goals conflict, requiring regulators to weigh their relative importance and make trade-offs that best serve the public interest. State utility regulators need to engage themselves in a robust dialogue at the federal level, explaining the importance of economic factors in developing new laws and regulations.

One possible conflict exists between safety and "just and reasonable" rates. An example is achieving a high level of safety at excessive costs or with "exorbitant" rate increases. State utility regulators are in the best position to balance the safety and ratemaking goals, frequently confronting them with a difficult challenge. One rule that utility regulators can consider is the following: Ensure that utilities make their pipes safe by spending prudently and efficiently. Another regulatory goal—reliable service—is complementary with safety. A pipeline incident would likely shut down at least part of the gas utility's operation. One benefit of improved safety is, therefore, more reliable utility service. Another benefit of improved pipeline safety—from pipeline replacement, for instance—is lower maintenance and operating costs. Overall, efforts to improve safety can have a payoff that transcends making pipelines safer.

Safety has a cost that state utility regulators must take into account when evaluating a utility's proposal to invest in or spend on safety-related activities. Regulators must not only judge whether these costs actually improve safety but also assess whether the underlying actions are least cost. The first justification requires a cost-benefit-type review, while the second justification applies a cost-effectiveness rule. Good regulation requires these actions, although state utility commissions have limited authority to determine whether safety actions are cost-beneficial because of federal regulations.

A policy goal of "perfect safety" is contrary to how state utility regulators operate and their mandate to serve the public interest. This policy is inconsistent with the common interpretation of "just and reasonable rates." It also contradicts how rational individuals and organizations behave; all make trade-offs that generally compromise safety for other objectives they deem important. Specifically, they prefer to live with some risk rather than to spend additional money and time on reducing any residual risk. Spending excessive money on safety might result in less money being available to improve productivity or customer service. The "balancing act" of regulation—which history has shown best promotes the public interest—requires utility regulators to consider safety jointly with other objectives aligned with the public interest. Without this joint consideration, an imbalance and an asymmetrical outcome will likely compromise the public interest.

Appendix A: Major Tasks for Safety Regulations

- Inspect pipeline design and construction (e.g., material used, construction procedures, necessary welding) for compliance with regulations.
- Identify the riskiest segments of pipes that require repair, rehabilitation, or replacement.
- Review, monitor, and evaluate DIMP.
- Require operators to report on incidents and their causes.
- Require operators to report leaks and take appropriate actions in response to those leaks.
- Investigate incidents as to their causes and the utility's response.
- Inspect operator activities, such as leak surveys and corrosion, maintenance,[91] operations conducted by qualified personnel, emergency preparedness and response, and damage prevention.
- Oversee rehabilitation projects.
- Monitor compliance with standards and other requirements, such as operators periodically inspecting pipes and keeping records for review.[92]
- Enforce federal and state regulations by issuing fines, warning letters, or letters of concern for violations.

[91] Federal regulations require operators, for example, to document their procedures for carrying out maintenance activities.

[92] Another requirement is for contractors, excavators, and other parties to call 811 before digging and 911 in an emergency.

Appendix B: Questions Related to Gas Pipeline Safety

Core questions

1. What are the major decisions that regulators have to make about utility safety activities?

2. What criteria should regulators apply in making those decisions?

3. What incentives do gas utilities have to achieve safety?

    a. Are these incentives compatible with the utilities' undertaking cost-effective safety activities?

    b. How risk averse are utilities toward pipeline incidents relative to society's risk aversion?

4. What is the threshold for "safe is safe enough"?

    a. Who should make this determination?

    b. How do regulators know if utilities are meeting this threshold?

5. Why isn't zero tolerance for safety risk optimal from society's perspective?

    a. What would be the costs?

    b. What would be the benefits?

6. How can safety regulators best enforce laws and regulations?

    a. How high should regulators set fines?

    b. What factors should affect the size of fines?

Cost-effective/cost-beneficial actions

1. How do utilities determine where and how much to spend on safety?

2. How do regulators know whether utilities were prudent in their safety-related activities?

    a. How should regulators define and measure prudence when it comes to safety activities?

b. How can regulators know when utilities overspend on safety activities?

3. Should utilities apply a cost-benefit or a cost-effectiveness rule for evaluating safety activities?

4. What are the social benefits of safety? To what extent can utilities quantify them?

5. How can utilities exploit DIMP to better achieve cost-effective safety activities?

Balancing safety and other utility objectives

1. What potential conflict exists between safety and "just and reasonable" rates?

2. What constitutes "just and reasonable" rates that reflect a utility's safety-related costs?

3. Are safety and ratemaking activities mutually exclusive, or are they interconnected, requiring joint action?

4. How much safety should we have or can we afford? How much weight should regulators place on safety relative to other objectives?

5. Should the responsibility for economic and safety regulation of a utility reside in different government entities?

   a. What are the arguments for and against separate entities?

   b. What is the justification for assigning safety and ratemaking authority to a single agency?

Accelerated pipe replacement

1. On what basis should gas utilities accelerate pipe replacement? Is this action least costly for achieving a certain level of safety?

2. What are the benefits of accelerated pipe replacement? To what extent can a utility quantify these benefits?

3. What can regulators do to support accelerated pipe replacement, when found appropriate?

   a. How should they allow utilities to recover their costs?

   b. How should they monitor and evaluate expended costs as to their prudence?