Gas Distribution Infrastructure: Pipeline Replacement and Upgrades

Cost Recovery Issues and Approaches

Prepared For:
The American Gas Foundation

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July 2012

Founded in 1989, the American Gas Foundation (AGF) is a 501(c)(3) organization focused on being an independent source of information research and programs on energy and environmental issues that affect public policy, with a particular emphasis on natural gas. When it comes to issues that impact public policy on energy, the AGF is committed to making sure the right questions are being asked and answered. With oversight from its board of trustees, the foundation funds independent, critical research that can be used by policy experts, government officials, the media and others to help formulate fact-based energy policies that will serve this country well in the future.

Yardley Associates provides advisory services, expert testimony and litigation support to natural gas industry participants. The industry continues to undergo dramatic change that presents market participants with significant opportunities and challenges. Yardley Associates assists clients to navigate the ongoing industry transformation in a manner that captures opportunities to create value and minimizes risks. Areas of specialty include rate and regulation, strategic planning, market and economic analysis, and policy analysis.

Table of Contents

Executive Summary

Natural gas local distribution companies (LDCs) and federal and state regulators are resolutely committed to the safe and reliable operation of natural gas transmission and distribution networks. This commitment is demonstrated by continuous improvements in critical LDC business processes including incident prevention, inspections and monitoring, and by replacement of network facilities subject to leaks or material failure. Facilities most likely to require replacement on a priority basis are pipe and other facilities constructed using unprotected steel and cast iron pipe, certain early vintage plastic pipe, pipe fittings and other infrastructure that is leak-prone.

Approximately 9% of distribution mains services in the United States are constructed of materials that are considered leak-prone.[1] At the current pace of replacement, it will take up to three decades or longer for many operators to replace this infrastructure. Investments in new technologies and advancements in system design, monitoring, control and maintenance methods provide additional opportunities to enhance the reliability and safety of gas distribution infrastructure.

On April 4, 2011, in response to recent pipeline safety incidents, the United States Secretary of Transportation, Ray LaHood announced a “Pipeline Safety Action Plan” calling for pipeline operators, including LDCs, to accelerate their efforts to replace pipeline facilities and take other actions that will enhance the integrity of network facilities. Secretary LaHood’s “Call to Action” brought together federal, state and industry stakeholders in order to “discuss steps for improving the safety and efficiency of the nation’s pipeline infrastructure.” Equally important, the Call to Action called on state regulators to provide for timely recovery of pipeline replacement investments, recognizing that reliance on traditional cost recovery approaches may impede efforts to accelerate these activities.

Federal safety regulators did not mandate a timetable for completion of these efforts; however, the strong expectation of the Call to Action and related initiatives is that pipeline operators and their regulators will work towards addressing the replacement needs expeditiously. The benefits of accelerated replacement efforts are compelling and include:

- Achievement of safety and reliability benefits more rapidly;
- Alignment and compliance with the requirements of a pipeline operator's Distribution System Integrity Management Plan, a risk-based assessment of an LDC’s infrastructure that is mandated under pipeline safety laws;
- Cost savings resulting from increased scale through comprehensive planning, geographically-focused replacement efforts and the efficient use of outside contractor services;

[1] Although this report focuses on cost recovery approaches related to pipeline replacement and enhancements in the United States, the challenges and potential cost recovery solutions apply similarly to Canadian LDCs.

- Less disruption and improved coordination with affected municipalities; and
- Efficient deployment of capital for safety and reliability through a reduction in emergency repair efforts.

Additionally, current economic and natural gas market conditions support the acceleration of pipeline replacement activities while natural gas commodity costs are low and job creation is a national and local priority.

Timely cost recovery is an essential element of replacement efforts because, unlike investments that connect new customers and load, replacement facilities do not lead to increased revenues that offset investment costs. While LDCs, regulators and other stakeholders have traditionally relied upon base rate cases to provide cost recovery of capital expenditures for facility replacement, recent industry trends require the consideration of new cost recovery approaches. These trends include increasing proportions of LDC capital expenditures on non-revenue producing plant, slower load growth and harder to achieve incremental operating efficiency gains.

Several jurisdictions have adopted alternative infrastructure cost recovery mechanisms that provide for more timely recovery of pipeline replacement and upgrade costs. These include infrastructure cost trackers, infrastructure base rate surcharges, and deferred regulatory assets. There are at least 48 such cost recovery mechanisms that have been adopted in 22 jurisdictions, many of which were put in place during the last five years. Each mechanism accommodates LDC-specific circumstances and the particular statutory guidance, policies, and precedent of the respective jurisdiction. These ratemaking approaches support the increased capital requirements of replacing and enhancing leak-prone infrastructure, while preserving the fundamental elements of the traditional regulatory compact. The approval of these cost recovery mechanisms reflects the heightened focus on pipeline safety, the contribution of pipeline replacement efforts to improved safety and reliability, and the challenges to timely cost recovery attributable to large-scale investments in non-revenue producing facilities.

The implementation of infrastructure cost recovery mechanisms enhances the regulatory oversight of LDC infrastructure replacement and enhancement initiatives by facilitating stakeholder understanding of efforts to improve the safety and reliability of the LDC networks serving the public. These reviews allow commissions and other stakeholders to focus on pipeline safety and integrity to a greater degree than is usually possible in rate case proceedings. Commissions are able to concentrate their review on unique LDC circumstances, the extent of the challenges, the prioritization of investments, and potential bill impacts, all of which influence the pace of the replacement efforts.

The factors driving the need to replace or upgrade existing pipeline infrastructure and the recovery of the associated costs represent important issues requiring careful assessment by LDCs, regulators and other industry stakeholders.

I. Introduction

Natural gas provides approximately 25% of the nation's primary energy[2] serving over 71 million customers[3] and is used to generate approximately 21% of U.S. electricity supplies[4]. Competitive pricing, environmental benefits, and supportive public policies contribute to the widespread use of natural gas for heating, cooking, industrial process applications, and growing electric generation and transportation needs. Of course, this would not have been possible without public confidence in the safety and reliability of interstate transmission and local distribution pipeline delivery networks.

The overwhelming majority of our natural gas is produced within North America and transported to U.S. market areas by over 300,000 miles of large-diameter, high-pressure pipelines. Local distribution companies (LDCs) deliver gas supply within market areas to customers using 1.2 million miles of smaller-diameter, low-pressure mains and approximately 880,000 miles of customer service lines that deliver gas from a street connection to the customer's meter.[5] These distribution facilities were installed throughout the past century to accommodate the growth of natural gas, initially made possible by the discovery and development of natural gas producing areas in the southwestern and Gulf Coast areas of the U.S. and western Canada.

One of the present challenges facing LDCs, regulators and other industry stakeholders is the impact of leak-prone infrastructure installed using materials that are susceptible to corrosion or other material failure. LDCs are working closely with federal and state regulators to enhance the safety and efficiency of distribution networks by upgrading distribution facilities, including the replacement of leak-prone mains and service lines with medium and high-density polyethylene (PE) plastic pipe that is the current industry standard for most distribution pipe sizes.

This paper presents an overview of factors driving the need to replace or upgrade existing pipeline infrastructure, the status of these efforts and a discussion of alternative methods of recovering the costs associated with the necessary investments.

2 U.S. Energy Information Administration, *2010 Annual Energy Review*.
3 American Gas Association.
4 U.S. Energy Information Administration, *May 2012 Monthly Energy Review*.
5 U.S. Pipeline and Hazardous Materials Safety Administration (PHMSA), a division within the U.S. Department of Transportation.

II. Challenges of Leak-Prone Gas Distribution Infrastructure

LDCs and federal and state regulators are resolutely committed to the safe and reliable operation of natural gas transmission and distribution networks. This commitment is demonstrated by continuous improvements in critical LDC business processes including incident prevention, inspections and monitoring, and by replacement of network facilities subject to leaks or material failure. A primary focus of these efforts is the management of leak-prone distribution mains and services infrastructure that require eventual replacement.

Historical Development of Gas Distribution Infrastructure

The natural gas industry transformed from reliance on localized supply into a major North American energy source over the course of the 20th century. This progression occurred as advances in metallurgical technologies and welding techniques made it possible to construct transmission lines traversing hundreds of miles. Nearly half of the major natural gas transmission facilities in service today in the United States were constructed during the 1950s and 1960s as public policy supported the extension of natural gas to new markets.

Prior to 1940, the primary materials used for distribution pipe were wrought and cast iron. The 1940s and 1950s reflected a transition to steel materials, which were relied upon exclusively for a few decades. The strength and ductility of steel continued to improve throughout this period. The 1970s brought a transition from steel to plastic facilities except for large diameter installations that continue to rely on steel. Plastic pipe materials have evolved over time and rely predominantly on medium and high-density PE material today. Improvements in materials also provide for higher operating pressures, increasing carrying capacities.

Iron, steel and certain categories of plastic pipe pose distinct concerns as they age. Cast iron pipe exhibits brittle characteristics making it subject to cracking and breakage, sometimes as a result of ground movement in proximity to buried pipe. Frost heaves caused by large temperature variations are a particular threat. For steel pipe, the main concern is corrosion, which occurs as moisture present in the ground or internal moisture comes in contact with the pipe, welds and couplings. Many techniques have been employed to reduce steel corrosion including various pipe coatings. Pipe coatings were supplemented with cathodic protection techniques that utilize electric currents to prevent corrosion, increasing the lifespan of steel pipe. Federal pipeline safety rules mandated the cathodic protection of all steel pipe installed after 1970.[6]

[6] Cathodic protection is achieved through the application of an electric current in order to modify the electric potential of the metal surface in order to control corrosion.

A portion of the current inventory of plastic pipeline is also considered a candidate for replacement as it is comprised of materials that proved to be subject to cracking or other premature failure. Although the proportion of plastic pipe included in the replacement category is not separately reported in U.S. pipeline data, it is believed to be a small proportion of the total. Nevertheless, plastic pipe requiring replacement is a significant issue for some LDCs. The importance of understanding and evaluating the replacement needs of specific categories of plastic pipe led to the development of the Plastic Pipe Database Committee (PPDC), an industry group that compiles data on plastic pipe material failures submitted by pipeline operators on a voluntary basis. A number of LDCs have initiated programs to replace or more closely monitor plastic pipe composed of specific materials primarily installed prior to the mid 1980s[7]. Future analysis by the PPDC will inform LDCs and industry stakeholders regarding the potential failure of specific categories of plastic pipe.

The extensive use of cast iron and non-cathodically protected steel mains and services prior to 1970 as well as other leak-prone pipe represents a critical ongoing challenge for LDCs and regulators. While these facilities continue to provide adequate service, they require more extensive integrity management efforts, including more frequent surveys and efforts to maintain their fitness for service. As indicated in Table 1, over 112,000 miles of U.S. distribution mains in service at the end of 2011 are constructed using materials and techniques that are the most susceptible to corrosion and leaks, requiring eventual replacement.[8]

[7] These include Century Utility Products polyethylene (PE) pipe produced from 1970 through 1974, DuPont Aldyl® A low ductile inner wall PE pipe manufactured from 1970 through 1972, PE pipe manufactured from PE 3306 resin, DuPont Aldyl® service punch tee with a white Delrin® polyacetal threaded insert, and Plexco service tee with Celcon® polyacetal cap.

[8] Canadian LDC systems have significantly fewer miles of cast iron and bare steel pipe as a result of having experienced much of their growth after the introduction of cathodic protection techniques. However, some plastic pipe and other facilities installed in Canada are considered candidates for replacement.

Table 1
U.S. Miles of Distribution Main
by Material as of 2011[9]

Material	Miles	Percent of Total	Replacement Candidate
Bare Steel	62,329	5.1%	Yes
Unprotected Coated Steel	15,935	1.3%	Yes
Cast/Wrought/Ductile Iron	34,329	2.8%	Yes
Copper	30	0.0%	Yes
Subtotal	**112,623**	**9.1%**	
Protected Coated Steel	473,871	38.5%	No
Plastic	644,418	52.3%	Limited
Other	893	0.1%	Unknown
Total	**1,231,805**	**100.0%**	

The composition of service lines by material type is provided in Table 2, which reveals a similar percentage of services that are considered replacement candidates. State level data corresponding to Tables 1 and 2 as well as corresponding data for Canada are presented in Appendix A.

Table 2
U.S. Count of Distribution Services
by Material as of 2011

Material	Count	Percent of Total	Replacement Candidate
Bare Steel	2,859,628	4.3%	Yes
Unprotected Coated Steel	1,725,108	2.6%	Yes
Cast/Wrought/Ductile Iron	15,269	0.0%	Yes
Copper	1,054,804	1.6%	Yes
Subtotal	**5,654,809**	**8.5%**	
Protected Coated Steel	14,820,156	22.3%	No
Plastic	44,261,146	66.6%	Limited
Other	1,677,778	2.5%	Unknown
Total	**66,413,889**	**100.0%**	

9 Data in Tables 1 and 2 is compiled and reported by PHMSA.

System Upgrades and Safety Enhancements

Enhanced system design methods and modern technologies provide opportunities for improving the integrity, reliability and safety of gas distribution networks currently serving customers. State-of-the-art system design includes monitoring, control and information management tools that are deployed to significantly enhance the reliability and safety of gas distribution infrastructure. Older systems may be retrofitted with modern technologies either in concert with pipeline replacement efforts or as distinct initiatives.

The safety and reliability benefits that may result through retrofitting older systems with current technologies depend on the operating characteristics unique to each distribution area. The following upgrades and enhancements offer potential benefits:

Monitoring Technologies

- **Supervisory Control and Data Acquisition (SCADA):** More intelligent sensors, enhanced communications security, integrated field and control room communications, and more robust computing architectures significantly enhance the benefits of SCADA systems already deployed throughout the gas distribution industry. Achieving these potential benefits may require incremental investments in SCADA hardware, communications equipment and/or software.
- **Buried Pipe Monitoring:** Fiber optic systems capable of detecting disturbances near buried pipe provide operators with new information regarding potential or actual facility damages caused by third-party excavation or weather-related ground movements. Cost considerations limit the use of this technology to larger diameter facilities at the present time.
- **In-line Inspection:** Intelligent sensors, including magnetic and ultrasonic, are attached to an in-line device, or pig, that is run through the pipeline to perform detailed facility inspections of larger diameter facilities. The ability to utilize in-line inspection tools tends to be limited on distribution systems because it requires the presence of consistent diameter pipe, adequate turning radii and insertion and extraction points.
- **Methane Monitoring:** Equipment capable of remotely monitoring methane emissions may be strategically deployed as a means of detecting leaks in high-risk areas on a real-time basis.

Control Technologies

- **Excess Flow Valves (EFVs):** EFVs installed at the connection between the service line and the distribution main automatically cutoff gas flow that exceeds a preset rate of flow. EFVs significantly reduce the potential for a serious accident caused by excavation damage, which is a significant cause of distribution system leaks.
- **Remote Control Valves (RCVs):** RCVs utilize actuators to close valves remotely once operators have determined that isolating a portion of the system is necessary. The

RCV eliminates the need for dispatching field personnel to manually operate the valves reducing the response time to a suspected incident.

- **Automatic Shutoff Valves (ASVs):** ASVs incorporate sensing and control technologies that provide for automatic shutoff of lines that experience preprogrammed changes in pressure. ASVs also reduce the time required to isolate a portion of the transmission system that may have been compromised, but do not accommodate human intervention and oversight of flow control as do RCVs.

Information Management Technologies

- **Data Management Systems:** State-of-the-art data management systems integrate and provide analysis of geographic information, asset information, construction and maintenance data and operating information. They provide network operators with enhanced methods of preventing and responding to incidents.

Main replacement projects typically provide LDCs with the opportunity to make some additional safety and reliability enhancements if there are significantly increased operating pressures. In particular, older, low-pressure systems present a number of operational issues including the potential buildup of water in the distribution network that can cause freeze-ups. Low-pressure systems also preclude the deployment of EFVs. The replacement of low-pressure with higher-pressure systems allows customers to realize efficiency gains from newer high efficiency equipment designed for higher operating pressures and to avoid costly gas pressure boosters required for some process applications. Potential enhancements from increased operating pressures include regulator station improvements and meter sets that provide important pressure control and relief for connected homes and businesses.

The natural gas industry continues to invest resources in the research and development of new technologies that improve the safety and reliability of the gas distribution system. The resulting commercialization of various technologies for monitoring, analyzing and controlling the distribution of natural gas will continue to provide potential benefits from enhancing the integrity and efficient operations of distribution networks.

Distribution Pipeline Safety Regulation

The safety of natural gas transmission and distribution pipelines is regulated by a combination of federal and state laws and implementing regulations, with coordinated oversight by several agencies. Overall federal responsibility rests primarily with the PHMSA which delegates certain responsibilities and provides funding to the states, which also oversee any supplemental state-specific safety requirements.[10]

[10] In Canada, international and inter-provincial pipelines are regulated by the National Energy Board of Canada. Other pipe is regulated by provincial authorities.

PHMSA responsibilities and regulations have been expanded over the past decade with the enactment of two major legislative actions: the Pipeline Safety Improvement Act of 2002 and the Pipeline Integrity, Protection, Enforcement, and Safety Act of 2006. These two acts apply to interstate and intrastate pipelines, LDCs and other gas distributors that are considered system operators. Most importantly, the 2006 legislation required PHMSA to lead a stakeholder process to develop new distribution integrity management program (DIMP) requirements.

The DIMP regulations mandated that operators document a risk-based approach to distribution main and service integrity management in a plan to be prepared by each operator by August 2, 2011. The DIMP requirements include the need to document system characteristics; identify, categorize and assess risks; employ risk mitigation measures; and monitor the effectiveness of the program. The risk-management approach inherent in DIMP also recognizes that many factors, and not simply the age of pipe, must be considered when determining what measures, including replacement, are appropriate to maintain the safety, reliability and integrity of a distribution system. DIMP rules require pipeline operators to determine the fitness for service of pipeline infrastructure on an ongoing basis.

The recent implementation of DIMP reflects an increasing emphasis on distribution safety, which may result in more aggressive oversight and replacement mandates. One of the requirements of DIMP is that LDCs must install EFVs when constructing a new or replacement service to a single-family residence or when the connection between a single-family service line and the main are replaced under most conditions.

Call to Action

On April 4, 2011, in response to recent pipeline safety incidents, the United States Secretary of Transportation, Ray LaHood announced a “Pipeline Safety Action Plan” calling for pipeline operators, including LDCs, to accelerate their efforts to replace pipeline facilities and take other actions that will enhance the integrity of network facilities. Secretary LaHood’s “Call to Action” brought together federal, state and industry stakeholders in order to “discuss steps for improving the safety and efficiency of the nation’s pipeline infrastructure.”

Equally important, the Call to Action called on state regulators to provide for timely recovery of pipeline replacement investments, recognizing that reliance on traditional cost recovery approaches may impede efforts to accelerate these activities. PHMSA has devoted a section of its website to tracking state cost recovery programs as a means of informing stakeholders of the role that these mechanisms play in facilitating infrastructure replacement. Thus, while the Department of Transportation acknowledges that it does not have jurisdiction over cost recovery for LDC activities that are subject to state regulation, it recognizes that alternative and more flexible rate mechanisms are necessary steps to the achievement of its pipeline safety mandate.

III. LDC Actions to Replace and Enhance Facilities

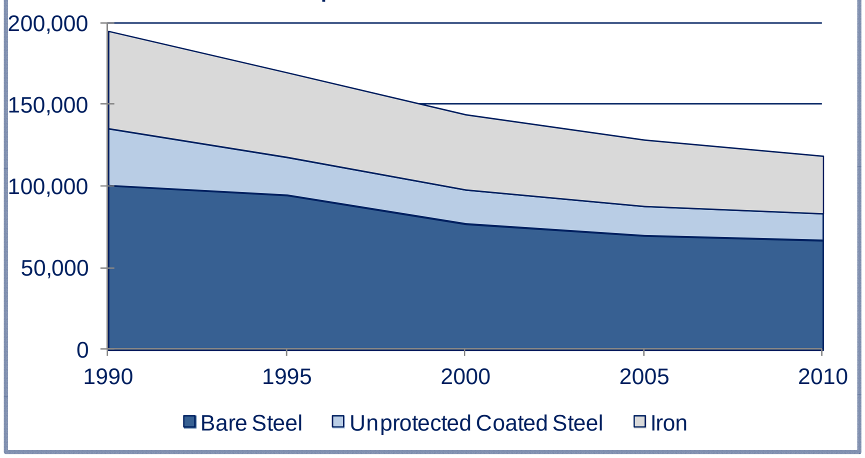
LDCs expend considerable effort and capital maintaining and replacing the infrastructure serving existing gas customers. These integrity management efforts encompass safety-related activities such as leak surveys, leak repair, operator qualification, one-call systems, pipeline replacement and facility upgrades. Even though the DIMP mandates have focused attention on this area recently, LDCs have been engaged for many years in proactive integrity management efforts to maintain and enhance public safety. The progress of these replacement efforts, associated cost drivers, and the implications for cost recovery are discussed in this section.

Status of United States Pipeline Replacement Efforts

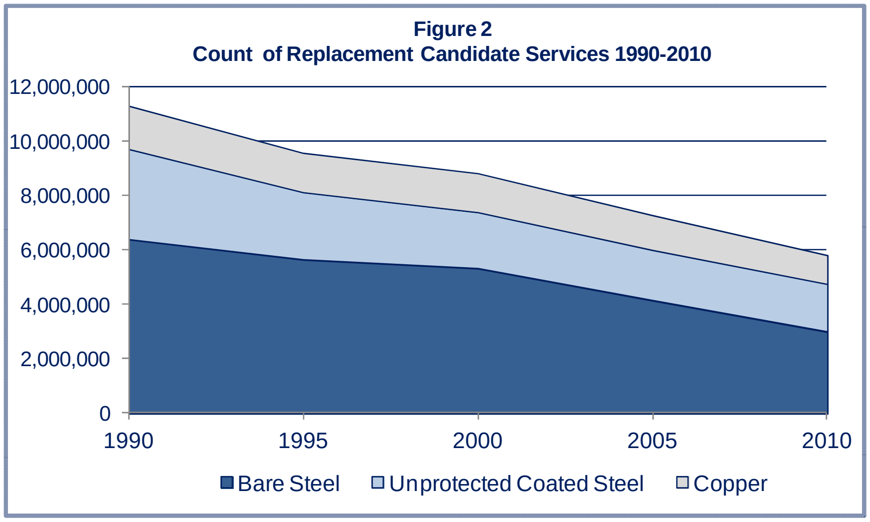
Although important progress in modernizing pipeline infrastructure has been made over the last two decades, significant challenges remain as considerable quantities of pipe in service are constructed of material types and vintage that will eventually require replacement. A review of PHMSA data from 1990 – 2000 supports the conclusion that substantial replacement efforts remain and that the current pace of replacement will need to be accelerated in order to finish the effort over a reasonable timeframe. As noted by Secretary LaHood, the current slow pace of replacement in some states will lead to significantly longer timeframes to complete.

As shown in Figure 1 for distribution main and Figure 2 for distribution services, significant replacement work remains even though progress has been made over the past 20 years.[11]

Figure 1
Miles of Replacement Candidate Mains 1990-2010



[11] Data in Tables 1 and 2 is compiled and reported by the PHMSA.



The miles of mains represented by these materials has declined from 195,000 in 1990 to 112,000 in 2011, the most recent year for which data are available. Similarly, the count of services has declined from 11,395,000 in 1990 to 5,655,000 in 2011. Progress has been made across the range of materials; however, it may easily take another three decades of effort to finish the job at the current pace of replacement.

Cost Drivers

While the primary objectives of efforts to address leak-prone pipe infrastructure are to preserve the public safety and maintain the reliability of supply delivery, an important secondary objective is to manage the level of costs incurred, particularly for LDCs that have significant replacement challenges. LDCs plan when and how pipeline is replaced to help moderate cost impacts in both the short-term and over the term of the replacement program. These cost efficiencies translate into an increase in miles of replacement for a given expenditure level. However, certain construction cost factors are largely outside the control of pipeline operators, such as terrain characteristics, population density and material prices.

When leaks develop, a fundamental choice faced by LDCs is whether to repair or replace aging pipe; a decision that requires an assessment of the safety risk along with the tradeoff between a current capital cost and likely ongoing operations and maintenance (O&M) expenses. While the replacement of mains requires a substantial capital outlay, the continued presence of older mains and services contributes to higher O&M costs associated with more frequent inspections and responding to suspected gas leaks. The pipe vintage, material and overall condition of surrounding facilities dictate the particular strategy that is likely to be most cost effective. The occurrence of leaks along a particular section of pipe is initially addressed through repair and subsequent monitoring. However, the number and severity of leaks along pipe segments typically accelerates over time. As a consequence, replacement eventually becomes more cost-effective than continued repair.

LDCs are continually evaluating the condition of their system and updating the inventory of pipe segments that are candidates for replacement. While some sections of pipe are addressed immediately to resolve a critical safety or reliability concern, most replacement activities can be accomplished on a planned basis. These decisions reflect several factors:

> **Pace of Replacement:** Managing the pace of replacement allows the LDC to pursue larger-scale projects, achieving economies of scale in material acquisition and resource deployment and steady workflow. Steady workflow reduces overtime, increases productivity, and supports the effective deployment of resources, all of which contribute to cost savings. At the same time, focusing on achieving a steady workflow may advance the timing of replacement of some infrastructure and result in earlier incurrence of capital costs..
>
> **Geographic Approach to Replacement:** Replacement work may either focus on discrete pipe segments in limited areas or on a broader geographic area. A broad geographic focus provides for cost efficiencies as a greater proportion of effort is focused on construction and less on readiness preparations. Broader replacement areas also reduce the number of tie-ins associated with connecting new pipe to existing lines.
>
> **Outside Contractor Costs:** The majority of mains installations are performed by outside contractors. Expanded scope and duration of commercial agreements with outside contractors provides an additional means of achieving cost efficiencies as does the ability to schedule work evenly.
>
> **Coordinated planning with Municipalities:** Longer planning horizons provide greater opportunities to sequence work involving street openings with other municipal activities and achieve greater overall efficiencies at lower costs.

In summary, proactive management of the integrity of aging pipe infrastructure, including accelerated replacement, enhances safety and reliability, contributes to cost savings over the longer-term and is less disruptive to customers and communities than a reactive approach. Acceleration of replacement efforts also delivers the desired integrity and safety benefits more expeditiously, lowering maintenance requirements associated with the aging plant that is being replaced.

Cost Recovery Implications

As recognized by Secretary LaHood and PHMSA, accelerated replacement of aging mains and services in order to maintain distribution system safety, reliability and integrity is facilitated by the ability of LDCs to recover the associated costs on a timely basis. This takes on added importance when expenditures do not directly lead to an increase in revenues, as is the case when addressing infrastructure serving existing customers. Timely recovery through an adjustment to revenues addresses the adverse earnings and cash flow impacts of significant pipeline replacement and upgrade initiatives.

With respect to the cost recovery aspect, the same fundamental cost-of-service ratemaking principles apply irrespective of the particular cost recovery method. These include the objective that the resulting rates are just and reasonable and that the determination of the associated revenue requirement sufficiently allows recovery of all prudently incurred costs including a reasonable opportunity to earn a compensatory return on investment. Another objective of cost-of-service regulation is that there be a matching of the level of costs incurred to provide regulated services and the expected revenues that are built into the calculation of rates. This is often referred to as the “matching principle”.

IV. Base Rate Case Recovery Approaches

One cost recovery method for infrastructure replacement and enhancements is through base rates that are periodically updated when LDCs file rate cases. Rate cases provide regulators and other participants with an opportunity to examine the reasonableness of additions to utility plant that have been made since the last rate case along with changes to all other components of cost-of-service (O&M expenses, administrative expenses, depreciation and amortization, taxes other than income taxes, return and income taxes). New base rates are determined by dividing the approved cost-of-service, or revenue requirements, by the units used for billing purposes (e.g., the number of customers, level of demand, or annual throughput) for a representative period.

Traditional Rate Case Recovery

The timeliness of base rate case cost recovery associated with new plant, including any pipeline replacements and enhancements, varies by jurisdiction. Ratemaking practices affecting timeliness of recovery include the length of the regulatory rate case review (generally six months to a year), the definition of the test year (e.g., historical average, historical end-of-year, or forward), and the degree to which post test-year plant additions are reflected in the calculation of rates. These components, along with the time required for the LDC to prepare its rate case and commission to issue its decision, determine the length of time between when costs are incurred and when cost recovery begins. This timeframe, frequently referred to as "regulatory lag", becomes a material concern for investments, such as replacement pipeline, that do not generate incremental revenue at the time they are placed in service. Regulatory lag can be an impediment to the achievement of public and regulatory policy objectives favoring the replacement of leak-prone infrastructure.

LDCs have a reasonable opportunity to earn their authorized rate of return when the growth in earnings achieved between rate cases compensates for increases in the cost of providing service. Thus, an LDC that is experiencing sales growth and/or is able to realize significant cost efficiencies may be able to offset the downward pressure on earnings that results from investing in significant non-revenue producing pipeline replacements and enhancements. However, frequent, and even annual, rate case filings may be required when there is pressure on earnings that can come from several sources including inflation, slowing customer or load growth, significant plant additions, and declining use per customer. Replacement investments place upward pressure on rate base because current pipeline investment costs are often substantially higher than the costs of plant being replaced.

Industry Trends Affecting Base Rate Cost Recovery

A number of important trends affect the ongoing suitability of relying on traditional base rate cases for recovery of infrastructure investments for replacing and upgrading existing infrastructure. These include:

> **Growing Non-revenue Producing Infrastructure Investments:** A number of factors are leading to a higher proportion of capital investment requirements that are non-revenue producing. These include the proportion of plant that is in need of replacement as facilities continue to age and increasing integrity management needs. In addition, pipeline safety requirements, including DIMP, require that LDCs meet additional safety mandates, and may require accelerated investments.
>
> **Slower Load Growth:** After years of increasing saturation of natural gas among U.S. households, penetration of natural gas in existing housing markets has subsided. Increased appliance efficiency and more efficient building structures continue to reduce long-run use per customer. Some regions of the United States are experiencing a decline in appliance saturation, exacerbating this trend. Lower net revenue growth due to these factors makes it more difficult for LDCs to absorb the increased costs from non-revenue producing investments without filing a rate case.
>
> **Reductions in Potential Operating Efficiency Gains:** Utilities experienced substantial efficiency gains over the last quarter century as mergers, technology investments and performance-based rate plans promoted significant cost-saving efforts. While the resulting efficiency gains continue to provide measurable benefits for consumers in the form of lower rates, incremental efficiency gains are harder to achieve. A reduction in the pace of cost efficiency improvements limits the potential for cost savings to offset increased non-revenue-producing investments.

In summary, at the same time that there are calls by Secretary LaHood and others to accelerate the pace of pipeline replacement, there are other trends that are making it increasingly difficult to offset the earnings impact from a greater proportion of non-revenue producing plant investments. These trends increase the importance of timely recovery of pipeline replacement investments in order to avoid frequent rate case filings. Frequent rate cases attributable to a discrete, known cause are less efficient in terms of resources and expense than other options. These factors have contributed to the interest in alternative approaches to recovering pipeline replacement investments, particularly in circumstances where the pipeline replacement contributes to a level of non-revenue producing investments that represent a significant portion of total capital expenditures. This is a primary driver behind the emphasis of the Call To Action on alternative rate mechanisms that will provide for timely recovery of costs necessary to address critical infrastructure needs.

Incentive Rate Plans

Incentive regulation seeks to serve the public interest by aligning the interests of utilities and consumers, replacing elements of command and control regulation with approaches that focus on desired outcomes. These outcomes typically emphasize economic efficiency, but often incorporate service quality or reliability goals. The most common alternatives to the traditional cost-of-service-based approach to setting base rates in a rate case are performance-based regulation (PBR) and multi-year rate plans. PBR rate plans typically entail a price or revenue cap mechanism that annually adjusts initial cost-of-service based rates using a formula that takes inflation, productivity and other relevant metrics into account. During the term of a PBR, the link between rates and costs is weakened, providing an opportunity for the LDC to retain a portion of efficiency gains until rates are reset based on costs at the end of the PBR plan.

Multi-year rate plans differ from PBR plans that rely on index-based formulas as rates are adjusted based upon predetermined step adjustments over the duration of the plan. The step adjustments may be derived from a multi-year forecast of rate base or total revenue requirements.

PBRs and multi-year rate plans benefit both customers and utilities because they provide utilities with incentives to realize cost efficiencies over the longer-term by virtue of the fact that future rate changes are determined by an alternative to utility-specific costs. Utilities operating under PBR and multi-year rate plans are afforded flexibility to achieve the plan's goals. However, plans that focus on economic efficiency do not intrinsically promote infrastructure investment. For example, under price-cap PBRs[12], the most common form of incentive regulation for gas distribution companies, economic efficiency gains are based on utility management of operating and capital investment-related costs of providing service in the aggregate.

Even though PBR and multi-year rate plans typically provide for rate increases over the term of the plan, the rate increases do not provide incentives to optimize investment in replacing and upgrading existing infrastructure. For example, rate adjustments in the form of predefined steps or determined by examining historical cost relationships will not promote accelerated infrastructure replacement given that the efficiency benefits extend well beyond the typical term of an incentive rate plan.

The concerns regarding cost recovery for infrastructure investment under PBR and multi-year rate plans may be addressed in two ways. The first is through an explicit recognition of non-revenue producing infrastructure replacement and enhancements in the incentive rate formula. The second is by pairing the incentive plan with an alternative infrastructure cost recovery mechanism such as those discussed in the following section.

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[12] Under "price-cap" PBR mechanisms, prices are adjusted according to a formula; the alternative "revenue-cap" mechanisms constrain the increase in overall LDC revenues.

V. Alternative Cost Recovery Approaches

Several jurisdictions have adopted alternative infrastructure cost recovery mechanisms that provide for more timely recovery of pipeline replacement and upgrade costs. These include infrastructure cost trackers, infrastructure base rate surcharges, and deferred regulatory assets. There are at least 48 such cost recovery mechanisms that have been adopted in 22 state jurisdictions, many of which were put in place during the last five years. Each mechanism accommodates LDC-specific circumstances and the particular statutory guidance, policies, and precedent of the respective jurisdiction. These ratemaking approaches support the increased capital requirements of replacing and enhancing leak-prone infrastructure, while preserving the fundamental elements of the traditional regulatory compact. The approval of these cost recovery mechanisms reflects the heightened focus on pipeline safety, the contribution of pipeline replacement efforts to improved safety and reliability, and the challenges to timely cost recovery attributable to large-scale investments in non-revenue producing facilities.

Alternative cost recovery mechanisms incorporate the unique operational circumstances of each LDC and the specific underlying approach to rate regulation of the jurisdiction. These various recovery mechanisms share many desirable outcomes related to efforts to address safety and reliability concerns associated with leak-prone elements of distribution systems including:

- Eliminating disincentives to the efficient deployment of capital for safety and reliability through timely cost recovery;
- Enabling accelerated investment in infrastructure replacement and enhancement to achieve benefits more rapidly;
- Providing appropriate, timely and effective regulatory oversight of LDC initiatives to replace and upgrade important infrastructure; and
- Allowing LDCs to reduce investment costs through broad scale, multi-year commitments that lead to maximum efficiency in managing workflow, reduced outside contractor costs, and better coordination with municipalities.

The infrastructure cost recovery mechanisms can be classified into three broad categories: (i) infrastructure cost trackers, (ii) infrastructure base rate surcharges and (iii) deferred regulatory assets. While the different types of mechanisms address cost recovery differently, each approach clearly delineates the infrastructure costs that are eligible for recovery to ensure that costs are only recovered once. Each of these types of cost recovery mechanisms are discussed in greater detail in this section. Additionally, Appendix B lists 48 cost recovery mechanisms that have been implemented in 22 states. This table reveals a preference for cost trackers (26 mechanisms) and base rate surcharge mechanisms (17) over deferral approaches (5). The table also summarizes the types of costs that are eligible for recovery under the various mechanisms. In addition to these three categories of targeted cost recovery mechanisms, earnings stability base rate mechanisms also provide for an innovative means of recovering infrastructure investment costs.

Infrastructure Cost Trackers

Cost trackers are implemented through tariff riders or adjustments to the base rates set forth in LDC rate schedules. The rates often appear as distinct rate elements on a customer's bill. Cost trackers are used for a variety of reasons, among them to address costs that vary significantly from year-to-year (making it difficult to establish a representative level during a base rate case), or are likely to materially increase between rate cases, or result from a statutory mandate or regulatory action. Cost trackers that focus on plant additions are often intended to remove impediments to investment, which is why the mechanisms are broadly used as a means to address the need to replace leak-prone infrastructure.

Infrastructure cost trackers incorporate a number of design elements that establish the calculation of recoverable costs, the timing of including accumulated costs in rates, applicable customer classes, method of recovery including whether the costs are recovered through customer charges or delivery charges, and any other applicable recovery provisions. Cost trackers include "true-up" provisions that prevent over- or under-recovery that results from variations in costs or throughput levels from those used to calculate the rate.

Infrastructure cost trackers promote safety and cost efficiency benefits through more timely recovery of pipeline replacement and enhancement costs. Even so, infrastructure cost recovery mechanisms typically result in a modest recovery lag that results from the time required to review and implement annual adjustments to the recovery rate. The most commonly expressed concerns are that they remove incentives to manage costs or that they lead to "piece-meal" or single-issue ratemaking.

The potential that cost trackers have an adverse impact on utility cost management is effectively addressed through distinct regulatory review processes. Specifically, the implementation of an infrastructure cost tracker typically provides for greater scrutiny and regulatory oversight of LDC replacement and enhancement efforts ensuring that they are prudent and cost effective. Regulators can review the overall program when the LDC first applies for a cost recovery mechanism and review updated investment plans, budgets and actual expenses on an annual basis in conjunction with setting recovery rates and reconciling recoveries with actual costs.

With respect to the concern that cost trackers amount to single-issue ratemaking, infrastructure cost recovery mechanisms complement rather than substitute for the base rate case process, applying the same fundamental cost-of-service ratemaking principles. Thus, they are designed to yield rates that are just and reasonable and recover all prudently incurred costs including a return on investment. Timely recovery helps preserve the matching principle as the incremental revenues are calculated to recover the incremental costs attributable to the infrastructure investments that occur after the conclusion of the test year relied upon to design base rates.

Infrastructure Base Rate Surcharges

Base rate surcharges involve the calculation of a fixed incremental change to base rates in order to accommodate the recovery of specified infrastructure investments. Infrastructure base rate surcharges are similar in many respects to cost trackers, particularly with respect to the ability to provide more timely cost recovery, but are fixed over a longer period, providing greater certainty with respect to rate impacts. The surcharge adjustment may be applied to the fixed monthly customer charge or the delivery charge.

Base rate surcharges promote rate simplicity and accommodate rate continuity and rate impact concerns. Base rate surcharges are desirable in situations where it is preferable to avoid future true-ups of under or over-recoveries of costs. The option to derive surcharge levels from agreed upon budgeted infrastructure spending is particularly valuable for larger programs providing an explicit means of controlling the pace of investment. Thus, an LDC may adjust its planned investments in order to remain within the rate surcharge level if unanticipated site conditions, materials cost increases, or other factors lead to higher costs than expected.

Infrastructure base rate surcharges achieve largely the same safety and cost efficiency benefits as do cost trackers. In addition, the base rate surcharge mechanisms address the regulatory concerns of insufficient incentives to manage costs and single-issue ratemaking.

Deferred Regulatory Assets

Deferred regulatory assets represent a third alternative cost recovery approach to reliance on base rate case recovery. Under these mechanisms, investment costs associated with eligible infrastructure replacement and enhancements are deferred with carrying costs as a regulatory asset to be amortized and recovered over a future period, typically when new base rates are established in a rate case. No recovery occurs until the new base rates are implemented.

The deferred regulatory asset approach exhibits some of the beneficial characteristics of the infrastructure cost tracker and base rate surcharge mechanisms, but also suffers from some of the concerns associated with relying on base rate case recovery. This is attributable to the fact that the mechanism provides improved earnings certainty for LDCs, but does not provide for timely recovery as it depends on a future base rate case to initiate recovery.

The deferred regulatory asset recovery mechanism may result in more pronounced rate impacts in situations where the infrastructure investments to be recovered are material. This occurs when the costs are finally reflected in rates. Both the size of the program and the length of time between rate cases contribute to increases in the size of the deferral to be reflected in rates at a future point in time.

Earnings Stability Mechanisms

There is one fundamentally different approach that deserves mention. Utilities in several states, including Alabama, Georgia, Louisiana, Mississippi, Oklahoma, South Carolina and Texas currently operate under earnings stability mechanisms (ESMs). These mechanisms represent a form of decoupling in which all costs, including the costs attributable to infrastructure replacement, are tracked and incorporated in changes to base rates on a pre-determined schedule. While ESMs were not designed principally to recover the costs of replacing aging infrastructure, these mechanisms produce a similar result as cost trackers and base rate surcharges by providing for more timely recovery of pipeline replacement costs. Some of these states with earnings stability mechanisms also adopted focused infrastructure cost recovery mechanisms that independently address the need for recovery of infrastructure costs.

Regulatory Review and Oversight of Alternative Cost Recovery Approaches

Regulatory commissions retain the full capability to review the prudence of investments under each of these non-base rate case approaches to cost recovery, although a final determination may also be deferred until the next rate case. Conversely, regulators may decide to pre-approve significant capital investments particularly if that approach is consistent with regulatory precedent.

The implementation of infrastructure cost recovery mechanisms enhances the regulatory oversight of LDC infrastructure replacement and enhancement initiatives by facilitating stakeholder understanding of efforts to improve the safety and reliability of the LDC networks serving the public. These reviews allow commissions and other stakeholders to focus on pipeline safety and integrity to a greater degree than is usually possible in rate case proceedings. Commissions are able to concentrate their review on unique LDC circumstances, the extent of the challenges, the prioritization of investments, and potential bill impacts, all of which influence the pace of the replacement efforts.

VI. Conclusion

A significant challenge facing LDCs is the need to accelerate efforts to replace leak-prone mains and services constructed using materials that are susceptible to corrosion and leaks and to upgrade facilities with newer technologies. Many of these facilities are constructed of cast iron, non-cathodically protected steel and certain plastic materials. In response to heightened public concern about the safety, reliability and integrity of the nation's pipeline infrastructure, US Secretary of Transportation Ray LaHood sounded a "Call to Action" to pipeline operators, regulators and all industry stakeholders to develop and carryout plans to address the replacement of leak-prone pipeline infrastructure. The Call to Action recognizes the need for states to establish cost recovery approaches that facilitate acceleration of needed replacement efforts. Timely recovery of pipeline replacement efforts is essential to achieving the goal of improving the safety and efficiency of the nation's pipeline infrastructure.

PHMSA, the federal pipeline safety regulatory agency, established significant new regulations that took effect in August 2011 requiring every LDC to prepare a risk-based assessment and plan and to take all actions necessary, including replacement of mains and services, to maintain the integrity of the nation's natural gas distribution systems. Addressing cost recovery is necessary for LDCs to design an efficient and expedient approach to pipeline replacement in consideration of potential rate impacts over the term of the program.

Many states have concluded that the historical reliance on resource-intensive base rate cases is not an effective or efficient means of meeting the safety imperative associated with aging pipeline infrastructure. Simply put, recovering substantial non-revenue producing investments through base rate cases does not provide timely recovery given current industry trends reflecting higher replacement needs, slower growth and harder to achieve efficiency gains. Several jurisdictions have implemented alternative cost recovery mechanisms to address the need for timely recovery including infrastructure cost trackers, infrastructure base rate surcharges, and deferred regulatory assets. The specific mechanisms reflect the LDC-specific circumstances and the particular statutory guidance, policies, and precedent of the respective jurisdiction. Notably, the majority of these programs have been implemented within the last five years. This is perhaps indicative of the influence of general industry trends, the heightened focus on pipeline safety and the contribution of pipeline replacement efforts to safety and reliability.

Cost recovery for replacement and enhancement efforts allows LDCs to develop and execute comprehensive plans that lead to cost efficiencies through comprehensive planning, concentrating construction activities within geographic areas, the efficient use of outside contractors that perform much of this work, and longer-term coordination with affected municipalities. The enhanced safety and economic benefits are compelling. Current economic conditions reinforce the strategic benefits of accelerating replacement efforts while natural gas commodity costs are low and job creation is a national and local priority.

Establishing appropriate cost recovery for infrastructure replacement and enhancement investments provides important benefits to customers in both the short and long run. Operational benefits include the ability to achieve greater safety and reliability more rapidly as well as improved service in areas that are converted from low pressure to higher operating pressures. Economic benefits include those attributable to economic efficiencies achieved through accelerated replacement efforts.

This paper presents an overview of factors driving the need to replace or upgrade existing pipeline infrastructure, the status of these efforts and a discussion of alternative methods of recovering the costs associated with the necessary investments. Application of the findings contained in this paper requires an assessment of the unique attributes of the infrastructure needs of each LDC and the approach to rate regulation of each jurisdiction.

Appendix A

Miles of Distribution Main										
State	Bare Steel	Coated Unprotected Steel	Iron	Copper	Subtotal Replacement Candidates	Percent of Total	Protected Steel	Plastic	Other	Total
AK	10	-	-	-	**10**	**0.3%**	568	2,392	-	**2,970**
AL	859	538	1,423	2	**2,826**	**9.4%**	12,436	14,599	49	**29,909**
AR	1,448	26	166	-	**1,640**	**8.2%**	7,401	11,033	-	**20,074**
AZ	570	-	-	-	**570**	**2.4%**	7,037	16,411	-	**24,019**
CA	5,801	2,466	116	-	**8,383**	**8.0%**	43,880	52,068	0	**104,331**
CO	261	654	47	-	**962**	**2.7%**	12,218	22,531	80	**35,792**
CT	195	55	1,521	-	**1,783**	**23.1%**	3,265	2,659	-	**7,708**
DC	28	68	425	-	**521**	**43.8%**	313	356	-	**1,190**
DE	26	25	96	-	**147**	**5.2%**	617	2,078	-	**2,841**
FL	1,303	526	253	-	**2,082**	**8.0%**	10,377	13,528	2	**25,988**
GA	247	-	19	-	**267**	**0.6%**	17,159	25,791	-	**43,217**
HI	130	-	-	-	**130**	**21.3%**	161	320	-	**611**
IA	187	133	19	-	**338**	**1.9%**	7,659	9,719	0	**17,717**
ID	-	-	-	-	**-**	**0.0%**	2,867	5,105	-	**7,972**
IL	364	15	2,116	-	**2,780**	**4.6%**	39,205	19,039	-	**61,023**
IN	877	174	340	-	**1,409**	**3.5%**	18,012	21,167	-	**40,587**
KS	3,568	0	117	-	**3,690**	**16.9%**	7,205	10,917	0	**21,813**
KY	884	86	89	2	**1,060**	**6.1%**	7,723	8,484	12	**17,279**
LA	959	125	484	-	**1,568**	**6.0%**	14,145	10,312	-	**26,024**
MA	1,902	1,161	3,903	-	**6,968**	**32.9%**	5,791	8,434	-	**21,194**

Appendix A

Miles of Distribution Main										
State	Bare Steel	Coated Unprotected Steel	Iron	Copper	Subtotal Replacement Candidates	Percent of Total	Protected Steel	Plastic	Other	Total
MD	361	131	1,424	-	**1,918**	**13.4%**	5,262	7,165	4	**14,350**
ME	2	15	59	-	**77**	**9.8%**	144	558	2	**780**
MI	1,400	1,926	3,156	2	**6,484**	**11.5%**	20,746	28,923	11	**56,164**
MN	524	196	65	-	**785**	**2.6%**	6,887	22,151	-	**29,822**
MO	1,233	-	1,180	1	**2,413**	**8.9%**	11,851	12,818	-	**27,082**
MS	587	14	81	-	**704**	**4.5%**	7,855	7,110	-	**15,669**
MT	11	-	-	-	**11**	**0.2%**	2,288	4,535	-	**6,835**
NC	-	-	-	-	**-**	**0.0%**	10,743	17,971	-	**28,714**
ND	8	-	-	-	**8**	**0.3%**	1,160	1,848	-	**3,015**
NE	1,057	2	538	-	**1,607**	**12.9%**	6,239	4,609	1	**12,455**
NH	38	23	140	-	**200**	**10.7%**	731	934	0	**1,866**
NJ	1,821	787	5,168	2	**7,807**	**23.2%**	10,647	15,219	3	**33,676**
NM	119	1	-	-	**120**	**0.9%**	5,528	7,451	-	**13,100**
NV	28	1	-	-	**29**	**0.3%**	1,387	8,375	0	**9,791**
NY	7,246	1,425	4,541	-	**13,212**	**27.7%**	13,877	20,593	18	**47,700**
OH	7,951	2,824	693	1	**11,473**	**20.2%**	20,470	24,379	523	**56,845**
OK	1,889	89	-	-	**1,978**	**7.8%**	9,223	14,248	-	**25,449**
OR	17	-	-	-	**17**	**0.1%**	7,883	7,409	-	**15,309**
PA	8,091	1,347	3,453	2	**13,084**	**27.4%**	12,972	21,547	92	**47,695**
RI	392	188	891	-	**1,488**	**46.8%**	588	1,103	0	**3,180**

Appendix A

Miles of Distribution Main										
State	Bare Steel	Coated Unprotected Steel	Iron	Copper	Subtotal Replacement Candidates	Percent of Total	Protected Steel	Plastic	Other	Total
SC	10	-	-	-	**10**	**0.0%**	8,257	12,187	-	**20,454**
SD	36	1	23	-	**61**	**1.3%**	1,798	2,712	0	**4,571**
TN	219	1	180	-	**426**	**1.1%**	14,849	22,338	-	**37,613**
TX	5,376	224	967	-	**6,567**	**6.9%**	39,606	49,170	22	**95,364**
UT	17	-	-	-	**17**	**0.1%**	3,893	12,665	-	**16,575**
VA	669	506	594	14	**1,883**	**9.0%**	5,604	13,380	12	**20,880**
VT	-	-	-	-	**-**	**0.0%**	188	499	-	**688**
WA	54	14	28	-	**96**	**0.4%**	8,587	13,003	-	**21,686**
WI	-	-	-	3	**-**	**0.0%**	12,936	24,389	45	**37,370**
WV	3,470	166	14	-	**3,649**	**34.6%**	1,248	5,652	12	**10,561**
WY	86	1	-	-	**87**	**1.7%**	2,382	2,535	3	**5,007**
U.S. Total	**62,329**	**15,935**	**34,329**	**30**	**112,623**	**9.1%**	**473,871**	**644,418**	**893**	**1,231,805**
Canada	**213**	**-**	**142**	**-**	**355**	**0.2%**	**72,013**	**162,864**	**991**	**236,223**

Sources: PHMSA, 2011 Gas Distribution Data

Canadian Gas Association, 2010 Gas Distribution Data

Appendix A

Count of Distribution Services										
State	Bare Steel	Coated Unprotected Steel	Iron	Copper	Subtotal Replacement Candidates	Percent of Total	Protected Steel	Plastic	Other	Total
AK	44	36	-	1,857	**1,937**	**1.6%**	14,288	101,291	-	**117,516**
AL	161,755	3,033	411	1,146	**166,345**	**15.7%**	252,279	634,275	4,202	**1,057,101**
AR	29,235	27,326	-	-	**56,561**	**8.4%**	230,682	388,003	4	**675,250**
AZ	13,470	-	-	-	**13,470**	**1.1%**	196,512	1,037,674	-	**1,247,656**
CA	19,569	886,369	-	15,918	**921,856**	**10.7%**	2,314,052	5,411,277	12	**8,647,197**
CO	17,819	-	-	-	**17,819**	**1.1%**	521,523	1,039,898	40,829	**1,620,069**
CT	61,186	9,729	32	1,342	**72,289**	**17.4%**	67,196	270,019	6,489	**415,993**
DC	7,225	13,847	-	11,560	**32,632**	**26.5%**	5,200	85,163	-	**122,995**
DE	1,203	14,389	-	5,293	**20,885**	**12.4%**	16,935	128,872	1,568	**168,260**
FL	52,391	15,465	-	296	**68,152**	**8.0%**	201,007	584,389	2,877	**856,425**
GA	46,267	8,042	-	18	**54,327**	**2.7%**	434,504	1,517,188	-	**2,006,019**
HI	7,642	-	-	40	**7,682**	**21.7%**	5,594	19,333	2,851	**35,460**
IA	9,338	12,498	7	484	**22,327**	**2.4%**	284,060	602,535	22,141	**931,063**
ID	-	-	-	-	**-**	**0.0%**	94,740	310,496	92	**405,328**
IL	30,950	468	411	73,110	**104,939**	**2.8%**	854,368	2,056,674	746,626	**3,762,607**
IN	5,177	20,424	-	571	**26,172**	**1.3%**	481,673	1,457,909	289	**1,966,043**
KS	133,648	7,647	-	598	**141,893**	**15.0%**	98,747	705,739	144	**946,523**
KY	28,406	1,484	2,141	7,928	**39,959**	**4.8%**	249,721	547,545	1,042	**838,267**
LA	27,949	40,816	387	3,882	**73,034**	**6.6%**	585,740	441,682	3,105	**1,103,561**
MA	201,231	58,460	1,742	11,426	**272,859**	**21.8%**	164,179	711,267	103,713	**1,252,018**

Appendix A

Count of Distribution Services										
State	Bare Steel	Coated Unprotected Steel	Iron	Copper	Subtotal Replacement Candidates	Percent of Total	Protected Steel	Plastic	Other	Total
MD	97,448	12,412	3	52,081	**161,944**	**16.2%**	146,585	691,286	74	**999,889**
ME	256	250	63	2	**571**	**2.5%**	255	22,084	42	**22,952**
MI	53,504	191,626	23	317,501	**562,654**	**17.5%**	524,368	2,092,374	38,570	**3,217,966**
MN	7,549	6,541	-	17,975	**32,065**	**2.2%**	132,577	1,282,966	3,467	**1,451,075**
MO	15,035	1,953	-	67,104	**84,092**	**5.6%**	240,030	1,188,043	74	**1,512,239**
MS	4,427	896	2	186	**5,511**	**0.9%**	281,864	304,727	-	**592,102**
MT	654	-	-	-	**654**	**0.2%**	111,107	176,792	-	**288,553**
NC	-	-	-	-	**-**	**0.0%**	280,571	1,076,781	-	**1,357,352**
ND	75	-	-	4	**79**	**0.1%**	42,637	105,533	-	**148,249**
NE	6,851	996	-	9,720	**17,567**	**3.1%**	204,475	292,225	56,554	**570,821**
NH	7,238	2,066	61	284	**9,649**	**11.0%**	14,578	61,895	1,731	**87,853**
NJ	300,194	12,494	-	68,398	**381,086**	**16.7%**	404,690	1,502,837	-	**2,288,613**
NM	10,431	267	-	-	**10,698**	**1.7%**	232,518	368,466	-	**611,682**
NV	2	-	-	-	**2**	**0.0%**	41,078	694,428	2	**735,510**
NY	391,036	155,140	8,947	195,860	**750,983**	**23.2%**	329,502	2,144,137	8,998	**3,233,620**
OH	188,191	38,397	57	110,101	**336,746**	**9.5%**	542,308	2,106,136	558,496	**3,543,686**
OK	62,966	3,471	-	1	**66,438**	**5.2%**	455,004	758,055	32	**1,279,529**
OR	111	-	-	-	**111**	**0.0%**	240,805	516,651	3,942	**761,509**
PA	339,384	106,614	61	22,785	**468,844**	**16.8%**	269,256	2,034,300	18,593	**2,790,993**
RI	46,199	9,850	210	209	**56,468**	**29.7%**	10,422	121,770	1,306	**189,966**

Appendix A

Count of Distribution Services										
State	Bare Steel	Coated Unprotected Steel	Iron	Copper	Subtotal Replacement Candidates	Percent of Total	Protected Steel	Plastic	Other	Total
SC	459	-	-	-	**459**	**0.1%**	180,730	564,360	-	**745,549**
SD	2,401	1,331	-	81	**3,813**	**2.0%**	47,607	140,563	1,645	**193,628**
TN	6,766	2,145	-	2,421	**11,332**	**0.9%**	405,045	892,200	-	**1,308,577**
TX	339,269	23,395	49	6,094	**368,807**	**7.6%**	1,541,348	2,883,995	33,858	**4,828,008**
UT	22	-	-	-	**22**	**0.0%**	135,522	638,499	5,918	**779,961**
VA	19,328	33,245	631	27,918	**81,122**	**6.7%**	159,637	962,359	7,233	**1,210,351**
VT	-	-	-	-	**-**	**0.0%**	4,841	29,092	-	**33,933**
WA	18,023	234	-	35	**18,292**	**1.5%**	324,037	902,821	498	**1,245,648**
WI	-	30	-	20,518	**20,548**	**1.3%**	300,208	1,288,355	2	**1,609,113**
WV	84,128	1,722	31	57	**85,938**	**20.2%**	68,335	269,626	728	**424,627**
WY	3,176	-	-	-	**3,176**	**1.8%**	75,216	96,561	31	**174,984**
U.S. Total	**2,859,628**	**1,725,108**	**15,269**	**1,054,804**	**5,654,809**	**8.5%**	**14,820,156**	**44,261,146**	**1,677,778**	**66,413,889**
Canada	**11,372**	**-**	**-**	**-**	**11,372**	**0.2%**	**1,677,344**	**4,238,390**	**26,615**	**5,953,721**

Sources: PHMSA, 2011 Gas Distribution Data

Canadian Gas Association, 2010 Gas Distribution Data

Appendix B

Infrastructure Replacement Cost Recovery Mechanisms

State	Year Approved	Utility	Eligible Investment Costs	Recovery Mechanism	Docket Reference
AL	1995	Mobile Gas Service	▪ Replacement of cast iron mains	Cost tracker	Docket No. 24794
AR	1988	CenterPoint Energy	▪ Replacement of cast iron and steel facilities	Cost tracker	Docket No. 06-161-U
AZ	2012	Southwest Gas Corporation	▪ Replacement of customer-owned yard lines	Base rate surcharge	Docket No. G-01551A-10-0458
CO	2011	Public Service Co. of Colorado	▪ Replacement of mains and services ▪ Other infrastructure improvements	Cost tracker	Docket No. 10AL-963G
GA	1998	Atlanta Gas Light	▪ Replacement of cast iron and steel facilities ▪ Other infrastructure improvements	Cost tracker	Docket No. 8516-U
GA	2000	Atmos Energy	▪ Replacement of cast iron and steel facilities	Base rate surcharge	Docket No. 12509-U
IN	2008	Vectren North Indiana Gas	▪ Infrastructure replacement projects	Deferred regulatory asset	Case No. 43298
IN	2007	Vectren South SIGECO	▪ Replacement of cast iron and steel facilities	Deferred regulatory asset	Case No. 43112
KS	2009	Atmos Energy	▪ Replacement infrastructure	Base rate surcharge	Docket No. 10-ATMG-133-TAR

Appendix B

Infrastructure Replacement
Cost Recovery Mechanisms

State	Year Approved	Utility	Eligible Investment Costs	Recovery Mechanism	Docket Reference
KS	2008	Black Hills	▪ Replacement infrastructure	Base rate surcharge	Docket No. 05-AQ-367-RTS
KS	2009	Kansas Gas Service	▪ Replacement infrastructure	Base rate surcharge	Docket No. 07-AQLL-431-RTS
KY	2010	Atmos Energy	▪ Replacement of steel facilities	Cost tracker	Case No. 2009-00354
KY	2009	Columbia Gas of Kentucky	▪ Replacement of cast iron and steel facilities	Cost tracker	Case No. 2009-00141
KY	2010	Delta Natural Gas	▪ Replacement infrastructure ▪ Other safety investments	Cost tracker	Case No. 2010-00116
KY	2001	Duke Energy Kentucky	▪ Replacement infrastructure	Cost tracker	Case No. 2001-00092
ME	2010	Northern Utilities	▪ Replacement of cast iron facilities	Base rate surcharge	Docket No. 2008-151
MA	2009	Columbia Gas of Massachusetts	▪ Replacement of steel facilities	Cost tracker	D.P.U. 09-30
MA	2010	National Grid Massachusetts	▪ Replacement infrastructure	Cost tracker	D.P.U. 09-30
MA	2011	New England Gas	▪ System reinforcement and safety infrastructure	Cost tracker	D.P.U. 10-114
MI	2011	SEMCO Energy	▪ Replacement of cast iron and steel facilities	Base rate surcharge	Docket No. U-16169

Appendix B

Infrastructure Replacement Cost Recovery Mechanisms

State	Year Approved	Utility	Eligible Investment Costs	Recovery Mechanism	Docket Reference
MO	2007	Ameren Missouri	▪ Replacement infrastructure	Base rate surcharge	Docket No. GT-2009-0413
MO	2008	Atmos Energy	▪ Replacement infrastructure	Base rate surcharge	Docket No. GO-2009-0046
MO	2004	Laclede Gas	▪ Replacement infrastructure	Base rate surcharge	Docket No. GR-2007-0208
MO	2010	Missouri Gas Energy	▪ Replacement infrastructure	Base rate surcharge	Docket No. GR-2009-0355
NV	2011	Southwest Gas Corporation	▪ Replacement of early-vintage plastic pipe	Deferred regulatory asset	Docket No. 11-03029
NH	2007	National Grid - EnergyNorth	▪ Replacement of cast iron and steel facilities	Base rate surcharge	Docket DG 06-107
NJ	2009	New Jersey Natural Gas	▪ Specific infrastructure projects	Base rate surcharge	Docket No. GO09010052
NJ	2006	NUI Elizabethtown Gas	▪ Replacement of cast iron facilities ▪ Specific infrastructure projects	Base rate surcharge	Docket No. GO09010053
NJ	2009	Public Service Electric and Gas	▪ Specific infrastructure projects	Cost tracker	Docket No. GO09010050
NJ	2009	South Jersey Gas	▪ Specific infrastructure projects	Cost tracker	Docket No. GO09010051

Appendix B

Infrastructure Replacement Cost Recovery Mechanisms

State	Year Approved	Utility	Eligible Investment Costs	Recovery Mechanism	Docket Reference
NY	2006	Corning Natural Gas	▪ Replacement infrastructure	Base rate surcharge	Docket No. 08-G-1137
NY	2008	National Grid Long Island	▪ Replacement infrastructure to accommodate municipal work	Cost tracker	Docket 06-M-0878
NY	2008	National Grid – NYC	▪ Replacement infrastructure to accommodate municipal work	Cost tracker	Docket 06-M-0878
NY	2008	National Grid – Niagara Mohawk	▪ Replacement infrastructure	Deferred regulatory asset	Case No. 06-M-0878
OH	2008	Columbia Gas of Ohio	▪ Replacement of cast iron and steel	Cost tracker	Case No. 08-72-GA-AIR
OH	2008	Dominion East Ohio Gas	▪ Replacement infrastructure ▪ Other infrastructure investments	Base rate surcharge	Case No. 09-458-GA-RDR
OH	2000	Duke Energy Ohio	▪ Replacement infrastructure	Cost tracker	Case No. 01-1228-GA-AIR
OH	2009	Vectren Ohio	▪ Replacement of cast iron and steel facilities	Cost tracker	Case No. 07-1080-GA-AIR
OR	2011	Avista Corp.	▪ Specific infrastructure projects	Deferred regulatory asset and step adjustment	Docket No. UG-201
OR	2009	Northwest Natural Gas	▪ Replacement of steel facilities	Cost tracker	Case No. UG-177
RI	2009	National Grid Narragansett Gas	▪ Replacement infrastructure	Base rate surcharge	Docket No. 4034

Appendix B

Infrastructure Replacement
Cost Recovery Mechanisms

State	Year Approved	Utility	Eligible Investment Costs	Recovery Mechanism	Docket Reference
TX	2004	Atmos Energy	▪ Replacement infrastructure ▪ Other infrastructure investments	Cost tracker	Docket 9560
TX	2010	Atmos Energy	▪ Replacement of steel services	Cost tracker	Per City Ordinances
TX	2010	CenterPoint Energy	▪ Replacement infrastructure ▪ Other infrastructure investments	Cost tracker	RRC GUD10067
TX	2003	Texas Gas Service	▪ Replacement infrastructure ▪ Other infrastructure investments	Cost tracker	Per Texas Utilities Code Section 104.301
UT	2010	Questar Gas	▪ Replacement infrastructure	Cost tracker	Docket No. 09-057-16
VA	2011	Columbia Gas of Virginia	▪ Replacement of steel and cast iron mains, steel services, first generation plastic pipe and certain risers	Cost Tracker	Case No. PUE-2011-00049
VA	2011	Washington Gas Light	▪ Replacement of steel mains and services and certain pipe couplings	Cost Tracker	Case No. PUE-2010-00087

Sources: American Gas Association Periodic Update on Infrastructure Cost Recovery Mechanisms, June 2012 and Utility Filings.