INTERIM REVIEW OF THE PIPELINE INFRASTRUCTURE REPLACEMENT PROGRAM OF THE EAST OHIO GAS COMPANY D/B/A DOMINION ENERGY OHIO

JULY 17, 2023

PREPARED FOR

The Public Utilities Commission of Ohio

PREPARED BY

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I. EXECUTIVE SUMMARY

Daymark Energy Advisors Inc. (Daymark) presents this report to the Public Utility Commission of Ohio (PUCO) and Dominion Energy Ohio (DEO) to share our findings on the status of DEO's Pipeline Infrastructure Replacement (PIR) program. DEO management has overseen the development of this program since its initial application in 2008 and has assembled a core team of experts, aided by executives from supporting departments, that has carried out the program in a competent manner consistent with best practices followed by other utilities in Ohio and in other jurisdictions that have authorized similar programs.

Reviewing natural gas pipeline replacement programs requires a deep understanding of how gas utilities operate their systems to meet both daily and long-term demand in a safe and reliable manner. For this reason, our review required a comprehensive review not only of the application and various related filings, but also how the utility models its system and prioritizes maintenance to meet the needs of all customers across the entire system, whether in densely populated or high consequence areas as well as in less dense or rural parts of the system. To make this assessment, Daymark conducted a series of interviews with key personnel who carry out PIR related functions within the gas distribution and regulatory departments to gain an understanding of how DEO models their system and makes decisions to identify and prioritize pipe replacement projects over time. We also followed up with questions to obtain confirmation of what we had heard during those interviews that support our findings and recommendations in this report.

The scope of this report follows the requirements of the joint settlement between PUCO and DEO that calls for the report to address topics as summarized below.[1] Sections where these topics are evaluated are shown in parentheses.

1. Evaluate the current status of the PIR program and review prior orders and decisions. (Section I, IV, VI)
2. Determine annual and total pipe replaced versus initial targets (Section II, IV)
3. Evaluate how DEO models its distribution system to manage the PIR program and assigns leaks by grade and allocates resources. (Section V)
4. Assess plan and results compliance with industry best practices. (Section IX)
5. Quantify estimated annual cost savings versus the plan. (Section VI)
6. Compare DEO cost per mile replaced with replacement programs in other states. (Section IX)

[1] PUCO Case No. 20-1634-GA-ALT, RFP No. RAD22-PIR-1, Section III, Scope of Investigation, pp. 3-4.

A more detailed list of determinations and where they are addressed in this report is discussed in Section II. B. Interim Review – Scope and Methodology below.

Daymark's draft report was provided on June 14, 2023, followed by a Final Draft report delivered on June 21, 2023. After receiving comments from PUCO and DEO on June 28th, Daymark has prepared the final report for submission to PUCO on July 17, 2023.

Daymark appreciates the extensive amount of time and resources that DEO dedicated to the interview and discovery process. We found DEO staff to be very competent, friendly, and forthcoming as well as generous with their time.

Daymark also held check-in calls with PUCO staff who were also ready to support the process we followed for this scope of work and who attended all the interviews we conducted.

In summary, DEO has made significant progress towards the goals of this program to remove specific categories of aging leak-prone distribution pipe, discussed in more detail below, to identify, remove and replace in a cost effective, timely and safe manner that minimizes overall system operating risk. While our overall assessment of the PIR program is positive, our review raised some concerns that are highlighted throughout the report and summarized in our list of recommendations in Section X. These recommendations are numbered according to the order in which they are presented by report section below.

Our most significant finding and our biggest concern is that DEO is not likely to complete the PIR program by the 2033 target date and may ask for an extension to 2041[2]. As discussed in this report, we remain concerned that even this revised target completion date may be difficult to meet. DEO has been able to prioritize pipe effectively to avoid increases in leakages of an aging pipe infrastructure, but we have raised some concern around the increasing risk distribution of remaining pipe and the crucial need for timely monitoring and prioritization, especially in future years. The implication for program management is to make sure that DEO is replacing PIR pipe at a fast enough rate so that they are *fixing leaks faster than the overall deterioration of the system* and they need to have sufficient resources to do this at all times.

This finding leads to our key recommendations that support a *managed extension* of the PIR program in which better reporting standards are met in terms of project selection and trends in metrics to evaluate effectiveness of the program and interim targets are set in order to assess the pace and prioritization of replacements. Within this managed extension, we also emphasize that DEO should leverage their advanced leakage surveillance technology and considerations for

[2] Gathered from Discovery response 4.02 and executive interview.

increased surveillance frequencies existing within their Standard Operating Procedures to ensure that an up-to-date view of existing and projected risks is maintained given the tendency of increasing risks on aging pipe segments.

In order to meet the increased pace projected for a 2041 completion, we include recommendation no. 6, that DEO should continue working with the top cities where majority of PIR pipe remain, especially in Cleveland, Youngstown and Warren which have high average risk scores and high percentage of remaining PIR pipe.

The acceleration of the program and effective prioritization of replacements will take significant coordination by DEO's PIR management team, and at all levels within DEO, as well as oversight and assistance from local and state government to provide timely and sufficient access to rights of way to complete the work.

II. INTRODUCTION

Daymark commenced its audit of the PIR program with a review of the history of the program as represented by the various proceedings before the Public Utility Commission of Ohio (PUCO), as summarized in Table 1 below. Our summary of these filings below forms a narrative of how the intent of the PIR program anticipated annual filings as well as the interim program review that led to PUCO's request for this audit report.

A. Regulatory background

Table 1. PUCO PIR Authorization Dockets

CASE NO.	Date or Year	Name of Docket
08-169-GA-ALT	2008	PIR Application by Dominion
11-2401-GA-ALT	2011	Modify and Further Accelerate Pipeline Infrastructure Replacement Program
15-362-GA-ALT	2015	Extension of PIR Program
18-1908-GA-UNC	2018	Implementation of the Tax Cuts and Jobs Act of 2017
20-1634-GA-ALT	2020	Approval of an Alternative Form of Regulation for PIR

Table 2. Annual PIR Rate Rider Applications

CASE NO.	Date or Year
09-458-GA-RDR	2009
10-0733-GA-RDR	2010
11-3238-GA-RDR	2011
12-0812-GA-RDR	2012

CASE NO.	Date or Year
13-2320-GA-RDR	2013
14-2134-GA-RDR	2014
15-1987-GA-RDR	2015
16-2205-GA-RDR	2016
17-2177-GA-RDR	2017
18-1587-GA-RDR	2018
19-1944-GA-RDR	2019
20-1625-GA-RDR	2020
21-1095-GA-RDR	2021
22-1019-GA-RDR	2022

Original PIR Application

In the original PIR application of 2008, DEO sought approval of the Pipeline Infrastructure Replacement (PIR) program and an associated rate adjustment mechanism. The PIR program was defined as a 25-year targeted infrastructure program to replace 4,122 miles of bare steel, cast iron, wrought iron and copper pipelines. Under the PIR Program, DEO assumed both ownership and responsibility for the replacement of curb-to-meter service lines that previously had been the property and responsibility of customers. The program also includes the relocation of inside meters outside the premises, in conjunction with a plan to operate the system serving that area at regulated pressure.

The total estimated cost DEO presented for the 25-year PIR program as scoped in the 2008 application, was $2.146 billion[3] (in 2007$) with a target end date of 2033. This estimate only addressed the costs of replacement of pipeline and main-to-curb service lines. (08-169 Appl. para. 11.) The total estimate in the 2008 application, which included the curb-to-meter component, was $2.662 billion (in 2007$)[4].

The 4,122 miles of target pipe identified had the following vintages as per the 2008 application:

[3] 2008 Application and confirmed with discovery response 02.01.

[4] 6/12/2008 Staff Report (p. 3) in Case No. 08-169-GA-ALT.

Decade of Installation	Percent of the Pipeline to be Replaced
Pre-1909	7%
1910 – 1919	5%
1920 – 1929	17%
1930 – 1939	8%
1940 – 1949	24%
1950 – 1959	39%
1960 – 1969	1%

Figure 1. 2008 PIR Application Vintage of Target Pipe

The program ultimately was not approved on a 25-year basis, but for a five-year period, and has since been subject to additional review and approval in five-year increments. Replacement of ineffectively coated main was also approved as part of the original PIR scope (2008 Order) but was not quantified.

The original application included within its scope, an annual PIR plan submission by DEO to PUCO staff. This plan was to be developed in conjunction with PUCO staff and include the following:

- A detailed description of the projects to be undertaken in the upcoming fiscal year.
- As well as an estimate of the associated capital and O&M expenditures.
- A comparison of planned to actual expenditures on projects completed the prior year.

2011 Application to Accelerate the PIR Program

In 2011, DEO applied for modification to the "2008 Order" to allow further acceleration to the PIR by increasing annual increase limits in the PIR cost recovery charge and thus, increase annual investments in PIR from about $100 million to about $200 million. Just 2.5 years into the initial 5-year term, DEO saw clear indications that the annual PIR investments had to be doubled to replace aging pipeline for "significant safety, ratepayer and economic benefits". In 2011 application itself, DEO stated that certain assumptions under which the 2008 PIR application was approved were no longer valid – including the assumption that the program could be completed in 25 years (and could take 35 years or longer under the then-existing spending levels and $1 cap on annual PIR cost recovery charge increases).

DEO had identified about 1,450 miles of additional, ineffectively coated target pipe by 2011, which was added to the PIR program, increasing the amount of pipe to be replaced by 35%.

Several tragedies in 2008 – 2011 involving pipeline failures in San Bruno, Philadelphia, and Allentown, involving older high-pressure distribution mains, were one of the main reasons DEO stated that the PIR program be accelerated.

At that time, DEO had more bare steel pipelines than any other LDC in the US. DEO stated in its application that "Given several recent, fatal incidences of pipeline failures throughout the country, it has become clear that addressing this potential hazard over a 25-year period entails significant — and unnecessary — safety risks."

DEO stated that the PIR program in its view was mainly about safety, and strongly disagreed with the assumption that it will *immediately* result in O&M savings or that O&M savings should be an indicator of prudence/ right prioritization. For example, prioritizing high pressure pipelines in spite of having no active leak history did not result in immediate O&M savings but was crucial because of safety concerns.

DEO further argued for the following benefits from accelerated replacement:

- Increased safety and reliability in both short-term and long-term.
- Accelerating replacements inevitably will more quickly generate O&M savings from avoided leak repairs.
- Further accelerating the PIR Program will concentrate investments at a time of relatively low and stable natural gas prices (for years 2012-2020), reducing bill impact to customers.
- Increased economic benefits from employment, payrolls, and increased property taxes.

Ineffectively Coated Pipe

As defined in TIMOTHY C. MCNUTT's testimony in Case No. 08-169-GA-ALT, "ineffectively coated pipe is pipe that was field-coated by hand with a tar-like substance to protect against corrosion, which despite the coating applied has experienced corrosion.

Based on current industry standards, a steel pipeline is determined to be ineffectively coated when the current requirements needed to achieve cathodic protection exceed 0.1 milliamps per square foot."

Under the 2011 stipulation in Case No. 11-2401-GA-ALT, all pre-1955 pipes are considered ineffectively coated and within the scope of the program without further testing.

2015 Extension

In the years 2011-2014, when the Commission issued its order in Case No. 11-2401-GA-ALT, DEO's PIR capital investment was sufficient to reach the annual rate-increase cap.

Table 3. Status of the PIR program by end of 2014

Infrastructure Category	Mileage Replaced
Bare steel	713
Ineffectively coated	203
Cast iron	9
Wrought iron	27
Copper	1

In 15-362-GA-ALT filing, DEO asked for PIR Program and the PIR Cost Recovery Charge to continue, under the existing scope and procedures applicable to both, subject to the following limited modifications:

1. Program extension for another 5-year period (2017 – 2021) or until the effective date of new base rates resulting from the filing of an application to increase base rates, whichever comes first.
2. Increased program investment to ensure timely replacement in accordance with existing scope.

DEO stated the following reasons for increasing investment into the PIR program:

1. To give DEO a reasonable opportunity to complete the PIR program within the 25-year timeframe. DEO also indicated that "further adjustments to the approved level of investment may be necessary" to complete the program within the 25-years' timeframe (2033) which remained DEO's goal at the time.
2. No adjustments for inflation or other cost pressures were approved in prior order despite DEO mentioning these pressures as hurdles in both 2008 and 2011 filings.
3. DEO assumed that it would be possible to replace dual mainlines with single mainlines, which has not been possible in many cases because some municipalities, including larger cities, such as Cleveland, did not permit DEO to directionally drill under city streets. Their concerns centered around unmarked water or sewer lines that may be damaged, potential settling of pavements or sidewalks or root damage to mature trees. This effectively required DEO to replace dual mainlines with dual mainlines. In other cases, cities did not permit DEO to close an entire road, as is sometimes necessary to replace dual lines with a single main line. This also effectively required replacing both lines.

Impacts of Tax Cuts and Jobs Act of 2017

The 2017–2021 rate increase caps were adjusted to reflect the impact of the Tax Cuts and Jobs Act (TCJA) of 2017 in Case No. 18-1908-GA-UNC.[5]

Table 4. Rate Cap Adjustment based on TCJA

Investment Year	Estimated Capital Investment	Proposed Residential Rate Cap		Revised Rate Caps
2017	$180 million	$1.75/month		
2018	$200 million	$1.82/month		$1.66/month
2019	$206 million	$1.83/month		$1.68/month
2020	$212 million	$1.84/month		$1.69/month
2021	$219 million	$1.85/month		$1.70/month

2020 Extension

In 20-1634-GA-ALT, DEO applied for another 5-year extension of the program for the years 2022-2026. DEO proposed to continue to increase the annual amount of PIR investment by the same factor of three percent per year previously approved for investment years 2019 through 2021, and to adjust the annual rate increase caps accordingly.

DEO presented updates on program status and the total PIR capital investment as of December 31, 2019, approximately $1,803,433,764[6].

Table 5: Status of the Program by end of 2019

Infrastructure Category	Mileage Replaced
Bare steel	1404
Ineffectively coated	427
Cast iron	32
Wrought iron	51
Copper	1

In the Staff report, they expressed significant concern as to whether DEO will be able to complete the PIR program by the end of 2033 and recommended that DEO continue to use its best efforts to replace all target pipe under the program by the end of 2033.

[5] 2022 PHMSA Filing

[6] Pg-4 Lori.S.Parker testimony in 20-1634-GA-ALT Application

The Staff recommended that when DEO files for its base distribution rate case no later than October 2024, the PIR assets be embedded into the rate base and the PIR associated EDIT be included in the Company's Tax Savings Credit Rider.

The Commission approved DEO's extension and rate increase caps and adopted the joint stipulation submitted by DEO and Staff.

Annual Rider Adjustment Applications

DEO files an annual application to adjust its PIR cost recovery charge for costs incurred during the previous calendar year called "RDR-Application to establish tariff riders" or RDR filings. DEO responded to discovery[7] asking for a copy of its annual PIR program plan that these RDR filings are the only filings they submit that include detailed information on PIR eligible pipe replaced and associated costs. In these applications, DEO files information related to PIR revenue requirement and proposed PIR Cost Recovery Charge by rate schedule. It also files monthly capital additions for pipeline replacement projects, associated main-to-curb service line replacements, curb-to-meter service line replacements, and other associated PIR Program investments for the previous calendar year. These RDR filings are made at the end of a calendar year to provide a look-back for PIR program activity through December of that year.

As part of the reauthorization filings filed in 2011, 2015 and 2020, DEO has filed projected spending for the next five years in support of proposed rate caps. These reauthorization filings include an update on the progress of the PIR program, discussion of any hurdles faced in completion of the program by 2033, some discussion on cost pressures and a projected program completion date.

We are unable to say that DEO's PIR Program filings include any annual/ interim targets to which DEO's progress can be regularly evaluated. We have also concluded that these filings do not offer any updates to budget through the completion of the PIR Program at any point of time except for the initial budget estimated in the original application.

B. Interim Review – Scope and Methodology

Under Case 20-1634-GA-ALT, Daymark was selected as the Auditor for interim review of the PIR program. The scope of the interim review includes, but is not limited to, the following:

[7] Discovery response 1.07

1. An effectiveness review to determine if the PIR Program is effective in meeting the stated goals of the program, including safety improvements, reliability improvements, leak-rate improvements, miles replaced targets, among other identified issues.
2. Evaluation of the management and effectiveness of the PIR Program, including a comparison with other natural gas accelerated replacement programs,
3. Evaluation of the projected completion and pace of the PIR Program, including consideration of PHMSA requirements and industry practices.
4. Evaluation of DEO's decisions as it relates to managing the PIR Program, including, but not limited to proper pipeline replacement prioritization, effective management oversight and controls, and effective cost containment strategies and practices, and
5. Determination of customers savings for operation and maintenance (O&M) savings associated with the program.

The RFP to review DEO's PIR program also included the following list of determinations to be made by the auditor. We show in the table below each of these determinations and identify where in this report, Daymark has reviewed and evaluated them.

Table 6 RFP Scope of Review: Items for Auditor Determination

RFP Topic for Determination (RFP RAD22-PIR-1, p. 4)	Reviewed in Section (*, **)
Annual and total target pipe replaced vs. initial targets by pipe type	IV.a (*)
Annual and total miles mains replaced in urban areas	IV.b
Annual and total miles mains replaced in rural areas	IV.b
Annual and total AMRP service lines replaced compared to initial targets	(**)
Annual and total hazardous service lines replaced	IV.a (***)
Annual and total Grade 1, 2, and 3 leak rates compared to initial rates and targets	IV.a (*, ***)
Annual and total lost and unaccounted for gas compared to initial rates and targets	VII
Annual and total costs and cost/mile for urban replacements	VI
Annual and total costs and cost/mile for rural replacements	VI
Comparison of DEO cost/mile replacements with replacement programs in other states	IX
Identification of improvements (if any) in corrosion monitoring results	V D
(*) No initial targets included with 2008 application nor were updated targets included in subsequent annual RDR filings. (**) AMRP meters not included in PIR program per 3/29/23 interview with DEO administration. (***) Most leaks in PIR program inventory are Grade 1 hazardous and Grade 2 non-hazardous.	

Terminology: Definition of Target

PUCO's directive for this interim review of the DEO PIR Program include comparison to targets, as discussed above and in the RFP. Also, throughout this report Daymark refers to DEO response to discovery that include references to PIR targets. Our understanding is that these two uses of the term 'targets' have different meanings.

Since it is difficult to ask DEO to change how it uses the term targets in its filings and discovery responses, we use this section of the report to clarify our understanding of the difference. We

view the meaning of the term "target" to mean DEO's plan to complete the program within 25 years unless the end date is extended beyond 2033. In this plan context, target means the total miles of pipe by class, location and material type by year and the associated costs to complete the program, including totals by sub-categories of pipe and costs.

However, DEO appears to use the term "target" to mean the pipe inventory they describe (in interviews with Daymark) as "PIR program-eligible" or just "PIR-eligible". The distinction between the two definitions may seem subtle, but it is important because DEO advised that they do not make annual filings other than the RDR filings discussed above, which do not include the RFP's definition of 'target'.[8] This makes it difficult to meet this scope requirement to review the program. Instead, we have tried to infer, as discussed in Section IV below, whether DEO will be able to complete its program by the end date, whether that remains 2033 or a later year.

Methodology

Daymark conducted a series of interviews with key members of the regulatory, gas distribution, accounting and executive staff (see Appendix-A). Following these interviews, we issued additional discovery to confirm information provided on these calls that were used to prepare this report. As a result, we collected information through a series of seven sets of data requests from DEO staff as part of this interim review. Each discovery set had multiple sub questions and all responses were accessible via DEO's PIR Interim Review eRoom. At subsequent interviews, Daymark and DEO reviewed the status of outstanding discovery responses and discussed information contained in responses received. Daymark also provided a brief agenda prior to each interview so that DEO personnel could anticipate what would be covered and, on several occasions, Staff used the time to make presentations on selected topics. At these interviews, several DEO personnel were present besides the person responsible for that interview topic, along with PUCO staff members.

C. Findings and Recommendations

Finding: The total budget through the end of the PIR program has not been estimated in any filing other than the original application of 2008 in PUCO Case No. 08-169-GA-ALT. We are unable to say that DEO's PIR Program filings include any annual/ interim targets for pace, risk reduction, leakage reduction or cost minimization, to which DEO's progress can be regularly evaluated as required in the RFP scope for review.

[8] Discovery response 1.07.

Finding: Annual PIR proposals as scoped in the Original Application and corresponding Order filed in 2008 have not been provided since 2010. There have not been any alternative filings to provide transparency and opportunities to review PIR project plans for the following year.

As part of the annual filing with the PUCO, DEO needs to provide a resource plan to demonstrate that they have the necessary internal and external resources needed to execute their plan. At a minimum the annual filing should include following information:

1. Construction Plan Detail for Upcoming Fiscal Year,
2. Construction Year Budget estimate.
3. Description of Available Resources and Deployment for Construction Year.

The plan will define the resources required for the PIR work as a proportion of resources needed to execute their entire capital program. The plan should address supply chain constraints for materials as well as a description of how DEO ensures it will have material necessary to execute their program.

A comprehensive plan that describes the progress, maintains some effectiveness metrics, highlights benefits and challenges, discusses resources and cost management is essential to a stipulated agreement between the PUCO and DEO relative to defining the program through its logical end. This plan would set a discipline and expectation for the Company to sincerely identify and manage all the important aspects of an effective program. For the PUCO, it provides reasonable assurance that the PIR program is on track and remains a viable program. Please refer to a D.P.U 20-GSEP-05 Filing[9] for an example of a well-structured plan update used in Massachusetts that is filed annually, and a D.P.U 18-GSEP-05 5-year report[10] as an example of a once-in-five years plan update. While it is not necessary that a PUCO/DEO plan be identical to this example, it does provide a good structure for a recommended plan.

Recommendation No. 1: The PIR program total budget estimation through completion of the program should be prepared and reviewed at least once every 5 years as part of reauthorization.

Recommendation No. 2: Annual filings should include a proposal for future replacements as per the original application.

9 https://fileservice.eea.comacloud.net/FileService.Api/file/FileRoom/12834099

10 https://fileservice.eea.comacloud.net/FileService.Api/file/FileRoom/10026695

III. DOMINION ENERGY OHIO NATURAL GAS ASSETS

A. General System Description:

DEO has 19,845 miles of pipeline[11] across a service territory that includes Cleveland, Akron, Canton and Youngstown in northeastern Ohio, Lima in western Ohio and Marietta in southern Ohio, with a total service area of 4,700 square mile.[12] DEO serves about 1.2 million customers with 1,178,791 service lines.

It is the 13th largest[13] gas distribution utility in the US in terms of mileage, with an annual average gas distribution of 331 Bcf[14].

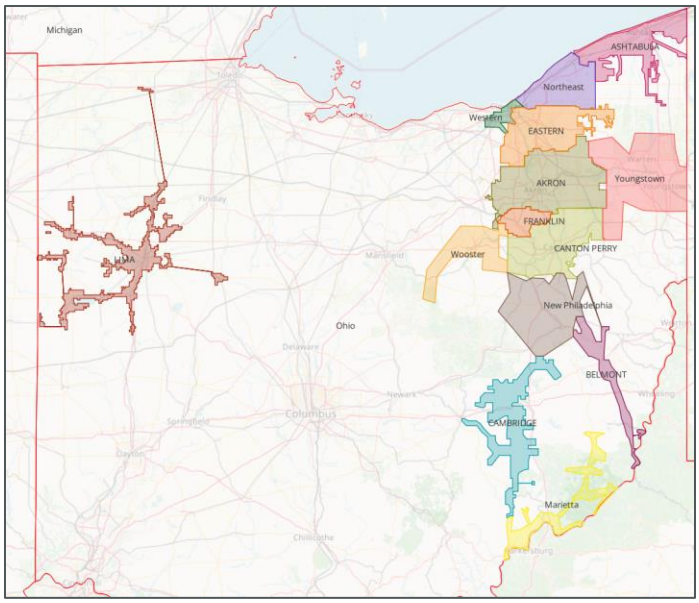


Figure 2. DEO Operating Area Map[15]

DEO's distribution territory of 27 counties in Ohio is divided into 13 distribution areas or "shops". These shops are a sort of geographical categorization used by DEO to account for their existing infrastructure. This categorization is used across all DEO's internal software for risk ranking and

11 Discovery Response 1.06 March 1st, 2023 snapshot.

12 https://www.pipelinesafetyinfo.com/user/file/Ohio/Dominion%20Energy%20Ohio.pdf

13 2022 PHMSA.

14 EIA Form-176 data.

15 This map has been created by Daymark using geographic data - Discovery response 4.03 (kmz file type) and pdf provided by DEO. The accuracy, sufficiency, or completeness of this drawing is not warranted for use outside of this Audit.

geospatial analysis. This shop-level categorization is also used in DEO's DIMP and urban/ rural/ residential categorization of existing infrastructure.

Some of these shops have multiple names such as Marietta is also known as River, Akron is also known as Eastwood, Canton is also known as Perry Yard, Eastern is also known as Randall and Warren is within Youngstown. Wilbeth overlaps with Franklin and can be considered to cover similar areas on the map.

Cambridge is a non-distribution shop and has no overlap with any other shops, while Franklin, North Canton, and Belmont are also considered non-distribution shops, but unlike Cambridge, they have some overlap with the distribution shops/systems.

B. Review of Existing Infrastructure - Mileage, Material and Vintage

We reviewed the latest snapshots of existing infrastructure within DEO. The mileage data by shop was provided as part of a discovery response[16], this has been used to illustrate regional differences in mileage, material, and vintage of existing pipe in Figures-3,4, 5 and 6, respectively.

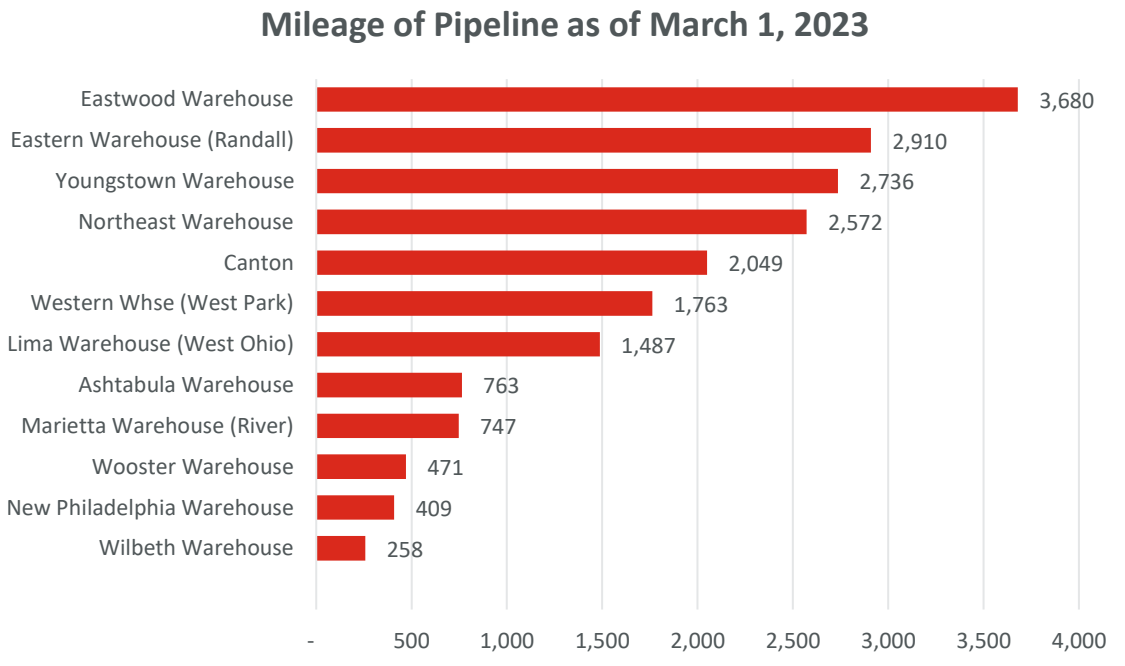


Figure 3. Mileage of Main Pipeline in DEO by Shop

[16] Discovery response 01.06. Data is up-to-date as of March, 2023.

The most mileage of pipe is in the Eastwood/ Akron area, followed by Eastern and Youngstown. Belmont region has been re-assigned to Marietta/River shop and Cambridge is accounted for within New Philadelphia.

Most of the material in the system is either steel (57.6%) or plastic (40%), and these are distributed in similar proportions across all shops. Other materials (4%) include cast iron (0.05-mile), copper, fiberglass and X-trube. The Western area has a slightly higher than average steel percentage of 71.5%.

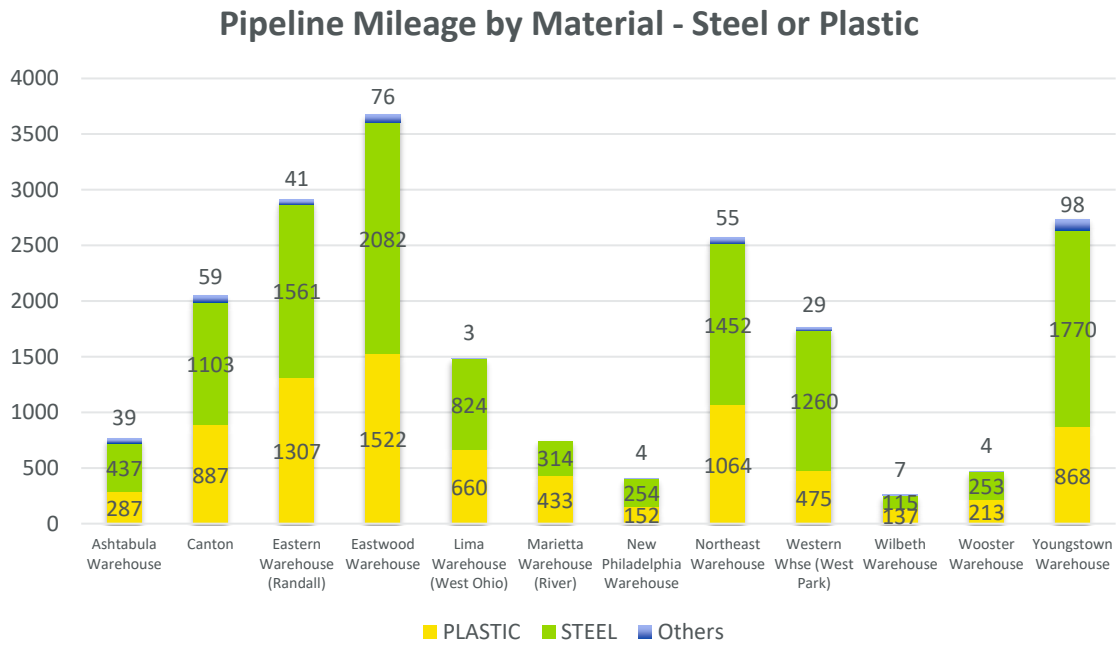


Figure 4. Pipeline Mileage in DEO by Material

In terms of vintage of existing pipe, about 10.8% of total pipe is pre-1950 (11.1% if pipe with unknown vintage included) and about 24.9% of pipe is pre-1960 (25.3% if pipe with unknown vintage included). The distribution of older pipe varies significantly across shop areas with the Western area having the most amount of pre-1950 pipe; 23% of Western area pipeline mileage is pre-1950.

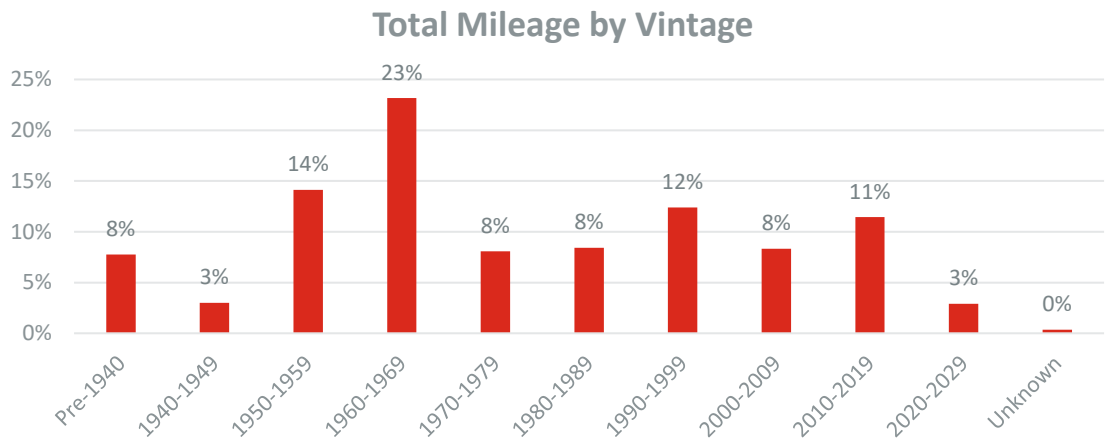


Figure 5. Total Mileage in DEO System by Vintage

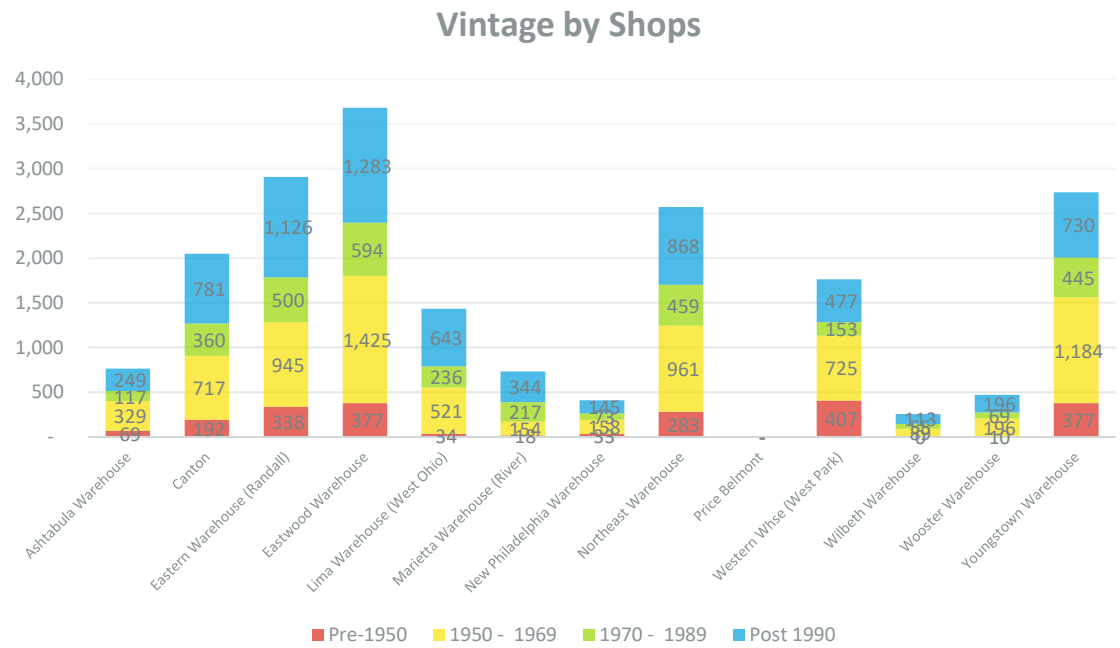


Figure 6. Pipeline Mileage by Vintage – Shop Level

C. Initial Review of Existing Infrastructure – Comparison with Other Utilities[17]

DEO has the 3rd highest number of corrosion leaks amongst all US gas utilities as per PHMSA filings, even on a leaks/mile basis, DEO is 5th in the nation. DEO also has one of the highest pr-1950 and pre-1960 percentages of pipeline amongst large utilities (>=10,000 Main Miles)

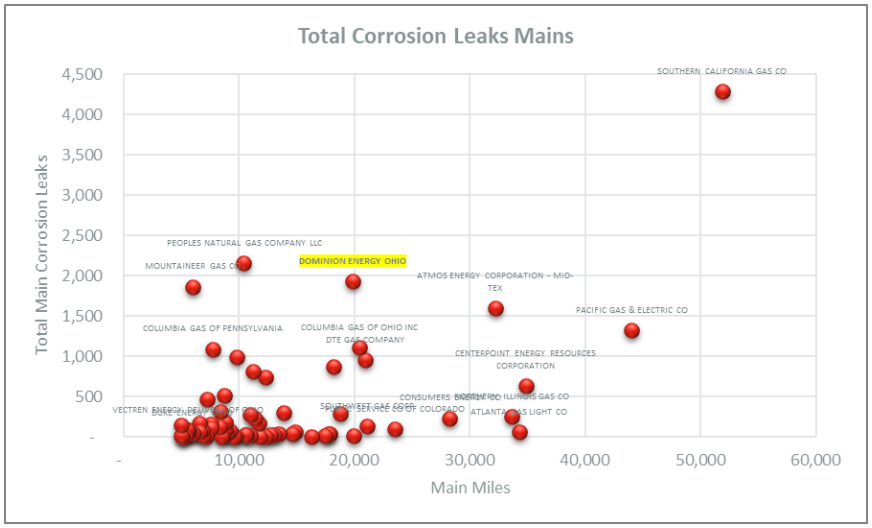


Figure 7. Corrosion Leaks Across Utilities

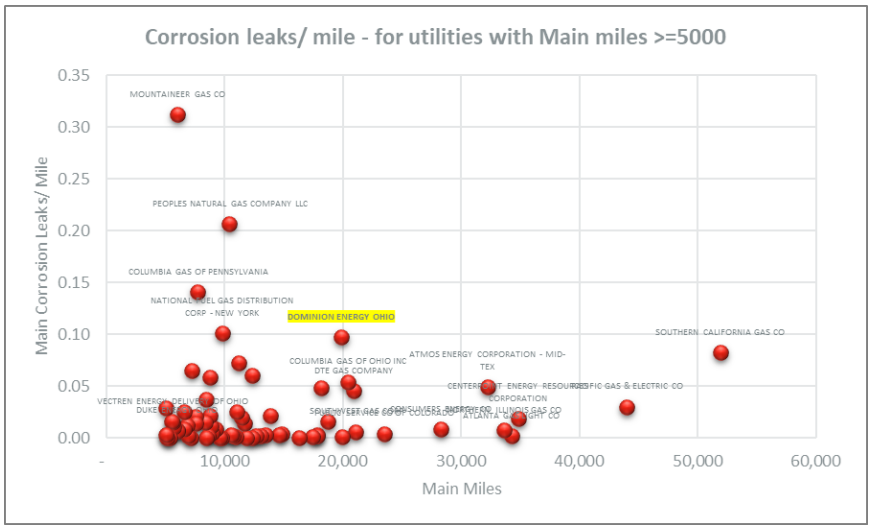


Figure 8. Corrosion Leak/Mile Across Utilities

[17] PHMSA Reports 2022 F7100

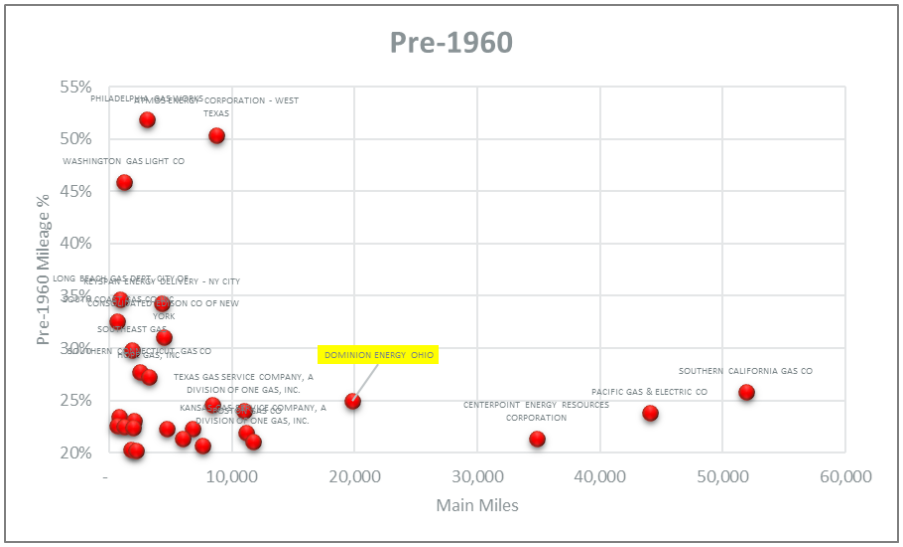


Figure 9. Pre-1960 Pipe % Across Utilities

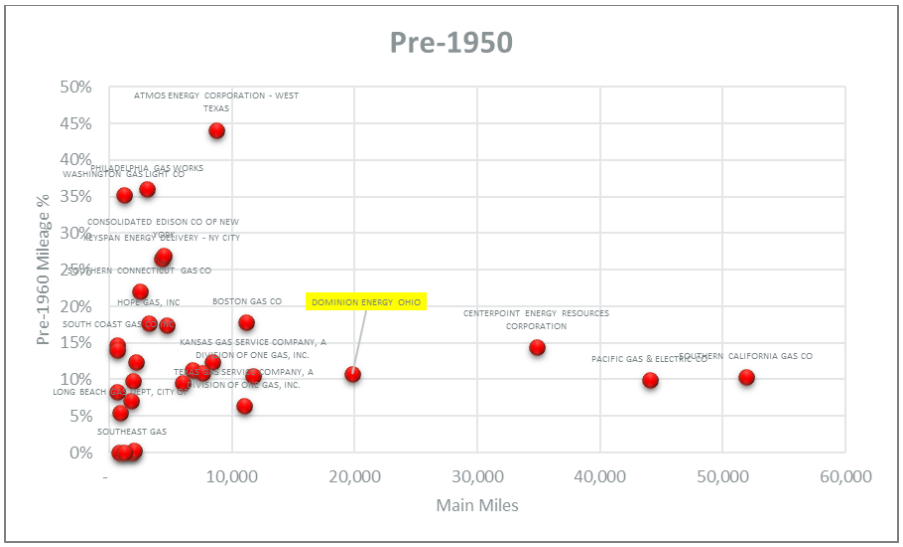


Figure 10. Pre-1950 Pipe % Across Utilities

D. Findings and Recommendations

Finding: DEO ranks higher than most US Utilities in terms of highest number of corrosion leaks and leaks per mile, underscoring the importance that DEO makes progress on reaching program goals for safety and reliability as well as cost reduction.

Finding: Some data for Shops are reported under more than one name which causes confusion for summarizing program progress. Similarly, we found some inconsistencies among service territory maps located on the DEO website[18] and other internal documentation received[19]. For example: Cambridge and Belmont shop areas (which are non-distribution shops) are not represented in the system map on DEO's website.

Recommendation No. 3: For consistency in reporting, PUCO review and subsequent plan reviews, DEO should establish a consistent set of Shop names and definitions accompanied by a common service territory map.

IV. PROGRESS AND PACE OF THE PROGRAM

A. Current and Projected Pace of the Program

A total of 2,334 miles[20] of target pipeline has been removed so far, that is about 42% of the total target of 5,572, comprised of 4,122 miles of pipe from the original application plus 1,450 ineffectively coated pipe added with the Commission's order in Case No. 11-2401-GA-ALT.

The pace of replacements was about 139 miles/year from June 2008 – June 2011, 169 miles/year in July 2011 – end-of 2013. The pace increased to 179 miles/year between 2014 – 2019, with the highest annual pace of 190 in 2017, and then it reduced back to 140 miles/year in years 2020-2022. DEO's near-term projected pace from 2023 – 2027 is 150 miles/year.

At the current pace and with projected pace of 150 miles/ year, DEO would complete only 3,994 miles by end of 2033, or less than 75% of eligible pipe included in the PIR program. This could mean that the PIR program will need to be extended for another 10.5 years at current pace projections.

All pre-1960 PIR pipe (17% of total system) will be 84 years or older by 2043; this can create severe reliability issues unless a combination of correctly prioritized replacements and active corrosion monitoring efforts are made along with finding opportunities to accelerate the program wherever possible.

18 https://cdn-dominionenergy-prd-001.azureedge.net/-/media/pdfs/ohio/transportation-services/deo-system-map.pdf?la=en&rev=31c3ab885d07442ea2ec6dfbd71048f0

19 Discovery response 4.03.

20 Discovery response 7.03.

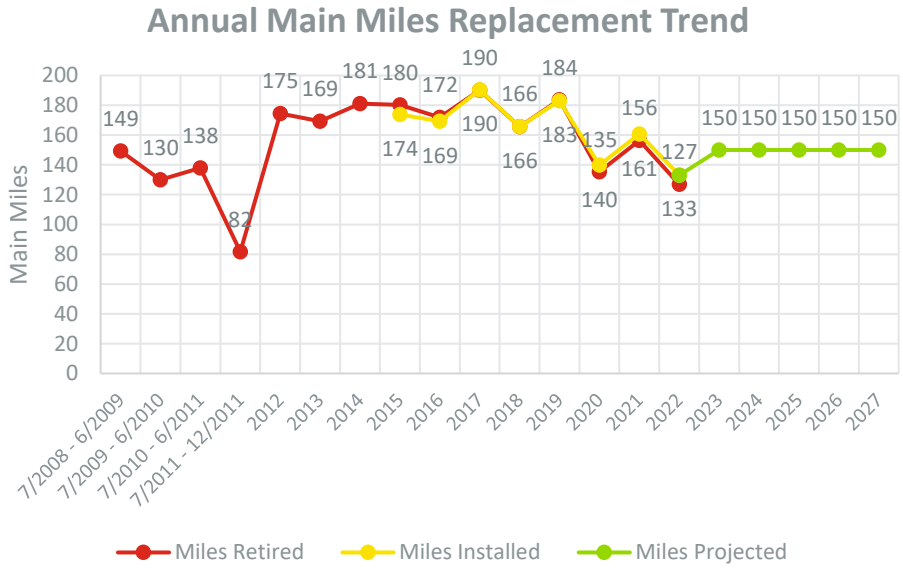


Figure 11. Annual Main Miles Replaced[21]

Several studies[22] have shown that leaks can exponentially increase with the age of pipeline based on material. All these studies and our experience indicate an increasing reliability risk to be considered while extending the program indefinitely.

DEO has two long-term projections[23] for two program completion dates and associated replacement rates. The alternative program completion date of 2041 projected by DEO has been proposed as the most reasonable and considers potential construction/permitting and rate impact challenges. In these projections, DEO has set the 2023 through 2026 pace based on the current rate structure approved through 2026.

The pace assumed for a 2041 completion (168.8 miles/year) is similar to the assumed pace originally accounted for in the original application (164.9 miles/year). When 1,450 miles of additional pipe got added to the PIR program, that was a 35% increase in scope which translated into years will be 8.8 years (35% of 25 years).

21 Data for miles installed unavailable by year before 2015 due to transition in DEO's data management system but should follow the miles-retired line as replacements are 1-for-1.

22 https://psc.ky.gov/PSCSCF/2009%20cases/2009-00141/20090501_Columbia_Gas_Application_Volume_7.PDF ATTACHMENT SV-I Black and Veatch Study Report

https://pubs.acs.org/doi/pdf/10.1021/acs.est.0c00437

23 Discovery response 4.02.

Daymark believes that the pace projected for a 2033 completion is unreasonable based on the information gathered through the executive interview, the upper limit of miles that can be retired within the top-5 municipalities[24], and the general hurdles in accelerating the program which are discussed in a subsequent section.

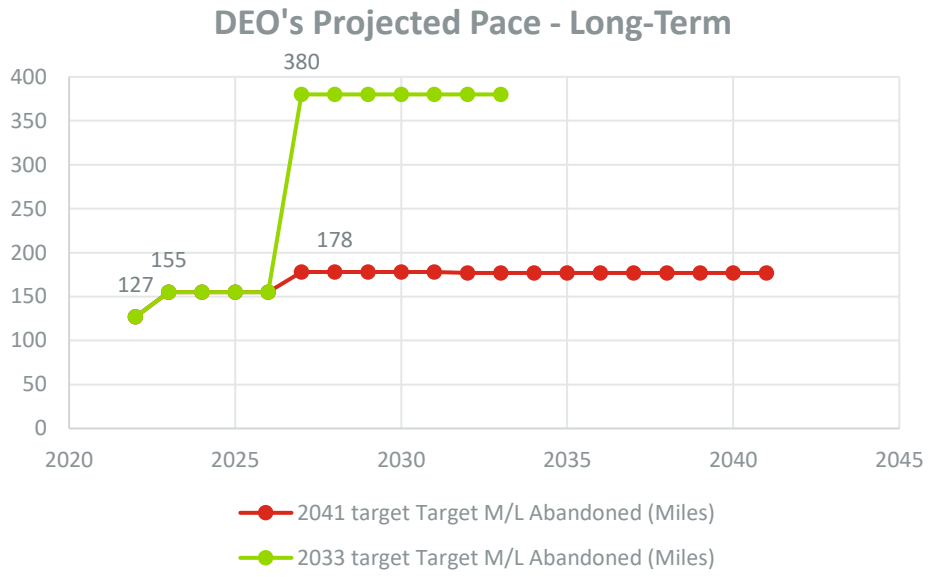


Figure 12. DEO's Long-Term Projected Pace for Program Completion

DEO has replaced 235,546 curb-to-main services and 272,189 main-to-meter services by end of 2022. The pace of replacement has been about 36,000 services per year and has followed the trend of Mains replacements. As per DEO's 2022 snapshot[25], 346,307 bare steel services remain in the system, and 477,321 total PIR services remain in the system indicating that about 35% of PIR target service lines have been replaced so far.

[24] Discovery response 7.11.

[25] Discovery response 5.02.

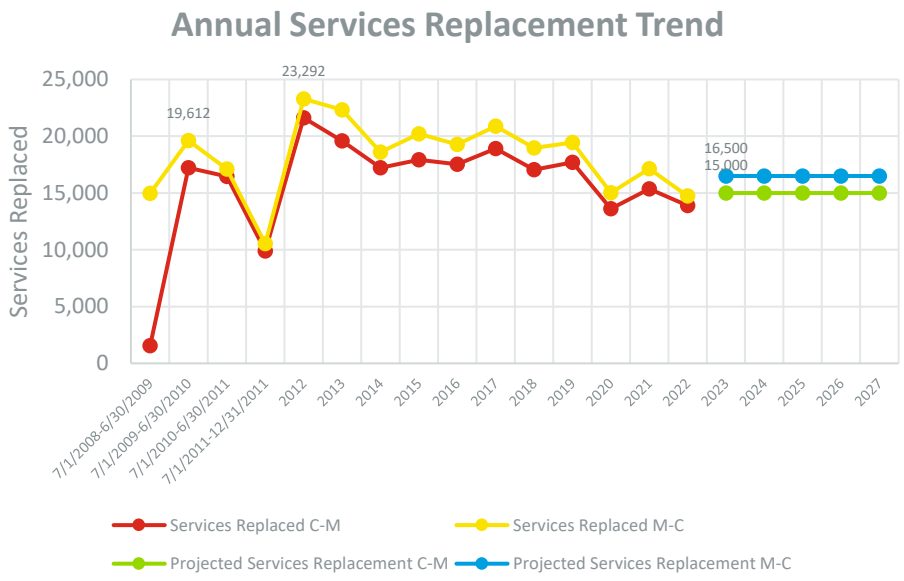


Figure 13. Annual Services Replacement Trend

B. Regional Differences in Pace

There have been regional differences in pace of replacements which have been guided by the material priorities, varying vintages and risk profiles, and ease of permitting within these regions.

All the 35 miles of cast iron pipe has been removed from the system, except for one 0.05-mile[26] segment. There are about 22 miles of wrought iron (down from 78 miles in 2008) and 0.39 miles of copper (down from 1 mile in 2008) left in the system[27]. The majority of remaining PIR pipe is bare-steel and ineffectively coated steel. DEO views both these categories as having similar risk profiles and are prioritized similarly for replacements.

The prioritization process discussed in Section-V will cover the risk score and material prioritization strategies pursued by DEO within the context of the PIR program.

26 2022 PHMSA Report.

27 Discovery response 4.01.

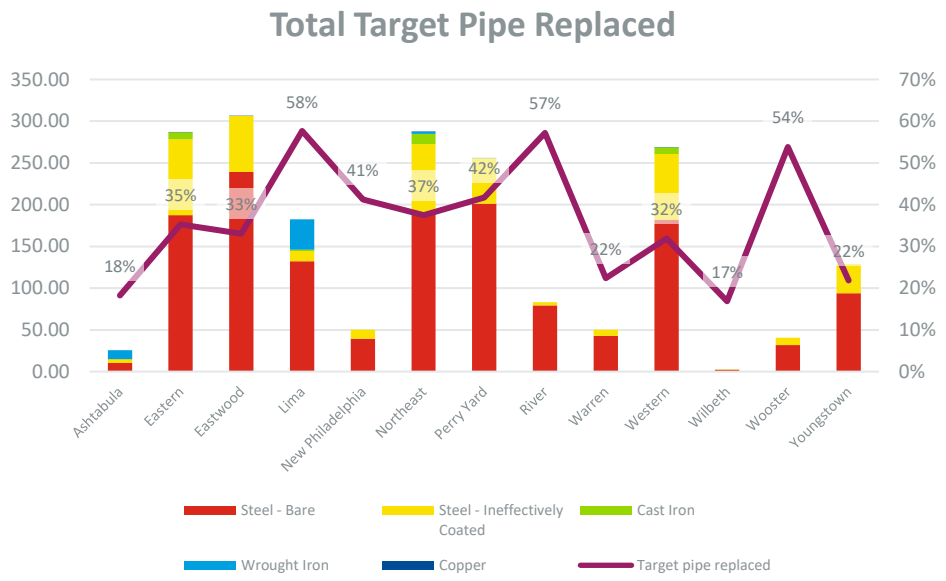


Figure 14. Total Target Pipe Replaced by Shop[28]

Urban/ Rural/ Residential Categorization

To define factors related to Consequence of Failure (COF) in DEO's Distribution Integrity Management Program (DIMP) Plan[29], areas were grouped based on population density where shops with similar density computations were grouped, essentially reflecting rural, residential, and urban location categories.

Table 7. Urban/ Rural Shop Categories as defined in DIMP[30]

Consequence Factor A	Primary Population Density Category	Shop Reporting Data
1	Rural	River Gas
2	Residential	Ashtabula, Lima, New Philadelphia, Perry Yard, Warren, Wooster, Youngstown
3	Urban	Eastern, Eastwood, Northeast, Western, Wilbeth

28 Discovery response 4.01.

29 DIMP Plan is a written plan and implementation program required by PHMSA that outlines the processes, procedures, guidelines, organizational support, and communication that will minimize or prevent hazards to people, property, and the environment as related to the Company's distribution system.

30 Distribution Integrity Management Plan (DIMP) Rev 14 10/29/2022.

Table 8. Urban/ Rural/ Residential Pace[31]

	Miles/year 2010- 2021	Remaining target pipe 2021-end	Percentage of target pipe replaced annually
Residential	66.63	1346.19	3%
Urban	104.66	2209.54	3%
Rural	7.55	62.08	6%

The pace of replacement in terms of percentage reduction of target pipe is higher in rural areas, but in terms of actual mileage of replacement, rural replacements are much fewer than urban or residential. Majority of remaining target pipe is in urban areas concentrated within a few cities, top 10 cities have >50% of target pipe. These are higher consequence factors and have the most hurdles in terms of costs and permitting.

Remaining Target Pipe

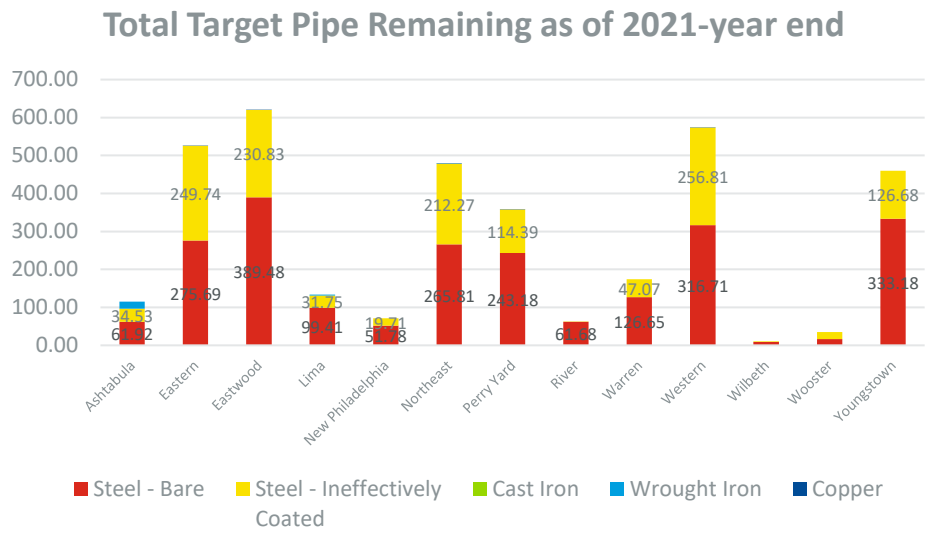


Figure 15. Total Remaining Target Pipe by Shop[32]

[31] Calculated using Discovery response 4.01. Miles/year calculated over 11 years say for example rural - River replaced 83.04 of PIR pipe over 2010 - 2021. 83.04/11 = 7.55

[32] Discovery response 4.01

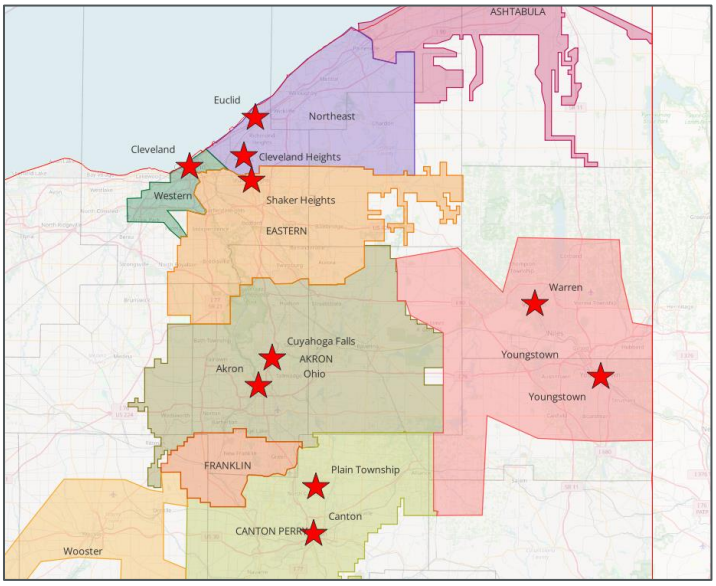


Figure 16. Top 10 Municipalities Map[33]

Table 9. Top 10 Municipalities[34]

CITIES	PERCENTAGE OF PIR REMAINING	PIR MILES[35]	Risk Rank Amongst 477 Cities and Townships[36]	Average Risk/1kFt[37]
Cleveland	20.0%	682.1	10	116.74
Akron	10.3%	349.9	98	20.64
Youngstown	6.4%	218.0	12	92.73
Canton	4.6%	158.1	36	40.50
Cleveland Heights	3.0%	102.6	67	26.90
Warren	2.7%	91.6	5	217.79
Shaker Heights	2.7%	90.3	63	28.63
Cuyahoga Falls	2.2%	75.0	32	42.96
Euclid	1.8%	61.7	61	28.91

33 Discovery response 6.05. Data valid as of 04/01/2023.

34 Discovery response 6.05. Data valid as of 04/01/2023.

35 PIR Miles estimated using 3407 miles of PIR inventory remaining as of YE 2022.

36 Calculated using Discovery response 7.15 using 2022 snapshots of all projects.

37 Calculated using Discovery response 7.15 using 2022 snapshots of all projects.

CITIES	PERCENTAGE OF PIR REMAINING	PIR MILES[35]	Risk Rank Amongst 477 Cities and Townships[36]	Average Risk/1kFt[37]
Plain[38]	1.6%	55.9	102	20.33
Sub-Total:	55.3%	1,885.1	NA	NA

Cleveland contains 20% of the remaining target pipe and contains the riskiest pipe segments. Cleveland consists of 36% of the top-50 riskiest pipe segments and 28% of the top-100 riskiest pipe segments in the system.

The Warren municipal area has the highest average risk score amongst these top-10 municipalities.

Table 10. Replacement Rate Projections by Municipality

CITIES	PERCENTAGE OF PIR REMAINING	PIR MILES	REPLACEMENT RATE (MILES/YR) YE 2033	REPLACEMENT RATE (MILES/YR) YE 2041	MAX MILES IN SINGLE YEAR SINCE 2008[39]
Cleveland	20.0%	682.1	62.0	35.9	54
Akron	10.3%	349.9	31.8	18.4	30
Youngstown	6.4%	218.0	19.8	11.5	15
Canton	4.6%	158.1	14.4	8.3	28
Cleveland Heights	3.0%	102.6	9.3	5.4	17
Warren	2.7%	91.6	8.3	4.8	
Shaker Heights	2.7%	90.3	8.2	4.8	
Cuyahoga Falls	2.2%	75.0	6.8	3.9	
Euclid	1.8%	61.7	5.6	3.2	
Plain	1.6%	55.9	5.1	2.9	
Sub-Total:	55.3%	1,885.1	NA	NA	

[38] Note: This is Plain municipality in Stark County. Some risk score statistics might be picked from Plain township in Wayne county as well due to same naming conventions.

[39] Discovery response 7.11

Table 11. Risk Statistics of Remaining PIR pipe – by Shop[40]

SHOP	AVERAGE OF RISK/1KFT	MAX OF RISK/1KFT	STDDEV OF RISK/1KFT	AVERAGE OF RISK/1KFT
NORTHEAST	114.17	473,920.39	5,353.91	19.42
WESTERN	104.17	382,236.84	4,966.93	20.65
BELMONT	32.42	57.73	17.20	32.42
WOOSTER	25.06	63,504.10	1,005.11	9.17
EASTERN	21.78	59,753.27	409.26	19.04
YOUNGSTOWN	21.08	6,006.41	74.85	21.08
RIVER GAS	20.20	1,200.00	65.58	20.20
NEW PHILADELPHIA	19.15	3,001.54	66.58	19.15
PERRY YARD	18.85	4,555.49	68.44	18.85
WARREN	17.20	49,544.13	479.26	12.61
EASTWOOD	16.90	1,917.12	48.42	16.90
LIMA	15.68	1,583.33	57.69	15.68
ASHTABULA	10.24	8,777.78	118.25	10.24
WILBETH	3.95	250.30	13.26	3.95

Rural
Residential
Urban

River Gas risk statistics indicate that it has less risky pipe compared to some of the other major municipalities, potentially because rural consequence factor is low. DEO also indicated that some of the very high risk scores (10,000 and above) are considered "outliers". These are mainly from selective seam weld corrosion and have been discussed under Section V.B.

C. Challenges Faced in Acceleration of the Program

The current pace of the program is not sufficient to complete the program in 2033, and hence we had several discussions with DEO on program acceleration and the potential challenges in doing so.

DEO maintains that if not for the 1,450 additional miles being added to the program in 2011, the 2033 completion date was reasonably achievable. The future scenario presented by DEO of a 2041 completion date, which estimates 178 miles/year of replacement post 2026 also requires some acceleration of pace. Through these discussions, we have identified that cost recovery has

[40] Discovery response 7.15 using 2022 snapshots of all projects.

been the bottleneck at times – depending on the interaction between the increase in costs of pipe replacement and cost caps (based on rate increase caps) approved during program reauthorizations, but permitting/ aggregation challenges consistently remains DEO's main bottleneck in achieving higher pace of replacements given the high concentration of PIR pipe within a few cities.

Cost Recovery

DEO has mentioned that the rate increase caps set by the Commission every 5 years during program extension filings has been one of the hurdles in accelerating the program.

There is no established budget cap on the PIR program, instead allowable rate-increase caps constrain the annual PIR budget available for the program.

In Case No. 15-0362-GA-ALT, the Commission approved DEO's request to increase annual PIR investment by three percent per year, and that three percent annual increase continues to guide the establishment of the annual rate increase caps.

In 2020-1634-GA-ALT, DEO's request to continue the three percent annual increase in investments was approved.

At this time[41], DEO believes that the current PIR ratemaking mechanism (the PIR Cost Recovery Charge) and the currently approved procedures, have generally been adequate to recover the costs of the PIR Program. Under the current procedures, the PIR Cost Recovery Charge is updated annually to reflect the PIR investments placed in service during the most recent calendar year. The existing Commission approved PIR cost-recovery timing and procedures associated with this mechanism, including the reconciliation procedures, provide DEO with the opportunity to gradually recover the costs of PIR investment in rates, including PIR-related deferrals, outside of a base rate proceeding. Based on the Commission's approval of the Stipulation in Case No. 20-1634-GA-ALT, DEO is authorized to accrue PIR related deferrals, file annual updates to the PIR Cost Recovery Charge, and implement approved rates for the PIR Cost Recovery Charge related to PIR investments through December 31, 2026, unless this period is modified in DEO's next base rate case or subsequent PIR reauthorization proceeding.

Permitting/ Aggregation

The majority of DEO's PIR program pipes are located within Public Right of Ways and concentrated within a few densely populated cities.

[41] Discovery response 04.09

Table 12. Concentration of PIR Pipe

CITIES WITH MOST PIR PIPE	PERCENTAGE OF REMAINING PIPE
Top – 20	65% of the remaining PIR inventory
Top – 5	44% of the remaining PIR inventory
Top - 2	30% of the remaining PIR inventory

This creates significant permitting/ aggregation challenges for acceleration of the PIR program.

DEO has suggested that acceleration of the program within cities beyond the historic maximum miles/year (see Table-10) would be a challenge due to several hurdles related to permitting/aggregation of projects.[42]

We have gathered the following potential challenges based on interviews and discovery questions with respect to permitting/ aggregation of projects[43]:

1. Coordination of multiple projects within a concentrated area could lead to difficulties in effective coordination and could lead to severe system reliability challenges and extensive customer outages.
2. Conflicts with moratoriums as well as co-existing municipal and third-party utility projects
3. Permits could be denied based on the type and extent of customer disruptions causing a bottleneck for aggregating pipe segments to a maximum of one block.
4. Lead time for obtaining permits could be a challenge at times. Lead times vary based on the city and area for example, historically, the timeline for obtaining a permit for railroad right-of-way encroachment requires at least a year of lead time.
5. Permits are provided for short windows of time within a year, which can cause delays based on planning contingencies.
6. Obtaining the necessary land rights could be challenging for projects.
7. Obtaining the necessary environmental permits could be challenging for projects.
8. Construction during winters is generally not approved, enforcing a shorter time window for project completions, this is a hurdle for the number and size of projects possible in any given year.

[42] Discovery response 7.11.

[43] Discovery response 6.06.

We reviewed three examples[44] of projects delayed due to permitting challenges; each are described below.

1. **Example 1: PIR-2902 Ashurst & Meadowbrook in University Heights**

   The project was originally scheduled for September of 2021 construction. DEO applied for a permit with the City of University Heights in July. Following the permit application, the City informed DEO that it would be required to finish restoration on all projects before starting construction on any new projects and that construction during winter months would not be approved.

   The City also stated a preference that construction would occur when a nearby school was on summer break. The PIR project was then rescheduled to spring of 2022. This experience has resulted in a more effective communication process when permitting projects in the University Heights area.

2. **Example 2: PIR-3486 W North St & PIR-3605 W North St in Wooster PIR-3486 was originally scheduled for 2021 construction.**

   Through traditional DEO communication channels, the City of Wooster let DEO know in advance there would be paving on W North St but was unable to give a firm window for when the paving would occur. DEO felt that construction for PIR-3486 would be able to occur before the planned paving, so the plans for PIR-3486 were expedited through the design and construction process.

   As DEO was planning to start the OUPS process, the City let DEO know the planned city paving was to begin immediately and stated that DEO should delay construction on the section of road being paved for a few years. The PIR replacement work that did not conflict with the recently paved area on W North St was completed in 2021 and PIR-3605 was created to replace the mainline removed from the original project, with a planned 2024 construction date. However, after the City paved W North St, leak clusters quickly started to appear, requiring DEO operations to cut open the new pavement to repair. DEO requested that PIR-3605 be approved for 2022 to minimize road impact required for leak repairs and provided the City with a mapping (kmz) file showing planned projects to better coordinate construction moving forward.

3. **Example 3: PIR-2903 Summit & Oak in Wadsworth**

   PIR-2903 was originally scheduled for 2020 construction. The original project information sent to the City received little questioning on the work to be completed. However, when the application for a permit from the City was submitted, it was met with excessive design requirements from the City. These requirements included providing information on preliminary bore spots and profiles that required a third-party contractor to visit the site before construction, to identify locations, which is non-standard for the permitting process. In addition, the City stipulated which side of the street the new mainline would

[44] Discovery response 2.10

be located and the closure of sidewalks. At least three revisions were required to the project design before the City approved the planned replacement project. These delays due to redesign resulted in delaying construction to 2021.

There were some requests by the City that DEO was able to compromise on, with one example being where the City requested double main in locations where DEO originally had single main. Instead, DEO was able to replace with single main, install long-side services, and utilized "mill and fill" in areas where the road had to be cut open. Due to this experience, project turnaround time with the City has improved. DEO maintains a municipality database where the company collects information on these types of requests and provides information to design teams and project managers on what to expect on future projects.

DEO has been aware of these challenges since the beginning of the PIR program and has continued to work with municipalities to improve coordination and reduce permitting hurdles. Some valuable processes in place have been the following:

1. Per DEO standard planning and municipality coordination processes, planned projects are communicated to municipalities 1 to 3 years in advance, prior to permits being requested. This allows for coordination of DEO PIR replacement projects with municipality driven infrastructure projects, minimizing community impact, and driving cost efficiency on restoration efforts.[45]

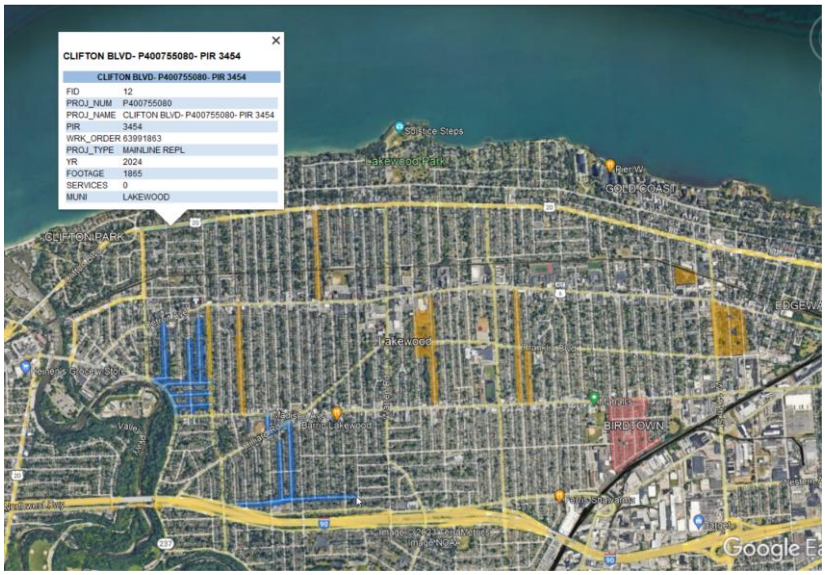


Figure 17. Sample 2-3 Year Plan Shared with Municipalities[46]

[45] Discovery response 2.10.

[46] Discovery response 5.14.

2. DEO has further worked with the City of Cleveland which is the largest city in DEO's service area and has more than 20% of total PIR pipe remaining by entering into a Memorandum of Understanding (MOU) with the city on March 3, 2015.

   (Begin Confidential)

   [redacted]

   (End Confidential)

3. Good Contractor management practices have helped DEO have a resource pool of contractors who have built familiarity and efficiencies within the various permitting processes.

Even though DEO's MOU with Cleveland has helped them with permitting efficiency, DEO has maintained that they have not experienced the need for MOUs outside of Cleveland[47]. We have still made this recommendation considering the increased pace of replacements needed for the 2041 completion date and standardization of processes needed for the succession of the program over the next 18 years.

Material Supply

Though there have not been any sustained shortages in material supply throughout the PIR Program, there have been periods of material shortages from external events. DEO shared examples of their experienced shortages, of which included[48]:

1. Hurricane Harvey in 2017, slowed the bi-modal resin production in Texas, creating a material shortage for the Program.
2. Similar to 2017, Winter Storm Uri caused a severe ice storm in Texas that impacted pipe production across the country.
3. COVID-19 broke down the global supply chain and many of DEO's suppliers temporarily closed their operations. It also created new procurement challenges due to the reduced availability of resources.

47 Discovery response 7.11 B and Q.46 in Michael C Reed's testimony in 15-0362-GA-ALT.

48 Discovery response 6.08 (Material Supply Shortages).

DEO has taken proactive steps to avoid potential supply disruptions to the PIR Program since the program began. Prior to shortage challenges started in 2017, DEO worked closely with suppliers to "ensure there is three-month supply on hand based on expected usage"[49]; however, the combination of the aforementioned events, has changed the availability of resources and has driven DEO to apply other solutions. In 2020, DEO initiated a multi-team research initiative to discover alternative sourcing materials, which allowed them to begin "multi-sourcing all materials" and increase available options.[50] DEO has implemented several other approaches since 2017 including:

1. Agreements that allow DEO to "obtain partial shipments on an as-needed basis."
2. Additional warehouse space for suppliers to stockpile materials.
3. Increased communication with suppliers and warehouse facilities to align on future material needs.
4. Material acquisition is handled through multiple channels to increase the program's capacity and efficiency. DEO collaborates with multiple producers and vendors, enabling timely and cost-efficient procurement of materials.

Labor Supply

DEO has not identified a labor shortage for the PIR Program; however, it has noted that there are limited labor resources available within the qualified contractor pool.[51]

To ramp up for a 2033 program end date, financial and labor resources would roughly need to be doubled, including contractor capacity.[52] Even for a 2041 program end date, it would be necessary to augment all these resources to appropriate levels. At the current pace, DEO maintains that labor shortages have not been the bottleneck for pace so far[53].

In addition to these increasing needs, DEO has shared that there is a lot of competition for labor.[54] DEO has sustained its qualified labor resource pool through blanket contracts.[55] The general blanket contract are three year initial contracts with two one-year extension options.[56] In the regions where there is the greatest amount of pipe that is a part of the PIR program, "DEO

49 Discovery response 6.08 (Material Supply Shortages).
50 Id.
51 Discovery response 6.07 (Sustained Contractor or Labor Shortage).
52 Discovery response 4.06 (DEO's Resource and Financial Plan).
53 Discovery response 6.10 (Contractors).
54 First interview with DEO, March 15,2023.
55 Discovery response 6.09 (Long Term Contracts).
56 Id.

has five blanket contract regions with 4-5 blanket contractors", where in the regions where there is less pipe to be replaced by the PIR program, DEO has 2 blanket contractors.[57]

DEO utilizes a competitive bidding and selection process through RFP's to determine the assigned contractor for a project.[58] Projects that that are allocated to blanket contracts are determined based on what DEO defines as "best value".[59] DEO articulates "best value" as including the review of "contractor cost, construction schedule, and the corresponding impact on inspection, traffic control resources, and relationships with cities and customers before assignment".[60]

(Begin Confidential)

[redacted][61]

(End Confidential)

Figure 18. Count of blanket contracts per pipeline contractor.[62] - CONFIDENTIAL

57 Discovery response 6.10 (Contractors).

58 Discovery response 6.09 (Long-Term Contracts).

59 Discovery response 6.10 (Contractors).

60 Id.

61 Discovery response 6.10 (Attachment 1)_CONFIDENTIAL.pdf

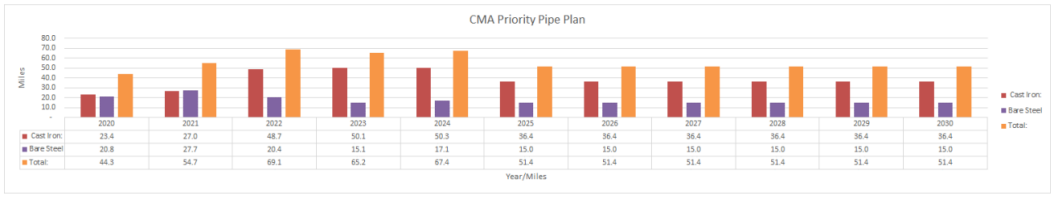
62 Discovery response 6.10 (Attachment 1)_CONFIDENTIAL.pdf

The high demand for contractor resources was discussed within the 15-0362-GA-ALT application as the driver of contractor costs and bid costs, which was reported to have increased 20% from 2009 - 2014. This has continued to increase from 2015 – 2022 at an average of 8% per year (adjusted for miles replaced)[63] indicating a potentially increasing demand to supply ratio.

D. Findings and Recommendations

Below is an example of how project pace is represented that should be included in DEO's report to PUCO.

Figure III-1. CMA Long-Term GSEP Plan



	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Cast Iron:	23.4	27.0	48.7	50.1	50.3	36.4	36.4	36.4	36.4	36.4	36.4
Bare Steel	20.8	27.7	20.4	15.1	17.1	15.0	15.0	15.0	15.0	15.0	15.0
Total:	44.3	54.7	69.1	65.2	67.4	51.4	51.4	51.4	51.4	51.4	51.4

Figure 19. How project pace is represented

Finding: In reality, it appears impractical that DEO will be able to complete the PIR program by 2033 based on the pace achieved to-date and the projected acceleration needed. The 2041 completion projected by DEO will also require effective resource management and continued efforts to improve permitting/ aggregation processes to achieve the acceleration needed to do so. Responses received during the interviews bears this out.[64] Just doing simple math, DEO will have to consistently replace roughly 36 miles in Cleveland and 18 miles in Akron annually over the remainder of the program to finish even by 2041.

Finding: DEO's MOU with Cleveland has helped DEO achieve better permit lead times, clearly stated responsibilities of DEO and the City of Cleveland and improved coordination between both the parties. This process improves permitting negotiations with the City which is conducted by project managers[65] of individual teams or external contractors[66].

63 Discovery response 6.02. Total contractor cots adjusted using a contractor cost $/mile retired.

64 Discovery response 6.06, including the interview with the President, Dan Weekley. NOTE: Discovery response 6.06 was meant for completing the program completion in a single year, yet we believe that all these potential challenges will be relevant even in a 2041 completion case.

65 Discovery response 2.09

66 We gathered from our Executive interview with DEO that most of their existing contractors are adept at permitting processes and have gained efficiencies with the same.

Finding: Subject to being able to review the historical rate of replacement in these two towns, DEO's plans will significantly impact these communities over the next two decades. Whether the impacts come in the form of leakage repair or replacement, these communities need to brace for the future.[67] DEO needs to advise communities, especially those with limited resources, of the necessary impacts to the communities from DEO's priority pipe replacement.

Finding: The concentration of PIR pipe is going to force some type of public/private policy or program to incent municipalities to open Right-of-Way (ROW) access so DEO can finish the program in a reasonable timeframe. Most likely, something like this will require the full force of DEO corporate leadership, as well as local and state government leadership, to come up with a joint infrastructure/economic development program that fairly addresses all stakeholder needs. Our interview with DEO's executive team suggested that DEO is pursuing something similar to this finding.

Finding: Availability of raw polyethylene for pipe and fitting manufacturing could be a hurdle in the near future. Certainly, the cost of petroleum could impact future manufactured costs.

Recommendation No. 4: DEO should consider utilizing geographical risk trends as an index or proxy for capital deployment at the shop or community level.

Recommendation No. 5: DEO should communicate with PUCO their pace of replacement based on e.g., the past 5 years through to the end of the program. Any PIR report should include an analysis of progress, issues and remedial measures to address replacement in at least the top 5 cities within their service area.

Recommendation No. 6: DEO should immediately prioritize and begin working on – or finalize -- development of MOU agreements with all of the top 5 cities that encompass 44% of remaining PIR inventory. Cleveland, Youngstown and Warren should be prioritized based on higher average risk scores. As part of this effort, DEO should communicate with these municipalities their planned annual pace of replacements within these cities, and the increasing risks associated with aging PIR pipe.

V. PROJECT PRIORITIZATION AND RISK MANAGEMENT

Since only about 150 – 190 miles of pipe can be reasonably replaced every year (based on historic replacement), prioritizing replacements is essential to maintaining a reliable system. We

[67] This is why we asked for the full system Optimain output report, so we could evaluate the relative risk associated with the remaining inventories of PIR pipe in each community.

reviewed DEO's prioritization practices and analyzed three metrics to understand effectiveness of the prioritization process:

1. Leakage trends
2. Risk scores
3. LAUF

Leakage trends are a key metric to evaluate the effectiveness of the PIR program as they directly relate to reliability and safety of the system. Periodic corrosion monitoring and communication of risks from the operations team play an important role in avoiding increasing leakages in an ageing system. Leakage reduction or management of trends in the system will directly translate into O&M savings, and it is crucial to avoid exponential trends indicated in Figure-12, in order for the Operations teams to be able to respond to leakages in time and avoid serious incidents of high consequence.

A. Leakage Trends

As expected from a system with a lot of vintage pipe, bare steel and ineffectively coated pipe, most leakages occurring annually in the system are due to corrosion[68], that is about 88%[69] of total mains leaks, or about 95%[70] of PIR mains pipe leaks and about 90%[71] of PIR service-line leaks are due to corrosion.

Remaining target PIR Main pipe is about 18% of the system and yet causes about 84%[72] of the total leaks. This indeed is a big indicator of the need for the PIR program.

There has been a gradual decrease in leaks on both Mains and Services since 2010, this indicates that the PIR program has been successful in maintaining/ reducing leakage trends within the overall system.

We reviewed leakage trends based on material and hazardous/ non-hazardous classifications. All hazardous leaks are considered as grade-1 leaks and through discovery and interviews we observed that most leaks on the system are grade-2 leaks with some grade-1 and grade-3 leaks in recent history.

68 Discovery response #01.05.
69 Discovery response 01.05 2021 data.
70 Discovery response 01.05 2015-2021 data for bare-steel.
71 Discovery response #01.05.
72 Calculated using PHMSA filings and Discovery 01.05.

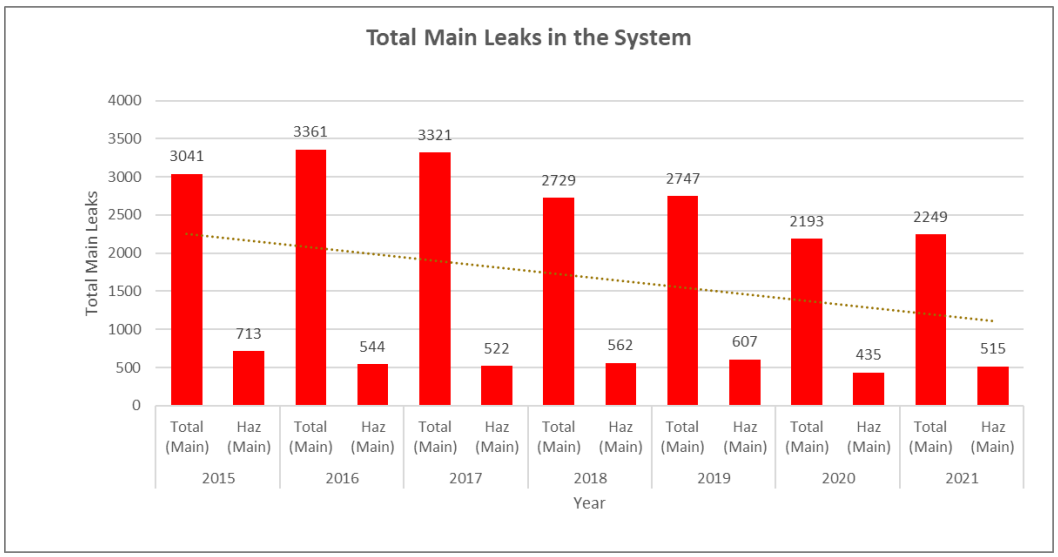


Figure 20. Total Main Leaks Trends

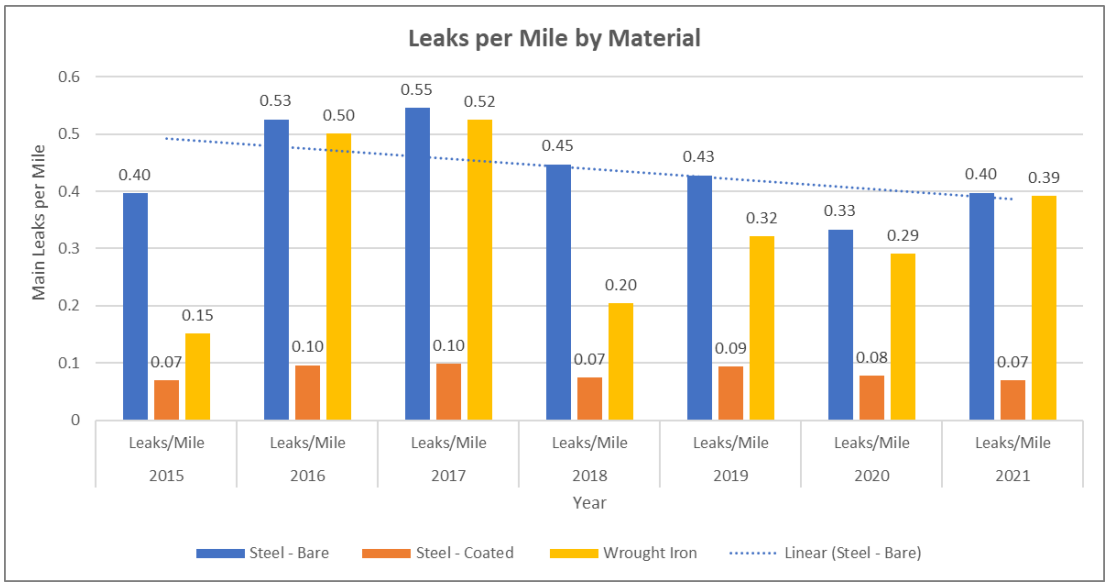


Figure 21. Leaks per Mile by Material

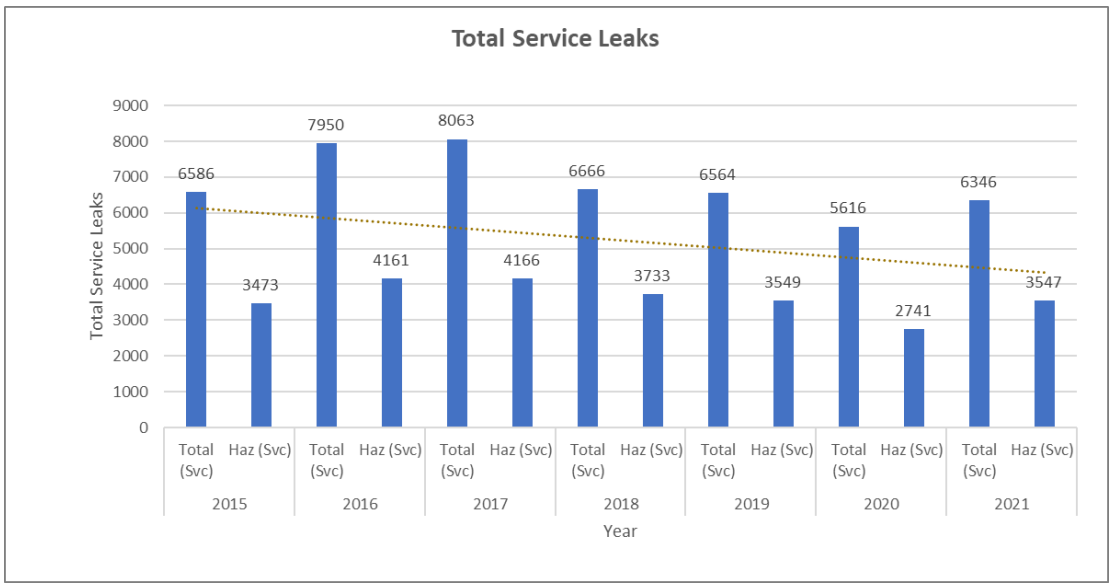


Figure 22. Total Service Leaks

Forecasted Leakage Trends

In order to study future risk potential and inform any discussion on extending the PIR program, it is important to assess leakage potential of remaining pipe within the system with time.

We reviewed a few studies of leakage trends with vintage of pipe and identified the Weller and co. study[73] published in 2020 based on leakage potential by material and vintage of pipe to be the most recent and used this study to make an initial estimate of leakage potential in future years. According to this study (see Figure-23)[74], 276,512 main pipeline segments of a total of 6,298 miles of pipeline across were surveyed across four urban areas, and corresponding leakage data was used to arrive at the leaks/mile forecasting model.

It is important to note that most target pipes within DEO's system are pre-1955, that makes them 70+ years old and the projections from Figure-23 indicate that the exponential growth of leakage rates start beyond the 50-60 years of age, especially in bare-steel pipe.

73 https://pubs.acs.org/doi/pdf/10.1021/acs.est.0c00437

74 https://pubs.acs.org/doi/pdf/10.1021/acs.est.0c00437

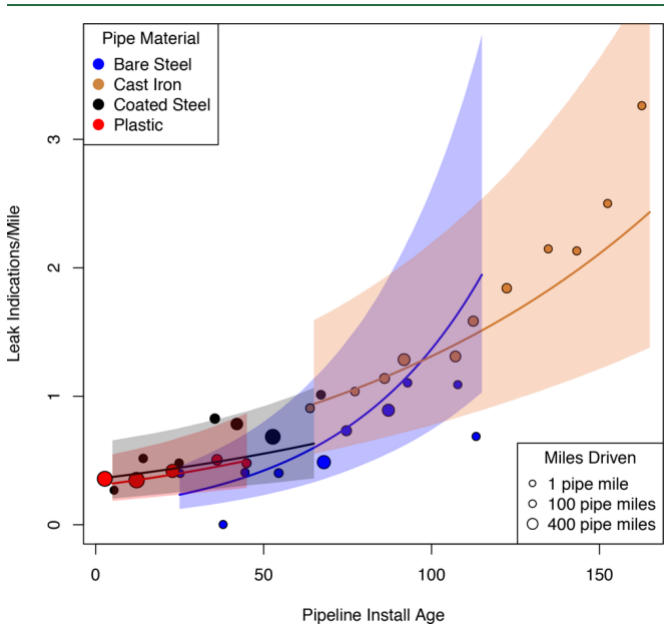


Figure 23. Leakage Trends of Ageing Pipeline[75]

Table 13: 2022 Snapshot of Material and Vintage[76]

Year	Age Category	Material	Mileage
2022	Pre-1955	Steel - Bare	1,803.6
2022	Pre-1955	Steel - Ineffectively Coated	1,125.2
2022	Pre-1955	Cast Iron, Wrought Iron, Copper	20.4
2022	1955-1970	Steel - Bare	306.7
2022	1955-1970	Steel - Effectively Coated	6,603.1
2022	1955-1970	Steel - Ineffectively Coated	137.4
2022	1955-1970	Cast Iron, Wrought Iron, Copper	0.2
2022	1971-Current		9,836.8

[75] https://pubs.acs.org/doi/pdf/10.1021/acs.est.0c00437 These estimates are based on an AMLD survey and pipeline GIS data from four urban areas. Estimates are derived from data on 5800 miles of pipeline mains in four urban areas. Pipeline installation age, material, and the age-by-material interactions are important predictors of leak activity factors. The shading shows 95% credible intervals for the mean leak indication rate.

[76] Discovery response 5.01

We replicated this model to evaluate current leaks/mile observed by PIR pipe in DEO and found that the leaks/mile of PIR pipe in years 2018 – 2022 was closer to the low-end of the 95% confidence-interval (see blue shaded region in Figure-23), with leakage for years 2020 and 2021 falling below the 95% confidence-interval of the study (outside the blue shaded region). This data along with falling leak/mile trends observed in Figure-22 indicates effectiveness of prioritization of PIR replacements.

To better analyze the risks associated with the different pace projections of the PIR program, we forecasted leakages on the system using the following Poisson Regression parameters:

Table 14. Daymark's Poisson Regression Model for Leakage Forecasts

	intercept	Slope (age effect)
P95	-2.30	0.029
P50	-2.30	0.024
P5	-2.30	0.018

These are based on the bare-steel model used in the Weller and co. study (represented in Figure-23)[77]. We used an adjusted intercept (starting point) to solve such that the average 2017 – 2019 leakage/mile[78] for PIR pipe was calibrated[79] with the model, and we maintained this adjusted intercept across projections to reflect DEO's historical data more accurately. For simplicity, we assumed the bare-steel model for all PIR pipe and used a weighted average installation of PIR pipe to be 1950

The formula used in the Poisson Regression Model is:

$$\text{Log}_e \text{ (rate of leaks/mile)} = \text{intercept} + \text{slope} * \text{age}$$

We observed that the likely scenario based on the 2041 program completion scenario provided by DEO[80], has PIR related Mains leakages less than 2,000 leaks in any future year. This means that the pace projected for 2041 completion may be completed with total Main leakages on PIR pipes below the recent high of 2,502 leaks in 2017.

77 Table-S2 Pg-12 of https://pubs.acs.org/doi/suppl/10.1021/acs.est.0c00437/suppl_file/es0c00437_si_001.pdf

78 Discovery response 5.01

79 2020-2022 leak/mile data were not used as they showed a significant dip from prior years and were treated as potential outliers.

80 Discovery response 4.02, also shown in Figure-13

But there are two parts to this story. The first part is that the implication here is that the pace may be sufficient to overcome a potential exponential increase in leakages and in turn reduce leakages compared to historical.

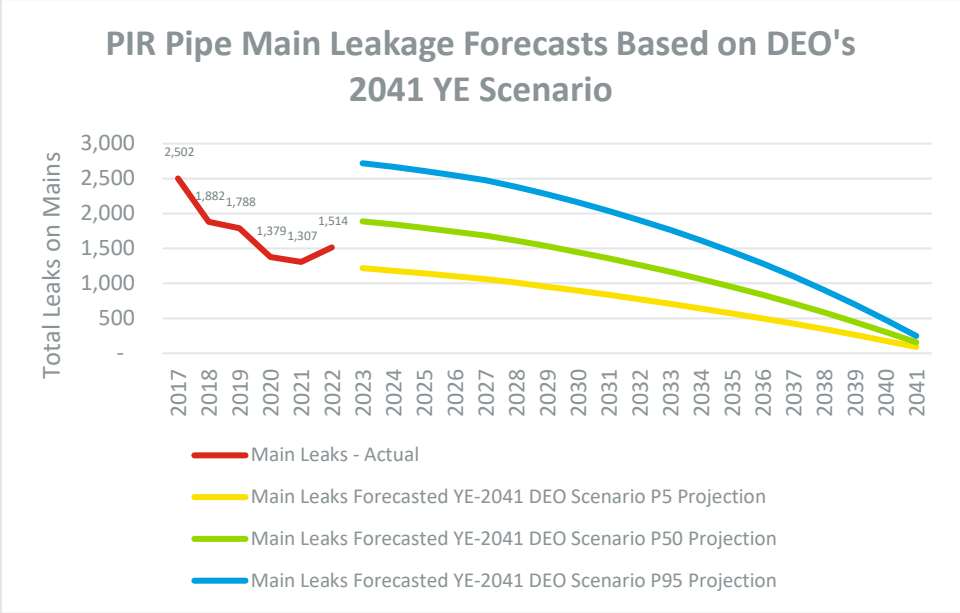


Figure 24: Daymark's PIR Mains Leakage Forecasts

The second part of the story, however, is based on projections seen in Figure-25 which illustrates what the distribution of leakage rates/mile on remaining PIR pipe may be in future years. This chart suggests that there is a high likelihood of a widening distribution of leakage potential on the system in future years. This is a problem because if DEO does not prioritize the right replacements and timing of replacements, it can offset DEO's ongoing commitment to system safety and reliability. This concern can already be observed in the risk score statistics discussed in Table-17 and Table-18.

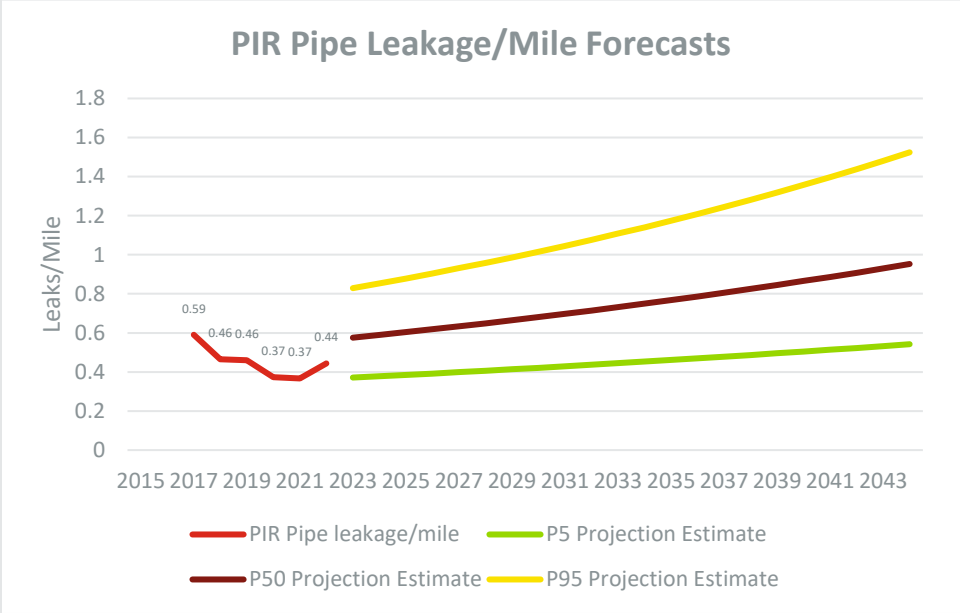


Figure 25: Daymark's PIR Mains Leaks/Mile Projections

It is important to qualify that this model and the resulting forecasts are based on a few assumptions and might not precisely reflect DEO's system conditions. We have used limited data from DEO leakage trends to calibrate and develop a forecast based on "age effect" (degradation of pipe with age) from a study of bare steel pipe in 4 urban areas which might have slightly different system characteristics. These forecasts are only to be used to directionally illustrate future trends and risks.

This analysis illustrates the importance of project prioritization and active corrosion monitoring for *future* years and re-emphasizes the need for effective monitoring and reporting of leakages by material and vintage. DEO could benefit from conducting reliability planning of the system based on probabilistic future-looking evaluation of risks.

B. Review of Risk Scores

Role of Optimain in Project Prioritization

Optimain DS Software is a risk-based pipe repair/replace decision support software product developed for natural gas and water utilities, that is marketed and supported by Opvantek, Inc, a subsidiary of Urbint.[81] The software is widely used throughout the natural gas industry as an

[81] Urbint announced the acquisition of Opvantek on Oct 28, 2019. https://www.urbint.com/news/urbint-acquires-opvantek-to-advance-ai-technology-for-enhanced-pipeline-risk-management

integrity management tool used to comprehensively analyze factors relative to implementation of Distribution Integrity Management Plans. The software is recognized as a commercially available risk assessment tool by many regulators including PHMSA.

In 2009, the Company implemented the Optimain DS software application to assist in its prioritization of replacement projects. The software considers pipeline attributes and maintenance data to calculate a relative risk score for the pipelines that are in scope for the PIR. This information combined with input from field personnel allows the Company to establish both its short-term and longer-term replacement plans.[82]

DEO continues to use the methodology agreed upon with Commission Staff in Case No. 11-2401-GA-ALT, in which the Optimain software is used to rank and prioritize all pipe replacements.[83] Optimain uses pipeline attributes and maintenance data to calculate a relative risk score for the pipelines within the scope of the PIR. The use of risk scores, coupled with input from field personnel informs the Company in developing and implementing replacement plans on both a long-term and short-term basis.

Section 7 of the Company's DIMP defines relative risk, for the purposes of integrity management threat evaluation as:

Relative Risk = Frequency of Failure Factor x Consequence of Failure Factor. (1)

As such, as the relative risk score increases, the priority for addressing the particular threat also increases. While DEO used the GPTC model in developing their threat assessment models within the Company DIMP plan, it has integrated the Optimain DS software with the DIMP plan as a means to support managing and prioritizing PIR related projects. In the case of Optimain, the software simply evaluates the relative risk of PIR pipe by evaluating probability of future leakage on the PIR mains and the consequences of future leakage consistent with the formula (1) shown above, thereby making it an effective prioritization tool consistent and aligned with the Company DIMP.

The Optimain DS software utilizes known physical system specifications, maintenance history, and the physical operating environment of the distribution system to develop statistical performance and risk profiles that are used to forecast future leakage and establish consequence profiles that are used to assign a risk score to each pipe segment within the system. The Optimain DS Configuration Manual for Dominion, provided in Appendix B, explains the details about physical system specifications captured within the program, data sources

82 DIMP Plan.

83 15-362-GA-ALT Application.

about maintenance history, particularly leakage, and the system operating environmental (e.g., population density, ground conditions, etc.). The following brief discussion describes how Optimain assigns a risk score to a specific segment of pipe, the sources of data used in calculating risk, and how the relative Optimain pipeline scores inform replacement decisions.

The core of the Optimain DS software are the predictive algorithms, developed within Optimain, by performing statistical analysis on historical system, maintenance, and operating environment data, provide by Dominion, to establish base probability and expected value curves for specific failure types (refer to page 14 of Appendix B for a list of failure types) and material failure families (as shown on page 15 of Appendix B) that exist across the system. These curves, based on variables such as pipe material, pipe size, failure type and the number of prior failures, are used to forecast future pipeline leaks of various failure types on each of the different material types within the system. Refer to the pages 2 through 8 of Appendix B for a comprehensive list of data types and variables used in the predictive algorithms within Optimain. Overall, there are more than 30 different data points describing the physical system, approximately 15 data points describing the operating environment, and approximately 23 data points or calculations describing the leakage data.

In addition to forecasting future leakage, Optimain DS models the consequence of failure for each leak type based on a risk profile for a given failure type that is then adjusted by the operating environment (pipe risk profile factors shown on pages 19 and 20 of Appendix B) and probability of occurrence on a given pipe segment to establish the failure type risk factor used in calculating the risk score for a specific pipe segment and failure type. Through the iterative calculations within the Optimain algorithms, the total risk for a given pipe segment or project is defined as the sum of the risk scores based on the forecasted number and type of each main and service failure on the main project that is weighted according to the likely contribution of risk for each predicted failure type. Pages 13 through 20 in Appendix B provide details of risk calculations within the Optimain DS Risk Model.

It appears that the core of Optimain DS software is maintained by the Opvantek, Inc technical staff. Some modification and calibration of various weighting factors is user adjustable. For example, the weight failure factors (shown on page 18 of Appendix B) adjusts the base probability curves to tune the influence of a given factor to the risk contribution of a given failure type. The risk profile factors (shown on page 20 of Appendix B) calibrate the risk to various operating environment factors such as population density, pipe depth, cover type, operating pressure, etc. However, Dominion has worked in conjunction with Opvantek to develop a risk profile for pre-1970 pipe manufactured with low frequency electric resistance welded seams

that is susceptible to selective seam weld corrosion. The adapted model is based on an industry published Kiefner SSWC study. Additionally, Dominion worked with Opvantek to include a risk factor for fluid outages. All these modifications are documented in the Optimain DS configuration model shown in Appendix B.

Considering the expansive size of Dominion system and the daily changes to the input data, apart from the ability to effectively forecast future risk and performance, data quality and the frequency of updates is vitally important to the relevance of the Optimain DS model. The system and data source for the project factors are provided in Appendix B on pages 2 through 8. The systems integrated into Optimain DS were also confirmed in Discovery Request 3.09. The system and data description provided by each system is recreated in Table 15 below.

Table 15. Optimain Supporting Systems - CONFIDENTIAL[84]

(Begin Confidential)

System		Frequency of updates
	[redacted]	
	[redacted]	
	[redacted]	
	[redacted]	

(End Confidential)

Moreover, regular, and frequent updates of the data sets used by Optimain ensure that risk and system characteristics are up to date in real time. This helps to ensure that decisions derived from Optimain output are relevant and based on the best information available.

As described above, risk scores are assigned at the pipeline segment also known as the single project level. This is the lowest level asset assigned a risk score within the system. To compare the relative risk of pipe segments with varying length, the scores are normalized to a 1000-foot length. Normalization of scores facilitates the ability to risk rank single projects for planning and

[84] Discovery response 3.09.

prioritization purposes. By ranking the single projects from highest to lowest risk scores, Dominion can establish a worst-first profile of projects within the distribution system that should have some basis for project selection and prioritization.

Optimain does have the functionality to combine single projects together to facilitate an area wide approach to PIR pipe replacement planning and execution. The area wide approach does provide benefits to replacement efficiency, project cost management, construction project design, system constructability, system planning and prioritization, and minimize construction impact on public convenience. These are called combo projects as described in Section II Miscellaneous Project Factors of Appendix B.

(Begin Confidential)

(End Confidential)

Figure 26. Optimain Project Combo Selection Example - CONFIDENTIAL

To compare combo projects for prioritization, the risk scores are normalized on a risk per 1000 feet of main basis. This provides DEO with the benefit of targeting areas within the communities they serve where concentrations of high-risk pipe are known to exist. Based on the Optimain demonstration that Dominion presented, the company has already planned and created high level replacement projects for the remainder of the PIR pipe in their system by aggregating the system into a series of combo projects. This is an effective and balanced approach to risk

management and creating flexibility and consistency of project selection and project management. However, to improve risk management and reduction, the area approach to project selection should be complementary to ensuring that replacement of the worst-first projects is addressed in the process.

(Begin Confidential)

(End Confidential)

Figure 27. Optimain Combo Filter Example - Filters for Existing Combos - CONFIDENTIAL

Through discovery and interviews with Dominion staff, it is unclear as to whether, through the use of Optimain, the Company proactively programs pipe selection to ensure that the highest risk pipe within the system is not being stranded in lesser priority areas. As a recommendation in this report DEO should develop a methodology or reporting structure that is agreeable to PUCO to annually show how risk is being reduced across the system on an aggregated system, shop level, community approach in addition to show how the risk from worst-first pipe segments is being reduced.

Risk Score Statistics

We reviewed risk score statistics of all pipe segments/ combos within the system and obtained two sets of tables – with and without outlier risk scores. These outlier risk scores of 473,920 risk/1kFt are associated with 1947 intermediate pressure (IP) steel mainline with unknown

coating. These segments have been flagged with extraordinarily high-risk scores because a similar pipe section has Selective Seam Weld Corrosion (SSWC) which is a high-risk type of corrosion that could lead to ruptures and serious incidents of failures[85]. All these potential SSWC pipes are currently in active projects for replacement.

On further review of SSWC risks and procedures, we discovered that[86]:

- SSWC is identified by operations technicians through visual inspections and once identified, all similar pipe segments are identified as potential SSWC mainline.
- Any HP or IP SSWC is targeted for replacement within 2 years if feasible.
- Any SSWC found on MP (Medium pressure, between 1psi and 60psi) mainline or LP (Low Pressure, 1psi and below) mainline is scoped in a replacement project scheduled for the next year with available funding.

Table 16. SSWC Mileage

City	Mileage
Canton	0.39
Cleveland	1.17
Elida	0.32
Madison	0.36
Silver Lake	0.44
Grand Total	**2.68**

Finding: It can be observed that the pipe sections/combos with highest risk scores are not necessarily prioritized for immediate replacement, see 3,545 risk score section in 2013/14, 6,006 risk score section in 2016/17, 8,778 risk score section in 2021/22. DEO reviews individual projects with highest risk scores and considers them for immediate replacement, but considerations around constructability and aggregation efficiencies can push some of these replacements. Since the highest risk scores tend to be on small pipe segments[87], these other considerations are more prevalent within prioritization. The average length of the top 50 riskiest (as per latest snapshot from Optimain risk scores) pipe segments is 3.62 feet.

85 https://kiefner.com/selective-seam-weld-corrosion-how-big-is-the-problem/

86 Discovery response 5.04.

87 Discovery response 7.15 confirmed by using data from Discovery response 7.15 Attachment-3.

Overall averages in risk scores have remained steady, and the maximum risk scores are showing tendencies of increase. The standard deviation of risk scores is also increasing slightly, indicating a widening distribution between the riskiest pipes and the rest of the system.

Table 17. Optimain Risk Score Statistics without SSWC Outliers[88]

Year	Maximum	Minimum	Mean	Variance	Standard Deviation	Snapshot Size	Total Footage
2012	5,500	0	18.1	3,490	59	155,512	44,998,309
2013	3,545	0	20.7	2,473	50	191,393	42,239,504
2014	3,545	0	22.0	3,116	56	189,281	41,535,567
2015	6,500	0	22.8	3,834	62	187,834	41,029,478
2016	6,006	0	17.6	2,574	51	193,491	40,610,084
2017	6,006	0	17.6	2,376	49	191,033	40,765,726
2018	11,000	0	18.2	4,399	66	186,482	39,762,840
2019	19,000	0	18.4	8,449	92	182,756	39,312,465
2020	7,508	0	17.9	4,230	65	218,836	55,826,600
2021	8,778	0	17.8	4,665	68	215,149	55,173,703
2022	8,778	0	18.0	4,846	70	217,014	55,602,506

This indicates that the risky pipe is being replaced periodically to maintain average risk profiles but the risky pipes remaining in the system are showing higher risk scores over time. This picture demonstrates that DEO is just able to maintain enough pace to manage risks, and if the risk for leakages shows sharp increases as shown in Figure-23, there is a high possibility that average risk score of the entire system shall rise beyond DEO's ability to accelerate pace of replacements.

Table 18. Optimain Risk Score Statistics with SSWC Outliers[89]

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[88] Discovery response 6.03.

[89] Discovery response 6.03.

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2018	11,000	0	18.2	4,399	66	186,482	39,762,840
2019	19,000	0	18.4	8,449	92	182,756	39,312,465
2020	473,920	0	35.4	5,410,386	2,326	218,854	55,826,724
2021	473,920	0	37.4	5,689,328	2,385	215,172	55,173,878
2022	473,920	0	37.5	5,640,652	2,375	217,037	55,602,681

C. Role of Administrative Cost Buckets

Since the beginning of the PIR program, the Optimain risk algorithm and operational feedback have been key inputs to DEO's PIR prioritization methodology. Early in DEO's PIR program, it was recognized that Optimain risk scores alone may not be as effective at prioritizing low probability, high potential consequence risk pipe. Since Optimain risk evaluation is primarily based on leak history, and because certain categories of pipe are only replaced, not repaired, associated risk scores in Optimain were lower.

In 2012 and 2013, DEO gathered additional subject matter expertise, leading to the proposal of the three-bucket prioritization methodology. DEO discussed this enhanced methodology with the PUCO and implemented it. This enhancement to DEO's prioritization methodology, incorporates low probability, high consequence scenarios, allowing for comprehensive prioritization for DEO's PIR program. As part of this enhancement, SME input is gathered annually and helps shape not only each bucket size, but also allows for DEO to adjust bucket allocation targets as required.

Optimain is not the only tool used for project prioritization, projects are also prioritized by inputs from the operations team and through internal capital allocation buckets set strategically by the administrative team sets.

These capital buckets are set based on program goals. Three buckets have been set in the past with corresponding target budget allocations:

- Cast Iron
- HP ≥ 8" (added IP ≥ 12" in 2021)
- All Other Pipe

These capital allocations are used as inputs to indicate program goals. The actual budget allocations might differ. This bucketized approach has been used since 2015, with initial target percentages formed based on subject matter expert (SME) input. These targets are reevaluated

every year, using SME input to determine future year targets. Several factors have influenced the number of projects DEO was able to complete in these categories including permitting and constructability considerations. DEO added large diameter IP (≥12") to the HP (≥8") bucket target in 2021, per SME input and risk analysis showing similar risk profiles between the remaining HP (≥8") and the IP (≥12").

Table 19. Capital Allocation Buckets[90]

Year	Bucket	Target %	Actual %
2015	HP	30.0%	28.7%
	Cast Iron	50.0%	1.8%
	All other	20.0%	69.4%
2016	HP	5.0%	14.1%
	Cast Iron	11.0%	15.2%
	All other	84.0%	70.7%
2017	HP	14.0%	26.0%
	Cast Iron	8.0%	4.1%
	All other	78.0%	70.0%
2018	HP	15.0%	32.4%
	Cast Iron	3.0%	4.9%
	All other	82.0%	62.7%
2019	HP	23.0%	24.2%
	Cast Iron	1.0%	1.7%
	All other	76.0%	74.2%
2020	HP	26.0%	16.3%
	Cast Iron	0.5%	0.5%
	All other	73.5%	83.3%
2021	HP/IP	16.0%	15.3%
	Cast Iron	3.0%	0.0%
	All other	81.0%	84.7%
2022	HP/IP	24.0%	19.8%
	Cast Iron	2.0%	2.2%
	All other	74.0%	78.0%

Since 2010 when a series of significant pipeline incidents occurred across the US, DEO has argued for the need to prioritize HP PIR pipe for safety and reliability concerns. The leakage rates of HP pipe are lower and HP replacements might not directly result in O&M cost savings, but

[90] Discovery response 2.03.

DEO has prioritized these replacements on the basis of consequence of failure. Eric Hall and Timothy. C. McNutt testimonies have discussed this trade-off within 11-2401-GA-ALT.

D. Role of Operational Inputs

Operational Inputs to Prioritize Replacements

During technical interviews conducted with DEO staff, it was noted that the Operations team proposes some pipeline replacement projects, which are sometimes prioritized higher than Optimain recommendations. Operational requested pipeline replacement projects occur when lower risk Optimain projects present difficult challenges in the field for Operations. Some examples would be replacing mainline that is actively leaking rather than putting clamps on the mainline, or areas where leak repairs are difficult to complete, such as under a railroad, on a bridge, or under a stream. Areas with customer outages can take priority over projects with higher Optimain risk scores. These requests are submitted online using SAP's EPPM (Enterprise Portfolio and Project Management) tool.

Between 2017 and 2023, approximately 75 projects were scheduled annually from operational requests on PIR pipe[91].

Corrosion Monitoring

Project prioritization goes together with leakage surveillance and monitoring of cathodic protection levels. It is crucial for periodic monitoring of PIR pipe to actively reflect risk scores in Optimain and also to gather operational inputs for high-priority replacement projects.

DEO has a multi-faceted approach to leakage monitoring with the following processes in place[92]:

1. Leak surveys are conducted using a combination of patrolling with hyper-sensitive infrared detection and remote leakage detection equipment.
2. Leak surveys are conducted at different intervals based on area and cathodic protection levels. The Standard Operating Procedure (SOP) for leak surveillance frequency in business districts is every calendar year (not to exceed 15-months) and for cathodically unprotected lines is at-least once in 3 years. DEO defines active corrosion as "continuing corrosion which, unless controlled, could result in a condition that is detrimental to public safety" and these pipes are subjected to surveillance at least once in 3 years as well.

[91] Discovery response 5.06.

[92] Discovery response 5.03

3. There are some considerations in SOP for higher frequency of surveillance for higher risk pipes based on age, material, operating pressure, leak history, high consequence locations etc.

4. DEO prioritizes active corrosion pipe to be replaced within 15 months as per internal operational guidelines on remedial measures.

5. Samples of pre-1971 pipe are monitored and tested for effectiveness of cathodic protection, and some remedial measures are planned as standard processes in case of deficiencies.

E. Recommendations

Recommendation No. 7: Develop risk reduction trend metrics that are incorporated into an annual plan review with the following details:

- Trend aggregated risk score by material asset type (i.e. Mains and services) at the:
- Company level
    - Shop level
    - Community level; e.g., top 20 towns
    - By single project "worst-first" basis
    - Based on Optimain data and in units consistent with those used in the DIMP

Recommendation No. 8: Contrast leakage trends on mains and service by material across the same dimensions as in Recommendation No. 7above. This will provide insights into the correlation between risk and leakage as a means to validate Optimain output and project selection, but to also ensure that replacement rates are keeping pace with system deterioration.

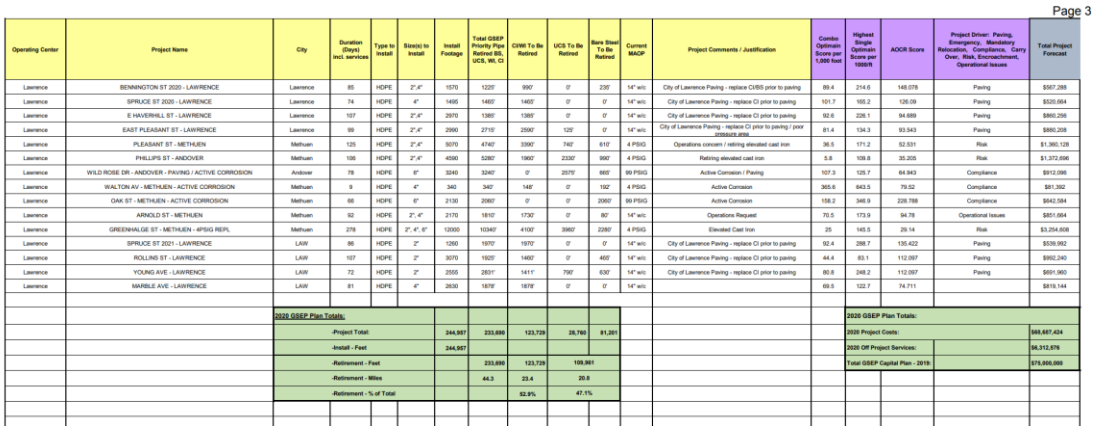
Recommendation No. 9: Ensure that Opvantek still supports Optimain; recommend that DEO develop alternative strategy for pipe replacement prioritization if they intend to continue the program for an additional 20 years and Optimain is no longer available or more enhanced tools are developed.

Recommendation No. 10: DEO should document in policy or program format how the Optimain model is maintained, updated, and validated which could be accomplished by adding a description of these items within their DIMP.

Recommendation No. 11: Develop an objective set of granular descriptions of guidelines and program objective accountabilities on how DEO monitors and addresses active corrosion. Based on the discovery and review of their SOP's, it is not clear how DEO complies with their own O&M

procedures. Active corrosion is a very important priority for the PIR project selection process, that they really need to identify, track and manage active corrosion detection, mitigation and remediation.

Recommendation No. 12: Based on discovery review and interviews, it is clear that DEO PIR projects face many conflicting priorities that influence project selection and execution. The report should recommend that as part of the annual PIR plan filing made to PUCO prior to the upcoming construction season, that each proposed project making up the program portfolio indicates the primary driver for project priority and selection. The following is an example of what a report could look like:



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Operating Center	Project Name	City	Duration (Days) incl. services	Type to Install	Size(s) to Install	Install Footage	Total GSEP Priority Pipe Retired BS, UCS, WI, CI	CI/WI To Be Retired	UCS To Be Retired	Bare Steel To Be Retired	Current MAOP	Project Comments / Justification	Combo Optimain Score per 1,000 foot	Highest Single Optimain Score per 1000ft	AOCR Score	Project Driver: Paving, Emergency, Mandatory Relocation, Compliance, Carry Over, Risk, Encroachment, Operational Issues	Total Project Forecast
Lawrence	BENNINGTON ST 2020 - LAWRENCE	Lawrence	85	HDPE	2",4"	1570	1225'	990'	0'	235'	14" w/c	City of Lawrence Paving - replace CI/BS prior to paving	89.4	214.6	148.078	Paving	$567,288
Lawrence	SPRUCE ST 2020 - LAWRENCE	Lawrence	74	HDPE	4"	1495	1465'	1465'	0'	0'	14" w/c	City of Lawrence Paving - replace CI prior to paving	101.7	165.2	126.09	Paving	$520,664
Lawrence	E HAVERHILL ST - LAWRENCE	Lawrence	107	HDPE	2",4"	2970	1385'	1385'	0'	0'	14" w/c	City of Lawrence Paving - replace CI prior to paving	92.6	226.1	94.689	Paving	$860,256
Lawrence	EAST PLEASANT ST - LAWRENCE	Lawrence	99	HDPE	2",4"	2990	2715'	2590'	125'	0'	14" w/c	City of Lawrence Paving - replace CI prior to paving / poor pressure area	81.4	134.3	93.543	Paving	$880,208
Lawrence	PLEASANT ST - METHUEN	Methuen	125	HDPE	2",4"	5070	4740'	3390'	740'	610'	4 PSIG	Operations concern / retiring elevated cast iron	36.5	171.2	52.531	Risk	$1,360,128
Lawrence	PHILLIPS ST - ANDOVER	Methuen	106	HDPE	2",4"	4590	5280'	1960'	2330'	990'	4 PSIG	Retiring elevated cast iron	5.8	109.8	35.205	Risk	$1,372,696
Lawrence	WILD ROSE DR - ANDOVER - PAVING / ACTIVE CORROSION	Andover	78	HDPE	6"	3240	3240'	0'	2570'	669'	99 PSIG	Active Corrosion / Paving	107.3	125.7	64.943	Compliance	$912,096
Lawrence	WALTON AV - METHUEN - ACTIVE CORROSION	Methuen	9	HDPE	4"	340	340'	148'	0'	192'	4 PSIG	Active Corrosion	365.6	643.5	79.52	Compliance	$81,392
Lawrence	OAK ST - METHUEN - ACTIVE CORROSION	Methuen	66	HDPE	6"	2130	2060'	0'	0'	2060'	99 PSIG	Active Corrosion	158.2	346.9	228.788	Compliance	$642,584
Lawrence	ARNOLD ST - METHUEN	Methuen	92	HDPE	2",4"	2170	1810'	1730'	0'	80'	14" w/c	Operations Request	70.5	173.9	94.78	Operational Issues	$851,664
Lawrence	GREENHALGE ST - METHUEN - 4PSIG REPL	Methuen	278	HDPE	2",4",6"	12000	10340'	4100'	3960'	2280'	4 PSIG	Elevated Cast Iron	25	145.5	29.14	Risk	$3,254,608
Lawrence	SPRUCE ST 2021 - LAWRENCE	LAW	86	HDPE	2"	1260	1970'	1970'	0'	0'	14" w/c	City of Lawrence Paving - replace CI prior to paving	92.4	288.7	135.422	Paving	$539,992
Lawrence	ROLLINS ST - LAWRENCE	LAW	107	HDPE	2"	3070	1925'	1460'	0'	465'	14" w/c	City of Lawrence Paving - replace CI prior to paving	44.4	83.1	112.097	Paving	$992,240
Lawrence	YOUNG AVE - LAWRENCE	LAW	72	HDPE	2"	2555	2831'	1411'	797'	630'	14" w/c	City of Lawrence Paving - replace CI prior to paving	80.8	248.2	112.097	Paving	$691,960
Lawrence	MARBLE AVE - LAWRENCE	LAW	81	HDPE	4"	2630	1878'	1878'	0'	0'	14" w/c		69.5	122.7	74.711		$819,144
		2020 GSEP Plan Totals:												2020 GSEP Plan Totals:			
		-Project Total:				244,557	233,690	123,729	28,760	81,201				2020 Project Costs:			$68,687,424
		-Install - Feet				244,557								2020 Off Project Services:			$6,312,576
		-Retirement - Feet					233,690	123,729	109,961					Total GSEP Capital Plan - 2019:			$75,000,000
		-Retirement - Miles					44.3	23.4	20.8								
		-Retirement - % of Total						52.9%	47.1%								

Figure 28: Sample Project Prioritization Report

Note the columns for Project justification and project driver. This will help inform PUCO how DEO is managing competing priorities and the challenges that they face from internal, external and policy influences. It will also help DEO maintain focus over managing the risk along with all the competition for resources and project selection.

VI. COST MANAGEMENT AND O&M SAVINGS

The total budget estimate for the program in the original PIR application was estimated to be $2.662 billion in 2007 dollars. This estimate was based on the 4,122 miles of target infrastructure (prior to addition of ineffectively coated pipe)[93] in a 25-year time frame assuming no inflation. There has not been an update to that total estimate ever since.

We assessed cost trends in $/mile and $/service of historic replacements. We tried to evaluate cost trends for replacements by geographic categories of rural/ urban/ residential, but DEO

93 Discovery response 2.01.

found it challenging to organize data in this format because DEO does not track data in a manner that allowed reporting along these lines[94]. As per experience of DEO staff, rural cost of replacements is much less than in urban areas mainly due to permitting costs and contractor costs, in particular costs associated with hard-surface restoration. The majority of PIR pipe is in urban areas and hence cost trends are only expected to increase with increasing share of urban replacements.

A. Cost Trends per Mile/Service

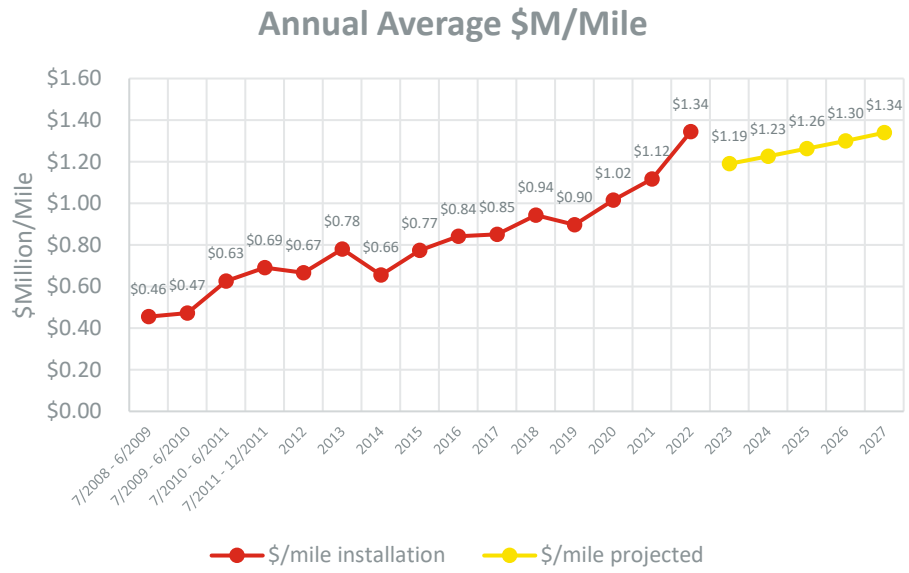


Figure 29. Annual Cost of Replacement - $/Mile Mains Replacement under PIR[95]

The $/mile costs for pipe replacement have increased by 195%[96] since the original application, an annual average increase of 8.7%per year, this could also increase the total cost of the program. The cost of service-replacements has been comparatively steady with an 5% annual average increase[97].

94 Discovery response 4.04 and 4.05. Cost data has not been organized into shop level data and shop definitions are the only way to distinguish between urban/rural/residential.

95 Discovery response 7.03. NOTE: Retired miles data used as replaced miles approximating them to be equal.

96 Calculated using Discovery response 7.03. NOTE: Retired miles data used as replaced miles approximating them to be equal.

97 Calculated using Discovery response 7.03 combined C_M and M_C replacements and total costs.

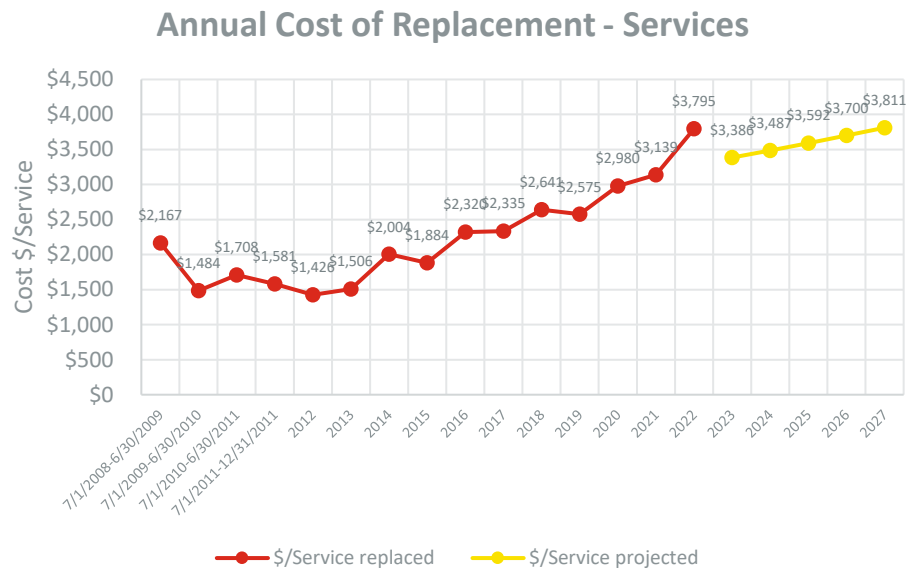


Figure 30. Annual Cost of Replacement - $/Service under PIR[98]

B. Cost Trends by Category

Total annual costs of the PIR program are tracked under the following categories:

Table 20. Cost Category Descriptions[99]

Cost Category	Description
Contractor	Costs associated with construction contractors
Emp Related Exp	Miscellaneous expenses related to DEO employees working on PIR
Environment Services	Costs associated with environmental controls, waste management, etc.
Fees and Permits	Fees and permits paid to municipalities or other entities
Labor	Hourly/Salary costs for DEO employees working on PIR projects
Material	Construction materials
Misc. Outside Svcs	Other non-construction contractors
Other Expenses	Miscellaneous project expenses
Overtime	Overtime labor charges for DEO employees
Overtime Meals	Cost of meals allowed for employees working overtime hours
Power Operated Equip	Surcharge for use of company-owned equipment on PIR projects
Surcharge	Surcharge to cover overheads applied to materials, labor, etc.
Travel related expense	Travel expenses for DEO employees
Vehicle Usage	Use of company-owned vehicles

98 Discovery response 7.03 and 7.04. Service line considered as main-to-curb-to-meter. Replacement count calculated by first summing the main-to-curb and curb-to-meter values and then dividing this value by two.

99 Discovery response 7.06

Table 21. Cost Trends by Category[100]

Cost Category	2015	2016	2017	2018	2019	2020	2021	2022
Contractor	$130,122,473	$138,531,551	$155,218,255	$146,874,266	$156,046,915	$131,007,695	$168,233,911	$166,313,877
Emp Related Exp	$345	$297	$794	$357	$127		$48	
Environment Services	$945,766	$1,299,297	$1,120,248	$802,610	$671,117	$526,295	$802,876	$934,433
Fees and Permits	$646,374	$1,309,546	$1,553,605	$1,574,144	$1,971,928	$1,939,389	$1,334,512	$1,746,958
Labor	$14,826,333	$15,773,576	$18,875,147	$19,111,349	$19,434,452	$17,944,174	$18,307,002	$17,370,203
Material	$10,027,868	$9,465,470	$10,684,936	$11,705,557	$9,678,490	$6,659,590	$9,260,925	$10,932,207
Misc. Outside Svcs	$8,965	$8,360	$15,183	$1,978	$9,453	$2,805	$5,143	$52,031
Other Expenses	$3,535,473	$4,392,062	$3,559,526	$2,326,669	$2,814,468	$3,145,137	$7,798,730	$8,116,591
Overtime	$3,030,277	$3,030,819	$3,234,907	$2,946,218	$2,810,188	$2,401,889	$2,706,170	$2,620,216
Overtime Meals	$154,701	$159,230	$170,272	$138,514	$105,192	$79,985	$91,278	$81,170
Power Operated Equip	$235,308	$302,182	$329,993	$331,559	$228,642	$239,606	$136,650	$110,040
Surcharge	$5,839,788	$6,516,239	$6,378,153	$14,217,618	$13,426,588	$11,881,253	$14,509,274	$13,357,802
Travel related expense	$10,979	$6,285	$12,245	$6,316	$8,198	$3,260	$4,112	$4,645
Vehicle Usage	$2,485,725	$2,339,131	$2,466,020	$2,402,940	$2,421,178	$2,481,466	$2,140,220	$2,078,007
Grand Total	**$171,870,374**	**$183,134,044**	**$203,619,284**	**$202,440,093**	**$209,626,936**	**$178,312,545**	**$225,330,850**	**$223,718,181**

We reviewed all trends by category and compared them across the years 2015-2022 to better understand increases year-over-year and understand reasons for any increases. The largest cost category has always been contractor costs. Contractor costs have stayed consistently at about 75% of the total cost of the program, with an annual average increase of 4% per year or 8% per year when adjusted for miles replaced every year. These costs have stayed slightly higher than the 2.7%[101] average inflation from 2015-2022 and indicate a steady increase in contractor costs.

The highest percentage increase in costs has been related to fees and permits. These costs increased about 100% on an annual basis in year 2016 and have increased at an average of 7% per year ever since.

Material costs (cost/mile) have also increased by about 7% per year. These costs saw a 32%/year increase in the years 2021 and 2022 indicating that these were severely impacted by global supply issues.

Cost increases within these major categories can affect the capital productivity (miles or services replaced per million $) of the PIR program. Since cost recovery is one of the constraints to the pace of the program, it is important for DEO to continue monitoring and managing costs related to all major categories and find ways to control costs over time.

100 Discovery response 6.02

101 https://www.bls.gov/regions/mid-atlantic/data/consumerpriceindexannualandsemiannual_table.htm US City Average CPI

To arrive at an initial estimate of total costs associated with the PIR program, we created a projection based on the 2041-YE scenario presented by DEO and a 3%/year[102] increase[103]. To adjust for the varying pace of the program from year to year, we adjusted the total annual costs based on miles of replacement forecasted by DEO in their 2041-YE scenario.

The 3% increase in $/mile and $/service replacement is also used as DEO's internal assumption for cost increases.[104]

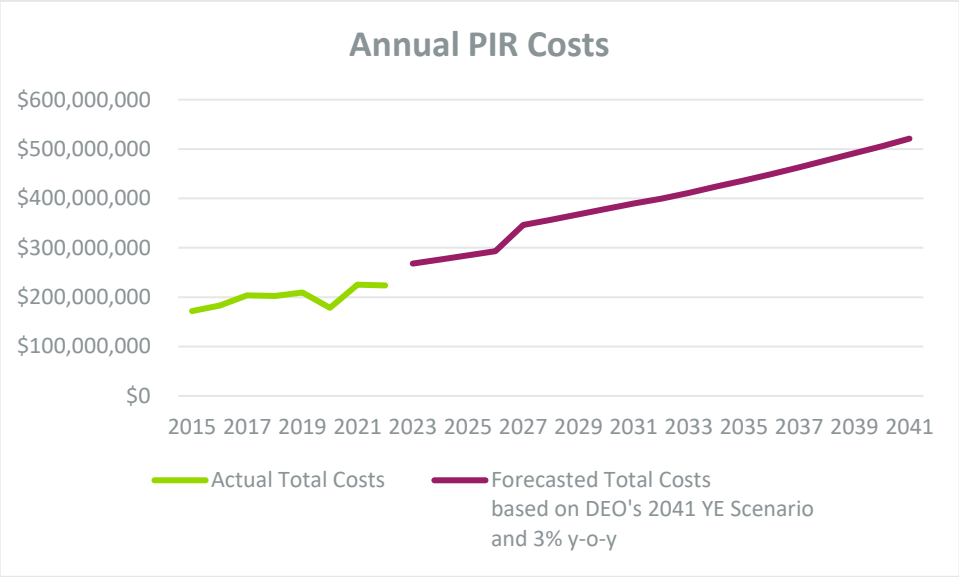


Figure 31: Annual PIR Costs – Projected Based on 2041 YE Scenario[105]

The total nominal cost related to the PIR program could be close to $10 billion. This seems much higher than the original estimate of $2.662 billion. Some of the cost difference can be explained by inflation and 35% increase scope of the program since the original application.

[102] An estimate of 3% used based on re-authorization filings even though annual PIR costs observed in years 2015-2022 increased by an average of 4% year-over-year and $/mile increased by a higher %. Even in $/mile, 2015 – 2019 average year-over-year is 4%.

[103] Discovery response 6.02

[104] Discovery response 4.04

[105] Discovery response 6.02 used for annual PIR costs 2015 – 2022. 2022 PIR cost was $223,718,181. Mains PIR pipe replaced was 703484 feet or 133 miles (Discovery response 7.03 installation). 2023 replacement miles projected is 155 miles (Discovery response 4.02 2041 completion). A "total PIR cost/ Main miles replaced" parameter was used to adjust for pace. 2022 had a total PIR cost of $1,679,116.54 per Main mile replaced. A 3% escalation was used to get $1,729,490.03 for 2023 total PIR cost per Main miles replaced. $1,729,490.03 * 155 = $268,070,955.20. Similarly following years costs are tied to projected pace for 2041 completion.

It is unclear if an increased pace of replacements will reduce or increase the total cost of the program because of the interplay of cost efficiencies of aggregation versus potential increases in permitting costs and contracting costs (increased demand).

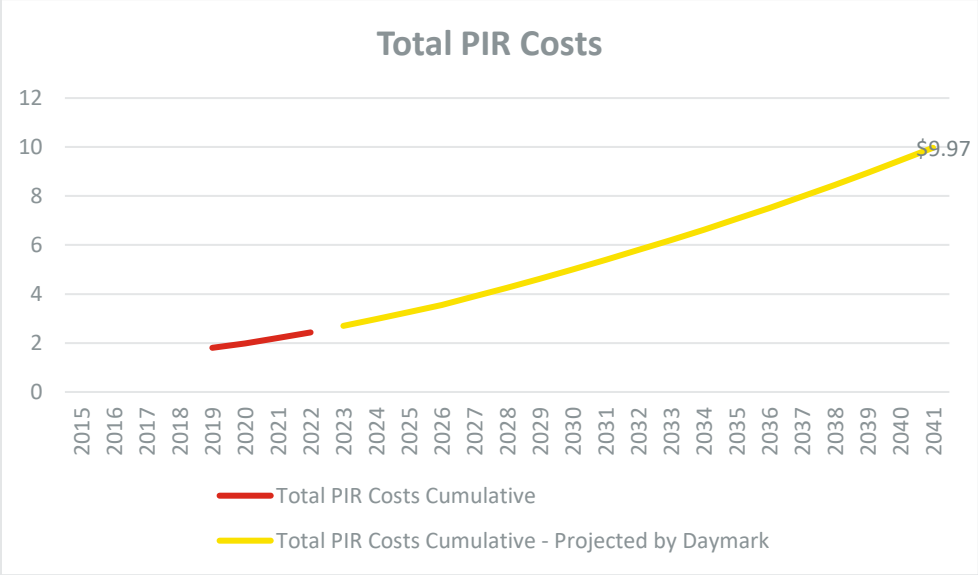


Figure 32: Total[106] PIR Costs – Projected Based on 2041 YE Scenario

The annual cost recovery filings are subjected to prudence reviews by PUCO staff[107]. We interviewed DEO staff on capital management practices and reviewed DEO's internal capital control policy documents[108]. We also reviewed a few sample PIR projects to understand processes around competitive bidding.

The following observations were made in terms of cost management practices[109]:

1. DEO procures contractor services for PIR projects mostly through Request for Proposals (RFPs) or through existing blanket contracts. The few projects whose RFPs were reviewed, all received at least two proposals and bids.

106 The $1,803,433,764 total cost stated in PUCO Case No. 20-1634-GA-ALT as of end of 2019 was used as the starting point for cumulative costs.

107 Discovered through interviews with DEO and PUCO staff

108 Discovery response 2.07

109 Discovery responses 6.09, 6.10, 6.11, 6.12, and 7.12

2. DEO employs third-party inspectors and contractors and periodically evaluates external resources for increasing the pool of contractors and monitors for more cost-effective supply of services.

3. DEO manages material acquisition through multiple channels to increase the program's capacity and cost efficiency.

4. DEO has been exploring longer term contracts with some of its vendors and contractors to control costs. DEO has three-year blanket contracts with two one-year extension options, and DEO maintains that this structure has provided long-term value when comparing blanket pricing versus market pricing, especially in the latter part of the contract.

C. O&M Savings

DEO is required to track and show savings in Operations and Maintenance (O&M) costs due to progress in replacement of PIR eligible pipe as part of this interim review.

Table 22 demonstrates the O&M savings attributable to the PIR Program, as well as the incremental O&M incurred by servicing the PIR Program. The methodology for calculating the O&M savings was detailed in the final order in docket 09-458-GA-RDR.[110] Through this methodology, DEO tracks four categories of costs against a test year (July 2007 – June 2008). Categories of costs tracked are leak repair, leak surveillance, corrosion monitoring, and corrosion remediation. Importantly, the Order in 09-458-GA-RDR set cost savings to zero ($0.00) when a category incurred additional costs in a given period above and beyond the test year.

Within the Incremental O&M sub-category, Contractor Services have notably risen from an average annual expense of under $200,000 from 2012 to 2019, the category grew to $5.4 million in 2021, and again to $6.3 million in 2022, forming a vast majority of PIR Incremental O&M in the latter two years. Daymark notes that in comments on the draft report, DEO highlighted that they believe the increase in Incremental O&M in 2021 and 2022 is “due to an accounting change and would not necessarily constitute an incremental increase in costs for contractor service.”

[110] PUCO Case No. 09-458-GA-RDR. Order and Opinion. December 16, 2009.

Table 22. Annual O&M Savings and Incremental O&M Attributed to PIR Program[111]

Year		O&M Savings		Incremental O&M
7/1/08-6/30/09	$	(554,301)		
7/1/09-6/30/10	$	(258,570)		
7/1/10-6/30/11	$	(2,127,563)		
7/1/11-12/31/11	$	(234,458)		
2012	$	(3,260,215)	$	2,515,913
2013	$	(4,161,186)	$	2,637,848
2014	$	(4,504,070)	$	2,701,990
2015	$	(2,822,588)	$	2,257,518
2016	$	(545,784)	$	2,554,205
2017	$	(1,121,281)	$	1,733,382
2018	$	(1,663,187)	$	1,731,198
2019	$	(2,246,811)	$	1,130,264
2020	$	(2,484,205)	$	2,338,588
2021	$	(2,512,949)	$	6,278,456
2022	$	(156,124)	$	7,265,858
Total (2012-2022)	**$**	**(25,478,399)**	**$**	**33,145,220**

From Recovery Period 2012 through Recovery Period 2016 O&M savings were allocated between the Company and ratepayers in a methodology set out in Case #11-2401-GA-ALT. Under this methodology, customers receive the first million dollars of O&M savings as credit on the PIR revenue requirement, while the next $500,000 dollars are allocated to DEO. Anything beyond the first $1.5 million in savings is split evenly. Under this methodology, customers were credited approximately $9.4 million[112] in O&M costs from the PIR program, while the Company saved approximately $6.4 million[113]. This methodology was ended in 2016 in Docket 15-362-GA-ALT, reverting to the methodology laid out in Docket 09-458-GA-RDR[114].

D. Findings and Recommendations

Finding: DEO has tracked O&M savings since the inception of the PIR program and can show savings from the test year levels in all years of the program's existence.

111 Discovery 5.05. DEO notes that capitalization of incremental O&M was first authorized in the 2011 PIR Reauthorization Case No. 11-2401-GA-ALT.

112 While actually O&M savings in the Recovery Period 2016 were less than $1 million, the Stipulation signed July 5, 2011 provides that a minimum credit of $1 million be credited to customers "notwithstanding actual O&M expense savings." Docket 11-2401-GA-ALT. Opinion and Order. August 3, 2011.

113 Discovery 5.05 Attachment 1.

114 PUCO Case No. 15-362-GA-ALT. Opinion and Order. September 14, 2016.

Finding: DEO says one reason O&M savings declined is due to supply chain constraints due to both the pandemic and the high demand for a limited pool of technical expertise in the current labor market.

Finding: It appears from Table 22 that incremental O&M costs are increasing at a faster rate over the last three years, suggesting that PIR program review might be better served by adopting a more straightforward calculation similar to that used in the Massachusetts GSEP program. In this program, the Massachusetts LDCs calculate the avoided O&M costs as average cost associated with fixing mainline or service line leaks over the last three years (to smooth out shocks in input costs) multiplied by the number of miles of pipe replaced. Daymark further notes DEO's belief mentioned previously that some of the increasing incremental O&M costs could be caused by an accounting change within DEO, and ultimately not caused by actual costs charged to customers rising. Due to the timing of this information being presented to Daymark, Daymark cannot independently verify these assertions.

Recommendation No. 13: Given that DEO is considering asking for an extension of the program through 2041, and our finding above that DEO has experienced cost benefits from using 3-year blanket contracts, DEO should consider using additional 18 years as an opportunity to build cost mitigation and risk reliefs for contractors, especially because DEO relies on continued availability of services from well-established and well capitalized contractors who may be willing to enter into a longer term contract that offers assurances for profitability, while also helping to stabilize DEO's costs.

Recommendation No. 14: Evaluate capital cost trends at the cost element level and forecast future cost relative to emerging trends and over the course of the program by monitoring capital consumption in annual dollars that is constrained by the annual PIR cap, and capital productivity defined by capital expenditures to replace specific quantity of mains and services.

The capital needed to execute the year-over-year plans must fit into the first bucket entitled capital consumption. Otherwise, DEO cannot finish within the understanding of the timeline expressed in the Order[115] for program completion (regardless of whether this date remains the same or is extended).

Here is an example of how these trend analyses could be used in the context of informing the Company and regulatory stakeholders of the factors influencing cost:

[115] Original Application, 15-362-GA-ALT and 20-1634-GA-ALT

The project estimates for 2020 are based on a mix of engineering estimates, where available, for a small number of large steel projects and plastic installation projects designed to replace leak-prone priority pipe with a weighted average pipe diameter in excess of 8", and an historical cost per foot of approximately $192 for all other core main replacement projects and an historical cost per service of approximately $8,056. The unit cost for mains and services in years 2021 through 2024 are inflation adjusted to account for increases in materials and supplies, and labor on average of approximately three percent per year. Due to the increasing demand for contractors in the region, based on regional labor market forecasts, contractor costs are expected to increase between four percent and nine percent over the planning horizon 2020 through 2024. The estimated unit cost of main and service installation for 2020 through 2024 is shown in Table VIII-1.

Table VIII-1

	2020	2021	2022	2023	2024
Estimated Unit Cost of Main	$ 192	$ 204	$ 217	$ 231	$ 246
Estimated Unit Cost of Services	$ 8,056	$ 8,467	$ 8,907	$ 9,376	$ 9,877

- The total planned spending in 2020 for non-cathodically protected steel replacements is $23.6 million.
- The total planned spending for 2020 for cast-iron replacements is $26.7 million.
- The total planned spending of 2020 for service line replacements is $24.7 million.
- The total number of G3SEI leaks expected to be repaired is 21.
- The total cost of planned G3SEI leak repair for 2020 is estimated to be $62,580.

VII. LOST-AND-UNACCOUNTED-FOR GAS ("LAUF") AND EMISSIONS TRENDS

A. Review of Trends

In docket No. 08-169-GA-ALT, DEO's Director of Rates and Gas Supply, Jeffrey Murphy testified to the cost allocation and rate recovery aspects of the PIR program. As part of his testimony, Mr. Murphy states that the "PIR Program will also reduce the volume of lost-and-unaccounted for gas as older vintage pipelines are replaced."[116] Mr. Murphy states this reduction will be reflected in the fuel retention rate, and thereby reduce the total amount of purchased gas required.

DEO's claim of a reduction in lost-and-unaccounted for gas ("LAUF") stands to reason on basic logic – as older vintage pipe, that is logically more prone to leakage, gets replaced, leaks should reduce. While LAUF numbers do not reflect only leakages, in many jurisdictions they certainly play a large role.

Daymark sought to explore the potential correlation between the PIR program progress and reductions in LAUF on the DEO system. While DEO was not able to provide Daymark with LAUF numbers explicitly, DEO did provide the Unaccounted-for-Gas ("UFG") historical values for all years during which the PIR program was active. Historical UFG percentages and a linear trend can be seen in the UFG rate can be found in Figure-31.

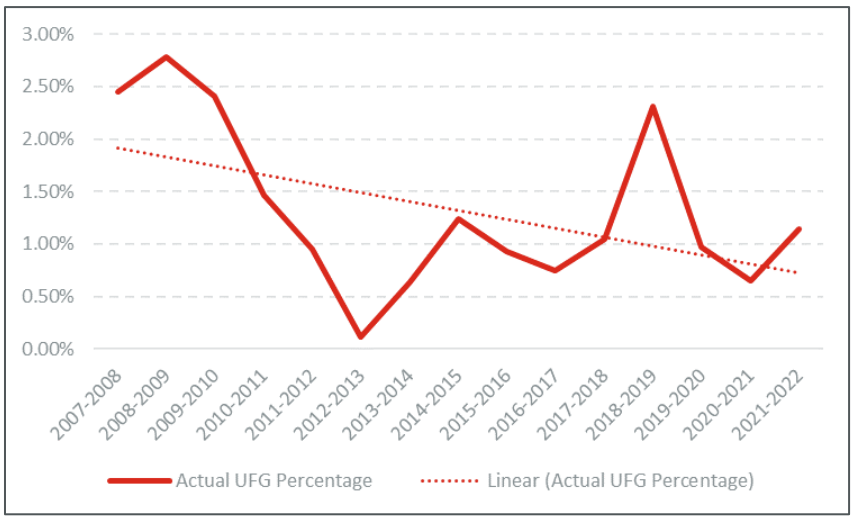


Figure 33. Historical Unaccounted-for-Gas ("UFG") as a percentage of supply of DEO[117]

[116] PUCO DEO Case No. 08-169-GA-ALT. Supplemental Direct Testimony of Jeffrey A. Murphy. Page 8, Lines 5-6.

[117] Discovery response 5.07

DEO noted that the UFG is also known as the "fuel retention rate" and is made up of several items, including LAUF, company use of gas, temperature effect, and the Ohio Production Btu adjustment[118]. In particular in their response to Daymark Set 5, Question 08, DEO had noted that the updated Btu Adjustment portion of the fuel retention rate could impact the UFG rate with the new heat content conversion process would increase the UFG rate by about 1.0%, noting these adjustments would be in the tariffs filed September 1, 2022. DEO also notes that LAUF rates are not explicitly approved by PUCO, but via Rule 4901:1-14-08, PUCO considers anything above 5% to be unreasonable.

When asked to point to data confirming the correlation and/or causation of the PIR program with UFG/LAUF, DEO was unable to do so[119]. Rather, DEO stated that while they believe "the PIR has a positive impact on LAUF… the Company does not specifically project or track the impact of PIR projects on LAUF values and believes that such tracking is neither practical nor feasible.[120]"

When asked to provide metrics on emissions levels by year since the inception of the PIR program, DEO pointed to annual PHMSA reports, which contained annual UFG percentages. As discussed above, UFG has several components, only some of which contribute to emissions, while others are related to temperature factors and company use figures. [121]. Nevertheless, in other discovery, DEO did note that a reduction of more than 30,000 MCF of methane annually was attributable to the PIR program[122]. In the same discovery response, DEO pointed to the Methane Challenge program of the US EPA, for which the highest annual methane reduction achieved by "Dominion Energy West Virginia and Dominion Energy Ohio (Hope Gas, Inc. and The East Ohio Gas Company)" was 27,451 metric tons of CO2 equivalent[123]. Over the 2016-2020 period, the EPA estimates the total metric ton CO2 equivalent of 122,323 was saved through the replacement program and estimates the value of natural gas savings at over half a million dollars. It should be noted that this data does include Dominion's former holdings in West Virginia – thus savings attributable only to DEO are likely lower.

118 Discovery response 5.08

119 Discovery response 5.09

120 Ibid.

121 Discovery response 5.10

122 Discovery response 5.13

123 United States Environmental Protection Agency. Natural Gas Star Program. Dominion Energy of Ohio Methane Challenge Partner Profile. https://www.epa.gov/natural-gas-star-program/dominion-energy-ohio-methane-challenge-partner-profile

B. Findings and Recommendations

Daymark's review finds that while specific LAUF numbers were not available from DEO, that investment and projects in the PIR program generally correlate to DEO's reduction in UFG rate of which LAUF comprises a portion of the UFG. Despite this finding, Daymark would recommend and encourage better tracking and data availability of UFG by source, as an additional metric to track the progress of the PIR program.

Specifically, Daymark would recommend UFG and LAUF tracking similar to those done in Massachusetts. In annual filings, Massachusetts local distribution companies file LAUF reports highlighting LAUF by category, such as company use, fugitive emissions by pipe material and split by mains and services, external damage, venting and purging, theft, and meter error, among others[124]. Such metrics would serve to allow DEO to track individual components of UFG and specifically track fugitive emissions by pipe material and type. Furthermore, such metrics would allow for DEO to support prior testimony and for PUCO and DEO to quantify additional benefits of the PIR program.

Finding: DEO has shown a general reduction in the UFG rate over the course of the PIR program's existence.

Finding: DEO claims it cannot attribute nor does it believe it feasible to track and report on metrics attributing UFG/LAUF to the PIR program specifically.

Finding: Massachusetts gas utilities are required to track LAUF gas separately from company use of gas, and the Massachusetts DPU has opened a docket on the protocol for tracking and reporting on LAUF gas.[125] This reporting includes LAUF by pipe material and type (service/main).

Finding: DEO has reduced methane emissions annually as shown in data reported in the US EPA's Methane Challenge Partner Profile of nearly 4,893 metric tons between 2016 and 2020 (122,323 metric tons of CO2 equivalent). This data includes savings attributable to former holdings in West Virginia as well.

Recommendation No. 15: DEO and the PUCO should consider revising how they track LAUF, including emissions factors by pipe material and type, so that it separates out company use gas to gain a better understanding of whether emissions are declining due to PIR program activity,

[124] Massachusetts Department of Public Utilities, Docket 19-44-A. Order Adopting Final Regulations. December 12, 2019.

[125] Massachusetts Department of Public utilities, Docket 23-LAUF-01.

and to what degree the reduction in emissions and overall gas supply purchases are additional benefits of the PIR program.

VIII. ADMINISTRATION OF THE PROGRAM

A. Program Goals

As described by DEO, the goal of the pipeline infrastructure replacement (PIR) program is to replace the vintage assets, prioritized based on risks and constructability, to ensure that DEO is managing their distribution system in a safe reliable way.[126] With the PIR Program covering 5,500 miles of pipe[127], it makes up about a quarter of DEO's 22,000 mile system (includes distribution, transmission, gathering and storage).[128] The goals described by DEO are reflected and in alignment with PUCO staff.[129]

Over the last 15 years since the beginning of the program, DEO has created several standard processes, dedicated teams, and communication protocols to effectively manage the PIR program.

B. Teams Involved

The execution of the PIR program falls within the purview of the Distribution Design and Construction team. (Begin Confidential) [redacted][130] (End Confidential) This team works closely with other entities of DEO, but the following PIR execution process only includes members of the Distribution Design and Construction team.[131]

PIR project execution

For each pipeline replacement project within the program, there is a dedicated Project Manager (PM).[132] Based on Daymarks information requests, there are four different ways that pipe within the PIR Program is identified to initiate replacement execution: (1) a "Third Party Conflict Submission", (2) an "Operational Request", (3) identified as a "High Optimain Risk Score", and

126 First round administrative interview with DEO. March 15, 2023.

127 Ibid.

128 https://www.dominionenergy.com/projects-and-facilities/natural-gas-projects/pipeline-infrastructure-replacement-oh#:~:text=The%20PIR%20project%20involves%20replacement,reliable%20service%20to%20our%20customers.

129 First round administrative interview with PUCO Staff. April 5, 2023.

130 Discovery response 01.01 Attachment 1 (Orgchart)

131 First round administrative interview with DEO. March 15, 2023.

132 First round administrative interview with DEO. March 15, 2023.

(4) an "Operational Emergency (C&M)".[133] The portfolio of projects vary "based on the size and complexity" of the projects assigned to each PM.[134135] For example, a PM that has a portfolio of smaller projects, would be designated around twenty to fifty projects each year[136]; projects that are at the "Optimain-level" are allocated ten to twenty projects each year.[137,138] The PM is present throughout the life-cycle of a project. The PM makes sure that the cost is maintained, and costs increase outside of the original estimate, they raise it to the necessary decision-making parties and explain why the cost has increased.[139]

Based on the process map provided by DEO (Figure 34, it appears there are two separate tracks for a project.[140] The first track applies to projects identified through "Third Party Conflict Submission", an "Operational Request", and a "High Optimain Risk Score". The second track applies to a project identified through an "Operational Emergency (C&M Project)".[141]

First track of PIR project execution

For the first track, when a project is identified for replacement through "High Optimain Risk Score" or "Operational Request", the project goes to the Project Prioritization Team (PPT) which works with the systems planning team to create a scope.[142143] The system planning team performs modeling, where they review the scope and provide recommendations on the size.[144] With the recommendations provided by the systems planning team, the PPT team combines this information and creates a project package, which includes the scope of the project that ultimately aligns with system needs.[145,146] When a project is identified through a "Third Party Conflict Submission", the project first has to go to the design team to review the submission.[147] If the PIR eligible pipe that was submitted through the third party is near an area of conflict, it

133 Discovery response 02.06 (Attachment 1). pdf
134 Discovery response 02.11 (Projects per Project Manager).pdf
135 First round administrative interview with DEO. March 15, 2023.
136 Discovery response 02.11 (Projects per Project Manager).pdf
137 Ibid.
138 First round administrative interview with DEO March 15, 2023.
139 Ibid.
140 Discovery response 02.06 (Attachment 1).pdf
141 Ibid.
142 Ibid.
143 Discovery response 02.06 (Attachment 1). pdf
144 First round administrative interview with DEO March 15, 2023.
145 Ibid.
146 First round administrative interview with DEO March 15, 2023.
147 Discovery response 02.06 (Attachment 1).pdf

will then go through the same aforementioned process of the projects identified through "High Optimain Risk Score" or "Operational Request".[148] From there the engineering team gets involved, reviewing the scope and preparing the project for construction.[149] Most projects have a designer to ensure the project is meeting internal and external standards. [150]

Before a project goes into construction the Project Scheduling Tracking Analytics and Costs (PSTAC) team schedules and assigns projects to a contractor. Permitting is required before the construction begins as well.

When projects go to construction, there is a dedicated member of the construction team that are ensuring the project is going to plan, which is communicated back to the PM.[151] Throughout construction, the project is being measured for Quality Assurance and Quality Control, by comparing with internal and external standards identified in the scoping of the project. During this time, the project is also being measured to ensure financial terms are aligning with how they were scoped. For example, the PM must ensure the project was paid appropriately and to account for any change orders that occurred.[152] Once construction is completed the project moves to the closing stage of project execution.

Second track of PIR project execution

When a project is identified for replacement via an "Operational Emergency (C&M)", rather than going to the PPT team to work with the system planning team, the project goes directly to system planning team for reviews and recommendations.[153] The project goes to the engineering team for design input, if it is needed; however, if it's not, then it goes directly to the aforementioned phase, where the project goes to permitting, if required. Following the permitting the process the project goes to construction. Dependent on the scope of the project the construction will be assigned to a blanket contractor.

148 Ibid.

149 First round administrative interview with DEO March 15, 2023.

150 Ibid.

151 First round administrative interview with DEO March 15, 2023.

152 Ibid.

153 Ibid.

Closing Stage of PIR project execution

As construction finishes, the closing team begins to engage in order to reconcile the assets that were involved in the construction.[154] When the project is deemed reconciled, it is put into the GIS system and mapped.

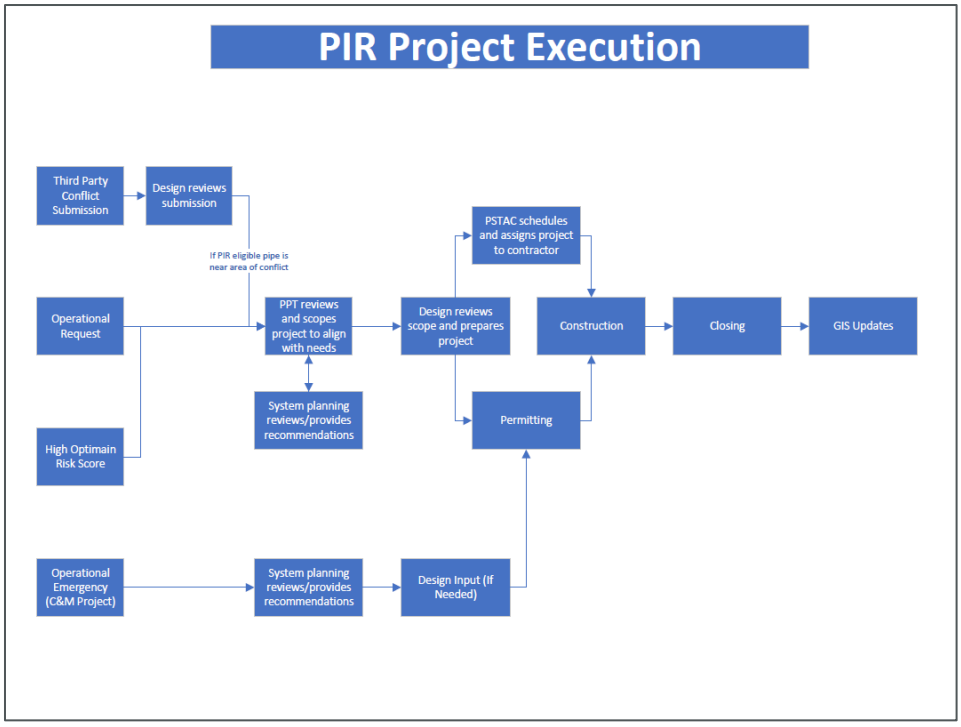


Figure 34. PIR Project Execution Process Map[155]

PIR management tools

The PIR program uses an assortment of software programs to manage the lifecycle of PIR projects. (Begin Confidential) [redacted] 156 [redacted] (End Confidential)[157] GIS is monitored at a program and project level monthly.[158] Optimain is another software that is critical to the management of PIR projects. Optimain is a risk ranking and scoping tool that is used for

154 Ibid.

155 Discovery response 02.06 (Attachment 1).pdf

156 Discovery response 02.04 (Software Programs).pdf

157 Ibid.

158 First round administrative interview with DEO March 15, 2023.

DEO's distribution mainline and services.[159] The Optimain model is managed by the client controls group, which is within the project prioritization team.[160]

(Begin Confidential) [redacted] (End Confidential) [161] Specifically, for the PIR program, SAP is used to capture projects that come through the execution process via an "Operational Emergency", a "Third Party Conflict Submission", or a "Operational Request".[162] (Begin Confidential) [redacted] (End Confidential)[163] and the assets of the project continue to live in SAP. [164]

C. Executive Team's Overview and Monitoring

Daymark had an informational interview with Daniel Weekley, DEO President.[165] Based on the interview and supporting data from DEO[166], it appears that senior leadership values the importance of DEO's PIR Program and believes it is tracking well to the organization's environmental, reliability, and safety goals. Specifically, the PIR Program's annual targets are included in DE's sustainability and emissions planning, of which includes executive involvement. In addition, each project within the PIR Program is required to be reviewed and approved by DE leadership based on the capital budgeting and approval process.[167]

In the approval process for capital budgeting, the "DEO Finance and Operational Leadership Teams plan and communicate upstream to the President of DEO and, subsequently to the Vice President of Finance of Gas Distribution and the President of Dominion Gas Distribution".[168] The budget is typically fixed and approved by the Board of Directors; however, executive leadership allows for flexibility in the budget to respond to environmental changes, like inflation.[169] Before the budget is given final approval by the President of DEO during the first board meeting of the

159 Discovery response 02.04 (Software Programs).pdf
160 First round technical interview with DEO March 27, 2023.
161 Discovery response 02.04 (Software Programs).pdf
162 First round administrative interview with DEO March 15, 2023.
163 Discovery response 02.04 (Software Programs).pdf
164 First round administrative interview with DEO March 15, 2023.
165 First round executive interview with DEO May 4, 2023.
166 Discovery response 03.14 (Executives involved with PIR Program).
167 Ibid.
168 Discovery response 2.07 (Capital Governance Policy).pdf
169 Ibid.

year[170], it goes through many iterations of reallocation through the facilitation of the finance team and operating entities.[171] If the PIR program has an increased amount of expenditures allocated, the business unit VP, president of gas distribution and chief operating officer would have to approve.[172] The dollars approved by the appropriate parties would then be incorporated into the capital budget plan for approval.[173]

A significant portion of the formal policy for senior management's involvement is articulated in the capital budget and approval processes, as well as the Sarbanes Oxley Act; however, much of the updates are also requested from senior management on a regular ad-hoc basis.[174] The frequency of the information that each business unit VP receives depends on the type of project; yet, for a construction year, updates on the replacement milage that year and associated expenditures are reported on a monthly basis, where projections, program scope and prioritization strategy is reported annually.[175]

Executives are involved with the governance of the PIR Program to inform strategic direction. They in particular "provide feedback, direction and approval on the current status, strategy and future planning of the PIR program".[176]

D. Administrative Challenges

DEO identified available external resources to their team as an administrative burden the PIR program faces.[177] They have recognized the "limitation on available resources within its current qualified contractor pool" [178] and also articulated that staffing levels will [need to] grow to meet an expanding scope and ensure adequate internal resources.[179] In terms of internal staffing, DEO noted the importance of finding and retaining talent so that both DEO and staff find the right fit. DEO articulated that it has focused on client retention by providing individuals with adequate support to be inspired to expand their skills and grow professionally. They also note the significance of seeing each staff as full individual by providing training and ensuring they feel

170 Discovery response 4.07 (Senior Executive Approval).pdf
171 Discovery response 2.07 (Capital Governance Policy).pdf
172 Discovery response 04.07 (Senior Executive Approval).pdf
173 Ibid.
174 Discovery response 03.14 (Executives involved with PIR Program).
175 Ibid.
176 Ibid.
177 First round administrative interview with DEO March 15, 2023.
178 Discovery response 06.07 (Sustained Contractor or Labor Shortages)
179 Discovery response 07.12 (Resource Plans).

heard.[180] Overall, the maintenance and growth of staffing and contractor resources will be crucial to ensure acceleration and succession of the PIR program, which requires specialized skills at every level of its execution and significant training for new personnel to fit in.

E. Findings and Recommendations

Finding: Throughout the interviews and discovery process, we note that it appears that DEO has effective and competent teams and processes in place, however, there seems to be reliance on some institutional memory (tribal knowledge) on how these processes are managed and controlled. The Standard Operating Procedures and process maps discussed above need to be augmented with institutional knowledge which we gathered through interviews in order to understand the overall execution of processes and protocols.

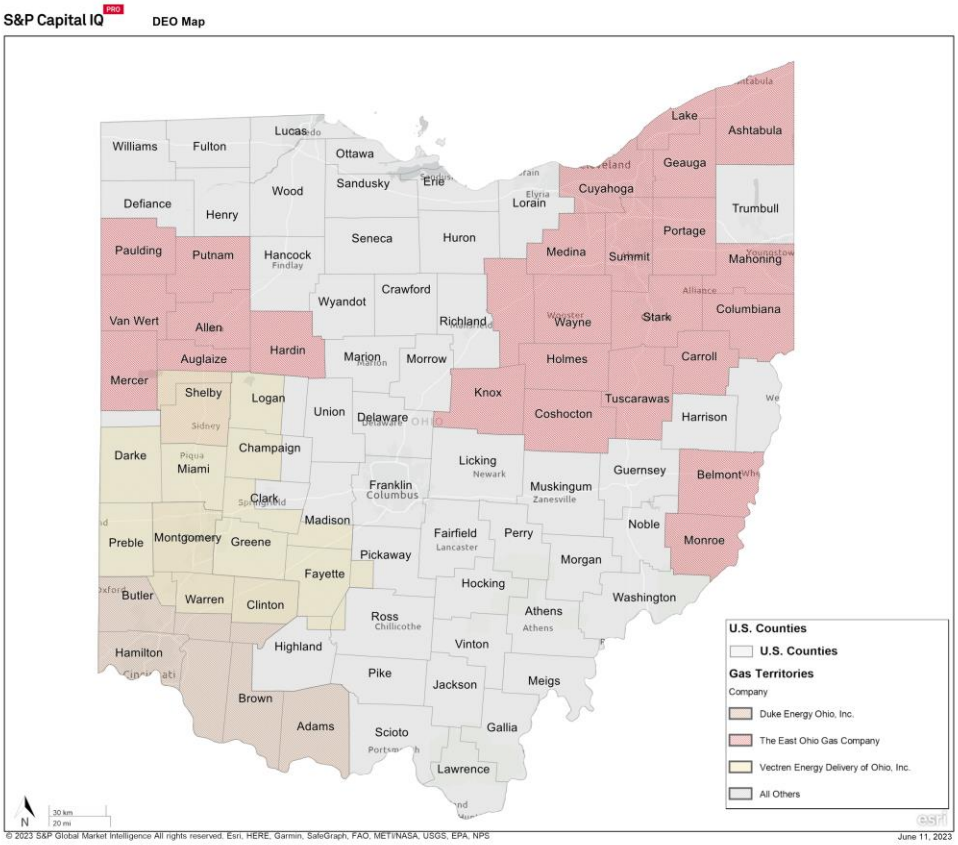
Recommendation No. 16: The Executive team should consider developing a document that memorializes in detail - the processes, roles and responsibilities, and controls of teams involved in the PIR program to assure that these processes are being followed and continue to be effective through the lifetime of the program, especially given that DEO has indicated that it may request an extension through 2041. The Executive team should also consider using the metrics defined within this report to internally evaluate the effectiveness of the PIR program, including:

- Pace
- Leakage trends
- Risk scores
- LAUF
- Cost of replacement.

These metrics should be periodically reviewed against program goals.

[180] Ibid.

IX. COMPARISON WITH OTHER SIMILAR PROGRAMS



NOTE: DEO has clarified that they have assets in Trumbull and Washington counties which are not highlighted in this figure.

Figure 35. Large Ohio Gas Utilities

Daymark performed an analysis across similar programs within Ohio and across the country. Within Ohio, Daymark identified Vectren Energy Delivery of Ohio (VEDO) and Duke Energy as two utilities that performed similar replacement programs for comparison. Across the country, Daymark focused on Eversource Gas Company of Massachusetts in Massachusetts and Baltimore Gas in Maryland. In this section, we will describe our findings across these different pipeline replacement programs, identify effective implementation methodologies, and detect potential gaps that DEO's PIR program could incorporate.

A. Vectren Energy Delivery of Ohio

In 2009, the Commission approved the use of a tracking mechanism that allowed VEDO the recovery of costs from the Bare Steel and Cast Iron Pipeline Replacement Program (VEDO Replacement Program).[181] Specifically, VEDO established a Distribution Replacement Rider (DRR) for the recovery of the following:

- the return on and of plant investment, including capitalized interest, or post-in-service carrying cost charges ("PISCC"), along with incremental costs incurred under a multi-year program for the accelerated replacement and retirement of cast iron mains and bare steel mains and service lines,
- deferred expenses incurred during Company's investigation of the installation, use, and performance of natural gas service risers,
- all costs of replacement of prone-to-fall risers,
- the incremental costs attributable to assuming ownership of service lines installed or replaced by Company, and
- the incremental cost of assuming maintenance responsibility for all service lines, less the actual annual savings of certain Operations and Maintenance ("O&M") expenses from the baseline O&M of $1,192,953."[182]

The VEDO Replacement Program originated at the end of 2008 when VEDO recorded 524 miles of bare steel and 172 miles of cast iron remaining in its system and proposed in the following rate case "to replace its remaining bare steel and cast iron infrastructure over a twenty year period".[183] The replacement was approved and included the replacement of both mains and service lines.[184] In the following year, as a part of the Replacement Program, "VEDO retired 18 miles of bare steel and 6.5 miles of cast iron" and "replaced 1722 bare steel service lines, retired 58 service lines and tied over an additional 74 service lines", as well as, "2,640 feet of plastic main within the projects completed in 2009".[185] To complete these retirements and replacements, VDEO invested $11,250,423 in 2009 for the Replacement Program.

Based on the direct testimony of James M. Francis, VEDO derived cost savings from the 2009 replacement projects through the reduction in maintenance expenses. In 2009 there was a

181 https://www.energy.gov/sites/prod/files/2017/01/f34/Natural%20Gas%20Infrastructure%20Modernization%20Programs%20at%20Local%20Distribution%20Companies--Key%20Issues%20and%20Considerations.pdf. Pg 56.

182 https://dis.puc.state.oh.us/ViewImage.aspx?CMID=A1001001A10D30B21135E01101 pg. 3.

183 Id. pg. 14

184 Id.

185 Id.

variance of $321,184.[186] The reduction in maintenance expenses can also be attributable to the change in service line responsibilities.[187] As an outcome of the DRR, VEDO reduced replacement time for cast iron to around 4 years and the replacement of Unprotected Steel from around 120 years to 15 years.[188]

The DRR includes the VEDO Replacement Program, the natural gas riser replacement program (Riser Program) and incremental costs associated with VEDO's service line responsibility. The DRR established the following charges.[189]

Table 23. DDR Charges

Rate Schedule	$/month	$/Ccf
310, 311, and 315	$0.66	
320, 321 and 325 (Group 1)	$0.66	
320, 321, and 325 (Group 2 and 3)		$0.00456
341	$3.33	
345		$0.00120
360		$0.00117

B. Massachusetts DPU Gas Systems Enhancement Program (GSEP)

In 2014, Massachusetts General Court established a natural gas infrastructure replacement program in Massachusetts on an accelerated basis enacted through Chapter 149 of the Acts of 2014, as codified in G.L. 164, §145, also referred to as "the Leaks Act".[190]

The Leaks Act also requires each natural gas local distribution company (LDC) having an approved Gas System Enhancement Plan ("GSEP") to file, at five-year intervals, a summary report of its progress to date, a summary of work to be completed during the next five years of the GSEP.

186 Id. pg. 26.

187 Id.

188 https://www.energy.gov/sites/prod/files/2017/01/f34/Natural%20Gas%20Infrastructure%20Modernization%20Programs%20at%20Local%20Distribution%20Companies--Key%20Issues%20and%20Considerations.pdf pg. 32.

189 https://dis.puc.state.oh.us/ViewImage.aspx?CMID=A1001001A10D30B21135E01101 pg. 5.

190 MA DPU Docket No. 18-GSEP-05, First Five-Year Review Report 2015-2019, 5-Year_GSEP Review_Report_11-1-18.pdf pg 1.

The Department of Public Utilities was authorized to review and approve the replacement programs for each LDC. The LDCs who participated in the GSEP program are Berkshire Gas, Boston Gas, Colonial Gas, Columbia Gas, NSTAR Gas, Liberty, and Until.[191] In a four-year period, the consolidated progress under the GSEP Program has replaced approximately 919 miles of main and 60,704 services, totaling an elimination of 3,300 leaks.[192] The statutory framework allows "for the recovery of annual program costs outside of base rates through a reconciliation factor".[193]

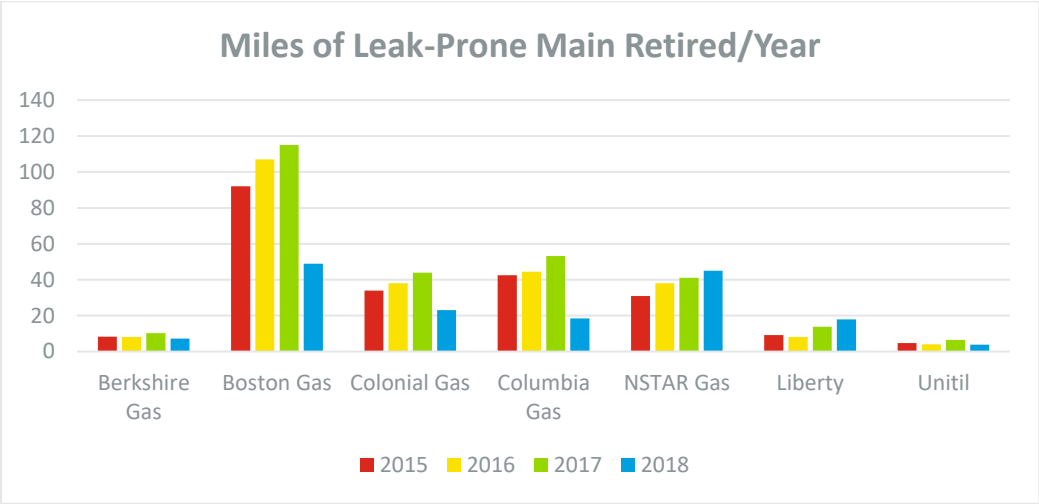


Figure 36: Miles of Leak-Prone Main Retired per Year across GSEP LDCs[194]

Given that the GSEP Program consists of more than one LDC, unlike DEO's PIR Program, Daymark broke down the year-by-year miles of leak prone main replaced across the LDC's in the GSEP Program. Boston Gas is comparable to the DEO PIR pace at an average of around 91 miles replaced per year.[195]

C. Duke Energy Ohio

In 2000, Duke Energy implemented an accelerated main replacement tracker. Duke's Accelerated Main Replacement Program (AMRP) was initiated in 2001 to replace the cast iron and bare steel mains and metallic service lines on an accelerated basis for Duke's Ohio

191 Id. pg 3.
192 Id. pg 2.
193 Id. pg 7.
194 Id.. Note that 2018 values are projected by each LDC.
195 Id.. pg. 12.

distribution system.[196] According to the direct testimony of Gary J. Hebbeller, prior to the AMRP, it would have taken over 70 years to complete the replacement of the mains. Given that the service lines were customer owned, the lines would have only been replaced when they were leaking. With the AMRP, the projects took 15 years to complete, replacing nearly all mileage by 2015.[197] The approximate total milage to replace all cast iron and bare steel mains on the system equate to around 1,421 miles.[198]

In Leonard C. Randolph JR.'s direct testimony he describes Duke's module approach in replacing the cast iron and bare steel main replacement that is a part of the AMRP. In Duke's AMRP, they prioritize replacement by the following:"

1. Cast iron immediate pressure main with mechanical joints installed after 1947;
2. Bare steel pressure main;
3. Cast iron intermediate pressure main with mechanical joints, installed in or before 1947;
4. Cast iron medium pressure main;
5. Bare steel intermediate pressure, medium pressure and 60-pound pressure main feeder lines;
6. Cast iron intermediate pressure main with bell and spigot joints installed after 1947;
7. Cast iron intermediate pressure main with bell and spigot joints installed in or before 1947;
8. Cast iron standard pressure main with mechanical joints;
9. Cast iron standard pressure main with bel and spigot joints."199

Duke's replacement priorities are designed to create a module, where cast iron and bare steel are grouped based on length and geographic area. Randolph describes the benefits as being more systematic allowing for lower costs through economies of scale.[200]

In 2002, the Commission approved Rider AMRP, which allows for an annual adjusted cost recovery mechanisms for the costs associated with the AMRP.[201] The costs would be recovered through the special annual Rider AMRP and allow Duke to pass any savings realized from fewer leaks on the system. Duke estimated that the cost over the at the time estimated 10 years, would

196 https://dis.puc.state.oh.us/ViewImage.aspx?CMID=A1001001A07B16B15820D25273 pg. 17.

197 Id. pg. 18.

198 https://www.ohiogasassoc.org/wp/wp-content/uploads/2012/10/Annual-Main-Replacement-Programs-Gary-Hebbeler.pdf

199 https://dis.puc.state.oh.us/ViewImage.aspx?CMID=HZ$5UQU5VRISMFXA pg. 6.

200 Id. pg. 6.

201 https://dis.puc.state.oh.us/ViewImage.aspx?CMID=A1001001A07B16B15820D25273 pg. 18.

be $716 million.[202] When Rider AMRP was implemented in 2002, it established the following rates:"

1. $1.00 per month for residential customers
2. $3.75 per month for general service and firm transportation customers
3. $0.01 per Mcf, subject to a per-month cap of $500 for interruptible transportation customers"[203]

In the direct testimony of Lee T. Howe, it is described how the AMRP was designed to pass the maintenance savings incurred from lower leak rate to the customers. He articulates how these "savings should be included in the annual revenue requirement and subsequent Rider AMRP rate calculation."[204]

D. Baltimore Gas & Electric (BGE), Maryland (STRIDE)

In 2013, the Maryland legislature adopted a law covering gas infrastructure replacement plans and associated surcharges for gas utilities, commonly called STRIDE (Strategic Infrastructure Development and Enhancement).[205] The STRIDE infrastructure replacement program covered three Maryland gas utilities, WGL, ColGasMD, and BGE, whose plan results are discussed below. STRIDE rules require that STRIDE plan assets be rolled into rate base within five years, unless the utility comes in for a rate increase sooner.

In order to qualify for Commission approval, a proposed capital plan must include eligible projects that:

1) Are truly accelerated, i.e., replaces or improves existing infrastructure on an accelerated basis, not already included in current rate base as determined in the most recent base rate proceeding.

2) Be designed to improve public safety or infrastructure reliability.

3) Reduce or potentially reduce fugitive greenhouse gas ("GHG") emissions by reducing leaks.

The proposed plan must include a timeline, description of customer benefits, and a cost estimate that, using the prescribed formula, adheres to a surcharge cap of $2.00 per month for residential customers, and a method for determining charges for non-residential customers.

202 https://dis.puc.state.oh.us/ViewImage.aspx?CMID=BV@RDHIOK6IKA75S pg. 4.

203 Id. pg. 4.

204 https://dis.puc.state.oh.us/ViewImage.aspx?CMID=HZ$5UQU5VRISMFXA pg. 15.

205 Md. PUBLIC UTILITIES Code Ann. § 4-210

The gas utility also must make an annual reconciliation filing to account for the difference between the actual amount the Company recovered under the surcharge and the actual cost of the Company's Plan. Prior year over/under collection in a subsequent year can be included in a subsequent year, but the resulting surcharge remains subject to the cap stipulated in the STRIDE statute.

For the years 2014 through 2018, BGE submitted annual capital plans for Commission approval along with a schedule including a surcharge as a cost recovery mechanism outside of normal base rates. In April 2017, BGE began reporting based on the plan costs and benefits consistent with the STRIDE set of metrics called the "STRIDE Plan Agreed-Upon Procedures Report that requires documentation for:

- Reductions in greenhouse gas emissions
- Average cost per leak repaired, leak rate per mile by material type
- Number of leaks repaired
- Estimated number of leaks avoided by material type
- Average replacement cost per foot for Mains - Urban vs Suburban

For example, for 2016 BGE reported an average repair cost/ft for main installs as shown below.[206]

w/o steel pipe greater than 8" diameter		w/ Steel pipe greater than 8" diameter	
Urban areas	$299/ft	Urban (only)	$440/ft
Suburban areas	$216/ft	N/A	

And when BGE filed its 2017 plan reconciliation report, it showed that actual results were below the plan by -2.5% overall and by -9.4% for mains replacement specifically, as illustrated in the table below.

[206] Baltimore Gas and Electric Company - STRIDE Audit Report for Year Ended December 31, 2016. PUBLIC and CONFIDENTIAL. Case No.9331. (ML 214914) Item 116, April 28, 2017, pp. 26-27. https://webpsc.psc.state.md.us/DMS/case/9331

In addition, BGE proposed, and the PSC approved, revisions to the tariff related to the STRIDE Rider that outline the treatment of an imbalance that represents an over-collection when the STRIDE surcharge is capped at the maximum monthly charge.[207]

Table 24: MD PSC Case No. 9331, BGE 2018 Rate True Up, Exhibit A [208]

	A	B	C	D	E
1		Calendar Year 2017 STRIDE Progam Costs		Projected Full-Year Program Variance	
2		2017 Projection (December 2016 Filing)	2017 Actual	$	%
3	Operation Pipeline Program	$ 93,635,555	$ 91,316,938	$ (2,318,617)	-2.5%
4	Main Replacement Program	$ 15,031,332	$ 13,623,741	$ (1,407,591)	-9.4%
5	Service Replacement Program	$ 22,000,000	$ 22,518,061	$ 518,061	2.4%
6	Total	$ 130,666,887	$ 127,458,740	$ (3,208,147)	-2.5%

E. Findings and Recommendations

Findings:

1) DEO's current pace of PIR eligible pipe replacement appears to be in line with that for Boston Gas (National Grid) at approximately 91 miles replaced per year.

2) As discussed above, other state jurisdictions with similar programs in place to allow for accelerated replacement of leak prone pipe, especially the STRIDE and GSEP programs, require annual filing of a proposed plan and subsequent reconciliation report showing costs and benefits and performance based on agreed upon metrics, including emissions

[207] Baltimore Gas and Electric Company -- Supplement 444 to P.S.C. Md. G-9 BGE STRIDE 2018 Rate with True-Up, or reconciliation, as of December 2017 associated with 2017 STRIDE work in the 2018 STRIDE surcharge. Effective May 1, 2018. Case No. 9331. (ML 219450), Item 128, March 15, 2018, Exhibit G, BGE Gas Tariff, page 92-G.
The MD PSC accepted this proposed tariff change on 4/26/2018, item 131.
https://webpsc.psc.state.md.us/DMS/case/9331

[208] Baltimore Gas and Electric Company -- Supplement 444 to P.S.C. Md. G-9 BGE STRIDE 2018 Rate with True-Up, or reconciliation, as of December 2017 associated with 2017 STRIDE work in the 2018 STRIDE surcharge. Effective May 1, 2018. Case No. 9331. (ML 219450), Item 128, March 15, 2018, Exhibit A, p. 1 of 1, https://webpsc.psc.state.md.us/DMS/case/9331

reductions, while DEO continues to use baseline emissions levels from 2010 to establish its emissions rates.[209]

3) The Maryland PSC has agreed to a change in the tariff governing STRIDE cost recovery that allows for the creation of a deferred revenue account to allow for future cost recovery in years when actual costs come in below the program cap.

4) Since DEO may propose to extend this program beyond 2033, there is time to work on the design and content of a report to be filed each year that summarizes in detail the performance of the PIR program through the end of the prior year to help with the next interim plan audit.

Recommendation No. 17: Daymark recommends DEO bring its PIR program closer in line with those in jurisdictions discussed above by changing how it evaluates program performance by:

1. Submission of a proposed plan for each plan year and at the end of that year provide an actual vs planned reconciliation report, including cost and leak management metrics.

2. Development of a metric for its report to the management that tracks pipe replacement time by material category to show whether it is improving or delayed, because it will be important to track pace at this level in the event that any request to extend the duration and budget for the program or addition to scope of PIR eligible inventory is requested and approved.

Recommendation No. 18: PUCO and DEO should work together to develop an agreed upon set of metrics and report structure to be used in an annual report to be filed with PUCO that summarizes PIR program performance based on a comparison of proposed and actual results for the prior year.

Recommendation No. 19: DEO should evaluate whether it could use as a model the Maryland PSC decision to allow the gas utility to establish a deferred revenue account to track approved PIR costs that exceed the program cap to help ensure that the PIR program is completed by the agreed upon timeline of 2033 or 2041.

X. SUMMARY OF RECOMMENDATIONS:

The following recommendations are found within the body of the report under the following sections identified below.

II.B. INTRODUCTION: Interim Review Scope and Methodology

Recommendation No. 1: The PIR program total budget estimation through to completion of the program should be prepared and reviewed at least once every 5 years as part of reauthorization.

Recommendation No. 2: Annual filings should include a proposal for future replacements as per the original application.

III. DOMINION ENERGY OHIO NATURAL GAS ASSETS

Recommendation No. 3: For consistency in reporting, PUCO review and subsequent plan reviews, DEO should establish a consistent set of Shop names and definitions accompanied by a common service territory map.

IV. PROGRESS AND PACE OF THE PROGRAM

Recommendation No. 4: DEO should consider utilizing geographical risk trends as an index or proxy for capital deployment at the shop or community level.

Recommendation No. 5: DEO should communicate with PUCO their pace of replacement based on e.g., the past 5 years through to the end of the program. Any PIR report should include an analysis of progress, issues and remedial measures to address replacement in at least the top 5 cities within their service area.

Recommendation No. 6: DEO should immediately prioritize and begin working on – or finalize -- development of MOU agreements with all of the top 5 cities that encompass 44% of remaining PIR inventory. Cleveland, Youngstown and Warren should be prioritized based on higher average risk scores. As part of this effort, DEO should communicate with these municipalities their planned annual pace of replacements within these cities, and the increasing risks associated with aging PIR pipe.

V. PROJECT PRIORITIZATION AND RISK MANAGEMENT

Recommendation No. 7: Develop risk reduction trend metrics that are incorporated into an annual plan review with the following details:

- Trend aggregated risk score by material asset type (i.e., Mains and services) at the:
- Company level

- Shop level
- Community level; e.g., top 20 towns
- By single project "worst-first" basis
- Based on Optimain data and in units consistent with those used in the DIMP

Recommendation No. 8: Contrast leakage trends on mains and service by material across the same dimensions as in Recommendation No. 7 above. This will provide insights into the correlation between risk and leakage as a means to validate Optimain output and project selection, but to also ensure that replacement rates are keeping pace with system deterioration.

Recommendation No. 9: Ensure that Opvantek still supports Optimain; recommend that DEO develop alternative strategy for pipe replacement prioritization if they intend to continue the program for an additional 20 years and Optimain is no longer available or more enhanced tools are developed.

Recommendation No. 10: DEO should document in policy or program format how the Optimain model is maintained, updated, and validated which could be accomplished by adding a description of these items within their DIMP.

Recommendation No. 11: Develop an objective set of granular descriptions of guidelines and program objective accountabilities on how DEO monitors and addresses active corrosion. Based on the discovery and review of their SOP's, it is not clear how DEO complies with their own O&M procedures. Active corrosion is a very important priority for the PIR project selection process, that they really need to identify, track and manage active corrosion detection, mitigation and remediation.

Recommendation No. 12: Based on discovery review and interviews, it is clear that DEO PIR projects face many conflicting priorities that influence project selection and execution. The report should recommend that as part of the annual PIR plan filing made to PUCO prior to the upcoming construction season, each proposed project making up the program portfolio indicates the primary driver for project priority and selection.

VI. COST MANAGEMENT AND O&M SAVINGS

Recommendation No. 13: Given that DEO is considering asking for an extension of the program through 2041, and our finding above that DEO has experienced cost benefits from using 3-year blanket contracts, DEO should consider using the additional 18 years as an opportunity to build cost mitigation and risk relief for contractors, especially because DEO relies on continued

availability of services from well-established and well capitalized contractors who may be willing to enter into a longer term contract that offers assurances for profitability, while also helping to stabilize DEO's costs.

Recommendation No. 14: Evaluate capital cost trends at the cost element level and forecast future cost relative to emerging trends and over the course of the program, by monitoring capital consumption in annual dollars that is constrained by the annual PIR cap, and capital productivity defined by capital expenditures to replace specific quantity of mains and services.

VII. LOST-AND-UNACCOUNTED-FOR GAS ("LAUF") AND EMISSIONS TRENDS

Recommendation No. 15: DEO and the PUCO should consider revising how they track LAUF, including emissions factors by pipe material and type, so that it separates out company use gas to gain a better understanding of whether emissions are declining due to PIR program activity, and to what degree the reduction in emissions and overall gas supply purchases are additional benefits of the PIR program.

VIII. ADMINISTRATION OF THE PROGRAM

Recommendation No. 16: The Executive team should consider developing a document that memorializes in detail the processes, roles and responsibilities, and controls of teams involved in the PIR program to assure that these processes are being followed and continue to be effective through the lifetime of the program, especially given that DEO has indicated that it may request an extension through 2041. The Executive team should also consider using the metrics defined within this report to internally evaluate the effectiveness of the PIR program, which should be periodically reviewed against DEO's program goals, including:

- Pace
- Leakage trends
- Risk scores
- LAUF
- Cost of replacement.

These metrics should be periodically reviewed against program goals.

IX. COMPARISON WITH OTHER SIMILAR PROGRAMS

Recommendation No. 17: Daymark recommends DEO bring its PIR program closer in line with those in jurisdictions discussed above by changing how it evaluates program performance by:

1. Submission of a proposed plan for each plan year and at the end of that year provide an actual vs planned reconciliation report, including cost and leak management metrics.
2. Development of a metric for its report to the management that tracks pipe replacement time by material category to show whether it is improving or delayed, because it will be important to track pace at this level in the event that any request to extend the duration and budget for the program or addition to scope of PIR eligible inventory is requested and approved.

Recommendation No. 18: PUCO and DEO should work together to develop an agreed upon set of metrics and report structure to be used in an annual report to be filed with PUCO that summarizes PIR program performance based on a comparison of proposed and actual results for the prior year.

Recommendation No. 19: DEO should evaluate whether it could use as a model the Maryland PSC decision to allow the gas utility to establish a deferred revenue account to track approved PIR costs that exceed the program cap to help ensure that the PIR program is completed by the agreed upon timeline of 2033 or 2041.

I. APPENDICES

A. Appendix - A – Schedule of Interviews with DEO Staff

Table 25. Interviews performed by Daymark Energy Advisors

INTERVIEW	CATEGORY	TOPICS/INITIAL QUESTIONS	INTERVIEW DATE
DEO staff	Administration	Goals and status of the program	3/22/23 @ 2pm EST
DEO staff	Technical	Project prioritization	3/27/23 @ 3:30pmEST
DEO staff	Cost	Cost to date v. total amount Cost per mile Breakdown of cost replacements Forecasted prices Cost management and control measures Cost recovery charge	4/6/23 @ 1:30pm EST
DEO staff	Administration	Reporting for program Governance and risk mitigation PHSMA trends	3/29/23 @ 2pm EST
DEO staff	Technical	Leakage information Compliance	4/5/23 @ 9am EST
DEO staff	Technical	Labor capacity	5/4/23 @2pm EST
DEO staff	Technical	Run through of Optimain model	4/19/23 @ 9am EST
PUCO Staff	Administration	Corrosion monitoring	4/5/23 @ 2pm EST
DEO Senior Management	Administration	Feedback so far Goal of the program Program effectiveness/cost Governance Reporting	5/4/23 @ 9am EST

B. Appendix – B – Optimain Manual

Optimain Manual – submitted electronically as a separate file – Discovery response 1.09 Attachment-1 Confidential.

C. Appendix – C – Example of GSEP Plan

Example GSEP Plan - submitted electronically as a separate pdf file.

Summary: Report Interim Review of the Pipeline Infrastructure Replacement Program of the East Ohio Gas Company D/B/A Dominion Energy Ohio electronically filed by Zee Molter on behalf of Daymark Energy Advisors, Inc..