Northern Indiana Public Service Company LLC

Cause No. 45967

VERIFIED DIRECT TESTIMONY OF ANDREW L. TRUMP

Q1. Please state your name, business address and job title.

A1. My name is Andrew L. Trump. I am employed by West Monroe Partners, LLC (WMP), a management and digital consultancy. My business address is 825 8th Avenue, 17th Floor, New York, New York, 10019.

Q2. On whose behalf are you testifying in this proceeding?

A2. I am testifying on behalf of Northern Indiana Public Service Company LLC ("NIPSCO").

Q3. Please describe your educational background.

A3. My educational background includes an undergraduate degree from Harvard College with a degree in Physical Sciences (Bachelor of Arts, cum laude General Studies, 1984), a professional Project Management certificate from the University of California at Berkeley (2003), and a master's degree in Public Policy from George Mason University (Master of Public Policy, 2011).

Q4. Please provide a summary of your professional experience.

A4. I have worked in a professional capacity since 1984, when I graduated from college, on a wide range of energy and transportation projects, programs, and initiatives. My experience includes work both as a consultant within management and professional services consultancies, and as an employee within technology and merchant energy firms. After working in Africa for a not-for-profit agency, I became a Senior Consultant with California Environmental Associates (San Francisco, CA) for eight years, until 1994. From 1995 to 1999, I was employed as a Senior Manager by CellNet Data Systems, a firm that developed one of the first radio frequency (RF) based advanced metering and meter data management platforms. My role involved, amongst other responsibilities, the development of cost-benefit analyses for the company's utility customers and the negotiation of multi-year contracts for the deployment and lease of these systems. Starting in 2000, I was employed by Duke Energy North America (DENA), a wholesale power generator owned by the Duke Energy Corporation. At DENA, as a Director of Project Development, I was responsible for the licensing approvals of two large "brownfield" power stations, entailing the securing of land use, environmental, interconnection, and other necessary agreements, settlements and approvals needed to permit the Company to

modernize these power stations. My role involved the hiring, supervising, and managing of a team of legal, technical, and environmental experts of over 80 individuals representing multiple disciplines related to wholesale power and industrial site development. Starting in 2007, I began consulting on grid modernization, mainly focused on electric and gas distribution systems. I was employed by Black & Veatch Management Consulting through October, 2018. From 2018 through 2020, I performed independent consulting services for several clients, in a similar capacity on gas and electric distribution system issues. Starting in January 2021, I was hired by West Monroe for my current role. At West Monroe I serve as a subject matter specialist focused on capital planning and valuation for energy market investments, including performing economic and business case analysis for grid modernization plans. Much of my work during the past 15 years has been focused on the strategy, justification, planning, implementation, and review of a wide range of technologies and programs for electric and gas companies.

Q5. Have you previously testified before the Indiana Utility Regulatory Commission ("Commission") or any other regulatory commission?

A5. Yes. I have provided direct written testimony to: (a) the IURC in the Southern Indiana Gas and Electric Company d/b/a Vectren Energy Delivery of Indiana, Inc. (Vectren South). IURC Cause No. 44910; (b) the Illinois Commerce Commission (Illinois Commerce Commission v. Commonwealth Edison Company, No. 12-0298 (2012), and Illinois Commerce Commission v. Commonwealth Edison Company. No. 14-0212 (2014). (Petitions to Approve Meter Deployment under ComEd's AMI Plan); (c) the Virginia State Corporation Commission (Petition of Virginia Electric and Power Company, for approval of a plan for electric distribution grid transformation projects, Case No. PUR-2021-00127); (d) the New Jersey Board of Public Utilities, (In The Matter of the Petition of Public Service Electric and Gas Company for Approval of The Second Energy Strong Program (Energy Strong II), BPU Docket Nos. EO18060629 and GO18060630); (e) the New Jersey Board of Public Utilities, (In The Matter of the Petition of Public Service Electric and Gas Company for Approval of The Next Phase of the Gas System Modernization Program and Associated Recovery Mechanism ("GSMP III"). BPU Docket No. GR23030102); (f) the California Energy Resources Conservations and Development Commission (California Energy Commission; as part of two thermal powerplant cases

before the Commission); and (g) the Central Coast Regional Water Quality Control Board (for purposes of federal water permit for a thermal coastal power plant).

Q6. Are you sponsoring any attachments to your direct testimony in this Cause?

A6. Yes. I am sponsoring Attachment 18-A, which is the NIPSCO Gas Meter Reading Technology and Solution Assessment and Recommendation prepared by West Monroe for NIPSCO (the "Business Case"), which was prepared by me or under my direction and supervision.

Q7. What is the purpose of your testimony?

A7. The purpose of my testimony is to provide context for the Business Case, to explain key observations and results of the Business Case, and to briefly explain NIPSCO's plan to implement new communications modules for its gas meters.

Gas Meter Communications

Q8. NIPSCO Witness Cocking describes NIPSCO's current gas metering technology, which utilizes automated meter reading ("AMR") technology. What has NIPSCO done in response to the changing

landscape of metering technology?

A8. First, with respect to the electric side of NIPSCO's business, in 2019, NIPSCO engaged West Monroe to analyze potential options for replacing NIPSCO's AMR electric meters and metering solution. This evaluation resulted in a formal "Electric AMI Metering Project" being presented to the Commission as part of NIPSCO's electric "TDSIC Plan" in Cause No. 45557. The Commission approved this project in late 2021. It includes replacement of all current electric AMR meters with new advanced metering infrastructure ("AMI") meters, as well as installation of the required field network communications backbone to allow for data collection and transmission. NIPSCO has also engaged West Monroe to assist with deployment of the Electric AMI Meter Project.

On the gas metering side, beginning in 2019, NiSource undertook a company-wide initiative to evaluate potential gas meter technology options, as all of NiSource's gas distribution companies were beginning to face the same technology/obsolescence issues for AMR metering technology, particularly since the manufacture of this equipment continues to recede (as AMI becomes the preferred metering standard). This evaluation looked at both the practical need for network communication

solutions and options (such as AMI), as well as fully integrated "smart gas meters," which offer incremental safety features and other benefits beyond meter reading.[1] By "smart meter" and "integrated," NIPSCO refers to new product innovation being rolled out by several leading AMI solution vendors.

Finally, earlier this year, NIPSCO also formally engaged West Monroe to assist with analyzing and evaluating various alternatives for future gas metering solutions.

Q9. Who was involved in the gas metering evaluation and what did this evaluation entail?

A9. Much like for the Electric AMI Meter Project, subject matter experts from numerous NIPSCO and NiSource business units were called upon for their expertise, and these groups worked directly with West Monroe to perform a formal technology, solution, and business evaluation, as West Monroe has

[1] Although West Monroe was not formally engaged in work related to NIPSCO's gas metering technology until recently, West Monroe was aware of this effort and had supported discussions and coordination efforts with NIPSCO stakeholders regarding the potential interplay between NIPSCO's electric and gas metering technologies and metering solutions.

deep industry experience in gas and electric metering projects[2] and is actively involved in NIPSCO's Electric AMI Meter Project.

As for the evaluation, the team engaged in a robust analysis of four alternatives, each of which is described in the Business Case. The analysis looked at everything from reverting to manual meter reading, attempting to procure and replace the AMR communication modules, known as ERTs,[3] replacing ERTs with AMI communications devices, and replacing gas meters with integrated, smart AMI meters. Ultimately, NIPSCO determined that replacing the ERTs on the Company's current meters with AMI communications devices—through a field installation of the AMI device onto existing gas meters—was the best solution for the Company and customers. NIPSCO refers to this project as program its "Gas AMI Upgrade Program."

This business case evaluation process – and the ultimate decision to pursue the Gas AMI Upgrade Program – is described in significant detail in the Business Case.

---

[2] *See generally* AMI Technology for Utilities | West Monroe.

[3] Encoder Receiver Transmitter, the term used by the AMR solution provider for the communications module which is installed onto an existing gas meter.

Q10. How is the Business Case organized?

A10. The Business Case begins with an Executive Summary. Section 1 provides the "Gas AMI Upgrade Business Case Evaluation," which includes the key decision factors used by the Company as part of its decision-making process. Next, in Section 2, there is a discussion of the "Current State of Gas Metering" (for both AMR and AMI), which establishes context for the options explored in the evaluation. Section 3 details the "Program Description, Goals, and Principles." Section 4 is focused on "Cost Evaluation." Within Section 5 there is an "Evaluation of Benefits," both quantitative and qualitative. Section 6 is the "Business Case Discussion and Results," providing detailed costs of the four evaluated alternatives, and a discussion on key observations and findings. Finally, Section 7 contains various "Appendices."

Q11. What were the key drivers of the decision to pursue the Gas AMI Upgrade Program?

A11. The overall decision-making process was driven by three key goals:

1) Addressing the Company's future gas meter reading requirements (due to the end of life of the current AMR system) in a cost-effective

and timely manner, and with minimal disruption to the Company metering, billing, and customer-care operations.

2) Fulfilling the Company's goal for establishing full AMI capabilities across all its gas and electric customer meters to bring the greatest amount of value to the NIPSCO customer (and a consistent experience) in areas of metering, billing, customer care, and energy management.

3) Positioning the Company to capture safety-related innovation opportunities within the AMI gas endpoint market (considering the future integration of fully integrated smart gas meters).

The Company concluded that there were three primary drivers that support NIPSCO's ultimate decision to pursue the Gas AMI Upgrade Program. First, the proposed direction is timely and represents a sound business decision that aspires to bring valuable gas AMI-related benefits to the Company and its customers. The Gas AMI Upgrade Program addresses the practical reality of AMR obsolescence and the need to replace AMR assets that may fail with technology that will continue to be supported by the industry in both the short- and long-term.

Second, the proposed business and technology solution is sound, fitting well within the norms of industry experience and aligned to the direction of NiSource's long-term technology adoption requirements.

Finally, the Gas AMI Upgrade Program represents *the most cost-effective solution* to meet NIPSCO's current and future gas metering requirements. In fact, as documented in the Business Case, the Gas AMI Upgrade Program is far more cost-effective than a path that replaces (by re-installing) the AMR system in a like-for-like manner,[4] or that replaces all the gas meters with the fully integrated AMI meter.[5]

These points are discussed further in the Business Case, which provides additional background and explanation and support of NIPSCO's Gas AMI Upgrade Program.

Q12. How will the Company carry out the new Gas AMI Upgrade Program?

---

[4] As discussed in the Business Case, there are also feasibility concerns with the like-for-like replacement, as current industry trends indicate it would be difficult, if not impossible, to procure hundreds of thousands of AMR communications modules. *See* Attachment 18-A at p. 14; *see also* Attachment 18-A Table 1, p. 10.

[5] It would likely also be difficult, if not impossible, to procure ERTs in the quantities that would be required to perform like-for-like replacements.

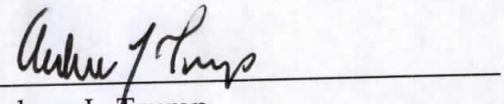
A12. Currently, NIPSCO is in the planning stages for program implementation. This includes negotiating with vendors to procure key equipment and services, assigning personnel to oversee and execute the program, and similar program commencement activities. Installation of the AMI communications devices on customer meters is expected to begin in mid-2024, and continue into 2025 and 2026. Executing this program in tandem with the Electric AMI Meter Project will also provide NIPSCO with opportunities to take advantage of efficiencies with the electric AMI roll out. For this reason, NIPSCO expects to focus and prioritize on gas meters in its combined gas/electric service territory. It will then move eastward to its gas-only service territory as the program progresses. With respect to the Forward Test Year (the period beginning January 1, 2024 and ending December 31, 2024) in this proceeding, NIPSCO estimates it will spend approximately $33 million in capital on the Gas AMI Upgrade Program during this period.

Q13. Does this conclude your prefiled direct testimony?

A13. Yes.

VERIFICATION

I, Andrew L. Trump, Senior Principal with West Monroe Partners, LLC (WMP), affirm under penalties of perjury that the foregoing representations are true and correct to the best of my knowledge, information and belief.



Andrew L. Trump

Dated: October 25, 2023

NIPSCO Gas Meter Reading Technology and Solution Assessment and Recommendation

453

Prepared for
NIPSCO
October 19, 2023

westMONROE

TABLE OF CONTENTS

Foreword iiv

Executive Summary 1

1. Gas AMI Upgrade Business Case Evaluation 9
2. Current State of Gas Metering: AMR and AMI 18
3. Program Description, Goals and Principles 33
4. Cost Evaluation 48
5. Evaluation of Benefits 53
6. Business Case Discussion and Results 61
7. Appendices 7071
   - 7.1. Detailed Business Case Cost and Benefit Input Assumptions 7071
   - 7.2. Benefits Inventory 73
   - 7.3. Class Estimate Definitions 82
   - 7.4. Business Case Decision Factors Radar Graphs 83

Acronyms and Definitions

Acronym	Definition
AFUDC	Allowance for Funds Used During Construction
AGA	American Gas Association
AMI	Advanced Metering Infrastructure
AMR	Automatic Meter Reading
BGE	Baltimore Gas & Electric
CIS	Company Information System
Company	Norther Indiana Public Service Company LLC (NIPSCO)
ConEd	Consolidated Edison
CRM	Customer Relationship Management
EE	Energy Efficiency
ERT	Encoder Receiver Transmitter
GHG	Greenhouse Gas Emissions
GIS	Geographic Information System
IT	Information Technology
IURC	Indiana Utility Regulatory Commission
LNG	Liquified Natural Gas
MDM	Meter Data Management
NIPSCO	Norther Indiana Public Service Company LLC (NIPSCO)
NiSource	Parent company of NIPSCO
NPV	Net Present Value
O&M	Operations and Maintenance
OCM	Organizational Change Management
OT	Operational Technology
OTA	Over-the-Air
PECO	Philadelphia Electric Company

RFI	Request for Information
RFP	Request for Proposal
RMA	Return Merchandise Authorization
RTU	Return to Utility
TDSIC	Transmission, Distribution, and Storage System Improvement Charge
TOU	Time-of-Use
SCC	Social Cost of Carbon
SLA	Service Level Agreement
SME	Subject Matter Experts
VEE	Validation, Estimation, and Editing
WACC	Weighted Average Cost of Capital
WAN	Wide Area Network
WMP	West Monroe Partners, LLC
WOMS	Work Order Management System

Foreword

West Monroe Partners, LLC., (hereinafter referred as "WMP") was retained by NIPSCO to assist NIPSCO in evaluating future metering solutions for its gas operations. WMP was selected in part based on its familiarity with and support of NIPSCO's electric AMI project. WMP worked with NIPSCO internal subject matter experts representing a wide range of disciplines to review the gas metering situation context and determine a range of reasonable and feasible alternatives. This work took place during Q3 2023.

As part of this robust evaluation process, WMP partnered with NIPSCO on the development of a Business Case which provides the basis for NIPSCO's decision to pursue a Gas AMI Upgrade Program during 2023-2026 in alignment with and parallel to its current electric AMI initiative.

The gas Business Case includes a description of costs and benefits along with program background information and key program decision support information. As part of this work, WMP gathered cost and benefit input assumptions and applied these to a scenario-based cost and benefit model. Where practical and feasible, benefits are quantified and monetized.

Report Authors:

Danny Freeman
Michael Lamb
Andrew L. Trump
Katie Pierce

Executive Summary

NIPSCO and its parent company NiSource are committed to the continued safe, reliable, and affordable sourcing and distribution of natural gas to its valued customers. As part of its service obligations, the Company must ensure that it can reliably, cost-effectively, and accurately obtain meter read consumption and other data from its gas meters to support accurate billing of customer energy consumption consistent with its approved gas tariff. The metering function, in fact, is the foundation of NIPSCO's billing and customer care activities, and a source of significant value-added opportunities for how NIPSCO engages with its customers about their use of NIPSCO energy services.

Due to metering technology moving away from the current once-a-month, mobile-based reading system (known as an Automatic Meter Reading system, or AMR), the difficulty in obtaining related AMR components and assets, and the fact that its AMR data collection system is beginning to reach end-of-life, the Company undertook an evaluation of technology options and has determined that its best and most cost-effective course of action is to upgrade the gas metering communications systems to AMI technology. This Business Case document describes its evaluation of reasonable and feasible options to upgrade its metering system and the decision factors it applied to these options in support of reaching its conclusions.

Business Case Preparation

To assess its business choices in a rigorous, thorough manner, and create its Business Case for the replacement of existing AMR technology, the Company assembled a cross functional team of Company subject matter experts (SMEs) and engaged WMP to evaluate the most reasonable and feasible options for the Company and prepare a Business Case report on its findings. This cross functionally supported Business Case evaluation team (involving financial, operational, technology, procurement, IT, implementation, customer care, and other SMEs) conducted its evaluation during Q3 2023. This report provides key issues, inputs, insights, decision factors, and conclusions resulting from this effort.

Considering industry advancement of technology alternatives over the past decade and due to AMR end-of-life considerations for the current gas metering system, the Company determined it was timely to conduct a Business Case evaluation to be prepared to recommend next steps for its meter reading system. The Company's SMEs worked diligently to assemble a range of meaningful scenarios for evaluation and comparison purposes, and to build the corresponding views of the costs, benefits, and other scenario attributes. The scenarios (four principal ones) and their assumptions form an essential feature of the Business Case. The team also presented its methods, over-arching perspectives and observations, and key findings to the Company's senior leadership.

By focusing on the gas metering technology and solution options, including implementation factors, and by coordinating with the teams focused on the electric AMI business process changes, benefit synergies, technology characteristics and procurement and cost assumptions, the gas metering Business Case demonstrates that NIPSCO has completed a comprehensive review of options and has selected a direction consistent with the interests of its customers.

The Gas AMI Upgrade Program

Informed by the results of the Business Case evaluation, the Company has concluded that the Gas AMI Upgrade Program is the best solution for meeting its metering upgrade requirements. The Gas AMI Upgrade Program, slated to officially beginning in Q4 2023 (when formal implementation planning activities will begin) and conclude in 2026, encompasses the planning and implementing of a Gas AMI solution for its approximately 850,000 residential and commercial gas customers.

AMI stands for "advanced metering infrastructure," a term (and acronym) that has been used by the gas, electric, and water utility industry for over two decades to describe what are now common and widely accepted metering technology solutions; AMI is the same network technology, solution and set of capabilities that the Company is deploying for its electric meter customers. To implement the Gas AMI Upgrade, the Company will install a gas AMI communication module on each of its existing gas meters. The modules will communicate to the same network as planned for the electric meter customers in NIPSCO's combination service territory, with only minor upgrades or modifications required, where a common network is in place.

For the gas meters located outside of this fixed network coverage 'footprint,' the Company will extend the same or similar fixed AMI network to cover these additional gas metering endpoints. Regardless of area, the network will be managed as a common network. Data from this common, fixed AMI network will be transmitted back to an AMI control system (using public, private, or Company owned communications circuits), and then presented to the billing and customer care systems (which are being modified to accept similarly structured and configured electric meter reading data). The fact that the Company can coordinate the gas and electric AMI deployments is a significant benefit for the gas metering solution, as documented in the Business Case.

Costs estimates for the Gas AMI Upgrade Program are summarized in Table ES-1 below, alongside the costs for the other scenarios evaluated.[1]

[1] The total life cycle costs of the Gas AMI Upgrade Program and the other three evaluated scenarios over a 15-year period are presented below in Section 4, Table 8.

Table ES-1: Cost Estimates Summary for Gas AMI Upgrade Scenario ($USD, Nominal)

Cost Categories During Deployment Period (2024-2026)	Gas AMI Upgrade
Capital Cost (Direct & Indirect)	$166.8MM
O&M Cost (One-Time & Recurring)	$11.8MM
Total	**$178.6MM**

The field deployment of the 850,000 gas AMI communication modules is a significant undertaking that requires rigorous planning and careful execution. It involves the training of field installation contractor teams in the technical, safety, and customer care aspects of performing the field installation, which takes approximately 10-15 minutes per customer meter. These skilled, front-line workers for the Company will be prepared to address customer questions about the deployment work, and they will otherwise serve as one of several resources involved with the Company's considerable customer outreach activities. As part of the field installation work, the installers will also be performing safety checks of the meters and gathering meter location information for purposes of updating the Company's equipment asset registry. Updating its asset databases aids in supporting future field work and supporting customer care functions.

Company Goals

As part of the Business Case development, the Company established several primary goals related to the metering solution upgrade. The Company seeks a solution and business direction that:

1. Addresses the Company's future gas meter reading requirements (due to the end of life of the current AMR system) in a cost-effective and timely manner, and with minimal disruption to the Company metering, billing, and customer-care operations.

2. Fulfills the Company's goal for establishing full AMI capabilities across all its gas and electric customer meters to bring the greatest amount of value to the NIPSCO Customer (and a consistent experience) in areas of metering, billing, customer care, and energy management. The Company recognizes that this AMI goal is highly synergistic with the Corporation's efforts to promote advanced metering technology across all its distribution utilities, in accordance with industry norms. It also recognizes that there are significant opportunities to coordinate the AMI electric and gas deployments, ensuring

that business and IT systems and processes enabled by AMI bring a common experience to the NIPSCO customer.

3. Positions the Company to capture safety-related innovation opportunities within the AMI gas endpoint market (considering the future integration of fully integrated smart gas meters).[2]

As documented in the Business Case, the Gas AMI Upgrade is the best scenario in terms of meeting these goals, including the cost-effectiveness criterion.

Evaluation of Reasonable Alternatives

To perform the Business Case effort during Q3 2023, in coordination with WMP, the Company engaged with its SMEs, key managers, and leaders across the organization to consider a wide range of feasible and reasonable alternatives. This evaluation effort levered the Company's growing experience and knowledge base of AMI, which it has gained through its active planning its electric AMI deployment.

The team explored features of four scenarios that formed the basis of the Business Case evaluation. The scenarios are:

- The Gas AMI Upgrade scenario implements the proposed program as described throughout this document.
- The AMR Replacement scenario is based on the like-for-like replacement of the AMR communication modules.
- The Manual Meter Reading scenario assumes the Company reverts to a manual meter reading operation as its current meter communication modules require replacement.
- The Integrated AMI Meter scenario assumes that the Company replaces all existing AMR communications devices *and* gas meters with fully integrated gas meters with embedded AMI communications capabilities.

The four scenarios are depicted in Figure ES-1. Also shown are value-add opportunities that were assessed as part of the evaluation effort. These contribute and are aligned to some of the scenarios and are considered as part of the Business Case for how they might add additional value.

[2] The Business Case further explains the features of the fully integrated smart gas meter, and how this is representative of the practical innovation being offered by the AMI solution providers.

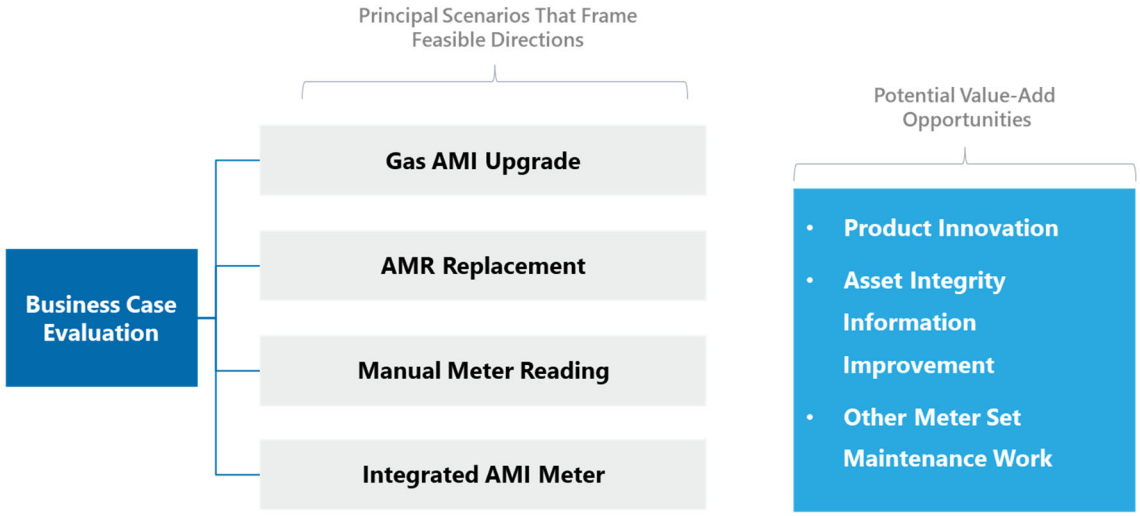


Figure ES-1: Four Principal Scenarios, and Value-add Opportunities Considered, Forming the Basis of the Business Case Evaluation

Evaluation of Key Decision Factors including Costs and Benefits

To create an objective review basis for the comparison of each alternative, the Company set out and defined eight (8) decision factors and scored each scenario against them, using observations and output results from the Business Case work. For each decision factor (row) the Company determined the low, middle, and high preference for each scenario, using the values 1, 2, and 3 respectively. 0 is also used to indicate that the scenario fails to meet minimum acceptable requirements for that decision factor.

- 0 = Fails to Meet Minimum Criteria
- 1 = Inferior, Meets Few Criteria
- 2 = Adequate, Meets Some Key Criteria
- 3 = Strong, Meets Most or All Key Criteria

This application of these factors, and the rank ordering of results, are shown in Table ES-2. Note that in some cases it scored the attribute equally across two scenarios when there is not a strong differentiation in that instance.

Table ES-2: Summary of Key Decision Factors for the Gas AMI Upgrade Versus Alternatives Using Scoring Method

Key Decision Factors	Return to Manual Meter Reading	AMR Replacement	Gas AMI Upgrade	Integrated AMI Meter
Timetable	3	1	3	2
Implementation Cost	3	1	2	0
On-Going Costs	1	2	3	3
Operational and Customer Benefits Potential	0	1	2	3
Feasibility	1	2	3	2
Vendor Fit and Support	0	1	3	3
Innovation Opportunities	0	1	3	3
Cost-effectiveness	0	1	3	0
TOTAL	8	10	22	16

Based on the decision factor scoring shown in Table ES-2, it is reasonable to conclude that the Gas AMI Upgrade is substantially superior to each of the other alternatives, especially considering its advantage on criteria (per Table ES-2) of Implementation Cost, On-Going Cost, Cost-Effectiveness, and Feasibility of execution (which includes consideration for whether the necessary components are available in large quantities sufficient to meet the requirements of the deployment timetable).

The Benefits of the Gas AMI Upgrade Program

To help guide the evaluation of benefit potential, the Company has identified the functionality differences between AMR and AMI. This helps clarify how functionality drives the impacts and the benefits that are important to the Company's operations and to the customers. The Business Case includes a ''benefits inventory" of 39 benefits associated with the Gas AMI solution created as part of the evaluation. These form a foundation of Company goal about the potential represented by the gas AMI solution. The Business Case also documents the benefits that are customer- and safety-oriented.[3]

Cost-Effectiveness Results

Cost-effectiveness is listed in Table ES-2 as one of the eight key decision factors. It is also elevated as a feature of one of the major goals. On cost-effectiveness grounds, the Gas AMI Upgrade scenario is superior to the alternatives because it's *'all in'* cost of $233 million ($USD, nominal) over the 15-year period is less than the AMR-based scenario of $516 million ($USD, nominal), *plus* AMI delivers a higher level of effectiveness in terms of achieving the Company's

[3] The focus within the Business Case is on the benefits of AMI. Because the Company currently uses an AMR system, there are few incremental benefits associated with replacing the AMR in a like-for-like manner.

other top-line goals (re: AMI-driven value for all NIPSCO customers, and an innovation platform).

The AMR solution is also approximately 25% more expensive to operate and maintain than the AMI solution, which also affects the cost-effectiveness conclusion. The cost-effectiveness of the manual meter reading option is 0 (zero) because it fails to meet the effectiveness criteria (re: the goals as set out). Although an Integrated AMI Meter scenario is also evaluated as part of the Business Case, and this solution could provide additional, incremental benefits beyond the Gas AMI Upgrade, cost is a significant factor weighing against 100% meter replacement, as the estimated all-in cost for the Integrated AMI Meter scenario is $640 million ($USD nominal) over the 15-year period and had a significantly poorer result from a net present value (NPV) perspective.

The cost-effectiveness result is concordant with the Company's commitments to pursue a direction that places customer interests first, and which respects the capital constraints of the business (which in turn plays a key role in supporting customer affordability for the delivery of safe and reliable energy services).

Fit within Industry Norms

The Business Case describes examples of developments within the AMR and AMI solution market. It includes descriptions of several large gas AMI deployments, demonstrating that AMI is the current norm within the metering industry and is commonplace for utilities to upgrade metering systems to AMI fixed networks, particularly when a fixed network is available as part of servicing electric meter customers.

The Business Case also describes the nature of some of the valuable innovation being carried out by AMI solution providers. This includes a focus on developing new gas meters that are "fully integrated" with communication capabilities and safety features (such as a remote shut off valve).

The Company evaluated the opportunities to deploy these new meters as part of the Gas AMI Upgrade scenario. It concluded that this new product has great appeal and long-term merit but is too costly to deploy *en masse* at this time. It also concluded the product needs more demonstrated market maturity (for very large-scale deployment, particularly as part of a 'mass' field deployment effort over a short period of time). Rather, it concludes for purposes of the Business Case that it would include a requirement that its AMI network solution must be able to provide this new product so it can be placed into the field as part of fulfilling routine, small quantity lot, new gas meter replacement requirements.

AMR Obsolescence Risk

The Company recognizes that the Business Case should be attentive to the risk of selecting a technology and direction that imposes a risk of unexpected obsolescence. It does not make good business sense to select a technology that cannot deliver the types of information (at the level of frequency, accuracy, and reliability) that is needed. From a regulatory standpoint, the risk of obsolescence could hamper the Company's confidence in its cost recovery assumptions. Accordingly, the Business Case includes consideration of AMR's potential *functional* obsolescence and concludes that it poses an unreasonable risk due to the possibility that it may be functionally obsolete before the new assets would reach end of useful life.[4]

The risk to AMR's functional obsolescence has several underlying factors. First, it does not represent state-of-the-art technology and is increasingly outside the norms of modern utility metering, billing, and customer care practice (particularly when they are deployed under AMI fixed networks available to read the gas AMI data). AMR also has significant deficiencies compared to AMI in the functionality it delivers. This is documented in Table 3 of the Business Case, listing the information types and attributes of each solution. The AMI product innovation fits into this general pattern of an expanding gulf in functional capabilities between the two solution types.

Summary Conclusions

The Company's Business Case conclusions and proposed direction – to implement the Gas AMI Upgrade – is timely and represents a sound business decision that aspires to bring valuable gas AMI-related benefits to the Company and its customers. The Gas AMI Upgrade scenario is well aligned to the Company's three main goals, including addressing the current communication module end-of-life in the *most* cost-effective manner when compared to the evaluated alternatives. In fact, the Gas AMI Upgrade Business Case recommendation is far more cost-effective than a continued path that replaces the AMR system in a like-for-like manner, or that replaces all the gas meters with the fully integrated AMI meter.

The proposed business and technology solution is also sound because it fits well within the norms of industry experience and direction, and it is aligned to the direction of the Corporation's long term technology adoption requirements. In fact, a replacement of the current AMR system with AMR introduces an unreasonable level of *functional* obsolescence risk given the direction of the AMR and AMI solution market.

[4] As further discussed below, there are also feasibility considerations, as the AMR communications modules are not likely to be available in the quantities necessary.

1. Gas AMI Upgrade Business Case Evaluation

The Company recognizes the importance of making a sound business decision -- grounded on (a) pursuing AMI-related technology and related operational and customer benefits, (b) addressing the future of NIPSCO's AMR metering in a timely manner, and (c) opting for a direction that is informed by cost-effectiveness. A good decision now will support the quality and cost efficiency of the NIPSCO's gas metering system for many years, an outcome which is the foundation for NIPSCO's long-term customer billing and customer care services.

In support of it goals, the Company defines eight (8) supporting decision factors. It cannot achieve its goals without achieving acceptable outcomes in these criteria areas. Underlying each decision factor is the requirement to protect the continuity to the NIPSCO customer's metering, billing, and other important customer care service requirements.

Table 1: Summary of Key Decision Factors for the Gas AMI Upgrade or Alternatives

Key Decision Factors	Company Requirements
Timetable	The Company's direction, and choice of technology and vendor(s), must support the timetable for the completion of the upgrade. (Solutions need to be in place and well-functioning not later than Q4 2026). Failure to complete the upgrade in time could drive manual meter reading costs to collect reads until such time as the new system is fully installed and negatively impact the customer experience.
Affordability and Overall Program Cost	The cost to implement the upgrade will directly affect customer rates. NIPSCO continues to invest capital in its gas system to support safe, reliable delivery of gas, and incremental investments will impact customer affordability. Additionally, NIPSCO's capital investment must fit within its overall capital budget, which is concordant with a wide range of Company and Customer priorities. Decisions cannot be made in a vacuum. Resources are limited, and a decision to pursue one effort may defer or change others. The capital budgeting process resolves these matters of priorities and timing of utility programs.
On-Going System Maintenance Cost and Complexity	The solution that the Company elects must represent a good fit for the Company in terms of its capabilities (which can lever the cost of ownership down) and be a good choice from a long-term ownership perspective. If the solution is new to the marketplace, or if it requires too much infrastructure, this could drive estimated costs too high.
Operational and Customer Benefits Potential	The solution should position the Company well to develop internal and customer-impacting and -facing applications and services in a way that add value to the business and to the customer experience. While not all the specifics are known today about the suite of services that the Company

Key Decision Factors	Company Requirements
	can implement in support of the gas meter customer, it is especially important that the Company decide about the directions of technology and vendor offerings, in pursuit of greater value from an operations and customer perspective. This is particularly relevant given the need to create a common AMI-centric customer care experience for both electric and gas customers. The other side of this factor is solutions that negatively impact the customer experience, due to separate solutions for gas and electric, and a lack of a common and consistent experience for the customer.
Cost-Effectiveness	Cost-effectiveness merits emphasis because of its implicit counterbalancing of costs (on the one hand) and impact, or effectiveness, on the other. For the latter, the Company defines *effectiveness* as that direction and solution which best meets Company goals as defined. (An additional secondary *effectiveness* criterion is in relation to a solution that makes best use of the Company's existing or planned infrastructures, (AMI network, telecommunications, IT platforms, Cyber, etc.), to improve asset utilization. This criterion factors into the solution feasibility criterion).
Feasibility (including ease of implementation and on-going operations)	The solution must be feasible to implement within the required timetable. If there are elements of the infrastructure that are overly complex to implement, or too numerous, or if there are gaps in the end-to-end solution architecture that are speculative, this introduces risk that should be assigned and addressed. The Company uses several supporting factors to evaluate the solution feasibility. (These factors may signal a feasibility risk). These include: (a) excessive deployment costs, (b) complex system architecture for IT and OT processes, (c) excessively large installation workforce required, (d) solution track record in the market, (e) solution and deployment flexibility in relation to the deployment of the fixed network (some solutions offer flexible mobile solutions as a short-term interim while the fixed network is deployed. Solution feasibility is also a function of the safety to employees and communities related to the solution, from an on-going operations point of view. For example, manual meter reading involves visiting customer homes and gaining access to yards etc. on a routine and continual basis.
Vendor Fit and Support	The Company places a strong degree of reliance on the support from its vendors to plan (and implement) all aspects of the solution effectively, carefully, and efficiently. This support involves a wide range of activities and technologies, in a variety of environments (field, back office, customer-facing, etc.). The Company must have the confidence in the maturity of the solution (as demonstrated in the marketplace), and in staying power of the vendor's solution in the marketplace to sustain the several year

Key Decision Factors	Company Requirements
	deployment cycle, to provide on-going maintenance warranty support, and to support product and solution innovation. The Company uses a range of supporting factors to consider the overall fit of the vendors to the Company's charge in deploying and operating the solution. These factors include: (a) fair terms and conditions as part of contract development; (b) best practices in client support as requirements are identified and work scopes developed; (c) adequate resources to support the Company's deployment timetable; (d) support for the Company's procurement values, including diversity in supply chain sourcing; (e) unequivocal embrace of the Company's safety culture and requirements, including the related emphasis on employee training; (f) Commitment to cybersecurity and other key IT protocols.
Innovation Opportunities	As noted above, a key decision factor is the ability of the Company to enjoy the benefit of a solution platform and provider that encourages, pursues, and promotes a wide range of product and service innovation. Additionally, because the span of the AMI metering solutions is wide in terms of business impacts, so too are the opportunities to introduce innovation into how the Company drives the platform to achieve customer and operational benefits. Supporting factors include participation on key industry research and standard setting organizations, in furtherance to innovation.

Evaluation Process

Company's SMEs, managers, and leaders worked directly with WMP and applied these decision factors in identifying and shaping the scenarios and, in ultimately determining a best fit solution.[5]

Each of the decision factors were subject of deliberation and discussion as part of all-team discussions and separate breakout sessions focused on specific topics. Source information for the discussions included the learnings and experience associated with the Company's current electric AMI deployment activities, the Corporation's on-going metering technology performance evaluation (performed in furtherance of the interests of all NiSource operating companies), vendor discussions and data requests, industry research and benchmarking, and input from experienced technology consultants.

[5] For simplicity, this Business Plan refers to "NIPSCO" and "the Company" throughout, but these terms include the work performed by WMP in coordination with NIPSCO SMEs, unless otherwise noted.

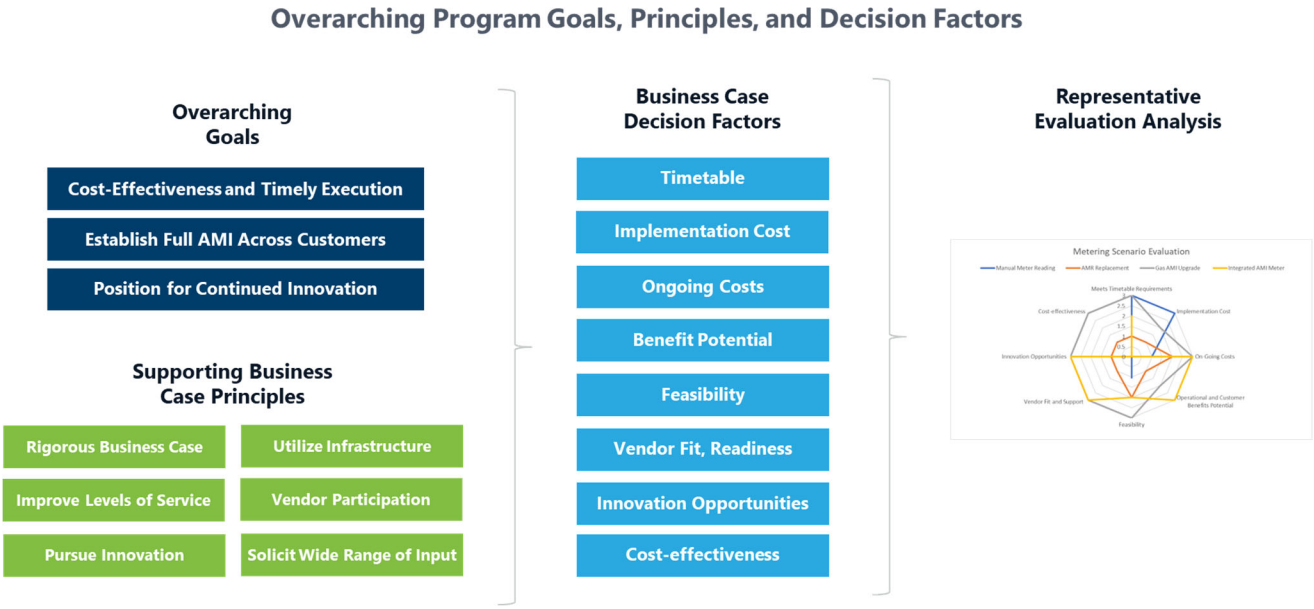


Figure 1: Relationships of Goals, Principles, and Decision Factors

Topic breakout sessions included, among others: Technology Solutions, Deployment Optimization, Procurement Requirements, Asset and Risk Management, Telecommunication Strategies, Financial Constraints, Regulatory Cost Recovery Requirements, Customer Impacts and Requirements, Safety, Electric AMI Planning and Operations (learnings to date), Program Team Governance, Business Process Requirements, IT Integrations and Development Requirements (including Cybersecurity).

Each of these areas was discussed in depth within a group of SMEs to vet the key considerations and pros/cons of the various alternative solutions. Additional, broader meetings and discussions were also held *among* the various groups to ensure cross-coordination, collaboration, and consideration of the interplay between and among competing interests. For example, the Integrated AMI Meters option may provide the most incremental benefits and functions, but it would require investment of more capital, significantly impact affordability, and present greater challenges to implement—as every customer's home would lose gas service and require relighting of gas appliances within the home.

Through this process and many sessions, the Company advanced its level of insight within these decision factor areas. This included a steady progression of improved cost estimation, informed by scope clarifications for major activity areas. The cost estimates (and key driving assumptions for the costs) were captured in a MS Excel financial calculation model.

The Company recognizes that addressing the decision factors (to answer how well each scenario meets the related requirements) requires consideration of a wide range of supporting questions and gathering of information (on a best-efforts basis) and discussing the importance and

takeaways from this information. Determining the Company's position on each of the decision factors, for each of the scenarios, requires discernment and ultimately the subjective judgement of Company experts and leaders.

Identification of Alternatives (Scenarios)

In addressing its metering challenges – commensurate with its opportunities to pursue the full integration of AMI into its electric and gas business – the Company SMEs evaluated four principal options or directions.

- Pursue a path towards full AMI with the upgrade of the gas metering system to AMI.
- Replace all gas AMR communications modules and meters with fully integrated gas meters with AMI communications capability.
- Continued reliance on an AMR solution by replacing its current AMR solution.
- Revert to a reliance on manual meter reading.

It organized these directions for assumption making in the form of formalized *scenarios* to best inform and describe the many attributes and to aid in making scenario comparisons. Forming scenarios allowed the team to explore the full scope of the potential impact of the solutions under evaluation.

In addition to the four scenarios, Company also evaluated variations (or options) that overlay the scenarios. These are features that may add value to the scenarios. One is to pursue certain field deployment opportunities related to safety checks, data capture and updates to the Company's asset registry information database—something NIPSCO will be performing as part of the chosen solution.

The other is to consider additional, incremental work that could be performed at the time of visiting a customer's premises, such as taking this opportunity to address known Grade 2 or Grade 3 leaks. This option of performing additional work is most available as part of a large deployment of the new, integrated gas meters that embed AMI functionality (re: the Integrated AMI Meter scenario). These value-added options are defined further below in Table 4. These variations were not inspected in relation to the two scenarios that did not involve some version of an AMI solution, largely because these options represent a furtherance of ambition in capturing customer value using AMI technology specifically.

The options do expand the scope (and cost) of the Gas AMI Upgrade program. However, one (basic safety-and integrity-related inspections and data capture[6]) adds value to the Program with only minor cost impacts. The other – engaging in additional, incremental maintenance work

[6] The field installation technician will be able to perform a check of the meter for corrosion, note any odor, and capture information about the meter location, for purposes of improving the asset registry. The field technician will flag conditions that warrant follow up by NISPCO gas technician.

– is deemed cost prohibitive and overly-complex to implement. Additionally, while the Company chooses the Gas AMI Upgrade over the Integrated AMI Meter scenario, NIPSCO determined there is merit to begin installing gas meters with the fully integrated gas-capable AMI technology when existing meters fail or new customers have meters installed.[7]

With these scenarios and options, the Company believes it has bracketed a reasonable range of alternatives worthy of further investigation. The scenarios and added options range from a low value capture perspective to high value one. Notably, for the four core scenarios, there is an *inverse relationship between low value options and their implementation and system sustainment costs*. Low value directions cost more, and provide significantly less value, than the higher value AMI direction.

By tabling these scenarios and additional options the Company does not *de facto* assume feasibility. Feasibility is one of the decision factors noted for consideration. For example, the team reviewed the vendor meter product innovation with an eye towards product maturity and readiness for deployment *at scale* (meaning the product is available in production quantities of many thousands per month).

Additionally, based on current industry trends, NIPSCO reasonably infers that it would be difficult, if not impossible, to procure hundreds of thousands of AMR communications modules. This makes the replacement of AMR communications modules on a like-for-like basis an infeasible solution strictly speaking. Instead, it bases its AMR replacement scenario on the acquisition of the standard replacement product, which is involves a mix of AMI communications modules and integrated AMI meters programmed for "AMR mode." It also considered the feasibility of hiring and maintaining the labor resources required for the manual meter reading scenario.[8]

Table 2: Summary of the Four Principal Scenarios and Additional Value-add Opportunities

	Return to Manual Meter Reading	AMR Replacement	Gas AMI Upgrade	Integrated AMI Meters
Description	Deploy manual meter readers to perform monthly	Purchase replacement AMR Communication	Migrate the gas metering to Gas AMI with communications	Migrate the gas metering to Gas AMI by replacing all gas meters with

[7] The Company informed WMP that beginning in 2022, NIPSCO started purchasing integrated meters with AMI capability for its AMR system replacement needs, deploying them in "AMR mode." This was required because the AMR replacement modules (ERTs) were not available from the manufacturer at quantities and on the lead times needed by the Company to fulfill their metering obligations. The Company also determined that beginning to install some volume of these integrated gas meters provided them with another opportunity to evaluate the safety features of this innovative product.

[8] In this case of the manual meter reading scenario, the Company would have to recruit, train, deploy and sustain a large team of meter readers.

	Return to Manual Meter Reading	AMR Replacement	Gas AMI Upgrade	Integrated AMI Meters
	reads as the AMR modules fail.	Modules to replace existing modules.	modules, leveraging fixed network and business and IT processes.	a fully integrated, AMI-capable gas meter.
Value add Opportunity: Field Deployment Activities (related to Asset Integrity Status and Improved Information); Safety Check Inspection (Corrosion, Meter Tamper, Odor), Meter Information	N/a	N/a	(Evaluate for possible inclusion) Pursue as part of AMI	(Evaluate for possible inclusion) Pursue as part of AMI
Maintenance Work: Perform Grade 2 and Grade 3 Leak Repairs as part of AMI deployment	N/a	N/a	(Evaluate for possible inclusion) Business Case Option: Potentially pursue as part of AMI	(Evaluate for possible inclusion) Business Case Option: Potentially pursue as part of AMI

Identification of Options (for AMI)

By **Product and Solution Innovation Opportunities**, the Company recognizes that depending on the AMI solution and vendor selected, there would be opportunities to deploy new metering technologies that in turn could provide a range of valuable safety- and asset-integrity features. The Company further recognizes that as part of the Business Case evaluation, this is an important criterion to factor into its directions for solution direction and vendor choice.

A leading example of this innovation is the availability of a fully integrated, communications ready, smart gas meter. This meter includes a set of alarm features and a mechanical valve, which can be controlled (open, closed) thru the network. Although NIPSCO is not proposing to replace all existing customer meters with fully integrated smart meters (re: the Integrated AMI Meter scenario), as current meters fail and new customers have service connected, NIPSCO expects to begin utilizing AMI smart meters for such installations.

By **Value-add Opportunity**, the Company recognizes, that it may be possible to pursue certain types of inspections and data gathering activities as part of the field deployment of the AMI communications modules. Data gathering and inspections can be performed of the meter location, and its general condition (and if warranted, the field technician would instigate a follow-on field trip by the Company gas technician to inspect more carefully). The installation can also include a visual corrosion inspection. The Company also evaluated as part of the Business Case the handling of Grade 2 and Grade 3 leak repairs at the time of the AMI communications module field deployment.

Figure 2 summarizes the principal scenarios and the value-add opportunities.

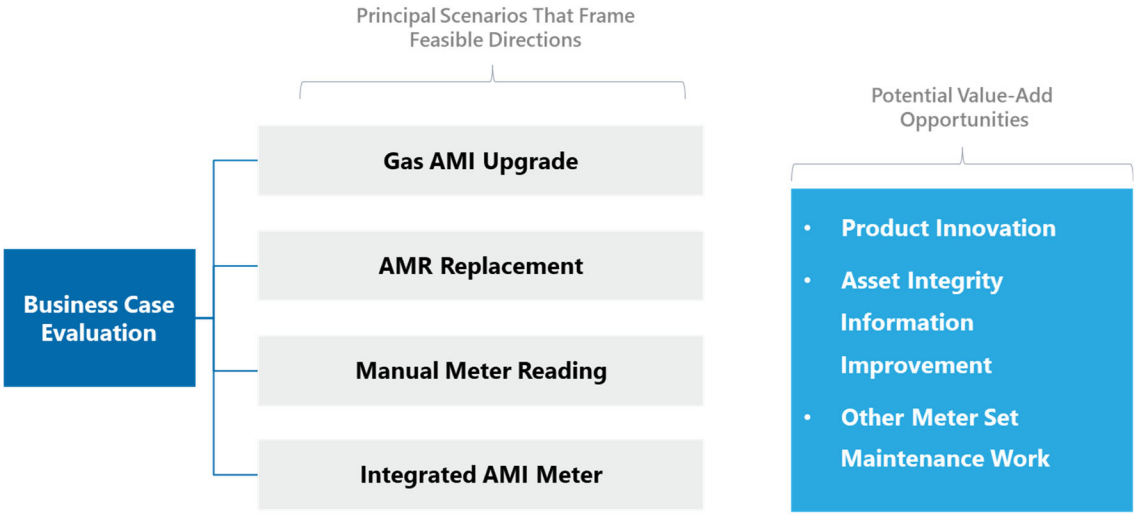


Figure 2: Four Principal Scenarios, and Value-Add Opportunities Considered as part of the Business Case Evaluation

Key Issues Identified During Business Case Evaluation

This section describes some of the topics influencing the Company's deliberation on the scenarios and options.

1. Given the solution implementation timetable, the Company identified the advantages of leveraging its planned electric AMI fixed network for the gas meters falling within this network area. It confirmed that the gas AMI communication modules would be easily managed within this network footprint with minor alterations to the field network design.

2. The Company identified how it could further leverage its telecommunication assets to supply backhaul network services throughout the gas-only territory, as part of several network solution options. It also identified the challenges inherent in some AMI fixed network solutions were they to require many takeout points.

3. The Company found an advantage of several AMI solutions in that they could provide valuable flexibility for the optimization of a field installation plan, as the fixed AMI network is built in the gas-only metering area. For these vendor solutions, the gas AMI communications module could be deployed, and mobile based equipment could read the AMI-equipped meter until the fixed AMI network is installed. This would likewise apply to the Integrated AMI Meter scenario.

4. The Company found many opportunities for achieving planning and implementation synergies by aligning and coordinating the electric and gas AMI program work. This alignment and coordination carry through the technical and business activities of setting up the AMI system capabilities and provide opportunities to build customer care processes and applications levering a common set of data management and presentation assets. This will improve the quality of these customer care service capabilities.

5. The Company determined the feasibility of including within the field installation contractor scope a set of data gathering tasks, including safety checks of the meter and related equipment (regulator, index, riser). Conversely, although performance of additional, incremental work is considered as a variation on two scenarios, (Grade 2 and Grade 3 leak repair) this work would greatly expand the scope of field installation and require additional qualifications/certifications by contractors.

6. The maturity of several new meter product offerings from leading AMI solution vendors were investigated to understand the use cases related to the meter functionality (and related handling of set points and alarm features in the AMI control system). The maturity of the product was also investigated to determine the practicality of sourcing this new meter in scale and at a cost point whereby it could be considered as part of the AMI solution.

2. Current State of Gas Metering: AMR and AMI

To inform its Business Case, the Company sought confirmation concerning the state of the AMR and AMI marketplace as it relates to both electric and gas metering. It looked to confirm that the pursuit of gas AMI – meaning fixed networks capable of providing highly reliable daily, hourly, and even sub-hourly measurement – is the norm for the gas distribution utility and that this direction has not experienced significant setbacks in terms of benefit achievement and the vendors' on-going ability to support. This is an area where WMP has particular expertise and provided information to NIPSCO to allow an informed decision to be made.

To provide this confirmation, the Company asked several questions in several general areas:

- What is the status and broad trend in the gas AMR and AMI market? How many meters are under AMR versus AMI systems?
- What are the key functional differences between AMR and AMI systems?
- What are several leading examples of decisions that major gas and/or combination electric and gas utility companies in the United States have made?
- Where is the innovation directed? Is the product evolution and innovation moving away from AMR and decidedly into fixed AMI network directions?
- From a functional obsolescence point of view, what are the potential risks and implications of choosing AMR?

The conclusion of the Business Case is that the further pursuit of AMR as the replacement choice would be a poor direction and conclusion. The electric and gas metering solution marketplace and technology landscape is moving away from mobile-based metering solutions that can only provide basic read functionality (see Table 3). This means, in summary, that a choice to pursue AMR is an unreasonable business risk due to the likelihood that the functional limitations of the AMR system, once deployed, could render it *functionally* obsolete. This result conflicts with the goal to set reasonable and confident expectations for the economic service life for the assets as part of amortization.

Status and Broad Trend in the Gas AMR and AMI Market

Through research and peer utility benchmarking, the Company has determined several key trends in the gas AMR and gas AMI markets. While not yet as prevalent as electric AMI meters

deployed,[9] gas and combination utilities are increasingly shifting away from manual meter reading and away from AMR to realize the benefits that AMI solutions are able to deliver. One key contributing factor to this trend has been the continuous improvement of gas AMI technology (endpoints, network solutions, backend systems) and the impact those technology improvements have had on the overall gas AMI Business Case.[10] Many of the largest combined electric and gas and gas-only utilities across the country have made the investment in AMI systems in recent years, pushing the total number of gas AMI endpoints deployed to over 25 million, with several large deployments expected to take place in the coming years. NIPSCO's position as a combination utility and one that is on the precipice of deploying electric AMI metering informed NIPSCO's evaluation and decision-making process.

Figure 3 provides a high-level depiction of the key differences between AMR and AMI systems.

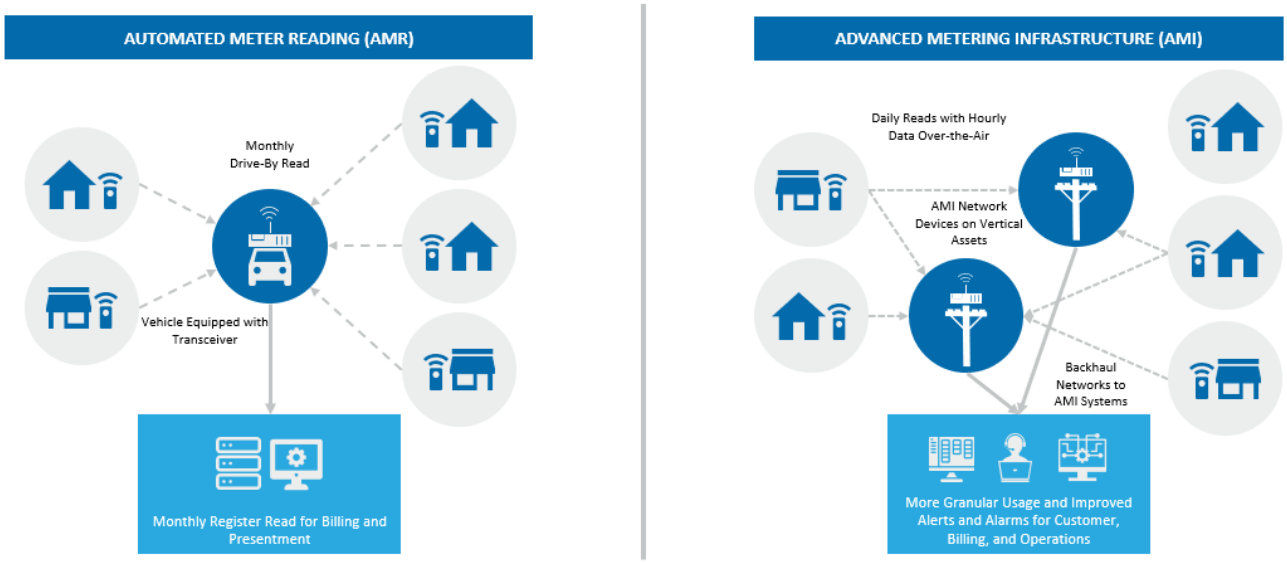


Figure 3: Gas Meter Reading Solutions in the United States

[9] See: https://www.eia.gov/tools/faqs/faq.php?id=108&t=#:~:text=In%202021%2C%20U.S.%20electric%20utilities,electric%20meters%20were%20AMI%20meters.

[10] See: https://sensus.com/wp-content/themes/sensus/inc/webdam_download.php?asset_id=80843063

What are the Key *Functional* Differences Between Gas AMR and AMI Systems?[11]

To provide perspective and context about the AMR and AMI market and technology directions, it is useful to consider as part of the Business Case the wide disparity in functional differences between the solutions. The Company has identified within Table 3 key functional differences of the technologies.

Table 3: AMR and AMI Functional Differences

Gas AMR	Gas AMI
• Once per month drive-by meter read • Register (bill cycle) reads • Read window: Read available within three +/- days of billing cycle date[12] • Read availability *somewhat* weather dependent (productivity could fluctuate based on weather-driven delays) • Additional truck roll to collect other reads (move in/out, on-demand, meter investigations, etc.) • Limited alert and alarm data for tamper, theft, or safety conditions • Single direction communications • Delay in usage, safety, and operational information flowing back to Company	• Monthly billing read (accessible in meter data management platform and CIS) • Daily consumption read • Hourly consumption data • Read window: Monthly read available in meter data management platform and CIS on billing cycle cut-off • Improved read availability • Validation, estimation, and editing (VEE) routines in meter data management platform for improved read accuracy • Read availability is less weather dependent, and productivity of system is levelized • Move in / move out reads available remotely • On-demand reads (customer complaint, meter investigation, etc.) supported • Ability to offer customer rate options (such as tiered rate structures) • Ability to offer customer information via web portal, apps • Ability to offer flexible billing dates, or summary billing options • Tamper alarms • Ability to identify excess flow • Other alerts and alarms supported in integrated gas smart meter products (temperature, pressure, etc.) • Battery life reporting (for improved long term module maintenance and network value)

[11] Additional information about integrated AMI meters is discussed further below. Information specific to benefits is also included in the Benefits Inventory, provided in Appendix 2.

[12] Reliance on manual meter reading would provide a lower level of performance compared to AMR. Read availabilities are often lower due to inherent productivity challenges of walking routes (and dealing with circumstances such as weather). Read accuracy also is typically lower when meter readers must read and key in meter reads to a handheld device.

Gas AMR	Gas AMI
	• Bi-directional communications and data flow • Ability to support customer pre-pay programs • Improved distribution system engineering and planning • Improved gas load forecasting • Improved EE program delivery • Synergies with vendor to offer added end point monitoring (such as cathodic protection, pressure sensors)

Understanding the functionality of each solution adds insights to the range and types of beneficial impacts (through processes) each technology can deliver. This informs the development (provided within the Business Case) of the benefit potential of the Gas AMI Upgrade direction. (See the Benefits Inventory, provided in Appendix 2). The functionality creates the means to modify business processes that result in the benefit aspirations. The benefit potential must start with this understanding of functional capabilities.

In addition to the functions enabled as part of the gas AMI solution, (as listed above in Table 3) several AMI solution vendors have introduced a new meter product described as "fully integrated." This meter includes the communications module as an embedded device within the meter housing. Instead of interfacing an AMI communications module to the meter index as part of a field installation, this meter is deployed to the field as a new product in a network-ready condition.

This product includes several alarm features for excess flow, pressure, and temperature (like the AMI communications module) and presents the opportunity for additional safety benefits. This product also includes a mechanical valve that can be used to open and close the gas flow. This valve is controlled remotely "over the air" through a control signal issued from the AMI operating system. Although it is relatively new to the market, this development has the potential to provide a valuable product safety feature. In the case of an emergency condition affecting one specific meter or the entire neighborhood, a utility could close meter valves and terminate gas flow almost immediately (depending on network performance), then follow with dispatching personnel to the premises, which could reduce gas ignition risks significantly during the time it takes for personnel to reach the premises.

As noted, NIPSCO anticipates deploying some version of an integrated gas AMI meter for new customer gas meter installations and/or when existing meters fail. Moreover, the Company will be carefully evaluating the industry trend line for the broad scale acceptance of the integrated product (including a large library of mature and demonstrated use cases for its important safety

features) It is also possible that the current standard gas meter may become increasingly expensive in comparison, or hard to procure (for some meter sizes and forms).

NIPSCO's Current Metering Systems and Progress on Electric AMI

NIPSCO's current metering system is comprised of approximately 490,000 electric and 850,000 gas meter endpoints located throughout 30 Indiana counties. Figure 4 depicts the Company's metering territory, showing approximate areas of gas-only, electric-only, and overlapping territories.

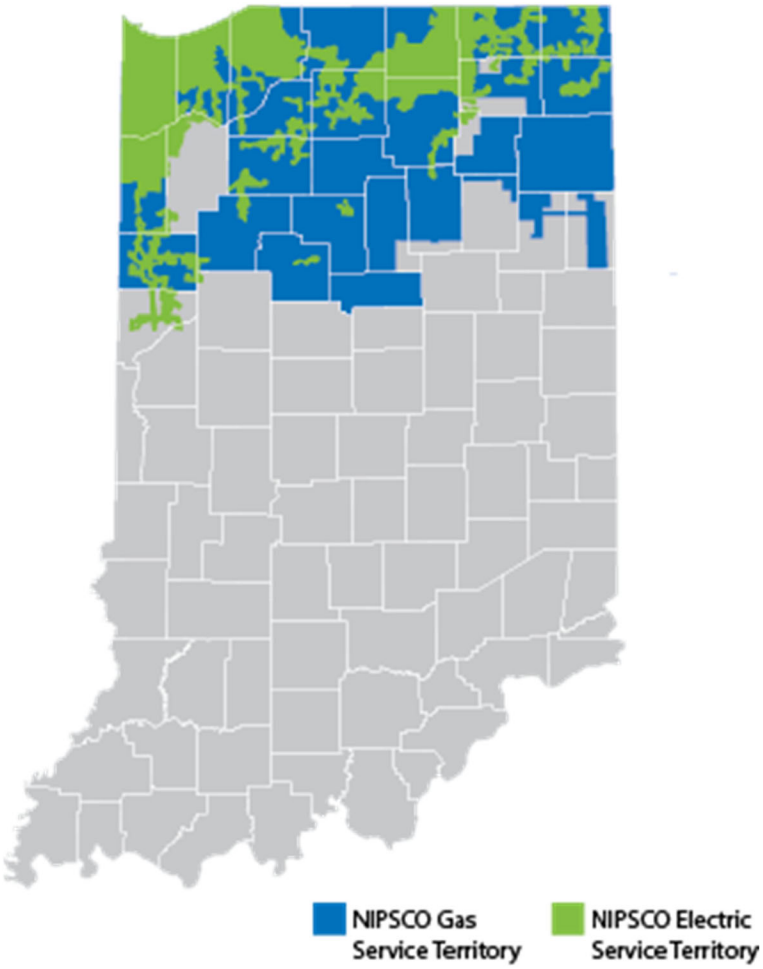


Figure 4: NIPSCO Service Territory

In 2013, NIPSCO implemented its AMR technology to achieve drive-by meter reading capabilities for both its electric and gas customers.

Due to the significant benefits of AMI technology, the Company has received regulatory approval of, and is actively engaged in, upgrading its electric meter customers to AMI by 2026. The electric AMI investment (supported in a separate 2021 Business Case) is proceeding on all

necessary fronts. Most of the most significant procurement activities are completed. Vendors have been selected and are on board and engaged in supporting the Company's detailed planning on all required IT and business process integrations and developments. The layout of the AMI fixed network is under active development with initial transceiver tower locations identified, and equipment slated for deployment, in Q4 2022. "First article testing" of electric meter endpoints is underway, and the initial deployment of electric AMI-equipped meters – for proposes of a large field trial – is slated for early 2024. The Company expects to complete the most important of the "meter-to-cash" metering and billing system integrations Q4 2023, and ahead of the field trial.

Based in part due to its successes in planning and executing on its AMI electric initiative, the Company remains extremely optimistic about the significant value AMI will bring to its electric customers. It contends that it is on track to deliver the many anticipated benefits of AMI, and which forms the foundation of its AMI electric plan.

What are Leading Examples of Decisions in the Market Place?

To supply additional perspective about the AMR and AMI market directions, the Company leveraged the expertise of WMP to research several recent gas meter system upgrades to determine major (apparent) investment decision criteria. In some cases, some information has been made public about the owner's experience in implementing the AMI solution also.

Table 4: Gas Metering System Deployment Examples[13]

Utility	Utility Type	Vol. of Gas Endpoints	Time of Upgrade	Earlier Solution	Upgrade Solution
Southern California (SoCal) Gas[14]	Gas-Only	6 million	2012-2017	Manual ("walk-by") reading	Gas AMI comms modules and AMI fixed network solution

[13] As a point of comparison, as of the end of 2021, the American Gas Association estimated that there were 77.7 million gas meters in the United States; *see* https://www.aga.org/wp-content/uploads/2023/04/Quick-gas-facts-sheet-2021.pdf.

[14] See: https://www.socalgas.com/documents/innovation/am/fact-sheets/FINAL_N1250011_SCG_AdvMtrFAQUpdate_ENG.pdf for a description of the SoCalGas AMI deployment background.

Utility	Utility Type	Vol. of Gas Endpoints	Time of Upgrade	Earlier Solution	Upgrade Solution
Pacific Gas & Electric (PG&E)[15]	Combination electric and gas	4.4 million	2006-2013	Manual ("walk-by") reading	Electric AMI meters and gas AMI comms modules with AMI "mesh" fixed network solution
Philadelphia Electric Company (PECO)[16]	Combination	545,000	2015-2018	Fixed network AMR solution (managed services)	Gas AMI comms modules and electric AMI meters with AMI "point-to-multipoint" fixed network solution; electric meters installed well ahead of gas endpoints (due to State Act and compliance requirement)
Baltimore Gas & Electric (BGE)[17]	Combination	650,000	2012-2015	Manual ("Walk-By") Reading	Electric AMI meters and gas AMI comms modules with AMI "mesh" fixed network solution
Consolidated Edison (ConEd)[18]	Combination	1.2 million	2017-2022	Manual ("Walk-By") Reading	Electric AMI meters and gas AMI comms modules with AMI "mesh" fixed network solution
Mid-American Energy[19]	Combination	697,000	2021-Present	AMR Drive-By Solution	AMR Drive-By Solution 'refresh'

15 https://www.pge.com/includes/docs/pdfs/myhome/customerservice/meter/smartmeter/FINAL_AMI_Report.pdf for a description of the PG&E AMI deployment background.

16 https://www.energy.gov/sites/default/files/2017/08/f36/PECO_Project_Description.pdf for a description of the PECO AMI deployment background.

17 file:///C:/Users/mlamb/Downloads/BGE_Project_Description.pdf for a description of the BG&E AMI deployment background.

18 https://lite.conedison.com/ehs/2021-sustainability-report/operational-excellence/core-system-upgrades/#:~:text=Deployment%20of%20the%20communications%20network,the%20Company's%20entire%20service%20area. For background on ConEd AMI deployment background.

19 https://www.midamericanenergy.com/amr#timeline for background on Mid-American Energy AMR replacement project background.

In evaluating its Business Case options, the Company considered the market background and its directions, as inferable by the information presented in Table 6. NIPSCO also reached out to the vendor community to learn about product and solution offerings, and the directions being taken for their respective innovation.

The key observations the Company took away from this informal evaluation and research are summarized in Table 5.

Table 5: AMR and AMI Deployment Examples, Highlights

Area	Observation
Metering System in Place Prior to AMI Adoption	Many U.S. gas utilities (and electric utilities) have moved from AMR to AMI system deployments. Some also moved away from an early version of today's AMI fixed network. (These were deployed starting in the late 1990s and early 2000s as part of a managed services outsourcing arrangement). The Company observes that fixed network communicating electric and gas endpoints have been available in the marketplace **since 1994** (with the deployment of the first large scale fixed network at Kansas City Power & Light).[20]
Examples of Replacing the AMR system with AMR	There are instances where gas utilities have opted to refresh or replace its AMR system with an AMR system. Mid-American Corporation (owner of Rocky Mountain) is an example. However, the Company's research has also not been able to determine the vintage of the communications endpoint used for the recent deployment. As noted below, utilities are increasingly being constrained to the buy and use an AMI-capable gas meter module even if this level of functionality is not needed. (The modules are then programmed for an AMR mode).
Like for Like Replacement Product is not available	A like-for-like replacement AMR module is not available in the market as easily as previously. Rather, vendors are promoting to utilities that are seeking a basic AMR system to purchase and deploy AMI modules that can be read in either a mobile modality ahead of or in lieu of fixed network. This means that the Company would be purchasing technology and capabilities that it might not be able to cost-effectively utilize unless it deployed that vendor's specific AMI network solution.
Gas Stand Alone Fixed Network	Gas AMI has been justified in circumstances where a shared network deployment opportunity exists and where a stand along gas network is required. At the same time. many of the gas AMI deployments benefit, as

[20] CellNet Data Systems pioneered the first fixed telemetry networks for large scale utility metering purposes during the 1990s. CellNet deployed over 20 million electric *and gas* endpoints in one dozen utilities. Technically the CellNet network – based on the retrofit of electric meters and on gas modules – was both one-way network (to the meter), and a two-way network (to a pole top data collector). The CellNet technology was acquired by Landis+Gyr in the early 2000s and became the basis of that Company's further development of its GridStream AMI business solution.

Area	Observation
	in the Company's case, with the availability of fixed network for electric AMI. PG&E has a hybrid system, which relies on both a common electric and gas fixed network and some standalone fixed network for gas-only areas.
Scale	Gas AMI deployments are at the scale that is required by the Company. Vendors appear able to support the production quantities required. In fact, they appear more capable of supporting AMI production quantities than AMI.
Time Period of Deployment	Gas AMI is deployed consistently as part of a well-managed large-scale deployment, involving the installation rates in the thousands per week.
Goals / Benefits Sought	Gas AMI is often supported by goals to build a common metering, billing and customer are platform and customer point of presence. This improves the customer experience across metering, billing, and other key customer care activities because the utility can design processes aligned to a shared information architecture (such as MDM, customer care functions in the call center, and billing system integrations).
Example of Innovation	Gas AMI solution vendors are pursuing innovation in a range of product and service offerings. Some of these innovations, such as the development of a fully integrated gas meter, have been positioned by the vendor for both ad-hoc and as-needed deployment (as meter replacement needs arise), and as part of large-scale deployment potential. However, the Company has not found examples of very larger scale deployment in the United States of the fully integrated AMI meter as part of a mass installation effort.

AMI-Centric Product and Service Innovation

The Company observes that AMI is a mature technology, with over 150 million electric, gas, and water utility meters connected to fixed networks, which are providing the means of two-way communications for a variety of operational and customer service-oriented purposes. This market presence provides a means for AMI solution vendors to bring added levels of innovation to the metering, billing, and customer care challenges their utility customers face.

Choosing a Business Case direction that taps into the innovation opportunities is one over-arching goal of the Company's Gas AMI Upgrade Program. Replacing the AMR system with a similar AMR system does little to advance innovation opportunities because significantly less product and service innovation is occurring in the AMR marketplace, given the legacy role of AMR technology. "Tapping into" means several tangible things:

- Adoption of a network solution that has adequate bandwidth, latency, security, and other features to enable a diverse collection of endpoints to communicate over the network.

- Selection of a network solution and vendor partner that promotes more network applications, and encourages the development, trial, demonstration, and commercialization of new endpoints and related applications.

- Choice of a technology that makes possible the efficient transfer of metering data into a wide range of utility metering, billing, customer care, and asset management systems. This attribute means that the utility and supporting ecosystem of IT system providers can bring new service capabilities to its customers.

- A vendor partner that is taking part in the development of industry metering and application standards and helping to break down barriers to continued product and service innovation.

There are several areas of innovation of specific interest to the Company as it has concerned its Business Case directions. First, the Gas AMI communication modules (and system solutions) are capable of being read in a mobile configuration for a period and ahead of the deployment of the AMI fixed network. This is not done as a replacement for a basic AMR-like system, but rather to create flexibility for the installation of the communicating endpoints and the fixed network elements. This feature de-risks the program accordingly. The field installation work can be coordinated with the installation of the fixed network elements, but should there be some delays in the installation of the latter, this would not imperil the ability to collect basic monthly read data. Once the fixed network elements are installed, the endpoints can be programmed to fixed network status.

Second, the AMI solution providers are building Gas AMI communication modules that include a range of alarm threshold features. These include pressure, temperature, and excess flow thresholds. This data can be integrated into utility operations in ways that promote customer service interests and demands and improve natural gas delivery (and use) safety. New AMI gas modules can also detect a stuck and non-registering meter (or broken index). While fully integrated gas meters present additional safety functionality, even communications modules alone offer important safety benefits.

Product innovation is also occurring in supplying low-cost measurement means on other types of gas assets, such as in metering and regulating station environments. Applications include the monitoring of cathodic protection systems (by monitoring anode conditions). There are also opportunities to use the AMI communication network to monitor non-critical metering equipment which is otherwise checked periodically for condition status.

The AMI solution providers have listened to the market and are *investigating* how the AMI networks can be further levered to detect fugitive methane emissions, an increasingly important source of a natural gas utility's scope 1 greenhouse gas (GHG) emissions (or supply an early warning indication about the customer's equipment condition).

These are some examples of product innovation. This is only part of the challenge, however, of getting practical use from these product features. The utility, working with the AMI solutions provider, and its system integrators, developers, and major software providers, must develop specific use cases, detailed IT system and process requirements, and end-to-end applications for utility operators and analysts and/or utility customers to get the value that promised from these product innovations. Regardless, the AMI solution vendor plays a key role in fostering and encouraging this innovation within an ecosystem of utility service providers.

A Fully Integrated Smart Gas Meter

As briefly noted in Section 1, one exciting area of product innovation is on the development, testing and initial deployment of a fully integrated smart gas communicating meter. This meter comes equipped with valving controls and telemetry to supply a full suite of AMI measurement and detection capabilities (metering, and the alarm features noted). It also supplies the means to activate a control valve to terminate or allow gas flow thru the meter. This valve product feature – sometimes analogized to the automatic disconnect switch available on electric meters – offers the potential to provide to the utilities another valuable tool in its portfolio of metering solutions. The Figure below highlights NiSource's evaluation of fully integrated meters, which began in late 2019 and ramped up in 2020. In addition to general research and investigation, NiSource has gone so far as to undertake targeted field trials of such meters in 2022.

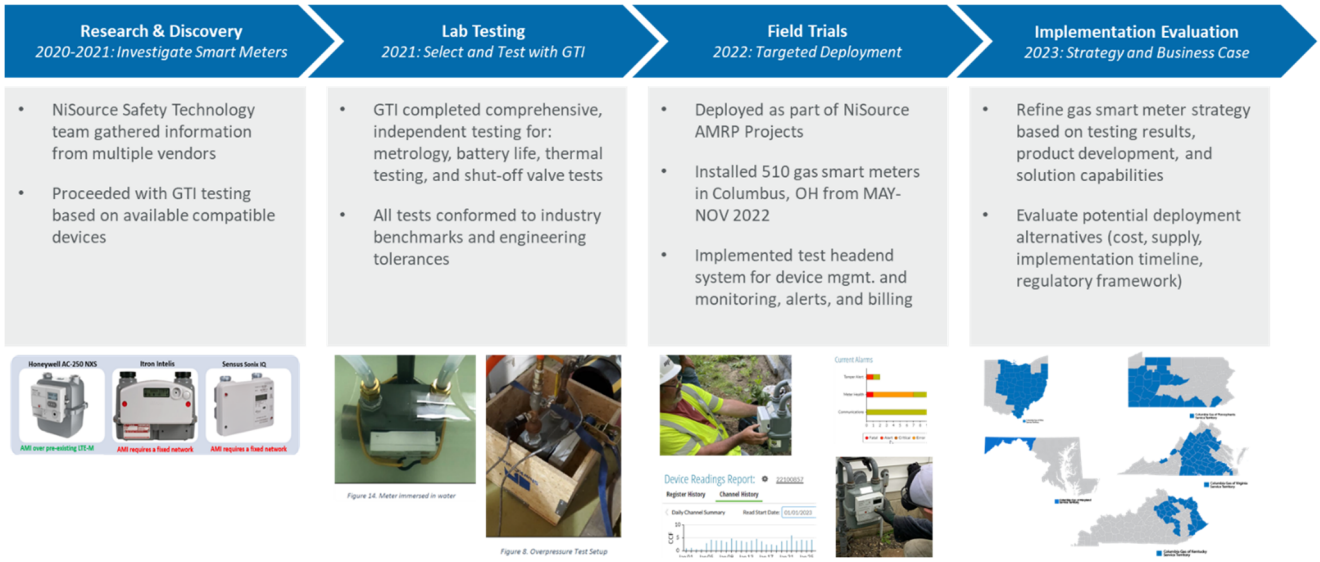


Figure 5: The NiSource Evaluation of the Fully Integrated Gas Smart Meters

AMI solution developers and manufacturers of this product include Landis+Gyr, Itron, Honeywell, and Sensus. Other manufacturers are also eyeing this market for new offerings (Pietro-Feorelli). Because the meter is fully integrated, and requires therefore a change of the meter itself, it is unclear how the utility community will adopt to its deployment and use (since

large scale rollouts of the meter during a compressed period can be cost and person-power prohibitive).

There are also product-readiness questions, such as ability to sustain large scale production, and product warranty terms and conditions. The Company also wants to make sure robust testing procedures and standards are in place. Performance and warranty are especially important given the fact that the valving feature has important safety attributes, which can only be built into use cases and applications through a detailed understanding of product performance attributes.

While innovation is slow (due to the limited total size of the gas metering market), the Company perceives that this product is firmly entrenched for the future. Hence, it evaluated this option as one of the four future scenarios. It also is undertaking its selected Business Case solution (the Gas AMI Upgrade) in a way that anticipates the eventual use of these new products on its AMI communication network over time.

While these products are newer to the gas metering market in the United States, the Company perceives that this product is firmly entrenched for the future. Hence, it evaluated this option as one of the four future scenarios. It also is undertaking its chosen Business Case solution (the Gas AMI Upgrade) in a way that anticipates the eventual use of these new products on its AMI communication network over time.

As in the case of the alarm features briefly discussed, adoption of this technology as a meaningful end-to-end capability and customer-facing service enhancement requires lots of work through the use case and applications development lifecycle. This work has started at NiSource during the past two years, with the Corporation "standing up" an evaluation, test, and initial pilot of this technology across several fixed AMI communication network topologies.

Company's Innovation-Related Efforts

The Company is keenly aware of the importance within the metering industry of collective efforts to pursue innovation. The Company supports and participates in this innovation as part of industry associations, research efforts, standard setting organizations, and conference activities.

It is also investing in innovation directly by performing pilots and demonstrations of promising technology. This is particularly relevant to the trials of the fully integrated gas meter product. It intends to share what it learns with industry colleagues through these forums and determine what others have learned also. Use case development is a prime example about the kind of information sharing that can take place and which can quite valuable.

Industry organizations to note that play an important role in fostering industry innovation include:

- GTI Energy is a leading research and training organization focused on developing, scaling and deploying energy transition solutions. GTI is heavily involved in metering system innovation.
- The American Gas Association (AGA), and its foundation the AGA Foundation, provide valuable support to its member companies by being a source of valuable information on energy issues that affect public policy. It is involved important outreach both within and outside the natural gas industry, including the role of technology innovation to meet a wide range of policy aspirations.

The Company is also aware of the importance of the vendor community in supporting this innovation through these same and other industry associations, research efforts, standard setting organizations, and conference activities. The Company expects to see its selected vendor (as demonstrated as part of past practice and looking forward) actively involved in these forums, and within these associations. This innovation is focused on all parts of the system's value chain, from endpoint innovation to networks to back-office applications integrity and ease of use.

The AMR vs. AMI Direction from a Functional Obsolescence Point of View

In considering its future metering directions, the Company recognizes that the Business Case should be attentive to the risk of selecting a technology (inclusive of system and vendor) that may not be able to deliver on its requirements (that directly and indirectly relate to impacts and benefits) due to such factors of level of solution maturity, or the vendor's ability to support the solution long-term.

The Company is also aware that selecting a technology that fails to meet its current, modern requirements would also be a poor choice if that selection imposes a risk of obsolescence once it is deployed. From a practical standpoint, it does not make good business sense to select a technology that cannot deliver the types of information (at the level of frequency, accuracy, and reliability) that is needed.

The risk to AMR's functional obsolescence has several underlying factors: First, AMR does not represent state of the art and does not fit the norms of modern utility metering, billing, and customer care practices. The metering solution industry is evolving to a point where AMI solutions are the default choice, due to their cost efficiencies, and ability to provide the information that enables a wide range of features and benefits. A good example of this is the fact that several leading AMI solution providers are reducing production of basic AMR like-for-like communications module replacement. Relatedly, they are increasingly encouraging utilities toward the replacement purchase of an AMI communications module programmed for mobile (once a month) read broadcast and collection. This is discussed further below in the sub-section titled "NIPSCO's Current Gas Meter Communications."

Additionally, AMR has significant deficiencies compared to AMI in the functionality it delivers. This is highlighted in Table 3 listing the information types and attributes of each solution. The

AMI functionalities map directly to a wide range of business impacts and operational and customer benefits. The AMR functionality attributes constrain this solution significantly and hamper its capacity to support most of these benefits (as documented in the Benefits Inventory, Appendix 2). A good example is the innovation that the AMI solution providers are advancing into the market with a full integrated gas meter product (and in other products like cathodic protection monitoring devices). AMI functionality is required in lock step with the new safety related features that come with this product. These features would have little value in an AMR product.

The Company detects this AMR functional obsolescence risk in its work with the metering solution providers. Innovation is being directed into the leveraging of AMI communication networks and less so on adapting this innovation to AMR mobile solutions. The communication endpoints are increasingly being sold as AMI network-ready, regardless of whether the AMI network can be separately implemented (due to range of possible factors). Network management tools devoted to two-way, near real-time communication capabilities, as are the pursuit of product use cases and product innovation that levers these network attributes.

The consequences of AMR obsolescence are potentially severe. It is possible that AMR endpoints for replacement and growth purposes become unavailable, or very expensive. It is possible that the Company would have to begin separately repairing AMR modules to provide replacement stock. It could also mean other elements of the AMR solution could become more difficult and expense to maintain depending on the level of the vendor's ongoing support.

NIPSCO's Current Gas Meter Communications

Over the last few years, the Company has encountered issues with its current gas AMR meter reading system. The first issue is the ongoing availability of AMR assets, including the availability of like-for-like AMR communication module utilized by the meters. Vendors utilized by NIPSCO to source such equipment have informed the company that they are decreasing production of AMR technology, focusing their efforts on production of AMI metering solutions. In fact, due to supply and lead time challenges, over the last year or more, NIPSCO has had to procure AMI-capable endpoints but install them in "AMR mode" for new customer installations and for AMR devices that may fail. For these reasons, as discussed above, NiSource had already been evaluating future gas metering options for all its operating companies, evaluating what alternatives were available as the industry moves away from AMR technology, as well as the customer and safety benefits of various alternatives.

Additionally, NIPSCO ordinarily sees some baseline level of meter and communications module reaching end-of-life, but starting in late 2022, NIPSCO detected an increase in AMR communication modules reaching end-of-life due to battery performance. NIPSCO is now beginning to see more communications modules reaching end-of-life and, furthermore, it expects an increase in this occurrence over the next few years based on typical AMR

communication module lifespans. Accordingly, the Company must replace or make other changes to the gas metering system to avoid significant disruptions in its ability to gather monthly meter reads and accurately bill its customers for services provided.

These general industry trends, and the increase in AMR communications modules reaching end-of-life, led NIPSCO to perform this Business Case evaluation of alternative meter communications options for its gas customers. Following a robust evaluation process—which included NIPSCO and NiSource subject matters experts and WMP and is explained in detail below—NIPSCO determined the replacement of current communications modules with new gas AMI communications modules is the most reasonable choice. The explanation of this process and the ultimate decision is documented in this Business Case, including in Section 3 immediately below.

3. Program Description, Goals and Principles

As part of its development of the Gas AMI Upgrade Program, and this Business Case, the Company set out goals and principles to guide its evaluation, as noted earlier. First, the proposed direction is described to establish context.

NIPSCO's Proposed Gas Metering System Direction

NIPSCO is proposing to implement an advanced metering infrastructure (AMI) fixed network solution across its gas service territory during a 36-38-month period starting in Q4 2023 and concluding in Q4 2026. The Gas AMI Upgrade Program Team will work in close coordination with the NIPSCO Electric AMI system deployment team during the same time period to implement the gas AMI solution for its approximately 850,000 residential and small commercial gas customers.[21] The coordinated, parallel and shared resource dimension of the Gas AMI Upgrade Program with Electric AMI is a salient feature that supports the feasibility and cost-effectiveness of pursuing the Gas AMI Upgrade at this time, both in comparison to other alternatives. The Gas AMI Upgrade is also timely due to the AMR system performance.

The Gas AMI Upgrade Program is a significant undertaking and capital program and requires a rigorous planning effort in parallel to, and in coordination with, the AMI electric program. Detailed gas planning is underway and will continue over the course of the next 12 months as part of an initial Program Planning, Requirements, Procurement, and IT Implementation and Business Readiness Phase.

Like the AMR communication module (also called an "ERT" or "encoder receiver transmitter"), the AMI module is installed onto the gas meter index of the existing gas meter as part of a 10–15-minute field installation visit to the customer premise. The gas meter does not have to be replaced as part of the module installation, nor does a customer's gas service need to be turned off.[22] The AMI module gathers the metering information (gas volume, and certain messages and status alerts) and communicates this information to a fixed AMI communications network, which will be deployed throughout the service territory. This contrasts with the AMR module's reliance on mobile vans to establish communications during a once-a-month visit to the area.

The Company's goal is to begin installation of gas AMI communication modules in Q3 2024, prioritizing areas where the AMI network solution has been stood up to support data flow, which is generally in NIPSCO's combination service territory. The rate of AMI module installation during full deployment is estimated to gradually ramp up from a plan of approximately 20,000

[21] This figure represents the number of meters serving customer accounts.
[22] The Project anticipates the replacement of a small number of gas meters due to the meter age.

modules per month in 2024; 25,000 modules per month in 2025; and 35,000 modules per month in 2026.

An essential feature of the Gas AMI Upgrade is the opportunity for the Company to make use of its planned fixed AMI communications network it intends to construct and operate throughout its electric service territory for its electric AMI requirements. This Company-leased and operated AMI communications network can also read the AMI module-equipped gas meters with little modification. The Company will put in place appropriate cost tracking controls to ensure electric- and gas-specific costs are tracked and accounted for appropriately.

Should the Company move forward with a common (with electric) AMI system vendor, the Company anticipates that approximately 500,000 of its gas meters would be covered under the current planned network deployment for the Electric AMI Program.

For the remaining approximately 350,000 gas meters that are located outside of the electric AMI network geographic area, the Company intends to leverage a similar fixed AMI network. Ideally it will extend the same network into the gas only areas. However, it has yet to conclude the necessary procurement steps to determine that this is the appropriate plan. As explained in the Business Case, the Company leverages its knowledge about the requirements and features of its electric AMI fixed network to provide estimates of the requirements, features and costs of a similarly equipped AMI fixed network covering the gas-only areas until definitive procurement decisions are reached.

A key feature of the Company's gas AMI direction is that it can build gas metering, billing and customer care business and customer-facing processes as a common platform with the electric meter customers in mind and utilizing the same AMI system capabilities. This has many practical effects, which are elaborated in the Business Case. They include developing a common integration from the AMI system control (the AMI "headend" system) to the Company's billing engine and adopting similar processes for how customer care agents' access, view, and utilize the customer's metering and billing information to address customer transactions and inquires.

Company's Gas AMI Upgrade Program Goals

As noted, due to the nature of AMR technology and the specific issue with NIPSCO's AMR communications modules, NIPSCO determined that it required a comprehensive and meaningful long-term solution for its gas metering system.[23] Accordingly, it conducted an intensive review and evaluation process to analyze meter reading options, leading to its Business Case decision.

[23] The Company's evaluation of the AMR module end-of-life took place during Q2-Q3 2023. As part of this phase, the Company determined the period for the replacement or upgrade of the current AMR system and determined the related preliminary timetable for the decision support, planning and

As part of the Business Case development phase, the Company identified several over-arching goals for its consideration of a best path forward. The selection of the Gas AMI Upgrade Business Case is informed by these goals:

The Company seeks a gas metering business and technology solution that:

1. Addresses the Company's future gas meter reading requirements (due to the end of life of the current AMR system) in a cost-effective and timely manner, and with minimal disruption to the Company metering, billing, and customer-care operations.

2. Fulfills the Company's goal for establishing full AMI capabilities across all its gas and electric customer meters to bring the greatest amount of value to the NIPSCO Customer (and a consistent experience) in areas of metering, billing, customer care, and energy management. The Company recognizes that this AMI goal is highly synergistic with the Corporation's efforts to promote advanced metering technology across all its distribution utilities, in accordance with industry norms. It also recognizes that there are significant opportunities to coordinate the AMI electric and gas deployments, ensuring that business and IT systems and processes enabled by AMI bring a common experience to the NIPSCO customer.

3. Positions the Company to capture safety-related innovation opportunities within the AMI gas endpoint market (considering the future integration of fully integrated smart gas meters). Positions the Company to deploy in the future customer-service focused and safety-related innovation opportunities emerging from the AMI gas endpoint market (considering the future integration of fully integrated smart gas meters).[24]

Company's Decision-Making Principles

In evaluating its current metering situation, and various alternatives, the Company representatives defined the following decision-making principles. The proposed direction for the gas metering system should:

1. Be based on a rigorous Business Case and represent a sound business decision. The direction should be reasonable, feasible, cost-effective, practical, and risk informed.

2. Seek out a solution that will significantly improve the NIPSCO customer service experience as part of the customers' continued purchase of safe, reliable, convenient, and affordable energy services.

procurement activities related to its proposed directions. The Business Case work followed this evaluation phase, with this general information serving as broad guidance for it.

[24] The Business Case further explains the features of the fully integrated smart gas meter.

3. Pursue innovation opportunities in the gas metering and communications technology market, particularly when that innovation may improve safety.
4. Use the Company's resources and infrastructure to the greatest extent possible, improving the return on Company investments, lowering its operating and ownership costs over time, and thereby enhancing customer value.
5. Consider the essential role of the Company's vendor partnerships in achieving Program goals, minimizing implementation and ownership risks, enabling future innovation opportunities, and bringing long-term value to customers.
6. Be based upon a sound set of recommendations following engagement with a wide range of input from Company experts representing numerous disciplines, including Technology, Procurement, Customer Operations, IT, Telecommunications, Strategic Planning, Program Implementation, Finance, Asset Management, and Compliance.

The Gas AMI Upgrade Program Timeline

To ensure effective coordination and integration into the Electric AMI initiative, and to meet the required milestones to ensure an orderly transition from the current AMR to new AMI system, the Company has designed the following implementation timeline assumptions, as shown in Figure 6, to guide the Gas AMI Upgrade Program and to further inform Business Case assumption making.

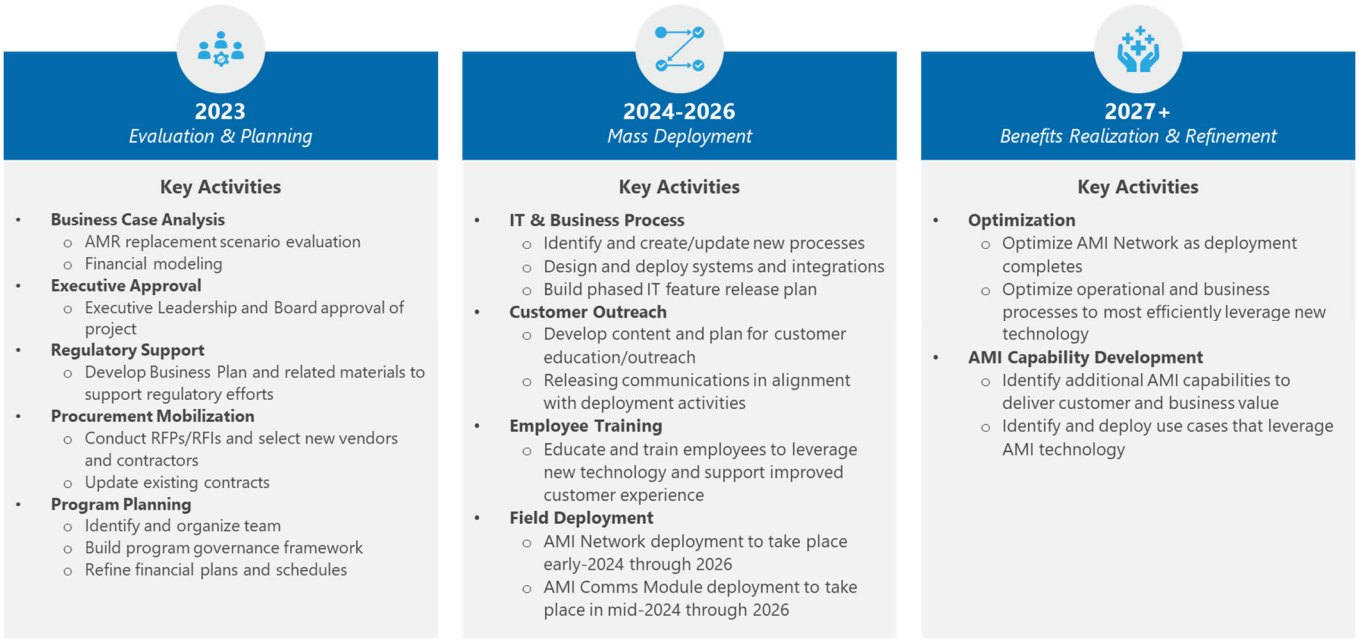


Figure 6: Timeline Summary of Key Activities

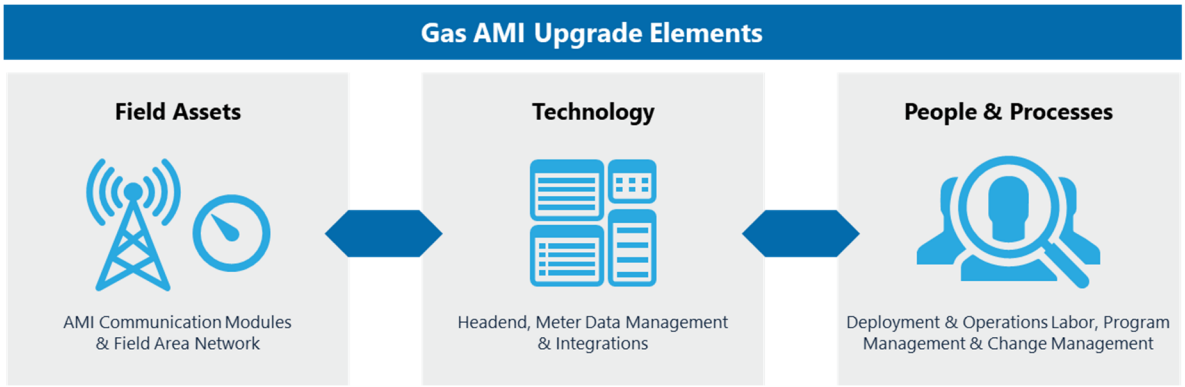
While preliminary in nature, and subject to on-going refinement, this timeline informs NIPSCO's development of refined requirements (to inform procurement, IT, and business process activities), capital budgeting, regulatory cost recovery, team formation, and program planning activities. The timeline reveals the multi-disciplinary nature of the Gas AMI Upgrade effort.

The Gas AMI Upgrade team is active across all fronts of the AMI implementation effort. It is refining its requirements for the resolution of its fixed AMI network choices. It is further upgrading its integration plans to ensure it folds into these plans gas metering data using the common AMI "head end" control (or comparable) system. It is also evolving a field deployment plan in both the combination (electric and gas) network and the stand-alone gas network area. The network build out is being planned to ensure timely availability of network read capabilities once the AMI communication modules are installed. To this end, the AMI communications module field installation work and the AMI fixed network elements deployment are being tightly coordinated. [25]

Main Elements of the Gas AMI Upgrade

The Company has performed a preliminary assessment of the major requirements and system elements required to implement the Gas AMI Upgrade Program. Figure 7 identifies several of the key elements.

Understanding the scope of these activities is very germane to this Business Case, as the Company needed to understand the cost, complexity, and related challenges of the Gas AMI Upgrade direction in relation to other alternatives. A key driver of understanding the scope of the Gas AMI Upgrade requirements was to understand the scope of the coordination opportunities between it and the Electric AMI Program.



[25] One advantage with the electric AMI fixed network provider's solution is the ability to install the gas AMI communications module before the fixed network is fully operational. The gas AMI reads can be collected with the vendor's mobile collector until such time that the fixed network is in place.

Figure 7: Gas AMI Upgrade – Main System Elements

For each of these areas, the Company developed an understanding of the requirements and the scope for Gas AMI Upgrade for cost estimation and other Business Case evaluation purposes.

Coordination with the In-Flight NIPSCO Electric AMI Program

Although exact monetary impacts have not been quantified, the Company reasonably expects that the Gas AMI Upgrade Business Case will be materially improved (and realized) when the synergies and coordination between the AMI electric and gas system planning and deployment are pursued.

Figure 8 identifies the many areas of coordination between the electric and gas initiatives. In most, if not all areas, this coordination opportunity presents itself across the time spans of the initiative – from planning and implementation to long-term operation phases.

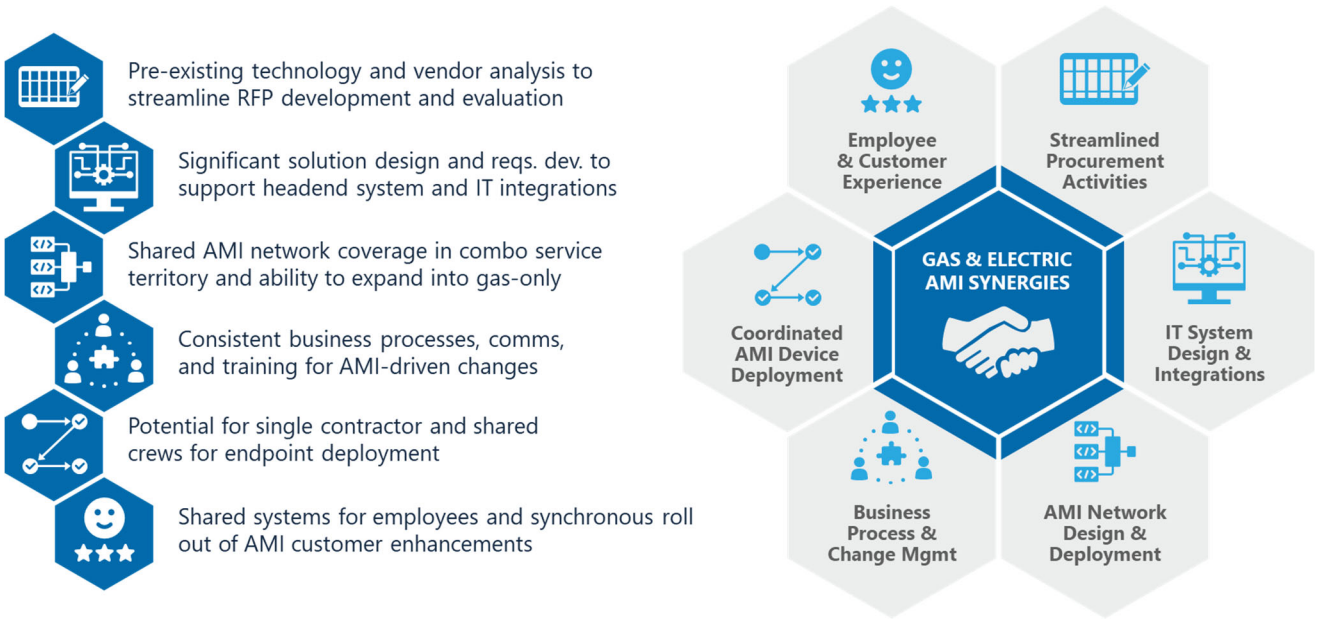


Figure 8: Areas of Coordination Between the Gas and Electric AMI Initiatives

The Company believes that the synergies of coordinated efforts between the Electric and Gas AMI Programs will enable cost savings through execution,[26] and support benefit realization following deployment:

- Implementing the AMI "headend" system (the control software system that controls, monitors, and manages the AMI system from endpoint to communication WAN transceivers to back office) and integrating to existing NIPSCO and NiSource IT systems

[26] The Gas AMI Upgrade cost estimates is based on these areas of coordination.

can potentially be done to support both gas and electric AMI capabilities, eliminating the need for duplicate applications, and simplifying integration work for gas AMI.

- Leveraging a shared AMI communications network for both gas and electric AMI meter endpoints, especially in the NIPSCO combination (electric and gas) service territory, would eliminate the need to purchase, deploy, operate, and maintain multiple solutions.

- Leveraging a single AMI headend system and meter data management platform simplifies not only front-end integration work, but also reduces the need for Company IT resources to maintain and monitor multiple different applications for gas and electric AMI. Additionally, end users of these systems avoid the "swivel chair" effect of needing to use duplicate systems to do the same task for electric and gas.

- Coordinating across field installation activities, where possible, especially in the NIPSCO combination service territory, will help streamline deployment management efforts and create consistency in gas and electric AMI install experiences. It also presents the opportunity to minimize customer impact and inconvenience, as gas and electric AMI solutions could be installed in a single visit to a customer's premise within the combo service territory.

- Developing coordinated customer communications and outreach strategies across the NIPSCO Electric and Gas AMI Programs will help deliver a consistent experience for all NIPSCO customers, providing proper preparation and coordination ahead of install, as well as thorough education for leveraging AMI to improve their experience going forward.

- Aligning gas and electric AMI deployment timelines, delivering consistent capabilities, and creating common customer messaging will also enable Company Customer Care agents to effectively handle customer questions and utilize consistent customer service tools.

Gas AMI Upgrade Program Vendor and Contractor Support

During the Program Business Case development phase, the Company has identified several key areas where AMI technology and services, technical professional services, and field services vendors and contractors will be leveraged to support execution. The Company plans to utilize key lessons learned from the NIPSCO Electric AMI Program and other parallel initiatives to define requirements, evaluate potential partners, and onboard supporting teams seamlessly. These areas for support include:

- AMI Technology
    - Gas AMI Endpoints ("AMI Communications Modules")
    - AMI Communications Network

    - AMI "Headend" System[27]
    - Professional Services to Support Implementation and Deployment
    - Backhaul Communication Services (if not Utility-operated)
- System Integration Services
    - Business and Technical Requirements Gathering
    - IT Integrations and Architecture Design
    - IT Build and Testing Support
- Field Deployment Contractor
    - Gas AMI Endpoints Installation
    - Field Deployment Management
    - Deployment Customer Outreach and Coordination Support
- AMI Communications Network Deployment Contractor
    - AMI Network Device ("AMI Base Station") Installation
    - Vertical Asset (Monopole) Installation
- Other
    - Supplier of Ancillary Equipment for AMI Communications Network (coax, antennae, etc.)

As part of the NIPSCO Electric AMI Program, several vendors and contractors have been selected and are actively supporting the effort. Scope for AMI technology, system integration services, and other ancillary equipment partners all provide significant overlap or synergies with work included in the Gas AMI Upgrade Program plan. Additionally, there are potential opportunities to drive synergies in field deployment and AMI communications network deployment efforts and the Company is working to finalize requirements, resources, and workforce skillsets needed for parallel deployment efforts as part of the in-flight procurement mobilization activities.

AMI Applications and IT Integrations

Through the Gas AMI Program, NIPSCO will be completing business requirements definition, business process design, IT system design and testing, and IT system integration work to support the deployment and utilization of AMI for their gas operations. Core to the strategy of the NIPSCO Gas AMI Program, the Company plans to leverage the work being conducted and completed as part of the NIPSCO Electric AMI Program across these IT systems to drive efficiencies and deliver a consistent experience for employees and customers.

[27] "Headend" refers to the software controls system that is deployed to monitor, control and otherwise 'run' the field communication system and the flow of metering data to back-office systems. This system is cloud based as part of a vendor established and managed cloud architecture. (It is not hosted locally).

IT systems that will be implemented to support gas operational, business, and customer functions for NIPSCO will be the AMI headend system and a platform for meter data management. As part of the NIPSCO Electric AMI Program, the Company is implementing an AMI headend system and meter data management platform that are both able to support gas AMI functionality seamlessly for NIPSCO business and operational users.

In addition to the AMI headend system and meter data management platform, several current NIPSCO and NiSource IT systems will have integrations and enhancements to leverage AMI data and functionality. Specifically, the Customer Information System (CIS), asset management system, and work order management system will all have integrations to accept AMI data. The customer-facing web portal and mobile applications will also both have integrations and enhancements to provide customers with more granular usage data. Lastly, the NiSource data lake will be leveraged to store gas AMI data and serve as a platform for building additional analytics tools to be leveraged across NIPSCO and NiSource business and operational functions.

AMI IT Systems

- **AMI "Headend" System –** System utilized for monitoring AMI network and device performance, AMI alerts and alarms, and meter read performance. The AMI headend system is critical for business and operations users to manage AMI devices, handle device firmware upgrades, analyze AMI system data, and triage any alerts and alarms remotely.

- **Meter Data Management Platform –** System responsible for receiving, processing, and storing AMI meter read data to support meter-to-cash and billing processes. The meter data management platform provides logic to ensure meter read accuracy, as well as key tools for analyzing meter read data for various business and customer applications.

Key Impacted Systems

- **Customer Information System (CIS) –** NIPSCO's CIS will have integrations to accept AMI data for meter-to-cash and billing processes, as well as enhanced customer service capabilities. These integrations and enhancements will help enable the key benefits of AMI associated with collecting meter reading data over-the-air, providing more granular data on energy usage, and improved handling of customer service requests.

- **Asset Management System –** The NIPSCO asset management system and associated processes will be updated to ensure that as AMI network base stations and gas AMI devices are installed and exchanged, asset management records are updated seamlessly to support key ongoing business and operational processes.

- **Work Order Management System –** Similar to the NIPSCO asset management system, the NIPSCO work order management system and associated processes will be updated

to support the creation, dispatching, tracking, and recording of work orders associated with new AMI network base stations and gas AMI devices.

- **Customer Web Portal and Mobile Application –** To deliver improved customer experience for NIPSCO gas customers, the Gas AMI Program will include enhancements to NIPSCO's customer-facing web portal and mobile application. These enhancements will deliver more granular usage data to customers to enable customers to understand their usage better and ultimately make more informed decisions about their usage.

- **Data Lake –** The Company's Data Lake solution is an emerging platform and set of tools to power data analytics by providing centralized storage, aggregation, and intelligence for data from across several different business and operational data sources. This Data Lake will be leveraged to store gas AMI data, in addition to electric AMI and other key operational and business data sources.

Business Process Design

In conjunction with the IT integration work outlined above, the NIPSCO Gas AMI Upgrade Program will update and enhance business processes to enable employees and customers to leverage the full capabilities of AMI technology for gas. Many of these business processes are being updated through the NIPSCO Electric AMI Program. These updates and improvements are also being structured to serve many business and operational processes for the Company's gas deployment and operations.

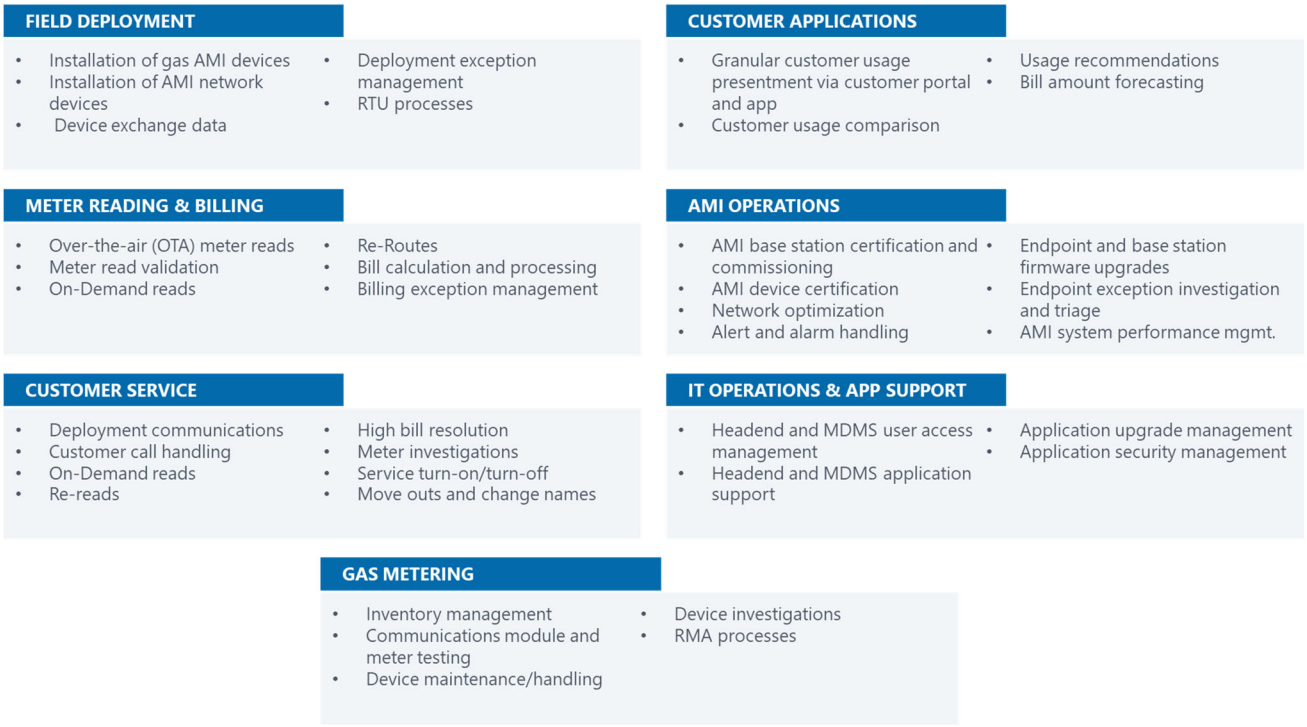


Figure 9: Key AMI Implementation and Steady-State Processes

Through the NIPSCO Electric AMI Program, NIPSCO has engaged with many NIPSCO and NiSource stakeholders, external partners, and vendors to define these processes. The Company intends to leverage this planning work and knowledge base and engage many of the same stakeholders to drive consistency and efficiency for the Gas AMI Program.

Gas AMI Program Team

The Gas AMI Program team will focus their efforts as part of several workstreams supporting program and change management activities. Each workstream lead person will own the execution of their specific workstream and will report to the AMI Program Director.

In addition to the workstream leads, each workstream will be supported by a team of contributors who may be internal NIPSCO or NiSource employees, or external contractors and/or consultants. The AMI Program Director, workstream leads, and workstream team members will be selected by the AMI Gas Execution Planning Team.

Table 6 – Program Management Activities

Category	Activities
AMI Program Management	• Program governance and oversight • Scope, schedule, and budget management • Issue management, including tracking and issue resolution • Employee/resource management • RFP development, issuance, evaluation, and vendor selection • Vendor contracting management and vendor management • Metrics development, implementation, and tracking for deployment and benefit realization
Field Deployment	• Field tools requirements, add, change, replace, delete actions and programming • AMI network design & optimization management, incl. RF engineering • AMI network deployment planning • AMI network equipment procurement • Gas AMI endpoint deployment management (schedule, IT integration of WOMS, material supply, inventory, warehousing, old ERT disposal, training, SLAs) • Network deployment (schedule, siting, tower build, base station equipment, commission) • AMI network deployment management • Installation quality assurance and safety • Warehousing and cross dock operations management
IT & System Integration	• Management of design, testing, and deployment of integrations between AMI headend • Management of design, testing, and deployment of integration between Field Deployment Tool and AMI headend

Category	Activities
	• AMI Cyber Security Plan management • Testing and supporting billing, WOMS, and GIS capabilities
AMI Operations	• Support testing and implementation of AMI headend system • Support deployment planning and execution for AMI network and electric meters • Monitor and manage AMI assets as they are deployed and in production
Customer Care & Operations	• Support planning and requirements definition for all customer care, billing, and other Customer Operations functions • Coordinate across Customer teams to support training prior to go-live and deployment activities, as well as customer care throughout deployment
Communications Engineering	• Work with AMI solution vendor and parallel NIPSCO communications deployment programs on AMI network design • Support AMI network deployment planning and coordination
Legal/ Regulatory	• Lead regulatory filing coordination between AMI Program and parallel teams • Lead activities related to other regulatory coordination / filings
Meter Reading & Processing	• Support transition from AMR to AMI and ongoing coordination with NIPSCO Meter Reading (route management, migration to AMI, data transfer)
Supply Chain	• Lead vendor selection and contracting across all procurement areas for the AMI Program (technology, materials, contractors, prof. services, etc.) • Lead ongoing management of vendor agreements (labor and materials sourcing)
Gas Meter Shop	• Support technical requirements definition and inventory management of new gas endpoints • Complete first article testing, incoming sampling, and RMA
Gas Operations	• Manage and oversee RTU and maintenance work for gas premises

To support an effective implementation, adoption, and utilization of the proposed new AMI solution and its related capabilities, separate Organizational Change Management, Customer Experience, and Communications teams will be formed and put in place as part of the Gas AMI Program team. The associated workstreams (shown in Table 7) will design and lead customer and employee outreach and education, training, and stakeholder engagement efforts throughout the Program term.

Table 7– Organizational Change Management and Communications Activities

Category	Activities
Change Management	• Define strategy and content for AMI training and organizational communications (various digital channels, Viva Engage, etc.) • Support OCM coordination with parallel NiSource transformation efforts

Category	Activities
Customer Experience	• Support requirements definition for all customer care, billing, E-Channels, and other AMI business requirements • Lead content development and planning for customer communications and outreach • Support training planning and delivery for Customer Org employee groups
Program & Corporate Communications	• Develop and manage distribution of employee and public-facing communications regarding the program

Status of the NIPSCO Electric AMI Deployment

In June 2021, NIPSCO petitioned the IURC approval of its electric TDSIC Plan, including its proposed Electric AMI Program. NIPSCO's electric TDSIC Plan was approved in full by the Commission in December 2021.[28] Since December 2021, the Company's Electric AMI Program team has made substantial progress and completed significant work in numerous foundational and essential planning requirement areas:

- Formally established Electric AMI Program team, with representation across Major Programs, Electric Operations, Metering, Meter Reading, Customer Operations, Engineering, Regulatory, and IT;
- Conducted RFPs for and select AMI technology vendors, system integrator, meter exchange contractor, and network deployment contractor;
- Completed business process design and business and technical requirements gathering;
- Progressed in IT system design, integration, and testing;
- Began hardware procurement and initial AMI network deployment;
- Hired and onboarded initial resources for new AMI Operations team; and
- Established a Change Acceleration Team to engage and prepare stakeholders for AMI across the organization.

The Electric AMI Program is progressing well across all workstreams and in alignment with the Plan approved by the IURC. Additionally, the Program is coordinating closely with parallel TDSIC programs and other NIPSCO and NiSource transformational initiatives. Change management and outreach efforts are in-flight to continue preparing NIPSCO employees to leverage AMI capabilities across business, customer, and operational functions.

[28] The Commission's 45557 Order was appealed by the NIPSCO Industrial Group in Case No. 22A-EX-00187. That appeal is pending.

The progress of the Electric AMI Program includes significant work across key workstreams that, in turn, will also support the Gas AMI Upgrade Program. Many documented requirements and newly designed business processes are consistent for both electric and gas operations.

Additionally, the Gas AMI Program intends to maximize shared value opportunities of IT design and integration, AMI network design and deployment, and training and communications. These opportunities will be realized through a thoughtful and rigorous selection of the gas AMI technology and supporting vendors (such as deployment contractors). Lastly, the Electric AMI Program team and governance structure are set up with many program management functions that can be slightly expanded to also encompass Gas AMI Program execution.

4. Cost Evaluation

As part of the Gas AMI Upgrade Program scope definition and Business Case evaluation, a 15-year financial model has been developed covering a 15-year forecast period covering the years 2024-2038. The programed capital and operations and maintenance (O&M) costs were identified based on an understanding and further clarification of the Gas AMI Upgrade program scope and related technical and business requirements. The cost estimates are based on the deployment of Gas AMI throughout the NIPSCO service territory over the years 2024-2026. The costs also include the O&M cost assumptions of the AMI system through 2038.

Costs are organized and calculated in accordance with the preliminary and major program phases identified in this document (see Figure 6). Costs estimates have been developed as part of the Business Case effort based on a combination of learnings from the in-flight NIPSCO Electric AMI Program, current Company cost factors solicited through interviews and workshops, RFI[29] cost assumptions and data, and industry and peer utility benchmarks.

Several key financial inputs are used in the Business Case analysis based on guidance from Company stakeholders and industry best practices, including:

- Weighted Average Cost of Capital (WACC): Calculate present value dollars using a 6.5% discount rate
- Inflation Rate (Labor, Equipment, Services, etc.): Calculate escalating costs of key Program investments 3.0% annual inflation
- Allowance for Funds Used During Construction (AFUDC): Apply 3.3% to capital costs eligible for AFUDC treatment
- Corporate Overhead: Apply 11.0% to capital costs only
- Materials and Sales Tax: Apply 7.0% to cost items eligible for materials and sales tax upon transaction
- Contracted Labor Contingency: Apply 20% contingency factor for contracted labor cost items based on model sensitivity range and confidence in contracted labor unit cost estimates for different implementation and installation work
- Materials Contingency: Apply 10% contingency factor for materials costs based on model sensitivity range and confidence in materials unit cost estimates developed from RFI data and parallel Company programs, including the Electric AMI Program

[29] The Company conducted multiple Requests for Information (RFI) with potential AMI technology vendors and field deployment contractors to validate unit and overall cost estimates for major cost categories. Information received will also support future vendor selection, negotiation, and procurement activities associated with the Gas AMI Program.

- The Business Case estimation effort showed an investment of $166.8 million[30] in the program deployment years of 2024-2026. These capital costs include the cost of gas AMI endpoints and installation labor, the costs for added fixed network infrastructure in the gas-only territory, and a comprehensive inventory of additional and necessary investments to execute an AMI program and deliver value to the Company and customers in alignment with the benefit goals. ($166.8M includes both direct and indirect capital, which are shown in separate rows in Table 9).
- The O&M costs identified in the Business Case model total $50.1 million for 2024-2038 and include ongoing license and maintenance fees for the AMI headend system and meter data management platform, steady-state AMI Operations and IT Operations labor, and AMI communications network backhaul[31] fees.

Table 8: Cost Estimate Summary for the Four Principal Scenarios ($USD, Nominal)

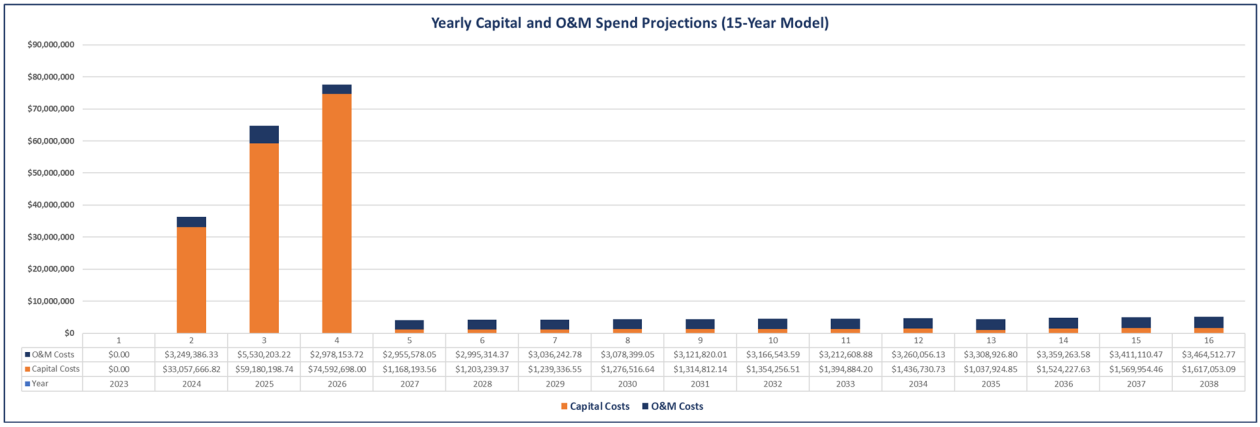
Cost Categories for 15-Year Model Period (2024-2038)	Gas AMI Upgrade	AMR Replacement	Manuel Meter Reading	Integrated AMI Meters
Capital Cost (Direct & Indirect)	$183.0MM	$453.1MM	$0.5MM	$596.2MM
O&M Cost (One-Time & Recurring)	$50.1MM	$63.0MM	$395.8MM	$44.3MM
Total	$233.1MM	$516.1MM	$396.3MM	$640.5MM
NPV	$148.2MM	($316.4MM)	($232.5MM)	$478.6MM

Table 9: Cost Estimates Summary for the Gas AMI Upgrade Program ($USD, Nominal)

Cost Categories	Deployment Period (2024-2026)	Average Post Deployment (2027-2038)	Operating Period (2027-2038)	Total (15 yrs.)
Capital Cost (Direct) AMI hardware, software, deployment labor, professional services, program contingency	$141.6MM	$1.1MM	$13.3MM	**$154.9MM**
Capital Cost (Indirect) Corporate Overhead, AFUDC	$25.2MM	$0.2MM	$2.8MM	**$28.1MM**

[30] All figures are $USD nominal, unless otherwise indicated.
[31] Backhaul communications refer to the data transfer from the AMI fixed network back to the AMI headend system. The Company intends to leverage a mix of Company-owned fiber and microwave assets, as well as commercial cellular networks (*i.e.*, Verizon, AT&T, etc.) where necessary.

Cost Categories	Deployment Period (2024-2026)	Average Post Deployment (2027-2038)	Operating Period (2027-2038)	Total (15 yrs.)
O&M Cost (One-Time Expense) Change mgmt. support during program, manual meter reading expenses, program contingency	$6.6MM	$0.0MM	$0.0MM	**$6.6MM**
O&M Cost (Recurring) Ongoing fees for AMI IT systems, AMI Ops labor, IT Ops labor	$5.2MM	$3.2MM	$38.4MM	**$43.6MM**
Total	$178.6MM	$4.5MM	$54.5MM	**$233.1MM**



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
O&M Costs	$0.00	$3,249,386.33	$5,530,203.22	$2,978,153.72	$2,955,578.05	$2,995,314.37	$3,036,242.78	$3,078,399.05	$3,121,820.01	$3,166,543.59	$3,212,608.88	$3,260,056.13	$3,308,926.80	$3,359,263.58	$3,411,110.47	$3,464,512.77
Capital Costs	$0.00	$33,057,666.82	$59,180,198.74	$74,592,698.00	$1,168,193.56	$1,203,239.37	$1,239,336.55	$1,276,516.64	$1,314,812.14	$1,354,256.51	$1,394,884.20	$1,436,730.73	$1,037,924.85	$1,524,227.63	$1,569,954.46	$1,617,053.09
Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038

Figure 11: Gas AMI Upgrade Program Scenario - Yearly Spend Projections

Estimate of Costs to Implement the AMR Replacement

As part of the Business Case financial modeling, the Company also developed cost estimates for a scenario where the Company replaced its current AMR assets with new devices compatible with their current AMR system.

Using the Gas AMI Upgrade scope as a guide of the potential scope of the replacement activities, and based on its detailed knowledge of building and maintaining its AMR system for both electric and gas for nearly a decade, the Company developed an estimate of the AMR system replacement costs in a manner similar to how it estimated its Gas AMI Upgrade scenario costs. The results of this estimate are summarized in Table 10.

Table 10: Detailed Cost Estimates Summary for the AMR Replacement Scenario ($USD, Nominal)

Cost Categories	Deployment Period (2024-2026)	Average Post Deployment (2027-2038)	Operating Period (2027-2038)	Total (15 yrs.)
Capital Cost (Direct) Replacement AMR hardware, deployment labor, professional services, program contingency	$264.7MM	$10.5MM	$125.6MM	**$390.3MM**
Capital Cost (Indirect) Corporate Overhead, AFUDC	$41.9MM	$1.7MM	$20.9MM	**$62.8MM**
O&M Cost (One-Time Expense) Customer outreach	$0.5MM	$0.0MM	$0.0MM	**$0.5MM**
O&M Cost (Recurring) Ongoing meter reading labor costs, AMR equipment costs, AMR IT system maintenance	$10.4MM	$4.4MM	$52.2MM	**$62.6MM**
Total	$317.5MM	$16.6MM	$198.7MM	**$516.2MM**

The Company concluded through its estimation of the AMR replacement requirements that its costs would in fact *exceed* those of pursuing the Gas AMI Upgrade. Based on this detailed cost estimation within the business case, this is true for both the upfront deployment period costs and the on-going costs.

The primary reason for the upfront cost difference is the fact that the like-for-like replacement AMR communications module is not available. In fact, the Company faces two related supply constraints. First, the AMR endpoints that would have to be purchased and deployed for replacement purposes are AMI-capable modules which can be programmed to send *less* information to the network than what the modules are able to transmit. Additionally, the Company has determined that it would not be able to source enough of these modules to meet its field deployment requirement. Therefore, it would be forced to acquire the vendor's "fully integrated" gas meters to compliment the supply of the replacement AMI communications

modules. Together the resulting average price of the endpoints – and resulting total endpoint cost – is much higher than the Gas AMI Upgrade solution.[32]

The AMR replacement-related costs form an important avoided cost of pursing the Gas AMI Upgrade. However, since this cost is not separately set up in the Company's go-forward capital plan, the Business Case does not 'wash' this avoided cost against the Gas AMI Upgrade Program costs to show an offset. Rather, a cost-effectiveness screening step is applied – along with the other Business Case decision factors – to determine the cost-effectiveness of this and all other scenario-defined directions. (As described in Section 6, the AMR replacement scenario is higher cost than the Gas AMI Upgrade scenario, and it fails to meet program goals; hence it fails on its effectiveness test).

Estimate of Costs to Implement Integrated AMI Meters

As part of the Business Case modeling, the Company also developed cost estimates for a scenario where the Company replaces its current AMR assets with new, integrated AMI meters.

NIPSCO developed an estimate of related costs for this scenario in a manner similar to the Gas AMI Upgrade scenario costs, which is based on a combination of WMP industry experience, recent pricing provided by potential vendors, and NIPSCO SME knowledge, including knowledge gained as part of the in-flight electric AMI metering project. The results of this cost estimate are summarized in Table 11.

Table 11: Detailed Cost Estimates Summary for the Integrated AMI Meter Scenario ($USD, Nominal)

Cost Categories	Deployment Period (2024-2026)	Average Post Deployment (2027-2038)	Operating Period (2027-2038)	Total (15 yrs.)
Capital Cost (Direct) Replacement AMR hardware, deployment labor, professional services, program contingency	$477.6MM	$3.0MM	$36.3MM	**$513.9MM**
Capital Cost (Indirect) Corporate Overhead, AFUDC	$74.5MM	$0.6MM	$7.7MM	**$82.8MM**

[32] While the Company is intending to deploy fully integrated gas meters as part of its new *AMI* network over time, acquiring and deploying a fully integrated gas meter programmed to communicate in *AMR*-mode would be ineffective, impractical, and unreasonable.

Cost Categories	Deployment Period (2024-2026)	Average Post Deployment (2027-2038)	Operating Period (2027-2038)	Total (15 yrs.)
O&M Cost (One-Time Expense) Change mgmt. support during program, manual meter reading expenses, program contingency	$0.6MM	$0.0MM	$0.0MM	**$0.6MM**
O&M Cost (Recurring) Ongoing fees for AMI IT systems, AMI Ops labor, IT Ops labor	$5.3MM	$3.2MM	$38.4MM	**$43.7M**
Total	$558.0MM	$6.8MM	$82.4MM	**$640.5MM**

5. Evaluation of Benefits

Overview

An essential part of the Business Case evaluation is the development of a benefits inventory for the Gas AMI Upgrade solution and scenario. The benefits inventory developed as part of the Business Case evaluation is presented in Appendix 2. It identifies 39 gas AMI-related benefits. Excerpts from the benefits inventory are also included in this section. Benefits potentially enabled by the Gas AMI Upgrade are then compared as part of the scenario scoring to each scenario to reveal differences and inform decision making.

The basis for determining the set of Gas AMI benefits begins with recognizing the functional differences of each of the solutions. Table 3 (Section 3) lists and describes several of the most important functional differences of AMR and AMI. The functional differences determine what is possible from the metering system. The fact that the AMI system delivers the metering data more frequently and reliably than AMR (in turn) impacts how the AMI data can be levered to improve billing and customer operations, including reducing billing exceptions that might otherwise occur. In this example, the lower the billing exceptions the fewer calls the Company might expect to the customer care center. These are just two examples of the many ways that the Gas AMI metering system can drive improvements into the business operations, thereby improving the customer experience.

The Gas AMI Upgrade benefits are not solely focused on operational improvements, or those improvements that indirectly improve customer experience. Rather, the gas AMI data will also be levered, alongside electric AMI data, to improve the customer experience directly by offering new services. For example, customer facing applications (web, mobile) can provide energy usage information and bill presentment. (This is particularly impactful if customers can see both electric and gas usage information). Or the Company may offer in the future flexible billing dates (since the metering and billing systems provide greater levels of flexibility to adjust billing cycles and read windows). Or consider the fact that the gas AMI system permits the Company to innovate over time in the offering of new rate designs, such as prepay options.

Safety is an important feature of the Gas AMI Upgrade opportunity. The Gas AMI system will improve safety in several ways. First, during the deployment, the field installers will perform basic safety checks, such as a visual corrosion inspection. Also, the field installers will be trained to detect meter tamper conditions, and/or broken meters or indexes.

Safety is built into the new Gas AMI communication modules. As part of the operations of the system, the Gas AMI communications module will be programmed to detect excess gas flow.

This feature can be programmed to alarm at a threshold value, alerting the Company about an errant condition worth investigation.[33]

Benefit Classification

The benefits inventory provides a detailed classification of benefits. Classifications include:

- Utility operations area, such as Meter Reading, Billing, and Revenue Protection, etc.
- Nature and Type of Benefit. (O&M savings, productivity enhancement, safety improvement, compliance, improved customer satisfaction, reduction in unaccounted for gas, etc.).
- Whether the benefit is monetized, quantified but not monetized, or assigned as a qualitative benefit.
- Whether the benefit is dependent on Gas AMI. (Some benefits derive from the field deployment activity. As a technical matter these could be achieved during a full-scale replacement of the AMR modules).
- Is the gas benefit synergistic with the Company's electric AMI deployment?
- A brief description of key functional requirements that enable the benefit.

An excerpt from the benefit inventory appears in Table 12.

Table 12: Benefits Inventory *excerpt*, showing classifications for four representative benefits

Area of Utility Operations	Impacts of AMI processes and capabilities	Nature and Type of Benefits	Synergies with Electric AMI	Core functional requirements
Billing Operations	Improved bill accuracy due to increased meter read availability and quality (frequency and granularity of read data, VEE functionality, etc.)	Fewer billing exceptions and estimated bills, improved customer experience	●	Availability of accurate daily read information; support for hourly read data improved

[33] The Gas AMI module includes excess flow threshold alerting capabilities.

Area of Utility Operations	Impacts of AMI processes and capabilities	Nature and Type of Benefits	Synergies with Electric AMI	Core functional requirements
Customer Care	Improved usage information in customer-facing applications to increase customer self service	Reduced customer calls related to bill questions/disputes	●	Availability of accurate daily read information; support for hourly read data improved
Customer Programs	Enhanced abilities to support the design and implementation of energy efficiency and conservation programs, particularly as linked across electric and gas usage profiles and other useful data sources	Improved effectiveness of customer programs (customer savings and energy reduction performance)	●	Availability of accurate daily read information; support for hourly read data improved; data analytics capabilities leveraging multiple data sources
Deployment and Project Synergy	As part of deployment, improve asset registry information (LAT/LONG, meter location, photos of meter sets), improving overall asset management	Reduced operational expense, improved asset management, improved safety of equipment	●	Mobile work order management system to capture information during installation

Benefit Monetization

The Company has classified most of its 39 Gas AMI Benefits as *qualitative* in nature. This is due to the long-term and goal nature of many of the benefits. Once the system is fully deployed, alongside the AMI electric system, the Company will pursue the many use cases for achieving the gas AMI benefits.

As part of the Business Case evaluation, several of the benefits have been quantified and monetized. They are:

- **Meter Reading & Processing Savings:** The Company estimates that there will be **$44.3 million** in savings from 2024-2038 associated with reduced Meter Reading and Meter Processing labor through the deployment of AMI. These cost savings reflect today's costs to collect and process meter reads, which will reduced gradually as AMI is deployed and meter reads can be collected automatically and over-the-air.

- **AMR Software Licensing & Maintenance Savings:** The Company estimates that there will be **$1.4 million** in savings from 2024-2038 associated with avoided ongoing expenses to maintain the current AMR IT system. Like Meter Reading and Processing Savings, the costs associated with AMR IT system software and licensing will be reduced gradually, then eliminated entirely as AMR is replaced with AMI.

- **Meter Reading Vehicle Savings:** Through the deployment of AMI for gas, the Company also estimates savings of **$4.4 million** due to reduced expenses to maintain and operate the meter reading vehicle fleet. Enabling automatic and over-the-air meter reading will enable the Company to move away from having to operate and maintain their current meter reading vehicle fleet.

- **GHG Reductions Due to Reduced Truck Rolls:** The Company has estimated the reductions in total vehicle miles of travel, and related reductions in GHG emissions, due to the deployment and use of the proposed AMI system. It has also estimated the value of these reductions in monetary terms by referencing the Social Cost of Carbon (SCC). The SCC is a benchmark value used by the U.S. EPA to place a value on a ton of GHG reduction. The value of this reduction is estimated at **$0.3 million** over the 15-year modeled period.

In addition to those benefits that are quantified and monetized, the Business Case also recognizes many benefits as qualitative in nature. For example, the Company will use the AMI system solution to identify sources of losses on the gas system (such as tamper conditions, or broken meters that are not registering). Today, these cost for these losses are socialized across all customers as part of a loss factor. Additionally, the Company expects that there will be reductions in the number and length of calls into the customer service center because, with the AMI system, the Company will be able to present a more informative bill, and present information through several portals. These improve the customers' access to their energy usage and reduces the need to call customer service for basic inquires.

Summary of Benefit Value Potential

In total, the Company estimates that it will deliver approximately **$50.4 million** in quantified benefits over the 15-year modeled period. This includes approximately **$3.9 million** in average yearly operating savings in the post-deployment years (2027-2038). This yearly savings in the post-deployment period is due, in part, to the fact that the costs of running and maintaining the AMR system is slightly more costly than AMI.

Finally, one of the key avoided costs is the avoided costs the Company would otherwise incur to implement a solution to replace the current metering communications modules, which are reaching end of life. This upfront capital expense is estimated to *exceed* the cost of the proposed Gas AMI Upgrade by approximately $280 million.

Improving the Customer Experience

The narrow enumeration of certain operating cost saving opportunities does not reflect the significant impact that AMI will provide the Company's ability to improve the customer experience. The AMI metering data, including safety alarm features, provides the Company with a powerful set of data that it can use to improve customer service. This data can be furthered levered through the growing data analytics capabilities that utilities throughout the United States are deploying.

AMI data is more reliable and accurate, and less prone to disruptions due to weather and other factors. Customers will get a better billing product, which will promote greater confidence in the Company's metering and billing accuracy. The Gas AMI information will aid in the move in/move out cycle and allow for a precise determination of gas usage for account closeout purposes (in those circumstances where there is a continuation of occupancy and no disconnect of the meter). Due to metering and billing accuracy and reliability improvements, customer inquiries and complaints should also decline, which is expected to improve customer satisfaction and reduce expense associated with such calls to some extent.

With AMI, the Company will gain improved data visibility into customer energy use patterns, aiding customer care representatives in addressing customer inquiries about their energy usage. This information will aid customers as part of energy efficiency and conservation programs to making informed choices about their energy appliances, particularly during periods where they are investigating replacement and upgrade decisions for these appliances.

AMI data will also allow the Company to develop customer applications (mobile, web) that provide new value-added features. Energy usage and bill presentment information can be provided alongside electric account information (for the combination customers). Alert functions can also be created to aid the customer in their inter-month usage, for circumstances where the customer is having difficulties with a growing outstanding balance.

AMI implementation will aid customer care agents in more quickly and thoroughly addressing customer inquiries. And for every call *not* taken addressing a billing inquiry or complaint, customer care agents can devote attention to other customer matters more quickly. If these changes (in call volumes, durations, and types) are material, the Company might be able to avoid the need to hire additional agents, or it could lead to productivity improvements and staff efficiencies over time in this area of operations.

Although not quantifiable, enhancing customer and public safety is a material benefit of the Gas AMI Upgrade. The gas AMI system includes alarm features for excess temperature, pressure, and volume flow. The Company plans to develop detailed use cases to understand the specific ways it can work with these important safety features to assist its customers, communities, and public emergency officials, in improving community safety.

Table 13 describes many Gas AMI benefits. It includes an indication of those benefits that may help shape a customer experience due to the ability to provide enhanced customer service, and/or support customer and/or public safety.

Table 13: Customer Experience- and Safety-Related Impacts and Benefits from Benefits Inventory

Impacts That Drive Benefit(s)	Customer Experience Enhancements	Improved Customer and Public Safety
Improved bill accuracy due to increased meter read availability and quality (frequency and granularity of read data, VEE functionality, etc.)	●	
Ability to offer flexible billing cycle date to customers; ability to provide summary billing to larger set of customers	●	
Ability to support advanced rate structures and designs, such as tiered rate structures, prepayment, or TOU	●	
Improved usage information in customer-facing applications to increase customer self service	●	
Improved ability to field routine customer inquiries about usage, resolve issues, and provide greater insights about energy usage patterns	●	
Potential to detect customer-sited appliance failure through improved usage data, pressure, and flow sensing		●
Enhanced abilities to support the design and implementation of energy efficiency and conservation programs, particularly as linked across electric and gas usage profiles and other useful data sources	●	
Enhanced abilities to support customer-facing apps (mobile and web) for billing and energy use (and energy options) purposes, to encourage usage awareness and informed choices	●	
Potential improvements to low-income customer program design and administration due to improved data availability and quality, particularly as linked across electric and gas usage profiles	●	

Impacts That Drive Benefit(s)	Customer Experience Enhancements	Improved Customer and Public Safety
Potential for expanded customer programs for customers leveraging backup generators in events of electric power outages, including critical facilities (hospitals, police stations, etc.)	●	
Detection of potential tamper conditions (as part of the field installation work), including damaged meter, damaged ERT or index, or bypassed meter		●
Field technician inspection of meter set for corrosion or other safety issues (such as odor, or need to replace meter or riser)		●
In the event of a major gas system outage, the fully integrated smart meter with disconnect can help safely shut off so that the system can be restored more safely, efficiently, and quickly		●
Future functions of the AMI network may include digital and remote cathodic protection monitoring, reducing field survey inspection costs, improving system integrity and safety		●
Future functions of the AMI network may include digital and remote pressure monitoring, reducing field survey inspection costs, improving system integrity and safety		●
Pressure detection can alarm when thresholds exceeded		●
Temperature detection can alarm when thresholds exceeded, in the event of detection of a high heat source near meter set		●
Improved safety in emergency conditions through use of disconnect valve		●
Reduced vehicle-related emissions (GHG)		●
Reduced vehicle-related injuries and accidents (company employees or contractors)		●
Detection of potential tamper conditions though increased granularity and availability of consumption and flow data		●

6. Business Case Discussion and Results

The Company's Business Case evaluation includes four scenarios. It also includes several value-add opportunities. The Company concludes based on a review of its goals, decision principles, and key decision factors, that the Gas AMI Upgrade is a superior choice compared to the alternatives, including the observation that it is also the most cost-effective direction of the scenarios in relation to the Company's stated program goals.

As a foundational matter, the Company's Business Case rests on several goals. Briefly stated, they are: (a) the Company seeks a path forward the fulfills its AMI goals across all gas and electric meter customers, bringing the value to AMI to customers through a focused, coordinated, and unified program effort over the 2024-202 period; (b) the Company must address its metering reading challenge in the most cost-effective way compared to the alternatives; and (c) the Company seeks to deploy gas-related safety- and other innovation opportunities over time. These goals are documented in Section 3.

Scenario Scoring

To provide an objective review basis for the consideration of each alternative scenario in comparison to others, the Company determined the rank order of each scenario for its eight key decision factors. The rank ordering results are shown in Table 14.

For each decision factor (row) the Company determined the low, middle, and high preference (least favorable, to most favorable) for each scenario, applying the definitions provided below. In some instances, the scenario fails to meet a minimum acceptable requirement for that decision factor (and is scored a zero (0). For example, reliance on manual meter reading fails in its potential to deliver operational and customer benefits.

- 0 = Fails to Meet Minimum Criteria
- 1 = Inferior, Meets Few Criteria
- 2 = Adequate, Satisfies Some Criteria
- 3 = Strong, Meets Most or All Criteria

Based on the scoring results, the Gas AMI Upgrade is overwhelming superior to each of the other alternative.[34]

[34] The Company recognized as a possibility while performing the Business Case evaluation that – if the cumulative score of two or more scenarios is close – it might have to provide a weight to the decision factors. This proved unnecessary due to the unweighted score results.

Table 14: Summary of Key Observations for the Gas AMI Upgrade Versus Alternatives

Key Decision Factors	Return to Manual Meter Reading	AMR Replacement	Gas AMI Upgrade	Integrated AMI Meter
Timetable	3	1	3	2
Implementation Cost	3	1	2	0
On-Going Costs	1	2	3	3
Operational and Customer Benefits Potential	0	1	2	3
Feasibility	1	2	3	2
Vendor Fit and Support	0	1	3	3
Innovation Opportunities	0	1	3	3
Cost-effectiveness	0	1	3	0
TOTAL	8	10	22	16

Cost-Effectiveness Results

Cost-effectiveness is one of the most important decision factors applied in the Business Case. (The summary provided in Table 14 does not place any differential weights on the factor scores to tally the sum shown in the Total row, so the outsized true influence of the cost-effectiveness scores for each scenario are not revealed in the Total row results). The Gas AMI Upgrade scenario is substantially superior to the alternatives in this decision factor category because its "all in" cost of $233 million ($USD, nominal) over the 15-year period is much less than the AMR-based scenario of $516 million ($USD, nominal), and it delivers a higher level of effectiveness in terms of achieving the Company's goals (innovation platform, and AMI goals for all customers).

Similarly, the Gas AMI Upgrade is superior to the Integrated AMI Meter scenario due to its much lower costs and its greater feasibility by comparison. Ostensibly the Integrated AMI Meter scenario can meet portions of the Company's three goals, except not in a cost-effective manner. The cost difference drives it to a much less attractive cost-effectiveness result (as its costs are higher by a factor of nearly 3X).

The cost-effectiveness of the manual meter reading option is inferior; its long-term costs are roughly equivalent to the AMI upgrade path, but it fails in its ability (its effectiveness in other words) to deliver on the Company's goals.

The cost-effectiveness result of the Gas AMI Upgrade scenario is concordant with the Company's commitments to pursue a direction that places customer interests first, and which respects the capital constraints of the business (which play a key role in supporting customer affordability for the delivery of energy services).

How the Value-add Opportunities Influence the Value of the Gas AMI Upgrade

The attractiveness of the Gas AMI Upgrade also improves when considering the value that is added with the inclusion of the basic set of field deployment activities. With the AMI deployment the Company will perform certain safety checks at the meter location. It will also gather customer meter data (location) and check for tamper conditions (all of which helps improve data integrity and quality in the Company's asset registries and supports asset management activities over the long term). Objectively, these would also provide additional value to an AMR replacement strategy and the Integrated AMI Meter scenario since field technicians could perform these checks also as part of either. But it adds value to the Gas AMI Upgrade scenario in an absolute sense.

Additionally, the Gas AMI Upgrade will benefit from the inherent "option value" of being able to deploy new, "fully integrated" smart gas meters as part of the AMI communications network at some point in the future. These products are being demonstrated by NiSource elsewhere to test their usefulness and reliability. While not yet a highly mature and widely deployed technology, these integrated AMI meters come equipment with additional safety features, including a remote "over the air" valve that can remotely shut off the gas flow in the event of an emergency. The Company has not yet developed detailed and complete deployment-oriented use cases for this product, but it is confident that this product will play a valuable role over time as part of metering system. By selecting the right AMI solutions partner, the Company can gain access to this technology innovation (and other innovation as well) and work with it gradually to validate product viability.

The scoring results shown in Table 13 considers the value of this innovation as an option (and as a general matter) as it improves long term AMI benefits. The scoring does *not* rest on any specific plan to deploy the new meter product, but it supports the benefit and innovation factors.

For all scenarios, the Company also evaluated the feasibility of performing Grade 2 and Grade 3 leak repairs. The Company determined that performing this work on top of the AMI-related responsibilities would add cost and complexity and could influence the feasibility of achieving the program timetable. It was, therefore, not included within the four evaluated scenarios.

Integrated AMI Meters: A More Expensive Alternative that Will Benefit with More Time

As part of the Business Case evaluation, the Company gave careful and thorough consideration to the scenario that would replace all current gas meters with new, integrated AMI meters. The shorthand of "fully integrated" is sometimes used to describe these gas meters because they are built with the AMI communications fully embedded into the gas meter housing as a complete unit.

The availability of a fully integrated smart meter is an exciting area of innovation in the gas metering market. The product includes the communications capability as well as a mechanical valve that can be controlled "over the air" to open or close the gas flow. As such it opens the door to use cases that will support public safety and other benefits.

If focusing purely on the potential, enabled customer service and safety enhancements, the fully integrated AMI meter presents an attractive gas meter alternative. However, as part of a wide-scale metering solution, the primary factor cutting in the opposite direction for its deployment is that such benefits would come at a significant, incremental costs as compared to the Gas AMI Upgrade solution (where the AMI communications module is installed *onto* the existing gas meter, which is left in place).

Additionally, the fully integrated smart gas meter is a new product in the metering market with few mass deployments when compared to gas AMI communications modules. There would, therefore, be the potential of unexpected deployment and/or operational issues that come with adopting new technology. As part of the Business Case, NIPSCO ultimately determined that pursuing the lower-cost AMI Upgrade alternative, which preserves the optionality to deploy the fully integrated AMI meter in the future as the technology matures, is the more prudent decision for both the Company and its customers.

Table 15 summarizes key features of this solution.

Table 15: Highlights of Integrated Gas Meter Scenario

Feature	Discussion
Product Availability	The Company determined it will be more difficult to acquire the fully integrated product at the needed scale and within the timetable of the Company's AMI deployment. This drives schedule risk (timetable, on the scoring table). It could also drive higher costs if manual meter reading is needed as a work-around until the product is shipped and the meter installed. (Implementation cost factor).
Customer Convenience	The Company is mindful of the fact that installing many new gas meters requires more disruption for the customers, since each gas meter installation takes up to two hours. Appointments would have to be scheduled, as the gas needs to be shut off and then pilots re-lite once the service is restored.

Number of Field Installers	To use the new meter product in a large scale would require that the Company hire a much larger team of field installers, further complicating deployment, driving more schedule risk, and potential for unexpected costs.
Excess Capital Requirements in Future Years	Introducing a new meter is best done gradually to avoid big surges or spikes in capital requirements involved in replacing many meters at one time. (For electric AMI, this is not so much of an issue because the swap out of the meter, conducted every 20 years, is a simpler "swap and replace" of the meter during a brief field visit. The same meter socket is used and not disturbed).
Technology Adoption	The Company perceives value in monitoring how this new technology is adopted in the gas metering industry for best practices and presuming increasing levels of product maturity. This reduces the technology risk.

With these considerations in mind, the Company was able to create its informed view of the comparative scenario scoring shown in Table 14.

The Gas AMR Direction: Maintaining Status Quo at a Significant Cost

The Company concludes that pursuing an AMR replacement direction is a poor choice and inferior to the Gas AMI Upgrade direction. First, it represents a higher cost solution both in its upfront capital needs as well as in its on-going maintenance requirements. Because it secures fewer benefits at a higher cost, its cost-effectiveness is inferior.

Second, the AMR replacement solution is riskier from an implementation standpoint, due to limits in securing adequate replacement communication modules from the manufacturer. Any delays in implementing the metering system replacement places a higher risk that manual meter reading will be required as a stop-gap measure, and these services would be costly and error prone.

The AMR solution may also fail from a feasibility perspective. The Company is not confident that the AMR solution would not be become obsolete after it is deployed, given the directions of the AMR and AMI technology and solution market. As described in the Business Case, AMR's functional limitations (see in part Table 3) drives obsolescence risk, and thereby fails to generate sufficient Company confidence in establishing an adequate economic service life of any new AMR assets.

Manual Meter Reading: An unacceptable Fallback

The Company considers a manual meter reading solution unacceptable. It is low cost to implement, but high cost to maintain. It achieves few benefits. In fact, it backslides on benefit value to customers, and causes error prone billing determinants and a cascade of customer service quality impacts. Its cost-effectiveness in relation to Company goals is scored "fails (0)" to meet minimum requirements.

The Company also considers it infeasible since it requires Company workers and contractors to visit customers' property (over 10 million visits annually) to collect reads, and this is viewed as a safety factor given range of reactions people have of perceived strangers visiting their property unannounced.

Summary of Business Case Decision Factors

Figures 12 and 13 represent the scoring provided in Table 13 diagrammatically, using the shape of a plane polygon. The figures are based on a representation of each decision factor assuming equal weights. The decision factors indices start at 0 at the center of the figure and progress radially to the edge of the figure along the eight separate axes.

In this figurative view, the best solution is the one that occupies the greatest area within the boundaries of the plane polygon. While this figure is not intended to be interpreted precisely, (as noted, the Company has not placed different weights on the decision factors) it can assist in gaining an appreciation for the overwhelming positive result for the Gas AMI Upgrade scenario compared to the two alternatives.

This is evident in inspecting the results shown in Table 13 also; of the eight (8) factors x four (4) scenarios = 32 separate contributing scores, only a few scores achieve a higher ranking than the scores supporting the Gas AMI Upgrade. (This includes the upfront implementation cost of a manual meter reading solution, which is lower because it makes no significant demands on capital).

Figure 12, when contrasted with Figure 13, supports the observation that the Gas AMI Upgrade presents the strongest direction for the Company in achievement of its goals, in relation to these specific decision factors. Given its upfront cost of approximately $178 million, and it's *all in* cost of $233 million, as compared to the all in costs of three other principal scenarios, the Gas AMI Upgrade represents the most cost-effective of the proposed solutions. **Given its AMI benefit potential, and its more limited cost, the Gas AMI Upgrade is aligned with Company interests to pursue a pathway of securing the most customer benefit while respecting capital constraints.**

A similar argument applies when comparing the Gas AMI Upgrade scenario to the Integrated AMI Meter scenario. The latter has a much higher implementation cost (due to the very high costs of the product and its installation), and its overall effectiveness as a solution is lower. It also introduces risk to the timetable.

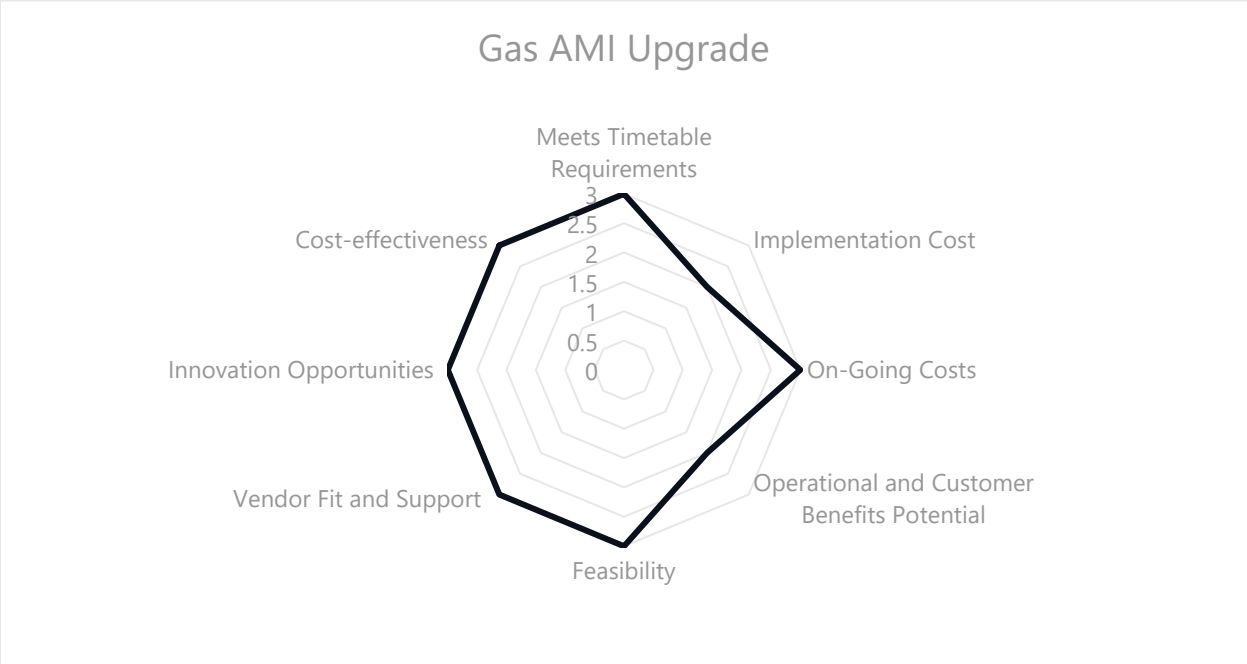
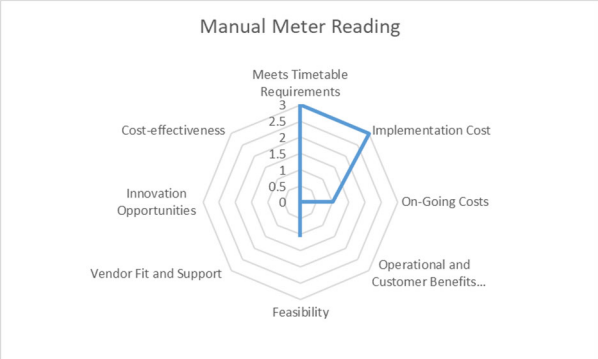
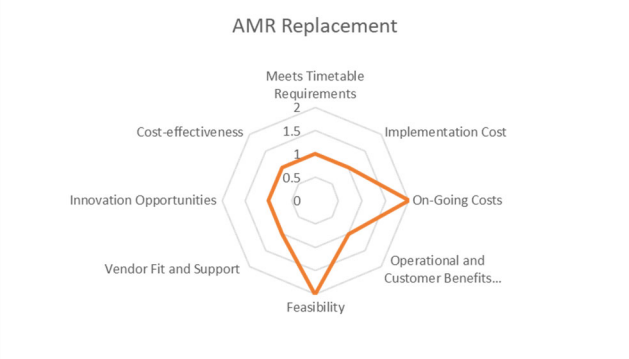


Figure 12: Evaluation of Gas AMI Upgrade Strengths and Weaknesses (Relative to Alternatives)





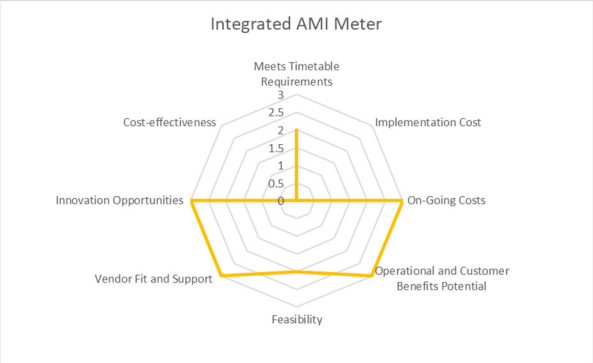


Figure 13: Evaluation of Manual Meter Reading, AMR Replacement, and Integrated AMI Meter Scenarios

Cost Estimate Quality

The Company recognizes that there is always inherent uncertainty to some degree in a cost estimate, and this observation also applies to the cost estimates for each of the four scenarios developed in the Business Case. While uncertainty is inherent in estimation, the Gas AMI Upgrade Program team plans to continue to refine cost estimates in the coming months through formal vendor evaluations and negotiations and detailed budget planning.

Clearly the nature and magnitude of the Gas AMI Upgrade costs are a key decision factor underlying the evaluation of this direction. As noted elsewhere, the Business Case concludes that the Gas AMI Upgrade is cost-effective: it achieves the desired outcomes in the most cost-effective manner possible. However, it is useful to also consider the underlying quality of the cost estimates that informs the conclusion.

The Company has prepared estimates for each of the major categories of spend that make up the Gas AMI Upgrade scenario and solution. According to its internal standards, it has concluded that its cost estimate falls between what is known as a Class 3 and Class 4 estimate. The reason its total cost estimate is between these two levels is because some of the categories of the estimates are further refined than others, and its total result reflects a midpoint of these two levels.[35]

[35] To determine the quality of its costs estimates the Company inspected each of the major cost elements and determined its separate quality in terms of its estimation class. The term "Class" is used by the Company in this instance in the same meaning as that established by the AACE International standard and cost classification system. Additionally, each major cost element is typically a composite cost involving the purchase of major or minor assets, the implementation of various program elements by Company employees and its contractors involving field communications and internal IT/OT system changes, and costs covering Project team labor efforts. The implementation of the Gas AMI Upgrade Project involves

In determining the quality of its estimates for the Gas AMI Upgrade, the Company has levered (a) current electric AMI-related vendor contracts, statements of work and purchase orders to inform estimates, (b) experiences gathered as part of the electric AMI program work for certain IT activities, and (c) informed judgement by SMEs with extensive experience in the cost category.

A key element of the cost estimate is an understanding of the Company's required scope for either the product or service in question. The degree of scope definition plays a key role in determining the Class estimate. Moreover, the knowledge gained by the Company in planning and implementing electric AMI has significantly aided the Company in identifying the scope elements for the Gas AMI Upgrade (in furtherance of the cost estimation process, and thereby improving the cost estimates).

Based on this cost estimation effort, it has assigned contingency to the upfront cost items to capture the fact that its planning is in progress, and in deference to the quality of its estimates at this time.[36] The Business Case conclusion considers the full cost that includes the assignment of the contingency.

Summary Conclusions

The Company's Business Case conclusions and the proposed direction to implement the Gas AMI Upgrade is timely and represents a sound business decision, one that aspires to bring valuable gas AMI-related benefits to the Company and its customers.

The Gas AMI Upgrade scenario is well aligned to the Company's three main program goals, including that it will address the current metering needs in a cost-effective manner. In fact, when compared to the other scenarios, the Gas AMI Upgrade scenario is far more cost-effective than either replacing the AMR system or deploying the fully integrated AMI meter at scale. The Gas AMI Upgrade brings AMI value to customers while respecting Company capital constraints and preserving optionality to capture product and solution innovation in the future.

The proposed Gas AMI Upgrade business and technology solution is also sound, fitting well within the norms of industry experience and aligned to the direction of the Corporation's long

several expanded or new contractual relationships in such areas as field installation (of AMI communication modules), IT integration design and implementation, customer communications, and telecommunications design and implementation services.

[36] The Company also recognizes as part of its estimation process that there is uncertainty to the on-going AMI system operating and maintenance costs. The Company will transition the AMI system operations to "steady state" operations once it is sufficiently deployed and main meter-to-cash and other core business and IT processes are well established and functioning within required specifications. However, as a proportion of the spend the on-going costs do not have a large impact on the total cost estimate. The new AMI support costs are also estimated to be less than the AMR system support costs.

term technology adoption requirements, and consistent with the direction of the industry in general. In fact, a replacement of the current AMR system with another AMR solution introduces obsolescence risk given the status and direction of the AMR and AMI solution market.

7. Appendices

7.1. Detailed Business Case Cost and Benefit Input Assumptions

Table A-1: Key Assumptions Utilized in the Financial Business Case Modeling

Business Case Assumption	Assumption Description	Relevant Scenario(s)	Cost or Benefit Driver
Weighted Average Cost of Capital (WACC)	Calculated to present value dollars using a 6.5% discount rate	All	Cost
Inflation Rate	Calculated escalating costs of key Program investments by 3.0% annually	All	Cost
Allowance for Funds Used During Construction (AFUDC)	Applied 3.3% to capital costs eligible for AFUDC treatment based on Company corporate governance	All	Cost
Corporate Overhead	11.0% factor applied to all capital cost items	All	Cost
Materials and Sales Tax	7.0% applied to all items eligible for materials and sales tax upon transaction	All	Cost
Contracted Labor Contingency	20% contingency factor applied for contracted labor cost items based on model sensitivity range and confidence in contracted labor unit cost estimates for different implementation and installation work	All	Cost
Materials Contingency	10% contingency factor for materials costs based on model sensitivity range and confidence in materials unit cost estimates developed from RFI data and parallel Company programs, including the Electric AMI Program	All	Cost
Deployment Period Duration	Three-year deployment timeline assumed based on Company strategy, capital and resource availability, and alignment with Electric AMI and other Company initiatives	AMI, AMR	Both
Deployment Field Labor	Assumed that contracted deployment field labor would be utilized to supplement NIPSCO labor to execute field deployment; Company plans to coordinate closely with local unions	AMI, AMR	Cost
IT Implementation Labor	Assumed mix of contracted support from system integration partners, AMI technology vendors, Company IT service providers, and internal employees	AMI	Cost
Customer Growth	Assumed 1.5% annual growth of Company gas customer meter population based on recent Company data	All	Cost
Customer Outreach & Education	Assumed that similar number and types of communications would be created and shared with customers prior to, during, and after deployment as are planned for the Electric AMI Program	AMI	Cost
Manual Meter Reading Labor	Assumed that Company would hire full-time resources to collect manual reads (in relevant scenario)	Manual Meter Reading	Cost
Current Meter Reading Labor Expenses	Assumed that current Company Meter Reading labor expenses would only increase with inflation (would not increase substantially due to customer growth)	AMI, AMR	Both
AMR Replacement Devices	Assumed a mix of true AMR ERTs, AMI communications modules (set to AMR mode), and integrated gas safety meters (set to AMR mode) would need to be deployed in the AMR scenario due to current vendor supply and lead time constraints for AMR-compatible devices	AMR	Cost

Business Case Assumption	Assumption Description	Relevant Scenario(s)	Cost or Benefit Driver
AMI Comms Module Unit Costs	Leveraged unit pricing received from multiple AMI technology vendors via RFI	AMI	Cost
Integrated AMI Meter Unit Costs	Leveraged unit pricing received from multiple AMI technology vendors via RFI	AMI	Cost
Meter Exchange Job Scope	Assumed that any work involving a new integrated gas smart meter install would require a customer outage and relight	AMI, AMR	Cost
AMI Comms Module Install Unit Costs	Leveraged unit pricing received from multiple deployment contractors via RFI; peer utility benchmarking also reinforced cost estimate	AMI	Cost
Integrated AMI Meter Install Unit Costs	Leveraged unit pricing received from multiple deployment contractors via RFI; peer utility benchmarking also reinforced cost estimate	AMI	Cost
AMI Headend System Implementation Costs	Assumed that Gas AMI Upgrade Program would include costs associated with updating the AMI Headend System being implemented for the Electric AMI Program in order to handle and support gas endpoint data	AMI	Cost
Meter Data Management Platform Implementation Costs	Assumed that Gas AMI Upgrade Program would include costs associated with updating the meter data management platform being implemented for the Electric AMI Program in order to handle and support gas endpoint data	AMI	Cost
AMI Network Deployment Costs	Assumed that Gas AMI Upgrade Program would include costs associated with extending the AMI network system being deployed for the Electric AMI Program in order to cover the full Company gas service territory	AMI	Cost
Meter Reading Labor Expense Reductions	Assumed that current Company Meter Reading labor expenses would be reduced gradually as Gas AMI Upgrade Program progresses	AMI	Benefit
GHG Emissions Reductions	Utilized Social Cost of Carbon (SCC) method to calculate the financial value of GHG emissions reductions from fewer required truck rolls for meter reading activities	AMI	Benefit

7.2. Benefits Inventory

Table A-2: Inventory of Potential Benefits Enabled Through a Gas AMI Upgrade

Area of Utility Operations	Impacts That Drive Benefit(s)	Nature and Type of Benefit(s)	Nature in Business Case (Monetized or Qualitative)	AMI Dependency	Synergistic with Electric AMI	Core Business/Functional Requirement(s)
Billing Operations	Improved bill accuracy due to increased meter read availability and quality (frequency and granularity of read data, VEE functionality, etc.)	Fewer billing exceptions and estimated bills, improved customer experience	Qualitative	AMI	❍	Availability of accurate daily read information; support for hourly read data improved
Billing Operations	Ability to offer flexible billing cycle date to customers; ability to provide summary billing to larger set of customers	Improved customer satisfaction (higher quality service)	Qualitative	AMI	●	Availability of accurate daily read information; support for hourly read data improved
Billing Operations	Ability to levelized billing labor workload requirements, avoiding excessive peak or surge demands on billing operations	Reduced strain on billing operations resources	Qualitative	AMI	●	Availability of accurate daily read information; support for hourly read data improved
Billing Operations	Ability to support advanced rate structures and designs, such as tiered rate structures, prepayment, or TOU	Improved customer choice, opportunities for improved system balancing	Qualitative	AMI	❍	Availability of accurate daily read information; support for hourly read data improved
Customer Care	Improved usage information in customer-facing applications to increase customer self service	Reduced customer calls related to bill questions/disputes	Qualitative	AMI	●	Availability of accurate daily read information; support for hourly read data improved

Area of Utility Operations	Impacts That Drive Benefit(s)	Nature and Type of Benefit(s)	Nature in Business Case (Monetized or Qualitative)	AMI Dependency	Synergistic with Electric AMI	Core Business/Functional Requirement(s)
Customer Care	Improved ability to field routine customer inquiries about usage, resolve issues, and provide greater insights about energy usage patterns	Improved customer satisfaction (higher quality service)	Qualitative	AMI	●	Availability of accurate daily read information; support for hourly read data improved
Customer Programs	Enhanced abilities to support the design and implementation of energy efficiency and conservation programs, particularly as linked across electric and gas usage profiles and other useful data sources	Improved effectiveness of customer programs (customer savings and energy reduction performance)	Qualitative	AMI	●	Availability of accurate daily read information; support for hourly read data improved; data analytics capabilities leveraging multiple data sources
Customer Programs	Enhanced abilities to support customer-facing apps (mobile and web) for billing and energy use (and energy options) purposes, to encourage usage awareness and informed choices	Improved effectiveness of customer programs (customer savings and energy reduction performance)	Qualitative	AMI	●	Availability of accurate daily read information; support for hourly read data improved; enhancements to customer-facing applications for data presentment
Customer Programs	Potential improvements to low-income customer program design and administration due to improved data availability and quality, particularly as linked across electric and gas usage profiles	Improved effectiveness of customer programs (customer savings and energy reduction performance)	Qualitative	AMI	●	Availability of accurate daily read information; support for hourly read data improved; data analytics capabilities leveraging multiple data sources
Customer Programs	Potential for expanded customer programs for customers leveraging backup generators in events of electric power outages, including critical facilities (hospitals, police stations, etc.)	Improved customer experience, public and customer safety	Qualitative	AMI	●	Availability of accurate daily read information; support for hourly read data improved; data analytics capabilities leveraging multiple data sources

Area of Utility Operations	Impacts That Drive Benefit(s)	Nature and Type of Benefit(s)	Nature in Business Case (Monetized or Qualitative)	AMI Dependency	Synergistic with Electric AMI	Core Business/Functional Requirement(s)
Deployment	Avoided capital cost for the purchase and installation of AMR communication modules and equipment	Reduced capital expense	Qualitative	AMI	N/A	AMI system deployment
Deployment and Project Synergy	Avoided future replacement of old meter (upgraded as part of deployment where necessary)	Avoided future capital expense	Qualitative	AMR or AMI	N/A	Mobile work order management system to establish need for meter replacement
Deployment and Project Synergy	Detection of potential tamper conditions (as part of the field installation work), including damaged meter, damaged ERT or index, or bypassed meter	Improved safety, reduction in gas revenue losses (unaccounted for gas)	Qualitative	AMR or AMI	●	Mobile work order management system to capture information during installation
Deployment and Project Synergy	Detection of meters that are not properly registered in the system (lost or inaccurate meter location)	Reduction in lost revenues (unaccounted for gas)	Qualitative	AMR or AMI	●	Mobile work order management system to capture information during installation
Deployment and Project Synergy	As part of deployment, improve asset registry information (lat/long, meter location, photos of meter sets), improving overall asset management	Reduced operational expense, improved asset management, improved safety of equipment	Qualitative	AMR or AMI	●	Mobile work order management system to capture information during installation

Area of Utility Operations	Impacts That Drive Benefit(s)	Nature and Type of Benefit(s)	Nature in Business Case (Monetized or Qualitative)	AMI Dependency	Synergistic with Electric AMI	Core Business/Functional Requirement(s)
Deployment and Project Synergy	Field technician inspection of meter set for corrosion or other safety issues (such as odor, or need to replace meter or riser)	Reduced future cost (to resolve issue)	Qualitative	AMR or AMI	N/A	Mobile work order management system to establish need for follow on repair visit (or other process, as required due to severity)
Deployment and Project Synergy	Reduced complexity and activity due to avoided, uncoordinated and postponed IT and Business process development and implementation related to meter-to-cash, asset registry work order management, and customer care systems	Reduced investment cost	Qualitative	AMI	●	AMI system deployment coordination
Deployment and Project Synergy	Reduced deployment complexity and activity for shared AMI network system; reduced process development and implementation related to AMI operational systems and metering related integrations	Reduced upfront capital cost; reduced long-term network management costs	Qualitative	AMI	●	AMI system deployment coordination
Gas Operations	In the event of a major gas system outage, the fully integrated smart meter with disconnect can help safely shut off so that the system can be restored more safely, efficiently and quickly	Customer and public safety; reduced costs during major restoration activity following large-scale outage	Qualitative	AMI	N/A	Fully integrated gas smart meter with valve

Area of Utility Operations	Impacts That Drive Benefit(s)	Nature and Type of Benefit(s)	Nature in Business Case (Monetized or Qualitative)	AMI Dependency	Synergistic with Electric AMI	Core Business/Functional Requirement(s)
Gas Operations	Future functions of the AMI network may include digital and remote cathodic protection monitoring, reducing field survey inspection costs, improving system integrity and safety	Reduced operational expense, improved corrosion monitoring, improved system integrity and safety	Qualitative	AMI	N/A	AMI communications installed on other assets
Gas Operations	Future functions of the AMI network may include digital and remote pressure monitoring, reducing field survey inspection costs, improving system integrity and safety	Reduced operational expense, improved corrosion monitoring, improved system integrity and safety	Qualitative	AMI	N/A	AMI communications installed on other assets
Gas Operations	Pressure detection can alarm when thresholds exceeded	Improved customer and public safety	Qualitative	AMI + Smart Meter	N/A	Pressure detection alarm feature in fully integrated gas smart meter
Gas Operations	Temperature detection can alarm when thresholds exceeded, in the event of detection of a high heat source near meter set	Improved customer and public safety	Qualitative	AMI + Smart Meter	N/A	Temperature threshold detection alarm feature in fully integrated gas smart meter
Meter Operations	Improved safety in emergency conditions through use of disconnect valve	Improved customer and public safety	Qualitative	AMI + Smart Meter	N/A	Fully integrated gas smart meter with valve
Meter Reading	Reduced vehicle-related emissions (GHG)	Improved public health; reduced social cost of carbon	Monetized	AMI	N/A	Over-the-air reads delivered and available for billing

Area of Utility Operations	Impacts That Drive Benefit(s)	Nature and Type of Benefit(s)	Nature in Business Case (Monetized or Qualitative)	AMI Dependency	Synergistic with Electric AMI	Core Business/Functional Requirement(s)
Meter Reading	Reduced vehicle-related expenses (lease, maintenance, repair, fuel, insurance, taxes)	Reduced operational expense	Monetized	AMI	N/A	Over-the-air reads delivered and available for billing
Meter Reading	Reduced vehicle-related injuries and accidents (company employees or contractors).	Improved employee, customer, and public safety	Qualitative	AMI	N/A	Over-the-air reads delivered and available for billing
Meter Reading	Reduction in meter reading expenses associated with performing on-cycle and off-cycle reads. (Reduced labor costs)	Reduced operating cost	Monetized	AMI	N/A	Over-the-air reads delivered and available for billing
Meter Reading	Avoided replacement costs for the replacement of vehicle-based meter reading equipment related to the AMR system	Reduced capital expense	Monetized	AMI	N/A	Over-the-air reads delivered and available for billing
Meter Reading	Avoided IT support costs to maintain the AMR metering reading system	Reduced operating expense	Monetized	AMI	N/A	Over-the-air reads delivered and available for billing
Meter Reading and Processing	Reduced field visits to perform meter read, as part of billing investigations or other demands and inquiries of customers	Reduced operational expense, and/or productivity improvement	Monetized	AMI	●	Availability of accurate daily read information; support for hourly read data improved

Area of Utility Operations	Impacts That Drive Benefit(s)	Nature and Type of Benefit(s)	Nature in Business Case (Monetized or Qualitative)	AMI Dependency	Synergistic with Electric AMI	Core Business/Functional Requirement(s)
New Business	Improved sizing of meters with availability of hourly measurement as diagnostic	Asset productivity	Qualitative	AMI	N/A	Availability of accurate daily read information; support for hourly read data improved; data analytics capabilities leveraging multiple data sources
Revenue Protection	Detection of potential tamper conditions though increased granularity and availability of consumption and flow data	Reduction in lost revenues (unaccounted for gas)	Qualitative	AMI	●	Availability of accurate daily read information; support for hourly read data improved; data analytics capabilities leveraging multiple data sources
Revenue Protection	Detection of unusual consumption patterns, such as usage on vacant, or unusual consumption patterns in relation to type of structure, or pattern of use	Reduction in lost revenues (unaccounted for gas)	Qualitative	AMI	●	Availability of accurate daily read information; support for hourly read data improved; data analytics capabilities leveraging multiple data sources
Revenue Protection	Faster detection of malfunctioning or failed metering equipment (i.e. indexes).	Reduction in lost revenues (unaccounted for gas)	Qualitative	AMI	●	Availability of accurate daily read information; support for hourly read data improved; data analytics capabilities leveraging multiple data sources

Area of Utility Operations	Impacts That Drive Benefit(s)	Nature and Type of Benefit(s)	Nature in Business Case (Monetized or Qualitative)	AMI Dependency	Synergistic with Electric AMI	Core Business/Functional Requirement(s)
Supply and Optimization	Improved understanding of hourly consumption behaviors may improve insights of gas operation planners on how to best utilize assets and balance system across resource options (storage line pack, wholesale purchase, LNG peakers) during period of stress or other periods; opportunity to combine consumption data and correlate with weather and geospatial information	Reduced wholesale market purchase activity and costs; improved system planning and balancing	Qualitative	AMI	N/A	Availability of accurate daily read information; support for hourly read data improved; data analytics capabilities leveraging multiple data sources
Supply and Optimization	Improvements to the day-ahead gas system forecast and purchase requirements due to improved fidelity of gas consumption in immediate proceeding period	Reduced wholesale market purchase activity and costs; improved system planning and balancing	Qualitative	AMI	❍	Availability of accurate daily read information; support for hourly read data improved; data analytics capabilities leveraging multiple data sources
System Engineering	Improved system integrity, and reduction in losses, through improved fidelity on gas usage across the system with ubiquitous AMI; improved loss detection, reduced losses	Improved loss detection and resolution	Qualitative	AMI	N/A	Availability of accurate daily read information; support for hourly read data improved; data analytics capabilities leveraging multiple data sources

7.3. Class Estimate Definitions

Definitions for Class 3 and Class 4 Estimate Purposes

- Class 4 estimate is used when the program is at the Feasibility or Pre-Design stage.
    - Level of Program Definition = up to 15% (expressed as a percentage of complete definition)
    - End Usage (purpose of estimate) = Study or Feasibility
    - Expected Accuracy Range
        - Low Range: (-) 15% to (-) 30%
        - High Range: (+) 20% to +50%
- Class 3 estimate is used when the program progressed beyond the feasibility and pre-design stage and has begun implementation stage.
    - Level of Program Definition = 10% to 40% (expressed as a percentage of complete definition)
    - End Usage (purpose of estimate) = Budget Authorization, Control purposes
    - Expected Accuracy Range
        - Low Range: (-) 10% to (-) 20%
        - High Range: (+) 10% to +30%

7.4. Business Case Decision Factors Radar Graphs

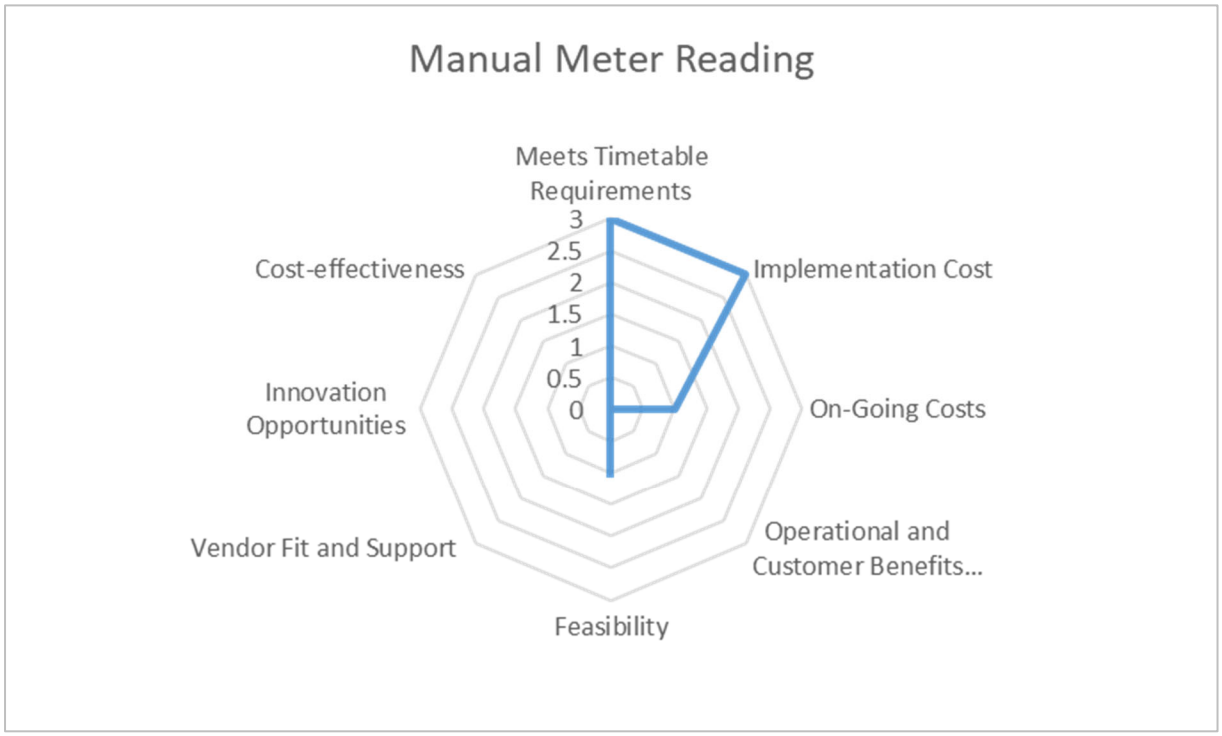


Figure A-1: Evaluation of Manual Meter Reading

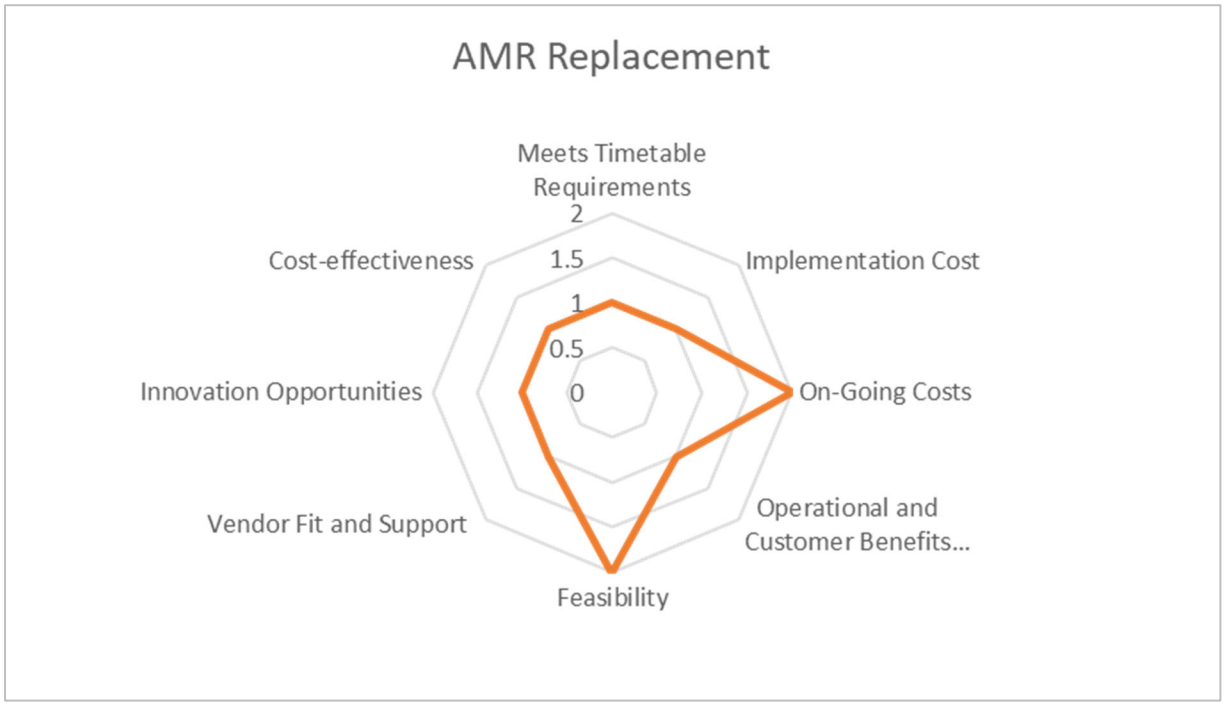


Figure A-2: Evaluation of AMR Replacement

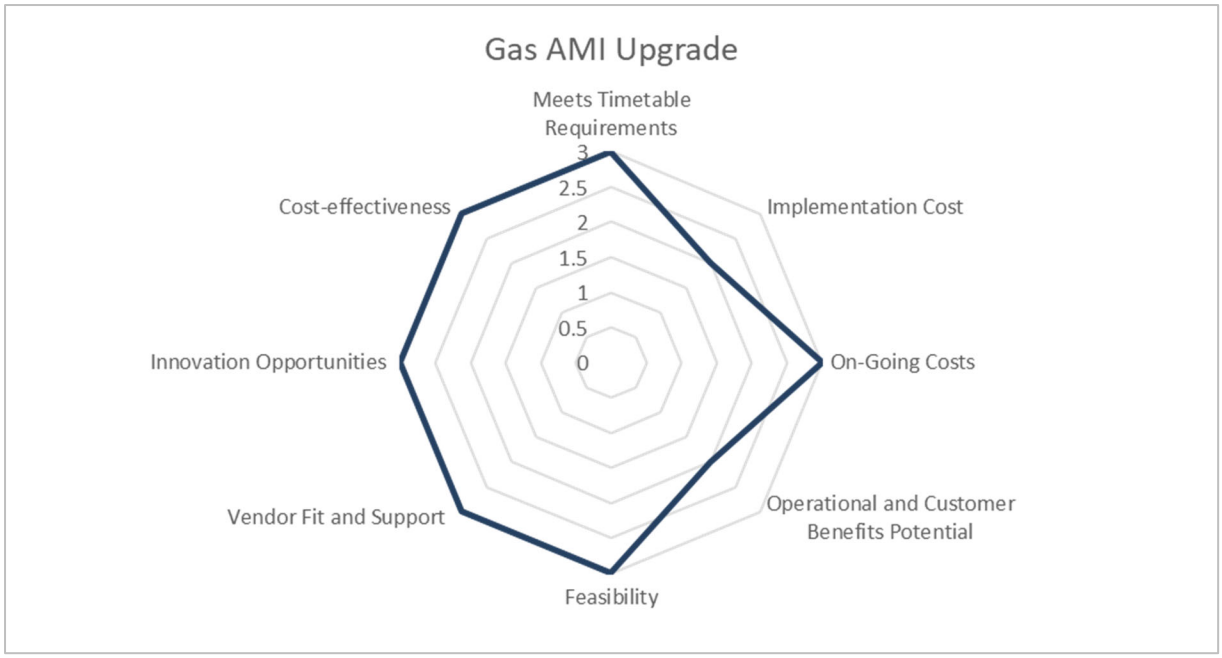


Figure A-3: Evaluation of Gas AMI Upgrade

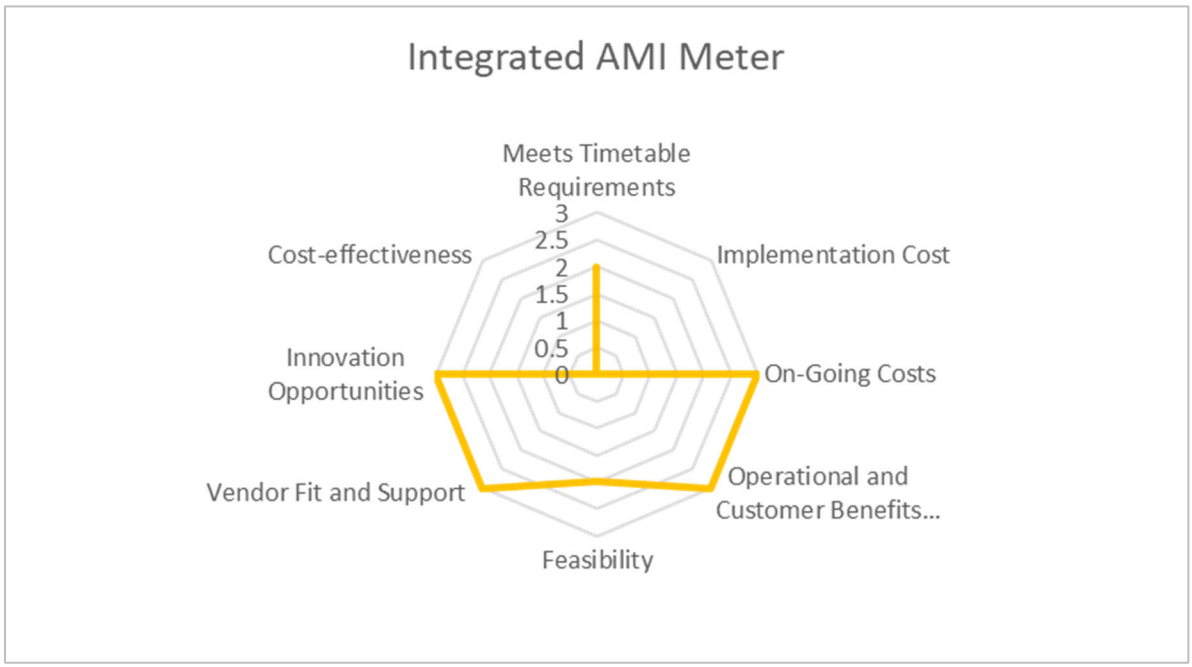


Figure A-4: Evaluation of Integrated AMI Meter

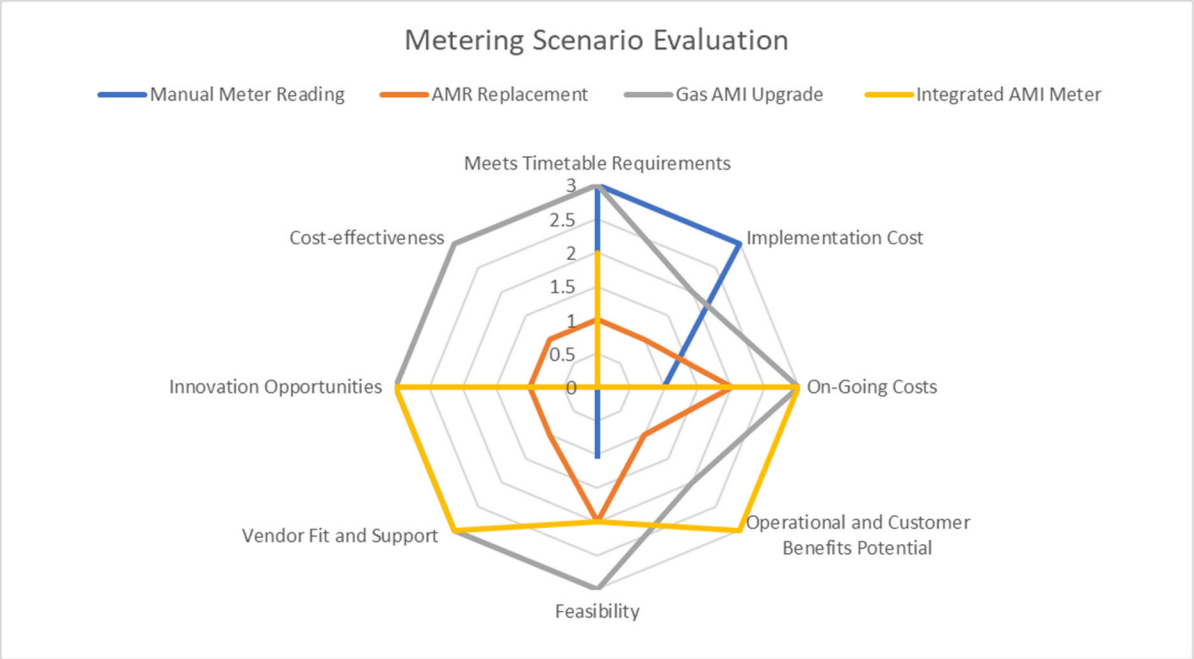


Figure A-5: Evaluation of Four Scenarios