AusNet

Gas Network

Customer Metering Strategy

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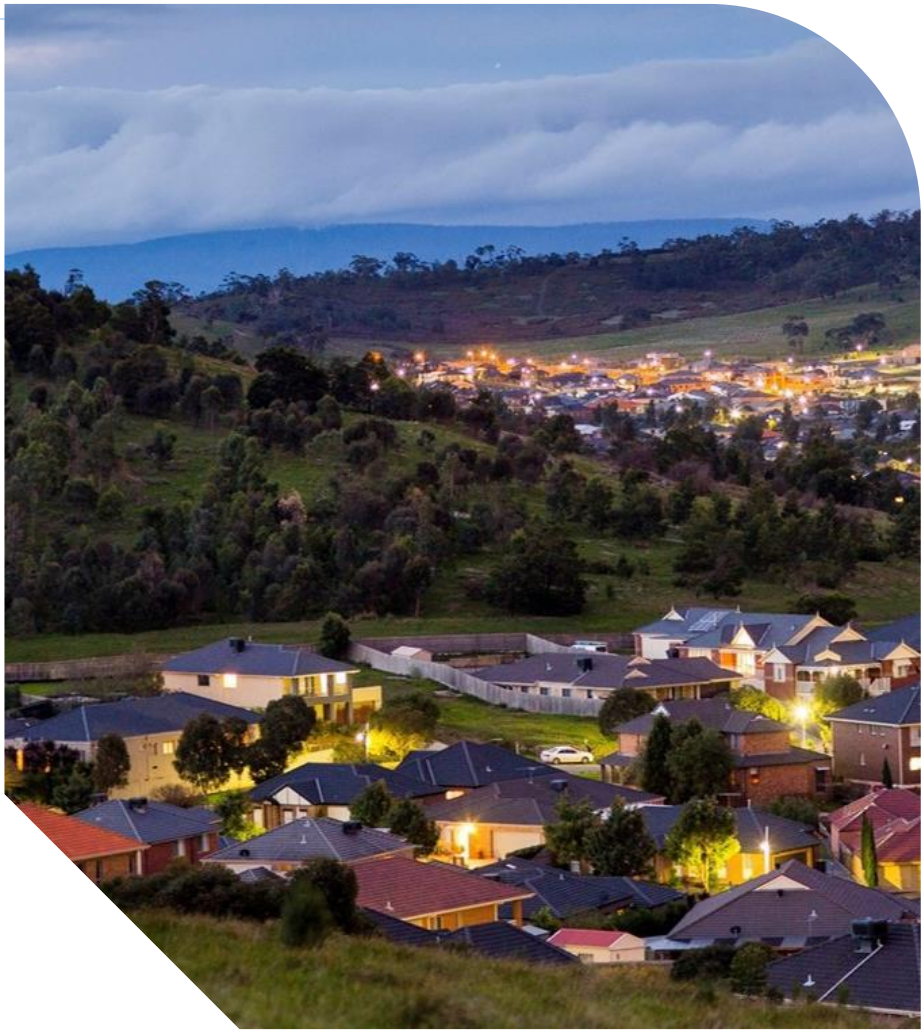

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Executive Summary

This document details AusNet Services' approach to the management of existing gas metering assets. The following annual programs maintain consumer safety and compliance with obligations under the current version of the Gas Distribution System Code (GDSC). To achieve the objectives of safety and reliability with accurate billing for AusNet Services and the largest industrial end users (over 10 TJ annual gas consumption), the turbine meter replacement program, and the data logger and flow corrector replacement program are introduced in the 2024-28 access arrangement period along with the following programs:

- Annual In-service Compliance Testing of domestic meters nearing the end of their compliance periods. The outcome of compliance testing leads to a field life extension or the meter family being removed from the field.
- Time Expired Meter Replacement Programs to remove domestic, and Industrial and Commercial (I&C) meters, from the field at the end of their useful life.
- Reactive Meter Replacement to replace meters that are faulty or have been damaged within the field.
- Turbine Meter Replacement Program
- Data Logger and Flow Corrector Replacement Program
- Reactive Data Logger and Flow Corrector Replacement to replace this type of assets that are faulty or have been damaged within the field.

Further to this, AusNet Services has 7 key network objectives to which the gas network is operated. These objectives are:

- Maintain network safety in accordance with the Gas Safety Case;
- Maintain top quartile operating efficiency;
- Undertake prudent and sustainable network investment;
- Delivery of valued services to our customers;
- Simplify and remove cost by investing in technology and automation;
- Provide sector leading customer experience by improving systems, processes and communication; and
- Secure future of gas with increased utilisation and renewable gas options.

Error! Reference source not found. summarises the proposed capital works programs and expenditure in 2024 to 2028. These forecasts are based on detailed analyses of historic asset performance and predicted failure rates as well as compliance with the GDSC.

Table 1: Planned Customer Metering Capex Summary ($2022, $'000)

PROGRAM	2023-24	2024-25	2025-26	2026-27	2027-28	2024-28 TOTAL
	[C.I.C]					

1. Document Overview

1.1. Purpose

This Asset Management Strategy articulates AusNet Services' approach to the management of its gas metering assets. The strategy details the asset performance, risk and investment requirements to support delivery of safe and reliable gas services.

The document is for use by:

- Internal staff and senior management; and
- Regulators – economic, technical and safety.

1.2. Scope

This document details strategies to maintain regulatory compliance and consumer safety relating to existing metering assets. Existing metering assets include domestic, industrial and commercial gas meters as well as data loggers, flow correctors and telemetry equipment in AusNet Services' gas distribution network.

The forecast cost of new connections (i.e. network growth) is not included in the scope of this strategy. Custody Transfer Meters (CTMs) located at city gates are also excluded from this strategy, as they are owned and maintained by the respective transmission businesses.

This plant strategy does not cover consumer regulators, often located immediately upstream of gas meter installations, as these assets are detailed in a standalone plant strategy, AMS 30-53 Consumer Regulator Strategy.

1.3. Definitions

Attributes	A method of statistical analysis where the meter is classified as either conforming or non-conforming or the number of nonconformities in the meter is counted, with respect to given requirements.
AER	Australian Energy Regulator. Body responsible for the economic regulation of energy networks, including natural gas distribution in Australia.
Commercial Meter	Large meter installations (>25m^3/hr) operating at pressures less than 4kPa.
CTM	Custody Transfer Meter. Large capacity meter installed at every injection to AusNet Services' transmission and distribution networks.
Data Logger	Means an electronic device which collects gas usage information from a physical gas meter.
Diaphragm Meter	A type of gas meter with two or more chambers formed by movable diaphragms.
Digital Meter	Means the modern metering technology and is commonly referred to the terms of "smart meter" or "advanced meter". It is a gas measurement device that automatically records, stores and reports gas usage at regular time intervals. Additional features may include, for examples, remote shut off supply, meter tampering alert, reverse flow warning, pressure and temperature compensation for accurate billing etc.

Domestic Meter	Small capacity (<25m^3/hr) residential meter operating at a pressure less than 4kPa and typically located at the front of a domestic property.
ESV	Energy Safe Victoria. Government body responsible for the safety and technical regulation of Victorian energy networks, including gas distribution network.
FLE	Field Life Extension. See in-service compliance testing.
Flow Corrector	Means an electronic device which collects gas usage, gas pressure and gas temperature form a physical gas meter.
GDSC	Gas Distribution System Code. Defines the minimum standards for the operation and use of a gas distribution system.
Gas Meter	A device which measures the quantity of gas passing through it.
Gas Metering Installation	Comprises a gas meter, equipment, fittings and associated pipework, which may include a data logger or a flow corrector, a telemetry, filter(s), regulator(s), and valve(s).
Industrial Meter	A large capacity gas metering installation (>25m^3/hr) operating at pressures greater than 4kPa. Industrial meters can only be maintained by System Operations trained personal.
Initial In-service compliance period	The period of time allowed to a meter population or meter type to remain in-service without retesting or replacement.
In-service compliance testing	A sampling program for diaphragm meters (<25m^3/hr) nearing the end of their initial in-service compliance period. Outcomes of testing determines whether extensions of on-going in-service compliance periods can be applied. Also known as Field Life Extension (FLE).
Installation type	The classification of domestic, commercial or industrial meters.
Meter Family	A group of the same meter brand, and type, installed on the network within the same calendar year. (e.g. Email 602 1999)
Meter Type	The meter technology used to measure gas flow; Diaphragm, Rotary orTurbine.
'No Access' Meter	A meter that was unable to be replaced due to inability to safely access the meter (e.g. due to locked gates, aggressive dog, etc.)
PSP	Primary Service Provider. AusNet Services' contracted provider of operational and maintenance services.
Refurbished Meter	A meter that has been removed from the field, at the end of the initial compliance period, and sent back to the meter manufacturer for refurbishment.
Regulator	A device that that reduces the gas to a usable pressure as per the customer demand.
Rotary Meter	A type of meter with two rotors that spin in precise alignment, with a known volume of gas passing through the meter with each revolution.
Telemetry	Means a device which automatically records and transmits the data of a data logger / flow corrector from a remote location to a designated IT platform. Communications of telemetry data may be relayed using radio, GSM or cable etc., depending on the application. Main supply or solar panel are commonly used to power a telemetry.
Time Expired Program	The annual program that replaces meters at the end of their compliance periods with new approved meters.

Turbine Meter	A type of meter which measures the volume of gas by determining the speed of the gas moving through the meter.
UAFG	Unaccounted for Gas. Defines as the difference between the measured quantity of gas entering the gas distribution system from various supply points and the gas delivered to customers.
Variables	A method of statistical analysis that measures a quantitative characteristic for a sample taken from this population. The quantitative characteristic is used to establish the acceptability of the population.

1.4. Asset Management Framework

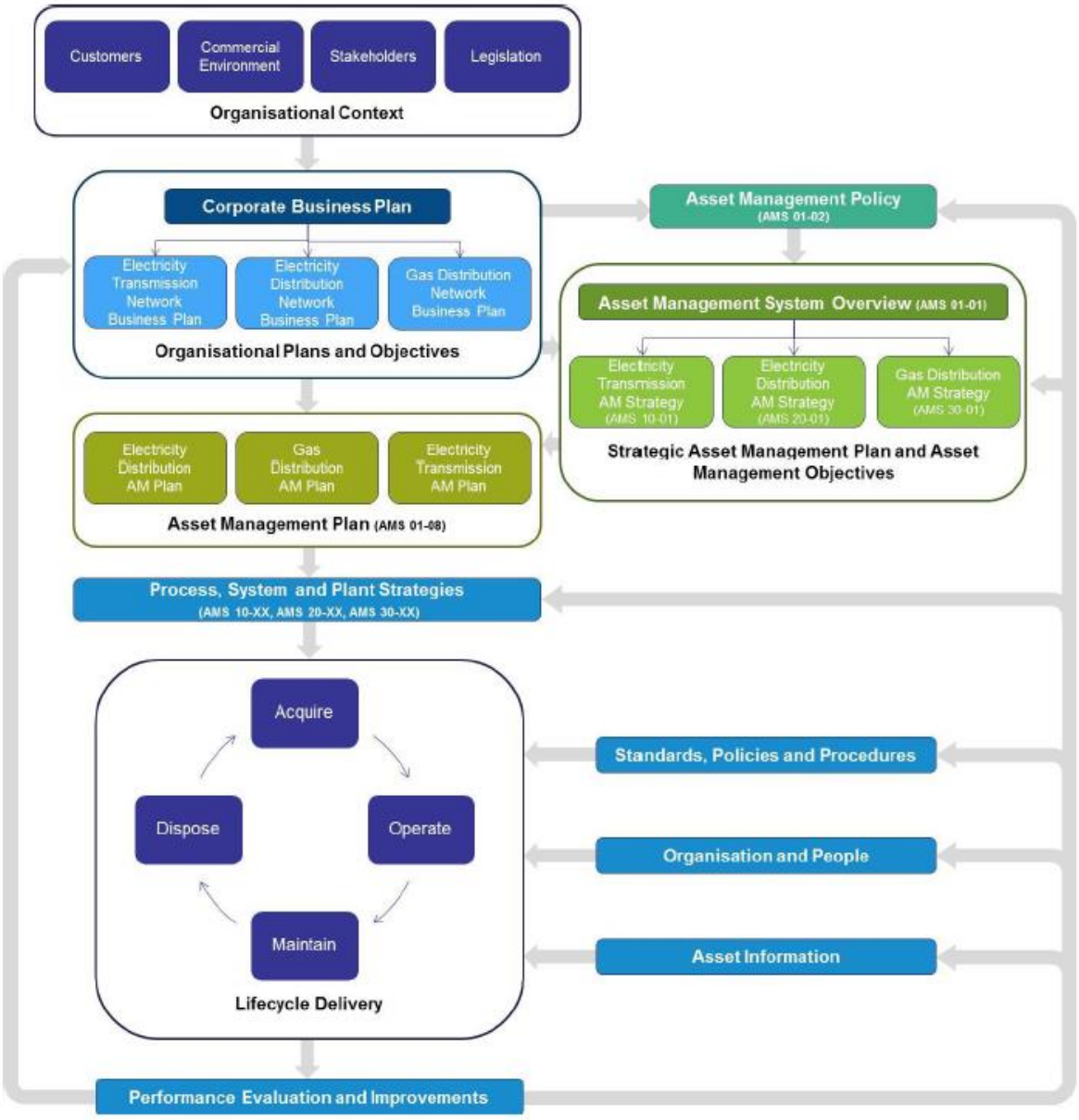

Figure 1 below provides an overview of AusNet Services asset management framework. This framework is centred around the objective to operate the network in top quartile of efficiency benchmarks with an aim to care for customers and strive to make energy more affordable.

The Gas asset management strategy plays a key role in ensuring alignment between asset management objectives, corporate objectives, and stakeholder requirement. This document is one of the strategies providing visibility on network performance, issues, risks, and investment required to support delivery of safe and reliable service and achieve the long-term objectives of the gas distribution network.

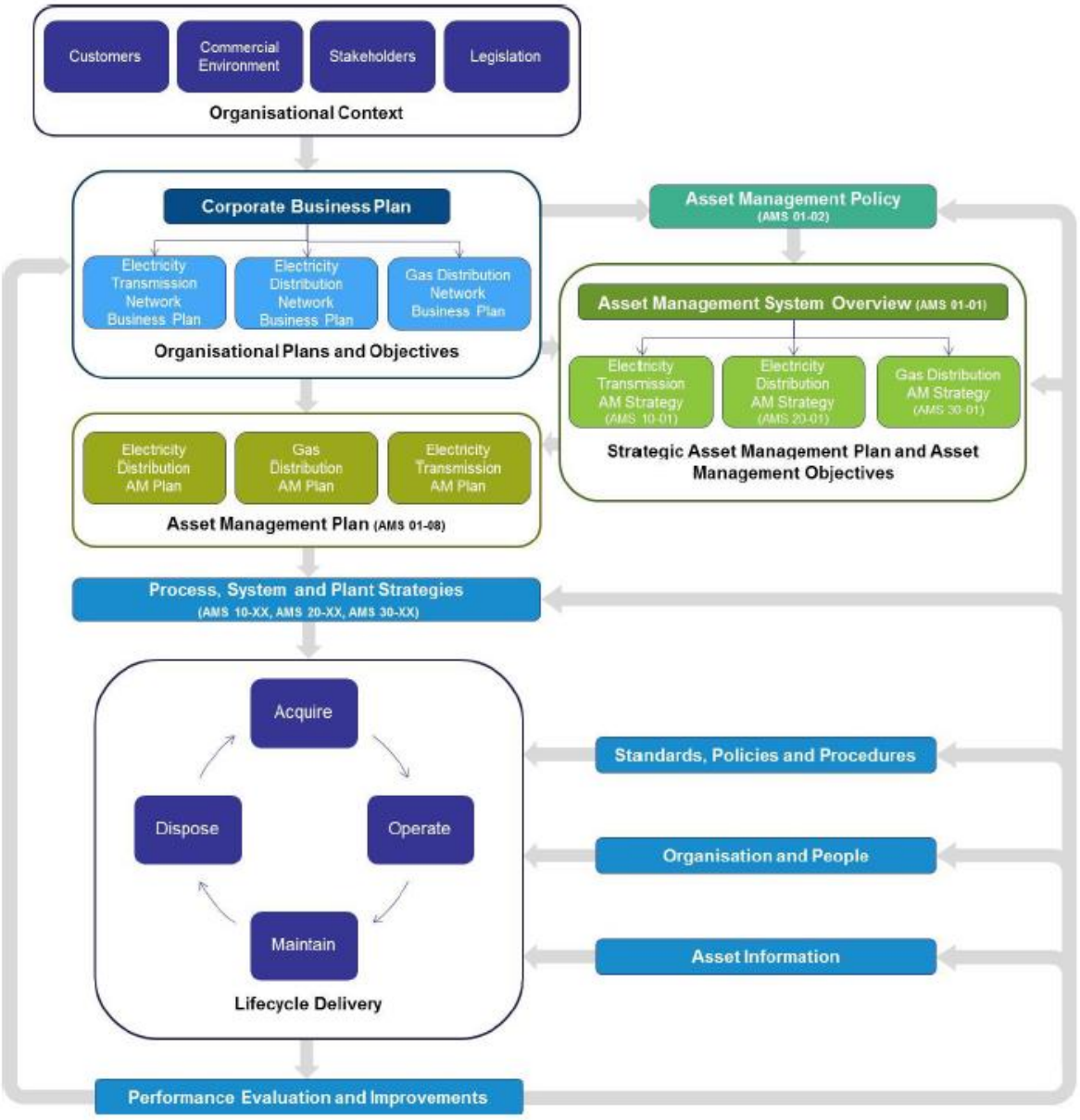

Figure 1: Ausnet Services Asset Management Framework

1.5. References

Other referenced documents within this strategy are:

- 30-4004: Materials Manual – Section 12: Meters;
- AS/NZS 4944:2006 – In-service compliance testing of diaphragm meters up to 25m3/hr
- AS 4647:2011 – Diaphragm gas meters
- Gas Distribution System Code; Sections 5-8
- TS 0501 – Gas Specific Materials and New Technologies Approval Process
- TS 5202 – In-service compliance testing of gas meters

2. Alignment with Drivers

AusNet Services' purpose statement is "Connecting communities with energy and to accelerate a sustainable future". This statement places the customer (as individuals and communities) at the forefront as a business driver and acknowledges the critical relationship with their energy supply and usage. The following diagrams shows that Customers are a key theme linking the Corporate Business Strategy with the Gas Network Vision and Gas Network Objectives, which influence the key plant strategies forming the basis of the regulatory submission.

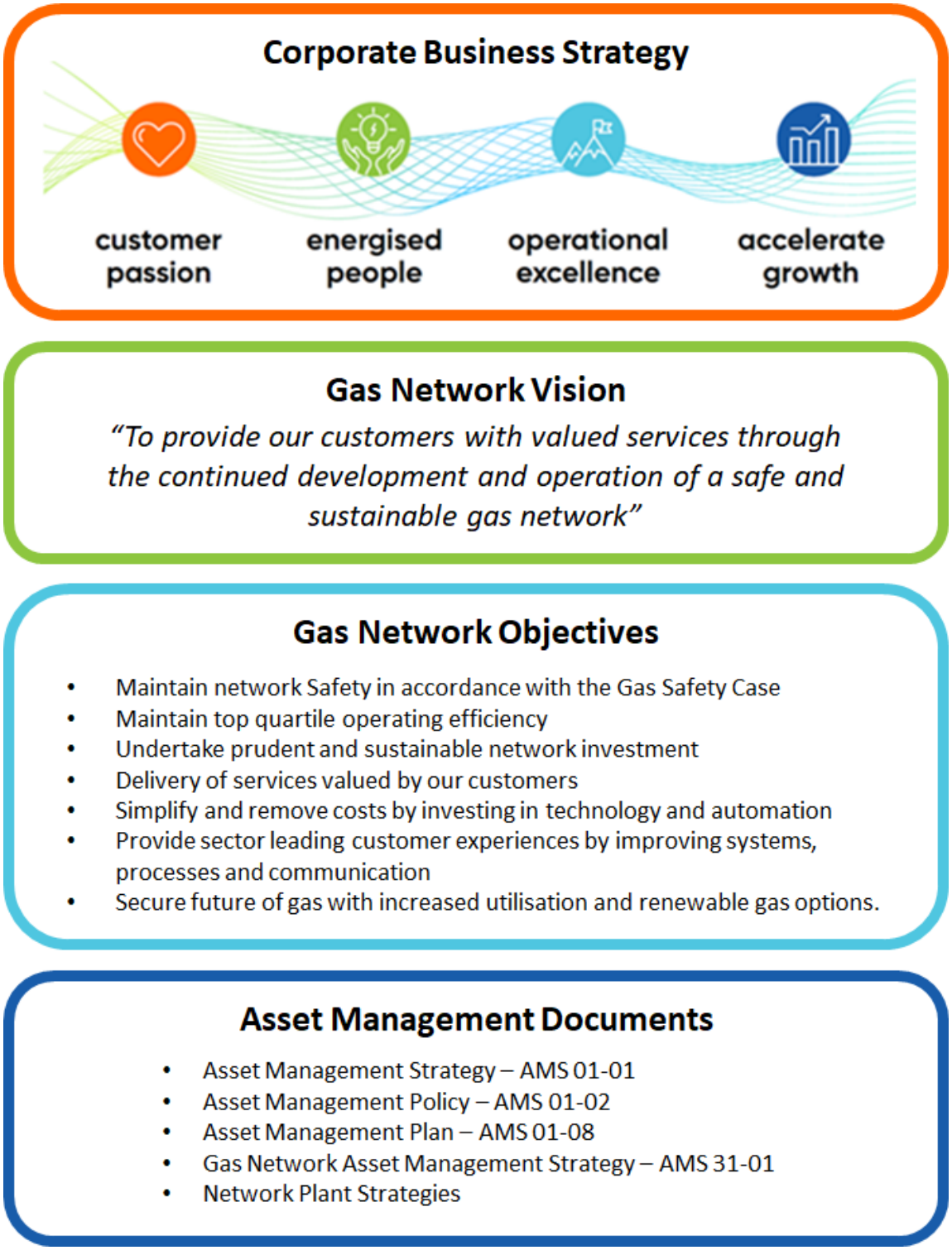

Figure 2: The Business Strategy, Network Vision and Objectives all centre around our customers

The Gas Network Objectives align with the four Corporate Business Objectives as shown below:

Maintain network Safety in accordance with the Gas Safety Case.

Maintaining network safety supports our commitment to "Mission Zero", ensuring our people go home safety at the end of the day. This is one of the strategic priorities of the "energised people" corporate objective.

Maintain top quartile operating efficiency.

AusNet Services aspires to operate all three of its core networks in the top quartile of efficiency benchmarks. This aligns with the "operational excellence" corporate objective.

Undertake prudent and sustainable network investment.

This network objective supports AusNet Services' obligation to undertake prudent and sustainable network investment, as defined in the National Gas Rules and Gas Distribution System Code. This in turn aligns with the "operational excellence" corporate objective.

Delivery of valued services to our customers.

AusNet Services strives to better understand our customers (their needs and behaviours) in order to deliver the services they value. This aligns with the "customer passion" corporate objective.

Simplify and remove costs by investing in technology and automation.

By working more efficiently, AusNet Services improves its "operational excellence" and provides better value for customers.

Provide sector leading customer experiences by improving systems, process and communication.

Similarly, improving how we work increases efficiency, thereby improving "operational excellence".

Secure future of gas with increased utilisation and renewable gas options.

Exploration of renewable gas options and the role gas will play in the energy ecosystem of the future will support the "accelerate growth" corporate objective.

3. Asset Overview

3.1. Introduction

A gas metering installation comprises a gas meter, equipment, fittings and associated pipework, which may include regulator(s), filter(s), valve(s), a data logger or a flow corrector with telemetry as an optional data communication device. The function of the gas metering installation is to accurately measure the volume of gas delivered to a consumer as well as safely control the pressure of the gas supply according to the GDSC and relevant Australian standards.

3.2. Asset Profile

3.2.1. Gas Metering Technology

A gas meter is a flow device, used to measure the volume of gas consumed by an end user. Gas meters are installed at domestic, commercial, and industrial sites to determine the volume of gas, and consequently the usage charges passed on to customers.

A variety of gas metering technologies are found within AusNet Services' distribution network. The most common types are summarised in Table 2 below. Other meter technologies include Orifice, Ultrasonic and Coriolis meters that are currently used for CTMs only.

Table 2: Gas Metering Technology within AusNet Services' Distribution Network

METER TYPE	DESCRIPTION	APPLICATIONS	EXAMPLES
Diaphragm	Positive displacement meters with two or more chambers formed by movable diaphragms.	Domestic Industrial & Commercial	
Rotary	Positive displacement meters with two figure "8" shaped lobes (also known as impellers), spin in precise alignment, with a known volume of gas passing through the meter with each revolution.	Industrial & Commercial	[C.I.C]
Turbine	Inferential meters measure volume of gas by determining the speed of the gas moving through the meter.	Industrial	

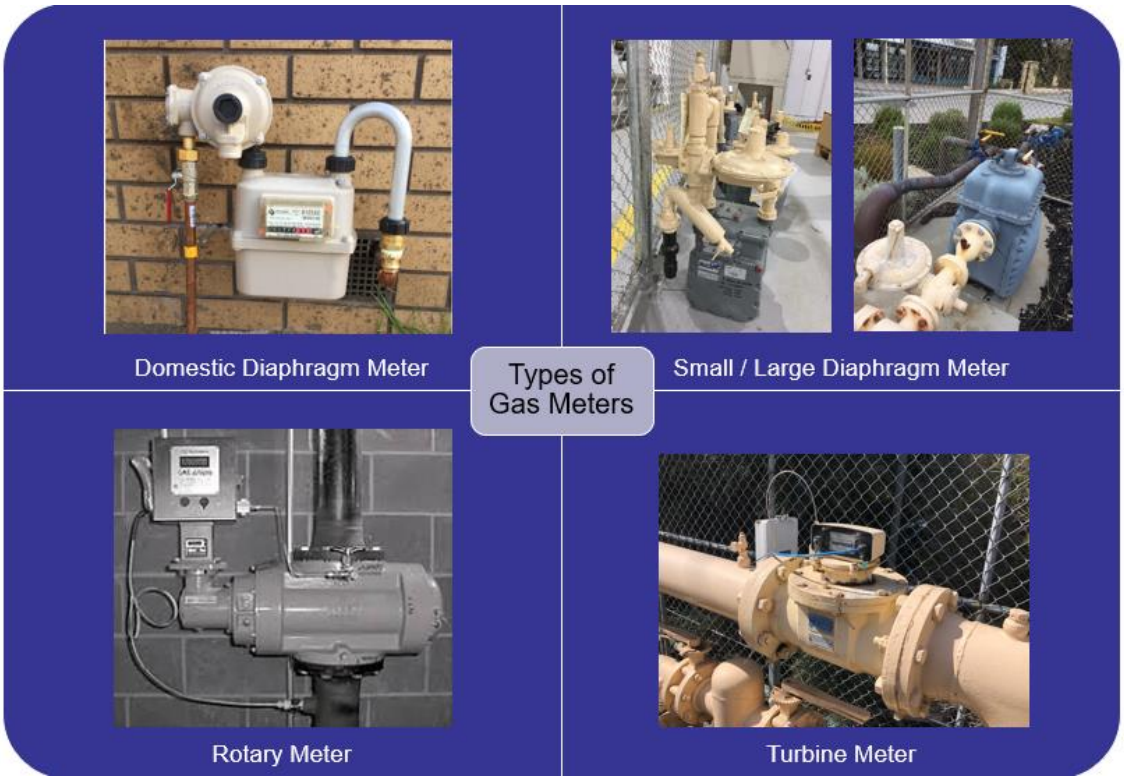

Figure 3: Types of Gas Meters – Diaphragm, Rotary and Turbine Meters

3.2.2. AusNet Services' Gas Metering Fleet

AusNet Services owns and operates a fleet of 763,412[1] domestic and industrial & commercial (I&C) meters.

Domestic (often referred to as residential) meters are small capacity (<25m^3/h) diaphragm meters. These are typically located at the front of domestic properties. I&C meters are larger capacity meters (≥25m^3/h), installed for higher volume users and may be a combination of diaphragm, rotary or turbine types.

Table 3 shows a summary of the meter fleet. AusNet Services describes a group of meters, of the same meter brand, model and type, installed within the same calendar year, as a 'Meter Family'.

Table 3: Summary of AusNet Services' Gas Meter Fleet[1]

INSTALLATION TYPE	UNITS	NUMBER OF METER TYPES
Domestic Meters	744,547	18
I&C Meters	18,865	50
TOTAL	763,412	68

3.2.3. Domestic Meters

A diaphragm meter, typically with a maximum flow rate of 10 m^3/hr is used for fiscal measurement of domestic gas consumption. To meet a small number of other domestic usages, for example, heated swimming pool, a diaphragm meter rated up to 12m^3/hr is permitted. Figure below presents the distribution of domestic meter models. [C.I.C] are discontinued models and are progressively being replaced with the [C.I.C] models.

[1] As of June 2021.

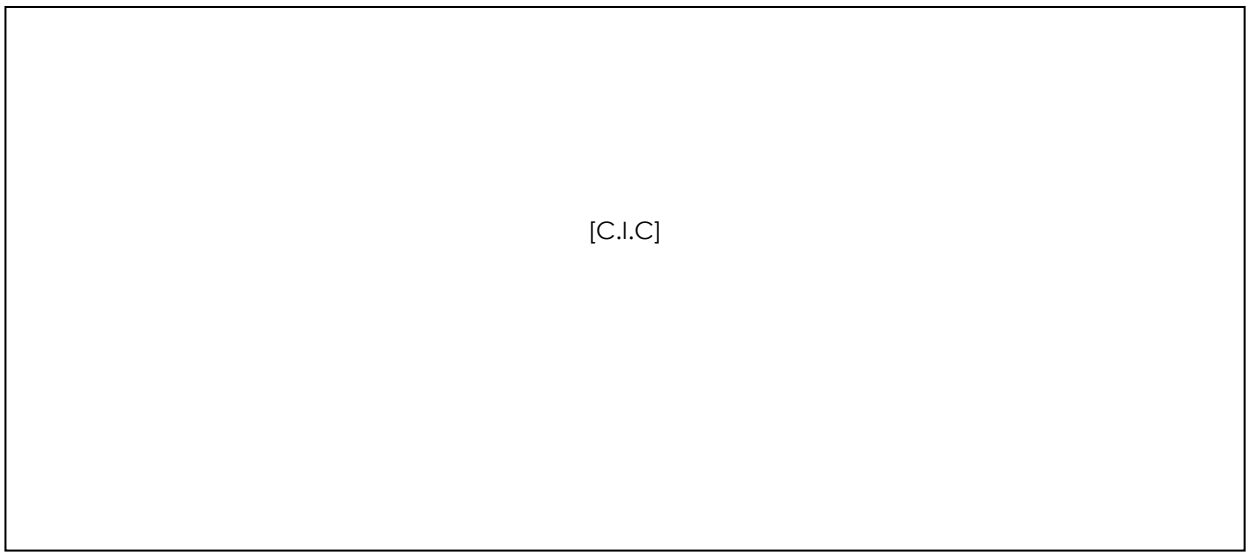

Figure 4: Domestic Diaphragm Meter Models Breakdown

3.2.4. Industrial and Commercial (I&C) Meters

A combination of three (3) meter types; diaphragm, rotary or turbine gas meters are commonly used at I&C sites. Table provides a breakdown of I&C meter types currently installed across the network.

Table 4: Breakdown of I&C Meter Types[2]

METER TYPE	MAXIMUM FLOW RATE M^3/HR	UNITS	PERCENTAGE
Diaphragm	500	18,286	96.9%
Rotary	1,500	426	2.3%
Turbine	9,000	153	0.8%
Total		18,865	100%

3.2.5. I&C Diaphragm Meters

Figure 5 below presents the distribution of I&C diaphragm meter models.

[2] As of June 2021.

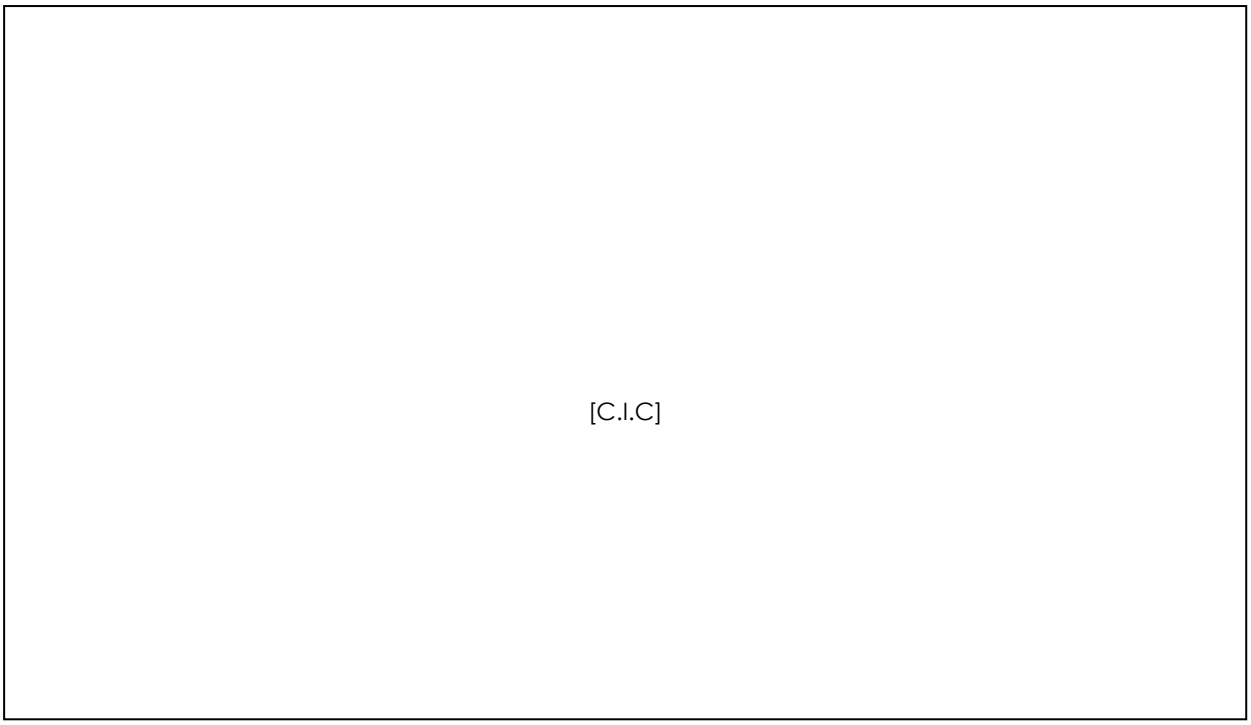

Figure 5: I&C Diaphragm Meter Model Breakdown

3.2.6. I&C Rotary Meters

Figure below presents the distribution of I&C rotary meter models.

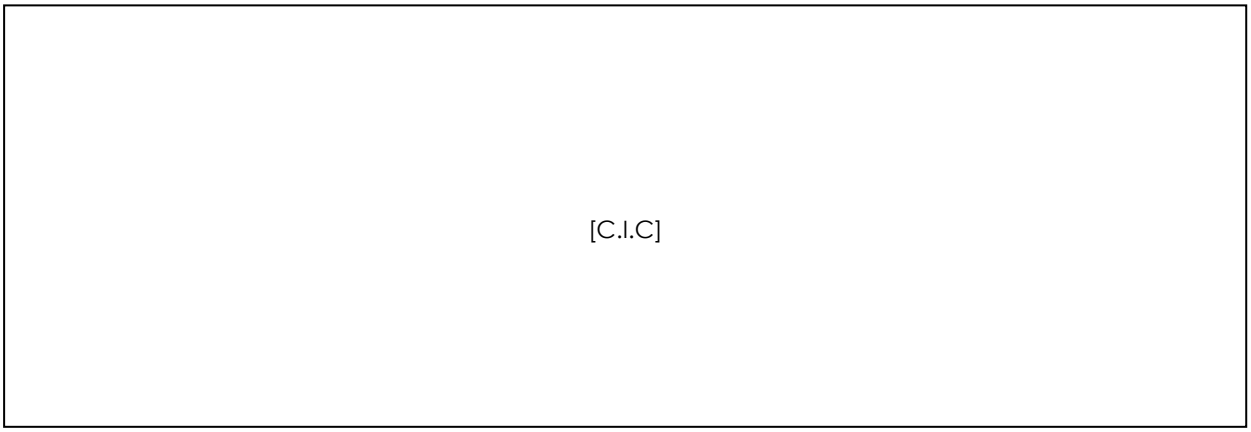

Figure 6: I&C Rotary Meter Models Breakdown

3.2.7. I&C Turbine Meters

Turbine meters are inferential meters which measure gas volume based on physical properties of the gas being measured. By spinning the turbine wheel and determining the speed of the gas moving through the turbine meters, volume of gas is inferred. With the advantage of high flow capacity, turbine meters are widely used in large I&C gas metering installations.

There are 153 I&C turbine meter sites across AusNet Services' network. They are typically tariff D gas customers and a few falls into the tariff V categories. Figure below presents the distribution of I&C turbine meter models that are currently installed in AusNet Services' network.

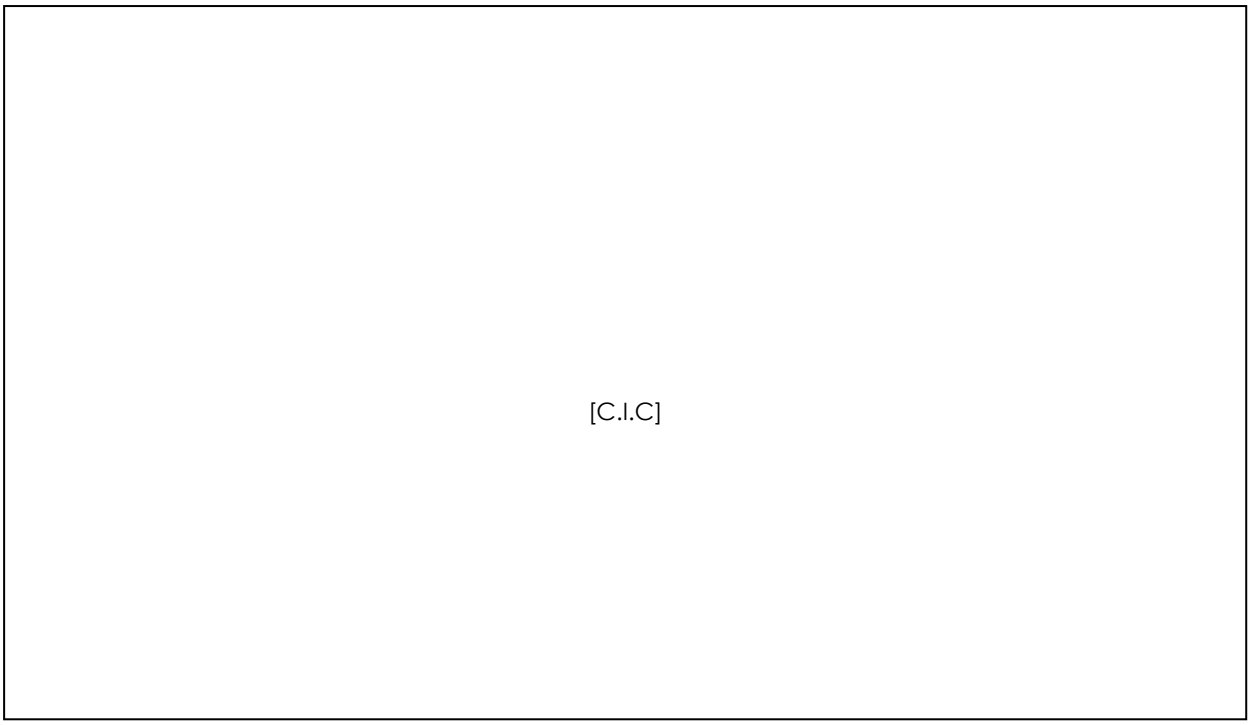

Figure 7: I&C Turbine Meter Models Breakdown

3.2.8. Data Loggers and Flow Correctors

A data logger or a flow corrector is an electronic device which measures and records the gas consumption in a real 'time of use' manner.

The function of a data logger is to collect pulses from the mechanical index of a physical gas meter and convert the signals into uncorrected volume of gas usage, typically in hourly interval. The volume of gas is then 'corrected' to standard pressure condition by applying a pre-determined fixed factor based on the meter delivery pressure called Pressure Correction Factor (PCF).

In addition to the basic feature of a data logger, a flow corrector spontaneously records metering pressure[3] and gas temperature[4] readings. By compensation with the available uncorrected volume of gas, live metering pressure and gas temperature, instant hourly gas usage is effectively calculated.

To comply with the requirements of metering data collection as stipulated in the GDSC, large industrial and commercial gas metering installations with gas consumption in excess of 10 terajoules (TJ) per annum are required to be equipped with either data loggers or flow correctors.

Figure below illustrates the use of data loggers and flow correctors as part of the gas metering assets.

[3] By means of a built-in pressure transducer.
[4] By means of inserting a temperature probe into a thermos well fitted on the pipework of the gas metering installation.

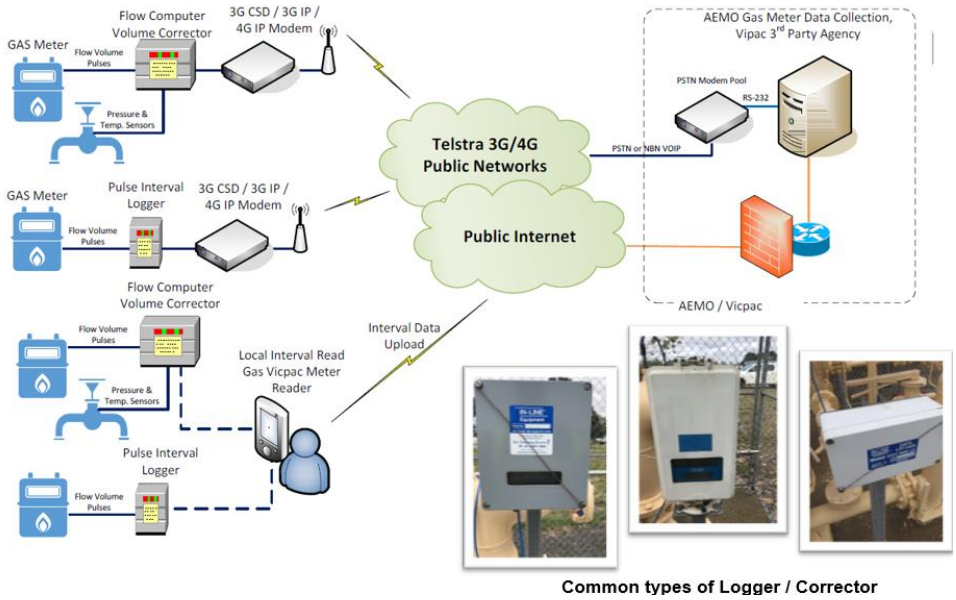

Figure 8: Use of Data Loggers and Flow Correctors

There are 379 large I&C sites that are equipped with either data loggers or flow correctors. These sites are commonly called 'Interval Sites or Interval Customers'. To remotely collect the gas consumption data, 81 sites are connected to telemetry, the equipment of which is powered by either renewable solar energy or main supply. For each of the remaining sites, the cycle of manual download of gas usage data in the field is run every fortnightly and is performed by AusNet Services' service provider.

Table 5 provides a breakdown of different models of data loggers and flow correctors currently installed across the network. Breakdown of gas usage data collected via periodic manual download and telemetry equipment are presented.

Table 5: Data Logger / Flow Corrector Models and Telemetry Equipment Breakdown

CATEGORY	MODEL	MANUAL DOWNLOAD	TELEMETRY	TOTAL
Data Logger		1		1
Data Logger		17	2	19
Data Logger		7	3	10
Data Logger		9		9
Data Logger		139	2	141
Data Logger	[C.I.C]	75	4	79
Flow Corrector		4		4
Flow Corrector		55	44	99
Flow Corrector			1	1
Flow Corrector			5	5
Flow Corrector		2	9	11
Total		**309**	**70**	**379**

Figure 9 below presents the distribution of data loggers/flow correctors models currently installed.

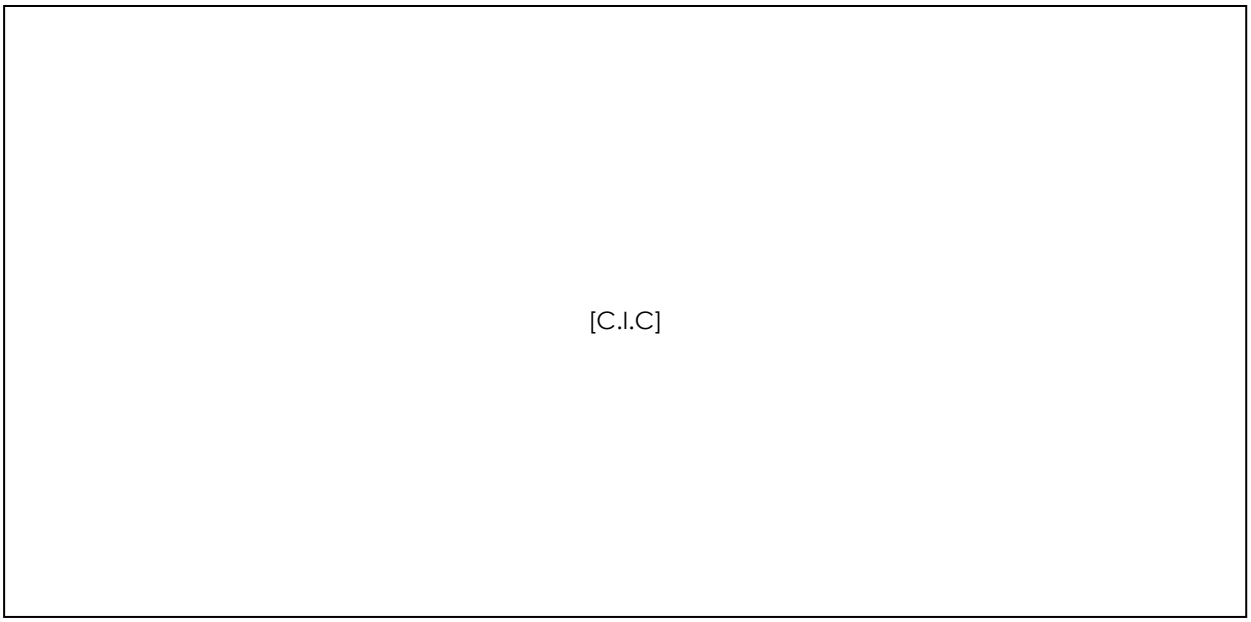

Figure 9: Data Logger / Flow Corrector Models Breakdown

3.3. Age Profile

3.3.1. Domestic Meters

Figure shows the age profile of domestic meters in AusNet Services' gas network. Each of the meter types [C.I.C] are represented. The average age of the domestic meter fleet is 9.3 years. The Australian Standard specifies a 15 year life for a domestic meter before any life extension or replacement is undertaken. **Error! Reference source not found.** below shows a large volume of meters installed during 2008 (13 years old). This will cause a large spike in field life extension testing or meter replacements in 2023 (after the initial 15 year life has expired). The proportion of meters that have exceeded their initial 15 year design life[5] is 14%.

[5] Meters exceeding 15 year initial design life have gained life extensions in compliance with relevant Australian Standards.

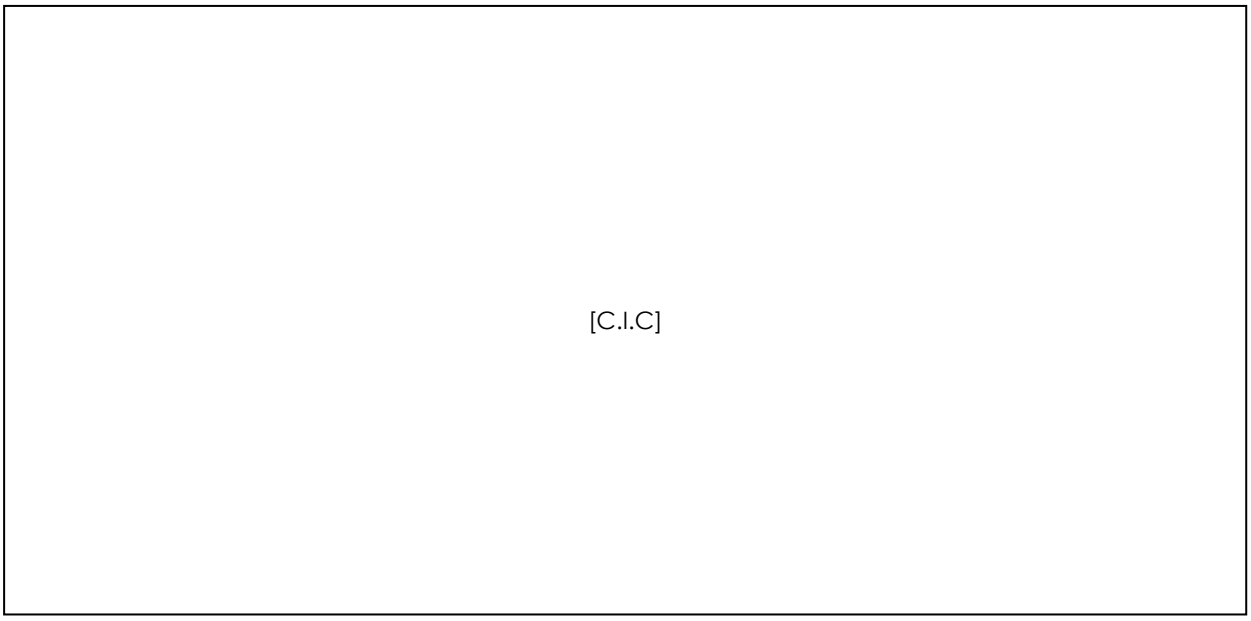

Figure 10: Domestic Meter Age Profile[6]

3.3.2. I&C Meters

Table shows the average age of I&C meters in AusNet Services' gas network. Large diaphragm, rotary and turbine meters are typically used for commercial and industrial metering installations. Each of the meter types are represented. The average age of the I&C meter fleet is 9.0 years. The GDSC specifies a 15 year life for a rotary meter or a turbine meter before any life extension or replacement is undertaken.

Table 6: Average Age of I&C Meter Types[7]

METER TYPE	MAXIMUM FLOW RATE M^3/HR	INITIAL TECHNICAL LIFE (YEARS)	AVERAGE AGE (YEARS)
Diaphragm	500	15	9.1
Rotary	1,500	13	6.8
Turbine	9,000	13	7.0

3.3.3. I&C Turbine Meters

It is a legacy issue that the manufacture year of each turbine meter has not been recorded since its installation in the field. Hence the actual age of this asset type is not tracible. To address this issue, an initiative was commenced in 2021 and the purpose was to collect this data attribute in the field as part of the condition assessment program. Refer to the below Section 3.3.4 for further explanation.

In the interim, the age profile of this asset type is derived using the current test year of each turbine meter. Figure shows the profile of I&C turbine meters in AusNet Services' gas network according to their current test year. Each of the meter models are represented. The average age of the turbine meter fleet is 7.4 years.

6 As of June 2021, the age profile is obtained based on 'current testing year' of each meter model.

7 As of June 2021, the age profile is obtained based on 'current testing year' of each meter model.

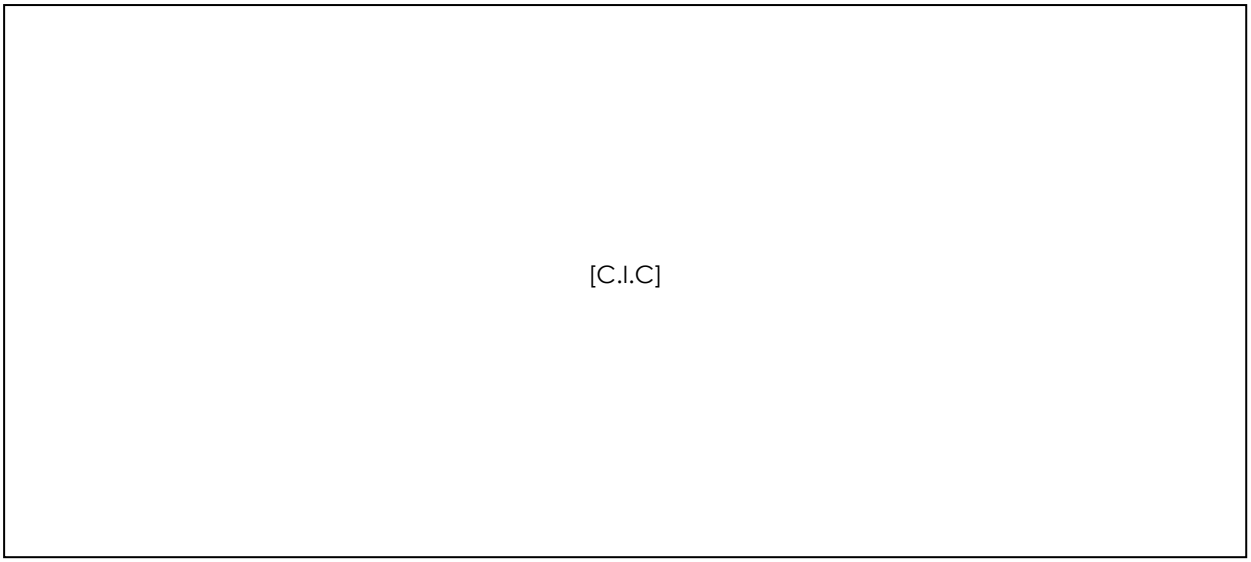

Figure11: Turbine Meter Age Profile (Based on Current Test Year)

3.3.4. I&C Turbine Meter – Manufacture Year Information

AusNet Services conducted a condition assessment program on all turbine meters installations in 2021. During the on-site assessment, the manufacture year of each turbine meter was captured as far as the information could be found on the meter badge. Whilst the assessment is still in progress, Figure illustrates the actual manufacture year of the turbine meters at the time of writing. The result of the average age of the turbine meter fleet is 39 years based on their manufacture years. Over 50% of the population were manufactured in 1979 or before.

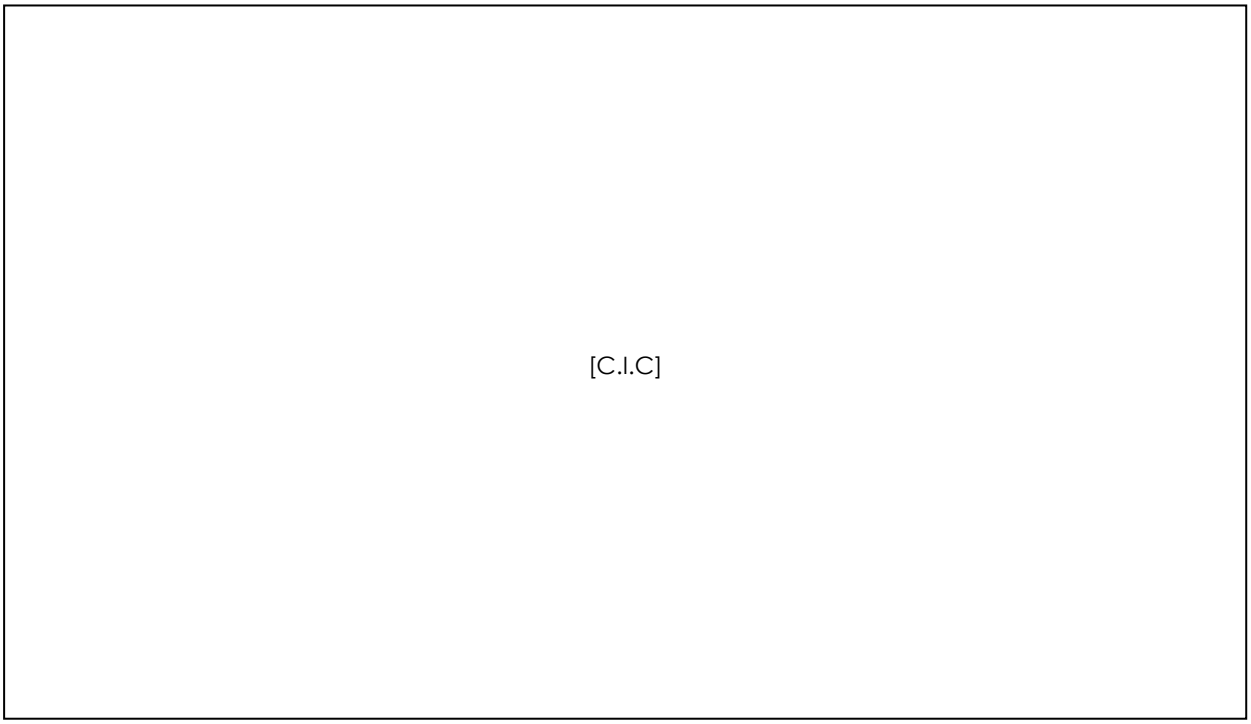

Figure12: Turbine Meter Age Profile (Based on Manufacture Year)

3.3.5. Data Loggers and Flow Correctors

The exact age of different types and models of data loggers and flow correctors are not known, compared with other metering assets. In the absence of this data attributes, the current service life for most of the installed sites (except for new sites installed in recent years) in the field are not readily identifiable.

However, by tracing the operational history of different models and combined with the known information and experience from AusNet Services' service provider, it is concluded that most of the models are very old. The below Table provides a reasonable assumption and estimation of the age and approximate year of manufacture for each model. About 73% of the data logger / flow corrector population is over 20 years old.

Table 7: Estimated Year of Manufacture vs. Data Logger / Flow Corrector Models

MODEL	TOTAL INSTALLATIONS	ESTIMATED YEAR OF MANUFACTURE
	5	Pre-1997 (Gas & Fuel Era)
	118	Late 1990s
	11	2019 – Now (Current Model)
[C.I.C]	9	Pre-1997 (Gas & Fuel Era)
	5	Pre-1997 (Gas & Fuel Era)
	141	Late 1990s
	90	2010 - 2018
Total	**379**	

4. Risk

4.1. Regulatory Obligations

AusNet Services' metering obligations are primarily defined in the GDSC. The code outlines the obligation to provide metering installations, the standard of those installations, testing requirements and the provision of metering data to retailers.

In summary, AusNet Services is required to provide an appropriate (type varies depending on application, e.g., provision of data logger or flow corrector, telemetry etc.) metering installation at each supply point (i.e. connection) off the distribution network. AusNet Services is required to periodically maintain these installations, replace meters when their field life has expired and provide periodic metering information to retailers for billing purposes.

To fulfil its obligations under the GDSC, a number of meter testing and replacement programs are undertaken. The programs are described in Sections 4.4 and 4.5.

4.2. Meter Specifications and Replacement Methodology

4.2.1. Meter Technical Specifications

As part of the meter replacement programs, only approved meters are installed within AusNet Services' distribution network. Document 30-4004: Materials Manual, Section 12: Meters, provides a complete list of approved meters.

Any new meter type (or significant variation to an existing meter type) is reviewed and approved for use by the Gas Network Management Department. New meter types conform to all requirements within the approved technical specifications. Once approved, the meter type is added to 30-4004. Document TS-0501 outlines AusNet Services requirement for approval of new meters.

4.2.2. Initial In-service Compliance Period

The initial in-service compliance period refers to the "period of time allowed for a meter family or meter type to remain in-service without retesting or replacement." The initial in-service compliance period is applied to a new family when it is introduced to the network. AusNet Services considers the start date of the initial in-service compliance period to begin on 1 January of the year in which the meter was installed.

4.2.2.1. Existing Meter Types

In-service compliance periods for existing meter types are outlined in

Table8 and prescribed in relevant sections of the GDSC and AS/NSZ 4944:2006.[8] Initial compliance periods for turbine and rotary meters have been adopted as an outcome of field tests conducted in 2006.

[8] AS 4944:2006 applies only to diaphragm meters, with capacity equal to or less than 25 m^3/h.

Table 8: Initial In-service Compliance Periods for Existing Meter Types / Families

METER TYPE	INSTALLATION TYPE	METER EXAMPLES (BRANDS)	INITIAL LIFE (YEARS)
Diaphragm (<25m³/hr)	Domestic		15
Diaphragm (≥25m³/hr)	Industrial / Commercial	[C.I.C]	15
Rotary	Industrial / Commercial		13
Turbine	Industrial / Commercial		13

4.2.2.2. New Meter Types (not previously approved for use)

When first approved for use on the network, the initial life for new diaphragm meter types (<25m3/hr), is calculated as per the requirements within AS/NZS 4944:2006 Section 6.

In-service compliance testing of these meter families is conducted no earlier than three (3) years and no longer than five (5) years after the meter type is first installed within the field. Test results are applied against the criteria in AS/NZS 4944:2006 to determine the initial life for the meter type. The calculated initial life is applied to all subsequent meter families of the same type.

For all other meter types, i.e. Rotary & Turbine and large diaphragm, for which AS/NZS 4944:2006 does not apply, the initial meter life as they fall under the requirements outlined in the GDSC.

4.2.2.3. Refurbished Meters

Several meter manufacturers offer a refurbishment program for selected gas meter types. Once removed from the field, at the end of the initial compliance period, meters are sent back to manufacturers for refurbishment. Refurbished meters can then be purchased at a lower unit rate, compared to a new meter. Once installed on the network, a refurbished meter is considered equivalent to a new meter and assigned a discrete meter family with an initial in-service compliance period as per Table 8.

Refurbished meters are installed at I&C and domestic sites, where the cost savings outweigh any additional whole of life costs associated with refurbished meters.

In 2020, AusNet Services commenced the refurbishment of selected types of domestic meters, [C.I.C]

This change in strategy is driven by economic analysis comparing the costs of a new and refurbished meter. Additionally, recent domestic meter refurbishment rates have been as high as 80% (i.e. for every 100 meters sent to suppliers, around 80 meters are returned as successfully refurbished).

Other types of domestic meters are disposed of and not refurbished once removed from the field (either at the end of the meters useful life, fault or abandonment). Each meter is replaced by either a new compatible meter or a refurbished meter of similar capacity.

4.3. Overview of Testing and Replacement Programs

AusNet Services complete the following annual programs to remain compliant with its obligations under the GDSC and to maintain consumer safety:

- **In-service compliance testing** of domestic meter families nearing the end of their compliance periods. The outcome of compliance testing leads to a field life extension (5, 3, or 1 year) or the meter family being removed from the field.
- **Domestic meter replacement program** to remove domestic meters (<25m3/hr) meters at the end of their in-service compliance period.
- **I&C meter replacement program** to remove I&C meters (≥25m3/hr) at the end of their in-service compliance period.
- **Turbine meter replacement program** to proactively replace old turbine meters that are installed in the largest I&C customer premises.
- **Reactive Meter replacement program** to replace meters that are faulty or have been damaged within the field.

The following sections describe each of these programs in more detail, providing an overview of scope, methodologies and historic performance.

4.4. Domestic Meters: FLE

Annual in-service compliance testing is carried out on all domestic meter families nearing the end of their service lives. This program is often referred to as the FLE (Field Life Extension) program.

A sample size of each meter family is removed from the field and tested by a NATA (National Association of Testing Authorities) accredited facility.

Based on the results of the FLE testing, a meter family is either retired from service or granted an in-service life extension (equivalent to 5, 3 or 1 years).

Meter families that fail FLE testing are then identified in the following year's Domestic Meter Replacement Program.

4.4.1. Program Scope

AS/NZS 4944:2006, and therefore the FLE program, applies to diaphragm meters with less than or equal to 25m^3/hr capacity. This includes all domestic meters and the [C.I.C] meter.

All other I&C meters are excluded from the annual testing program and replaced at the end of the meters initial compliance period (refer to

Table8).

For economic reasons (i.e. whole of life costs), the following domestic meter types are excluded from in-service compliance testing and disposed of when their initial in-service compliance period has been reached. These meter types are older models and comprise a very small proportion of the domestic meter fleet (<1% of total domestic meter population). Meters are replaced by a compatible meter of similar capacity.

[C.I.C] [C.I.C]

4.4.2. FLE Testing Method

Testing is conducted during the year preceding the end of the meter family's initial life.

AS/NZS 4944:2006 outlines two methods of statistical analysis that can be adopted for FLE testing:

- Variables:[9] A method that consists of measuring a quantitative characteristic for each item of a population or a sample taken from this population. The quantitative characteristic is used to establish statistically the acceptability of the population from results contained from the items in the sample; or
- Attributes:[9] Inspection wherein the meter is classified as either conforming or non-conforming or the number of nonconformities in the meter is counted, with respect to given requirements.

AusNet Services adopt the criteria for "Attributes" method for the in-service compliance of the accuracy of each meter family in the regulatory period. This involves more meters being removed from the field comparing with the sample sizes required for "Variables" testing. AusNet Services considered that the results of an Attributes sampling are more readily understood, interpreted and accepted.

In the scope of "Variables" sampling, it heavily relies on the examination of the distribution of measurements. According to AS/NZS 4944, the sample shall be tested for normality using recognised statistical techniques at the 5% confidence level. To determine whether a sample is a normal distribution at all test points under a set criteria of flow rates, various statistical tests for normality of distribution as described in AS/NZS 4944 are to be thoroughly examined prior to confirming the testing results of a sample of meter family.

4.4.2.1. Sample Size Determination

Sample sizes vary based on testing methodology adopted and population of the meter family. Sample sizes are defined within Table 1 of AS/NSZ 4944:2006.

4.4.2.2. Testing Requirements

Testing of sample meters is conducted in a NATA accredited facility. Examples of required tests are listed in Table 9.

Table 91: Tests carried out on meters

TEST	SUMMARY
$0.2Q_{max}$	Meter Accuracy (+/-) at 20% of max capacity
Q_{max}	Meter Accuracy (+/-) at max capacity
Q_{min}	Meter registration of flow only at minimum flowrate
External leakage	Pressurised to 2 times operating pressure

[9] Definitions are from AS/NZS 4944:2006 Section 4.2.

Source: AS/NZS 4944:2006

4.4.2.3. Test Results

Test results are analysed in accordance with the requirements of AS/NZS 4944:2006 and meters pass or fail in accordance with AS/NZS 4944:2006.

4.4.2.4. Ongoing in-service compliance period

Table 0 summarises the ongoing in-service compliance period in accordance with AS/NZS 4944:2006 that can be assigned to a meter family following testing. This is based on results from accuracy and leakage testing.

Table 10: Ongoing in-service compliance periods

ACCURACY	IN-SERVICE COMPLIANCE EXTENSION
± 3.0%	1 year
± 2.5%	3 years
± 2.0%	5 years

4.4.3. Historical Performance

In-service compliance testing is carried out when a domestic meter nears the end of its useful life. 13 meter families have failed testing over the last five years period, resulting in a further 75,357, meters replaced in the field (approximately 10% of current domestic meters). The primary reason for meter failure during testing is performance against meter accuracy criteria. A summary of the 2017-21 FLE program is provided in Table .

Table 11: Summary Results of Completed In-service Compliance Testing Programs

YEAR	METER FAMILIES TESTED	METER POPULATION TESTED	FAMILIES FAILED	METERS FAILED
2017		517		2,704
2018		930		19,374
2019	[C.I.C]	913	[C.I.C]	11,810
2020		605		19,149
2021		754		22,320

4.4.4. Proposed Works Program

AusNet Services' FLE program for 2023-2028 has been forecasted based on a set of assumptions around expected life extension and failure. The forecasting assumptions, as described in Table 12, have been developed from historical performance of the FLE program. Trends for specific meter type have been established and applied from historical FLE test results.

Table 12: Assumptions for Time Expired and FLE Testing Forecasting

EXTENSION	EXTENSION APPLIED TO:
5 Years	
3 Years	[C.I.C]
1 Year	
Failed	

FLE forecasts assume that all meter families will require testing by attributes. Forecast volumes include a 10% allowance for meters removed from the field which cannot be tested due to a fault or condition only identified once in testing labs (e.g. fused fittings which cannot be removed for testing).

A summary of the forecasted FLE program is summarised in Table **Error! Reference source not found.** below. An average of 1,202 domestic meters will require testing on an annual basis.

Table 13: Proposed In-service Compliance Testing Programs

TEST YEAR	METER FAMILIES TESTED	METER POPULATION TESTED	SAMPLE SIZE – ATTRIBUTES	NUMBER OF METERS REMOVED AND TESTED[10]
2023	12	52,702	1,742	1,916
2024	9	27,327	1,030	1,133
2025	9	84,017	1,845	2,030
2026	10	42,481	1,432	1,575
2027	4	13,179	440	484
2028	3	29,110	715	787

[10] Includes additional 10% of meters removed from field to allow for meters that cannot be tested.

4.4.5. Capital Expenditure of FLE Program

Capital expenditure for the FLE program is summarised in

Table and Figure 13.

Table 14: Capital Expenditure – Annual In-service Compliance Testing Program (Calendar Year)

PROGRAM		2023-24	2024-25	2025-26	2026-27	2027-28	2024-28 TOTAL
In-service compliance testing – Field Life Extension	Units						
	Exp ('000)		[C.I.C]				
TOTAL Expenditure ('000)							

[C.I.C]

Figure 13: Forecast Expenditure for Annual FLE Program

4.5. Domestic Meter Replacement (Time Expired)

This annual replacement program replaces meters at the end of their compliance periods with new approved meters. This program ensures the metering fleet remains compliant with the GDSC.

The domestic meter replacement program is commonly referred to as the Time Expired (TE) program. The program is finalised before or during the month of December each year. AusNet Services' primary service provider carries out meter removal and replacement in the field, along with relevant system updates.

4.5.1. Program Scope

The TE program applies to all domestic meters and is made up of the following elements:

- Meter families at the end of their in-service compliance periods that either failed FLE testing or were not included within the testing process; and
- Meter families being prematurely retired to avoid volatility in future replacement program sizes.

4.5.2. Historical Performance

Historical performance of the TE program (from 2017) is outlined in Table below. Meters that remain in the field beyond their initial in-service compliance period do not meet the requirements of the GDSC and result in an increased safety risk to consumer.

An inability to access a meter for replacement (i.e. 'No Access Meters') is the primary reason for meters remaining in the field beyond their initial compliance periods. See Section 4.5.4 for further details.

Table 15: Historic Domestic Meter Replacement Program Outcomes

YEAR	TOTAL NUMBER OF METERS	% COMPLETED	OUTSTANDING METERS
2017	27,155	98.50%	407
2018	33,223	98.91%	362
2019	30,131	99.22%	235
2020	21,115 *+ 2,339 no access meters*	Ceased at 36.6% (Due to COVID-19)	14,918
2021	18,139 *+ 14,918 deferred from 2020*	50% complete at time of document preparation, outstanding meters unknown.	

Mid-2020, due to the impact of COVID-19, the TE program and the targeted 'no access' meters replacement ceased. As a result, 14,918 meters were deferred and included in 2021 TE program.

4.5.3. Proposed Works Program

4.5.3.1. Predicted TE Replacement Program

Results from FLE testing directly influence the volume of meters requiring replacement in the following calendar year.

The forecasted volume of meter replacements from 2023 to 2028[11] (calendar year) is summarised in Figure. Volumes quoted are based on predicted outcomes of FLE testing. All assumptions have been based on historical performance of meter families and FLE test results, see Table . A rate of 2% for "No Access" meter replacement from the total annual volume is assumed in this strategy.

Figure4 indicates the predicted program is expected to peak in 2024, 2026 and 2030. Conversely, smaller replacement programs are expected in 2025 and 2027. It is predicted that no meter family would fail in the FLE in 2022, hence resulting in no meter due for replacement in 2023.

The average replacement volume for the regulatory period is approximately 27,000 meters per annum. The extreme variability in program size, from no meter (2023) to 69,391 meters (2026) is of concern as it places significant pressure on program delivery and per unit replacement costs. AusNet Services considers a replacement rate of a minimum of 20,000 to a maximum of 35,000 per annum based on the historical volume

[11] Forecasts are shown until 2028 to identify any future spikes in meter replacement beyond the 5 year strategy period.

of meter replacement program. The range should provide a sustainable annual replacement rate to avoid resourcing pressures and significant unit rate variation.

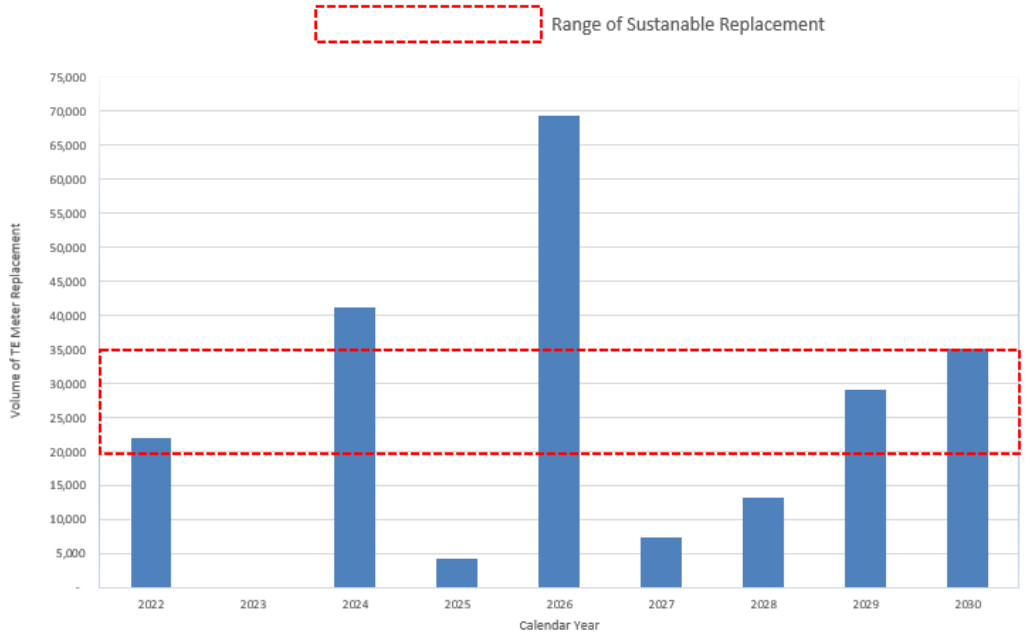

Figure 14: Predicted TE Program Volumes (Calendar Year)

4.5.3.2. Adjusted TE Replacement Program (Calendar Year and Regulatory Period)

A TE replacement program with the levels of variability, ideally between 20,000 to 35,000 meters per annum (refer range of sustainable replacement in Figure4 above), will be adopted to:

- **Ensure regulatory compliance is maintained:** The risk of major non-compliance increases with the size of the program due to constraints in labour and raw materials.
- **Demonstrate efficient spend:** Fluctuations in program sizes lead to increased unit rates due to the need to mobilise (and subsequently demobilise) resources to deliver programs. Smoothing replacement volumes provides the lowest sustainable cost of providing compliant domestic metering installations.

The adjusted TE replacement program (based on calendar year) is shown in Figure 15 below.

Smoothing of the program by a few years is achieved by bringing forward the replacement of meter families before the end of their deemed useful life. Delaying the replacement of an assumed failed meter family is not consistent with the requirements of the GDSC. Typically these meters have an actual life of over 13 years. A summary of all early retirements is provided in **Error! Reference source not found.** below. There are 14,484 meters (14%) of the early retired meter families with an age of 14 years. The adjusted TE program reduces the predicted peak of 69,391 in 2026 to approximately 31,000 meters for that year's annual replacement program as shown in Table 17.

Figure 151: Predicted TE Program Volumes – Adjusted (Calendar Year)

Table 16: Adjusted Retirements – Adjusted TE program (Calendar Year)

METER TYPE	INSTALLATION DATE	PREDICTED REPLACEMENT	VOLUNTARY REPLACEMENT	AGE AT REPLACEMENT	VOLUME OF METERS
			[C.I.C]		

Table 17: Adjusted and Smoothed TE program (Calendar Year)

METER TYPE	FAMILY	2023	2024	2025	2026	2027	2028
			[C.I.C]				

To align with the new commencement date of the 2024-28 access arrangement period, i.e., from 1st July 2023, the final predicted volume of TE program is further adjusted and is showed in the below Figure16.

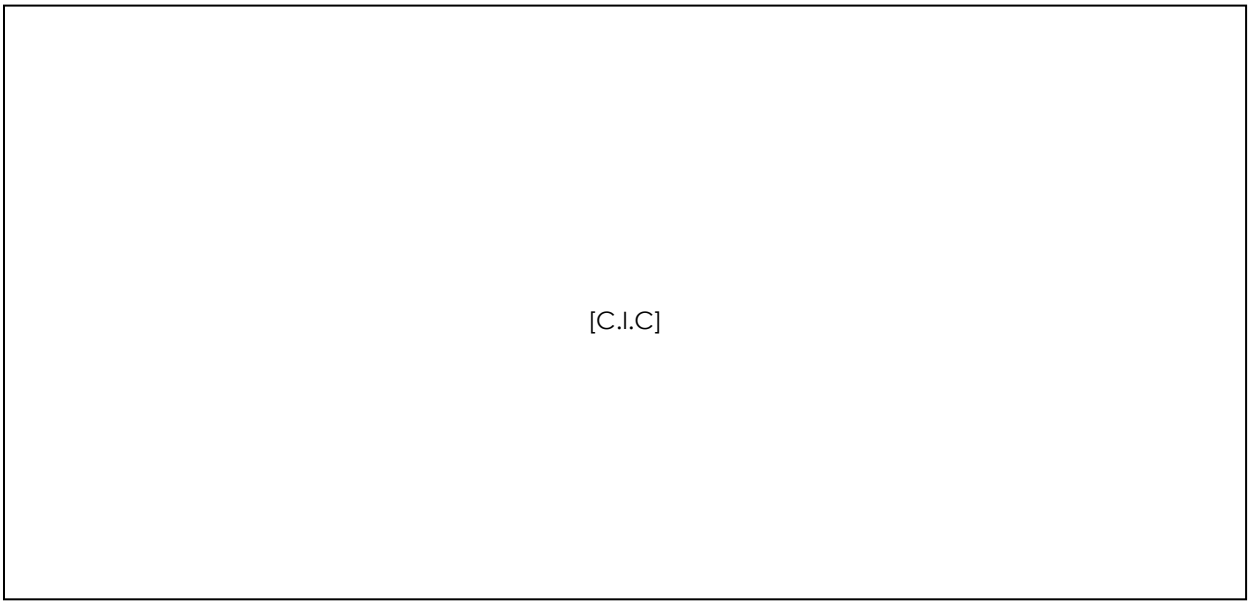

Figure 16: Predicted TE Program Volumes – Adjusted and Smoothed (Regulatory Period)

4.5.4. 'No Access' Meters

A 'No Access' meter is a meter that was unable to be replaced due to inability to access the meter. As a result, those 'No Access' meters may remain within the field beyond their in-service compliance period.

Reasons for this may include:

- Locked gates;
- Aggressive dogs;
- Refused access by owner.

In addition to the regulatory compliance implications, 'No Access' meters present a safety risk to the consumer as the integrity of the installation is unknown. As such, the removal of the non-compliant 'No Access' meters are of primary concern to AusNet Services.

Steps taken to reduce the volume of 'No Access' meters include:

- The introduction of incentive mechanisms to service providers (i.e. those who complete the physical replacement of the meters) for the delivery of defined meter replacement programs;
- Targeted replacement programs;
- Rollover of outstanding meters into the following time expired program; and
- Disconnection (in extreme circumstances).

AusNet Services undertakes a number of actions to limit the volume of 'no access' meters. Additional effort and hence additional expense is required to overcome the barriers for replacement including:

- Contact with retailers and/or customers directly;
- Multiple site visits;
- Special out of hours site visits; and
- Customer appointments.

The required additional effort, and unique characteristics of each installation, results in an elevated unit cost when compared to a standard domestic meter replacement.

Since this practice was introduced, 'No Access' meters, as a percentage of the annual TE program, have been reduced from 3% to 1-2%.

In 2020, there were about 2,339 known non-compliant meters that were also targeted from replacement. The 'No Access' meters are considered non-compliant meters as they have not been replaced at the end of their compliance period during earlier TE meter replacement programs. The replacement is planned to complete in 2021.

4.5.4.1. Predicted 'No Access' Meters in the Proposed Works Program

Historically, 'No Access' meters have equated to approximately 1-2% of the respective time expired replacement program (see Table for historical performance of domestic meter replacement programs). A rate of 2% has been applied to forecast TE volumes to determine the volume of 'No Access' meters falling out of the 2024-28 meter replacement programs.

Any unchanged meters due to accessibility issues in each annual TE program will be rolled into the following year's program. Significant effort will be made to remove these meters as they continue to present a safety risk while they remain in service.

4.5.5. Capital Expenditure of Domestic TE Program

Capital expenditure for the Domestic TE program is summarised in **Error! Reference source not found.**.

Table 18: Domestic Time Expired Replacement Program

PROGRAM	2023-24	2024-25	2025-26	2026-27	2027-28	2024-28 TOTAL
		[C.I.C]				

4.6. I&C Meter Replacement Program

As with the TE program for domestic meters, the I&C meter replacement program is conducted to ensure AusNet Services remains compliant with its obligation under the GDSC.

4.6.1. Program Scope

I&C meters are not subject to in-service compliance testing and field life extension, with the exception of [C.I.C] . All I&C meters are replaced at the end of their initial in-service compliance period (refer to

Table). [C.I.C] included in FLE testing scope as they meet the size and type requirements under AS/NZS 4944:2006. An [C.I.C] replaced under the I&C Meter Replacement Program.

4.6.2. Historical Performance

Historical performance of the I&C meter replacement program (from 2017) is outlined in Table 19 below.

Table 19: Historic I&C Meter Replacement Program Outcomes

YEAR	TOTAL NUMBER OF METERS	% COMPLETED	OUTSTANDING METERS
2017	281	99.50%	14
2018	1,132	99.03%	11
2019	440	97.05%	13
2020	420	Ceased at 44.5%	230
2021	727 new + 230 deferred from 2020	50% complete at time of document preparation, outstanding meters unknown.	

Mid-2020, due to the impact of COVID-19, the TE replacement program was suspended. As a result, 230 expired meters were deferred and included in 2021 TE program.

4.6.3. Proposed I&C Time Expired Program

I&C meter replacement is not exposed to the same uncertainty as the domestic program as the majority of meters are automatically replaced at the end of their initial in-service compliance period, without any field life extension.

The forecasted I&C meter replacement program is shown in Figure 17. Forecasts are based on the length of time a meter family has been installed in the field. Given that the annual replacement volumes are very even, with an average of approximately 580 meters, smoothing of the replacement volumes was not applied to the I&C replacement program.

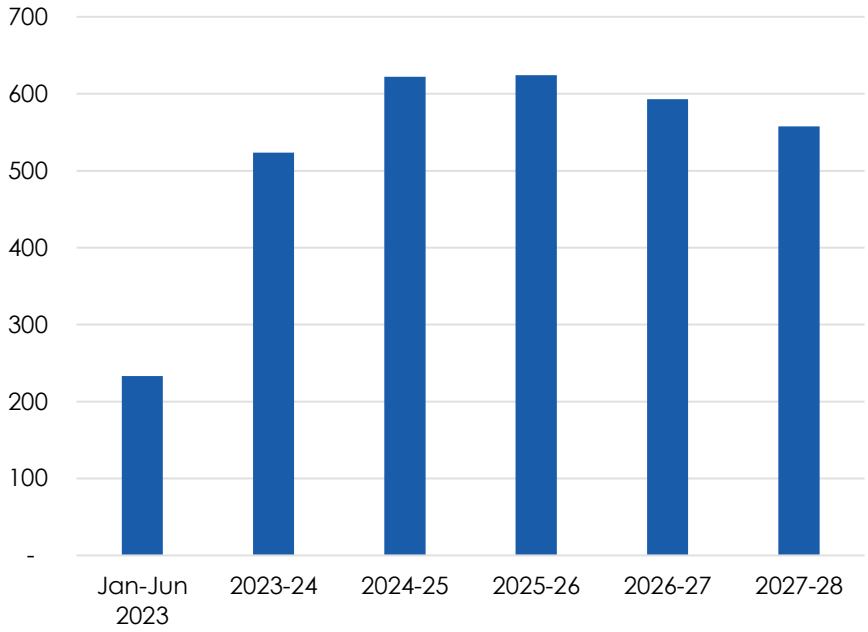

Figure 17: Annual I&C Time Expired Meter Replacement

4.6.4. Capital Expenditure of I&C Meter Replacement

Capital expenditure for the I&C Time Expired meter replacement program is summarised in Table.

Table20: I&C Time Expired Replacement Program (Calendar Year)

PROGRAM	2023-24	2024-25	2025-26	2026-27	2027-28	2024-28 TOTAL
	[C.I.C]					

4.7. I&C Turbine Meter Replacement Program

Turbine meters are designed for high flow capacity and typically used for fiscal measurement of the large gas consumption of industrial users. They are mostly installed in large I&C premises, and are commonly connected to data loggers or flow correctors to record hourly gas consumption for billing purpose.

4.7.1. Program Scope

As described in Section 0, over 50% of the turbine meters fleet were manufactured in 1979 or earlier. The spare parts of these aged turbine meters are becoming increasingly more difficult and expensive to source, rendering the meters unable to be maintained or repaired.

A known issue is that in the event of failure, turbine meters will allow gas to freely pass and the meter index will no longer be able to correctly register the gas usage. The failure is always unnoticeable until maintenance work is carried out. This will increase UAFG in the AusNet Services networks.

To assess the UAFG due to a faulty turbine meter during the period of breakdown, gas usage can only be estimated and recovered based on a set of substitution market rules. Recovery and reconciliation of UAFG are subject to investigation, co-ordination and negotiation with the respective customers. Depending on the complexity of the use and application of gas, types of industrial process and production, the availability of historical gas consumption data as well as estimation of the period of breakdown, the time and process to recover the amount of UAFG and making agreed settlements with the customers may take weeks or months.

Of the153 turbine meter sites, the aggregated total of annual gas usage is over 40% compared with AusNet Services' total gas output[12]. Any failure of this meter class would result in the significant impact on the UAFG and the process of investigation and recovery would be very time consuming.

To address the operational and financial risks, AusNet Services is planning to proactively replace the turbine meters. Priority of replacement is placed on the criteria of their age, condition, model, meter capacity and current gas usage of interval sites over 10 TJ per annum.

In conjunction with the turbine meter replacement, a large I&C site has been identified in very poor condition. it is recommended that a full rebuild of this site, including valves, filters, regulators and be undertaken.

Their replacement with a modern equivalent [C.I.C]

has been identified as a project to prevent operational costs increasing over the long term and to improve the reliability and performance.

The sites to be replaced are selected from the schedule of sites planned for full maintenance. In this way cost efficiencies will be realised through alignment of the replacement with planned preventative maintenance activities.

4.7.2. Historical Performance

About one third of turbine meter sites were maintained every six (6) months. Maintenance is performed by an AusNet Services' specialist metering provider. In 2021, to improve the reliability and performance of these assets, AusNet Services commenced the preventative maintenance for all 153 turbine meter sites.

Maintenance servicing for turbine meters covers oiling of the bearing to keep the bearing lubricated, to reduce wear, and reduce contaminants getting into the main bearing. While doing this, the index is checked and any necessary replacements are made to ensure they are fully operational.

Figure18 illustrates the failure modes of the I&C turbine meter installations in the last 5 years. Damaged meters are the primary cause of meter failure, followed by inadequate meter sizing.

[12] According to the annual figures in CY2020.

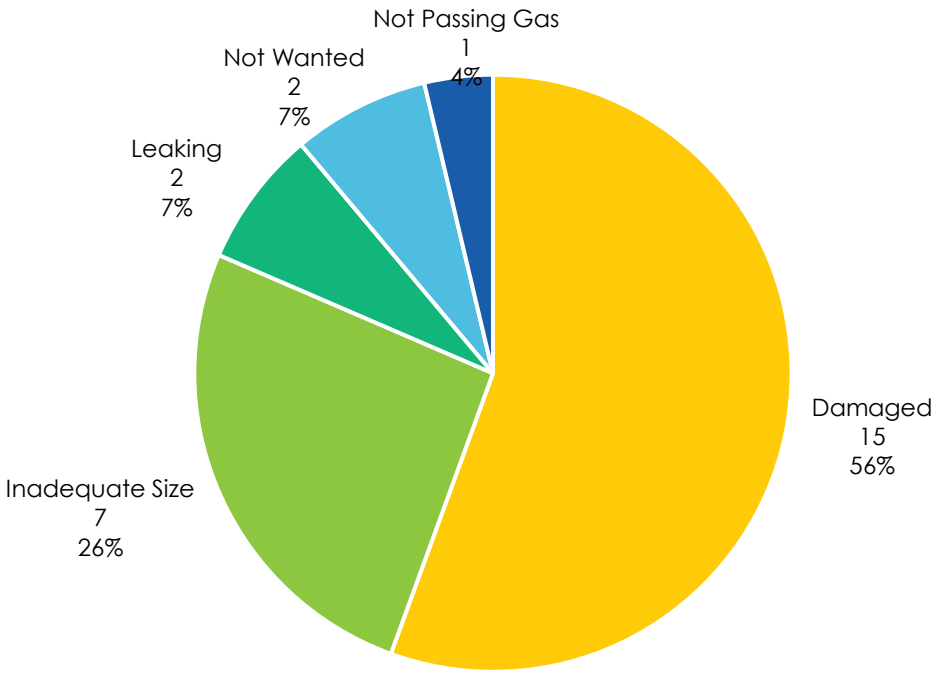

Figure 18: I&C Meter Failure Mode 2016 – 2020

Figure 9 shows failure modes by turbine meter models, experienced during 2016 – 2020.

[C.I.C]

Figure 19: Breakdown Maintenance by Model Type 2016 – 2020

4.7.3. Turbine Meter Replacement Program

19 turbine sites are proposed to be replaced with new turbine meters in the 2024-28 regulatory period. Replacement priorities are based on their annual consumption (over 10 TJ), age and condition, time expired and planned data loggers/flow corrector replacement.

Table 21: Proposed Turbine Meters Replacement Program

METER NUMBER	METER MODEL	INSTALLATION DATE	BUILD YEAR	ANNUAL CONSUMPTION (TJ)

0101HF		22-Jul-15	1972	6100
0000TC		3-Apr-19	1990	569
6876HP		9-Feb-19	1979	519
6762HP		4-Apr-11	1973	163
0488HT		18-May-15	1973	139
6046HR		31-Oct-18	1979	93
6585HP		11-Nov-16	1980	82
6776HP		31-Mar-11	1978	50
6758HP	[C.I.C]	5-Dec-19	Unknown	45
1908YE		11-Dec-09	2000	39
6579HP		12-May-15	1977	35
6743HP		14-May-15	1978	32
0184HT		23-Apr-15	Unknown	32
6107ZR		5-Feb-20	1976	25
6730HP		21-Mar-12	1973	25
6650HP		4-Jun-14	1977	21
6772HP		15-Apr-13	Unknown	20
6595HP		22-Sep-16	1978	19
6742HP		16-Apr-15	1972	18

4.7.3.1. [C.I.C] Full Rebuild

[C.IC] currently connects to gas transmission network and is identified in poor condition. Full rebuild of the site is recommended in order to mitigate safety risk and improve the integrity and reliability the metering installation at the customer premises.

4.7.4. Capital Expenditure of Turbine Meter Replacement

Capital expenditure for the I&C turbine meter replacement program is summarised in Table.

Table 22: Capital Expenditure – I&C Turbine Meter Replacement Program

PROGRAM	2023-24	2024-25	2025-26	2026-27	2027-28	2024-28 TOTAL

		[C.I.C]				

4.8. Reactive Meter Replacement

Reactive meter replacement is undertaken for all meters in AusNet Services' metering fleet. Meter faults described are predominantly identified by the public. Meters are then replaced following an investigation. Failed or faulty meters are replaced with new or refurbished units (I&C only) of similar capacity, where inadequate size is not the cause of failure. In circumstances where inadequate size is identified as the meter failure, a new meter of similar type, but appropriate capacity, will be installed in place of the existing meter.

4.8.1. Historical Performance

Over the last 5 years AusNet Services' metering assets have experienced average annual failure rates of 0.3%[13] of the total population. A breakdown of failures by type is shown in Table**Error! Reference source not found.**.

Table 23: Meter Failures by Installation Type

INSTALLATION TYPE	2016	2017	2018	2019	2020	AVERAGE
Domestic Meter Failures	1,164	2,202	2,580	2,767	2,864	2,315
% Population	0.16%	0.30%	0.35%	0.37%	0.38%	0.31%
I&C Failures	29	61	55	76	84	61
% Population	0.15%	0.32%	0.29%	0.40%	0.45%	0.32%
Total Meter Failures	**1,193**	**2,263**	**2,635**	**2,843**	**2,948**	**2,376**
% Population	**0.16%**	**0.30%**	**0.35%**	**0.37%**	**0.39%**	**0.31%**

Figure 20 below shows failure modes, as a percentage of total failures, experienced during 2016 – 2020.

[13] Failure statistics only include meters that have failed during operation. Results from in-service compliance testing are excluded from the percentages in **Error! Reference source not found.** and **Error! Reference source not found.**.

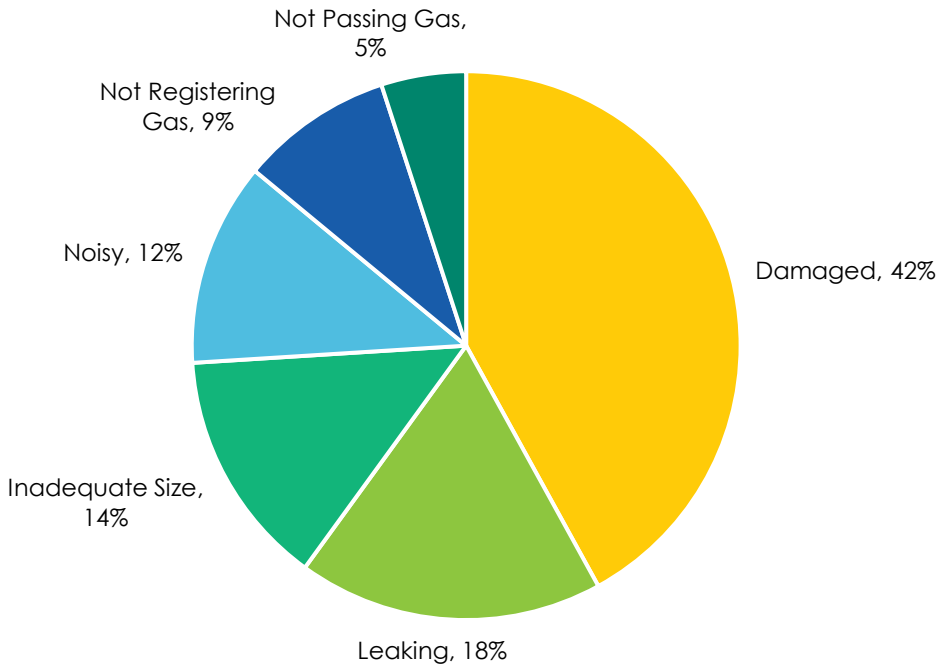

Figure 20: Percentage Breakdown of Meter Failure Modes (2016 to 2020)

Meter failures have increased since 2017, compared to previous years. The main failure mode resulting in this increase is damaged meters (including third party damage), which cannot always be prevented by AusNet Services. This trend is expected to continue in upcoming years due to increased population density, particularly in metropolitan areas.

Table compares failure modes across domestic and I&C meters. Damaged meters are the primary cause of meter failure for both domestic and I&C, followed by leakage and inadequate meter sizing.

Table 24: Meter Failure Modes (2016 - 2020)

FAILURE MODE	DOMESTIC (<10M³/HR)	I&C (≥25 M³/HR)	TOTAL
Damaged	44%	18%	**42%**
Leaking	19%	3%	**18%**
Inadequate size	9%	72%	**14%**
Noisy	13%	0%	**12%**
Not registering gas	9%	5%	**9%**
Not passing gas	44%	18%	**42%**

Meter failures have the potential to cause the following:

- Injury to property and public due to a gas leak. In the most extreme case, a gas leak at the meter has the potential to cause fatality;
- Inaccurate billing to customer, increasing customer charges if the meter is over reading; and
- Under recording of customer usage, impacting revenues that can be realised by both AusNet Services and retailers, in the event the meter is under reading, or not registering gas.

4.8.2. Reactive Meter Replacement Program – Domestic Meters

The volume of reactive domestic meter replacement for 2023-2028 is forecasted based on historical performance.

Figure displays the projected number of domestic meter faults, which is extrapolated from the actual volumes of meter failures from 2016 to 2020. By applying the average of the projected faults, it is forecast that [C.I.C] meters will be reactively replaced per year in the regulatory period. As the volume of reactive replacements has plateaued in recent years, the lower bound has been used for the forecast.

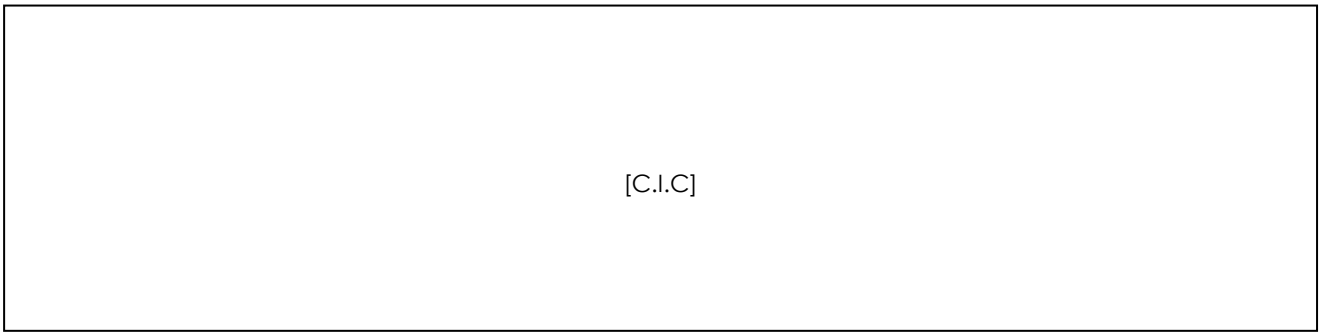

Figure 21: Forecast domestic meter faults requiring reactive replacement

4.8.3. Reactive Meter Replacement Program – I&C Meters

To predict the annual volume of faulty I&C meters in the regulatory period, AusNet Services analyses the number of recorded faults of each type and model of I&C meters over the last five years.

Table shows the annual quantities of reactive meter replacement from 2016 to 2020. By calculating the average of this period, the forecasted volume of each type of I&C meters are provided in Table 25.

Table 25: Average Reactive Replacement of Existing I&C Meters (2016 – 2020)

[C.I.C]

4.8.4. Capital Expenditure of Reactive Meters Replacement Program

Capital expenditure for the reactive domestic and I&C meter replacement program is summarised in Table.

Table 26: Forecast reactive meter replacement

PROGRAM		2023-24	2024-25	2025-26	2026-27	2027-28	2024-28 TOTAL
		[C.I.C]					

4.9. Data Loggers and Flow Correctors Replacement Program

To fulfil the regulatory obligation, AusNet Services require to supply and install data loggers or flow correctors to the gas customers, whose annual gas consumptions are over 10 TJ. These sites are commonly called 'Interval Sites'. This type of electronic device is to record the hourly gas consumption for billing purpose.

4.9.1. Program Scope

The models of data loggers and flow correctors tabulated in the below

Table are targeted for replacement due to their age, performance, reliability and maintainability. The priority and criteria of replacement are set based on the highest gas usage of each interval site, where the installed model falls into one of the target replacement models. Analysis indicates that 101 sites are to be replaced with new and modern Inline 846 data loggers or flow correctors.

Along with the planned replacement program, reactive volume of data loggers and flow correctors are included in the regulator period. The forecast is based on the historical performance, frequency of breakdowns and types of models.

Table 28: Aged Data Logger / Flow Corrector Models

MODEL	TOTAL INSTALLATION	TARGET REPLACEMENT	ESTIMATED YEAR OF MANUFACTURE
		[C.I.C]	

4.9.2. Historical Performance

Based on the installation and historical performance of this type of electronic equipment in the field, the physical service life spans from 10 to 15 years depending on the external environments, climate conditions and level of maintenance that the equipment installed.

Figure displays the annual breakdown maintenance by models over the last six years, accounting to an average of about sixty (60) faults each year.

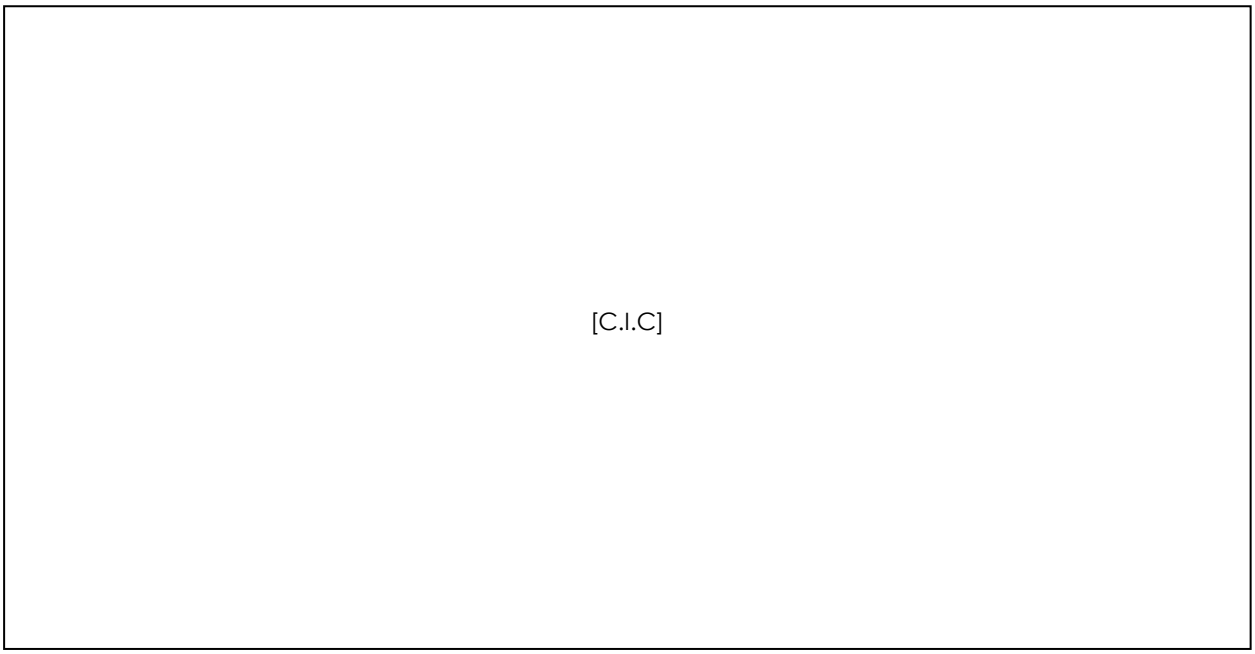

Figure 22: Annual Breakdown Maintenance 2014 – 2020

Figure illustrates the breakdown maintenance by model types. Inline 845 has contributed to 35% of faults since 2014, following by VDS 3000 model.

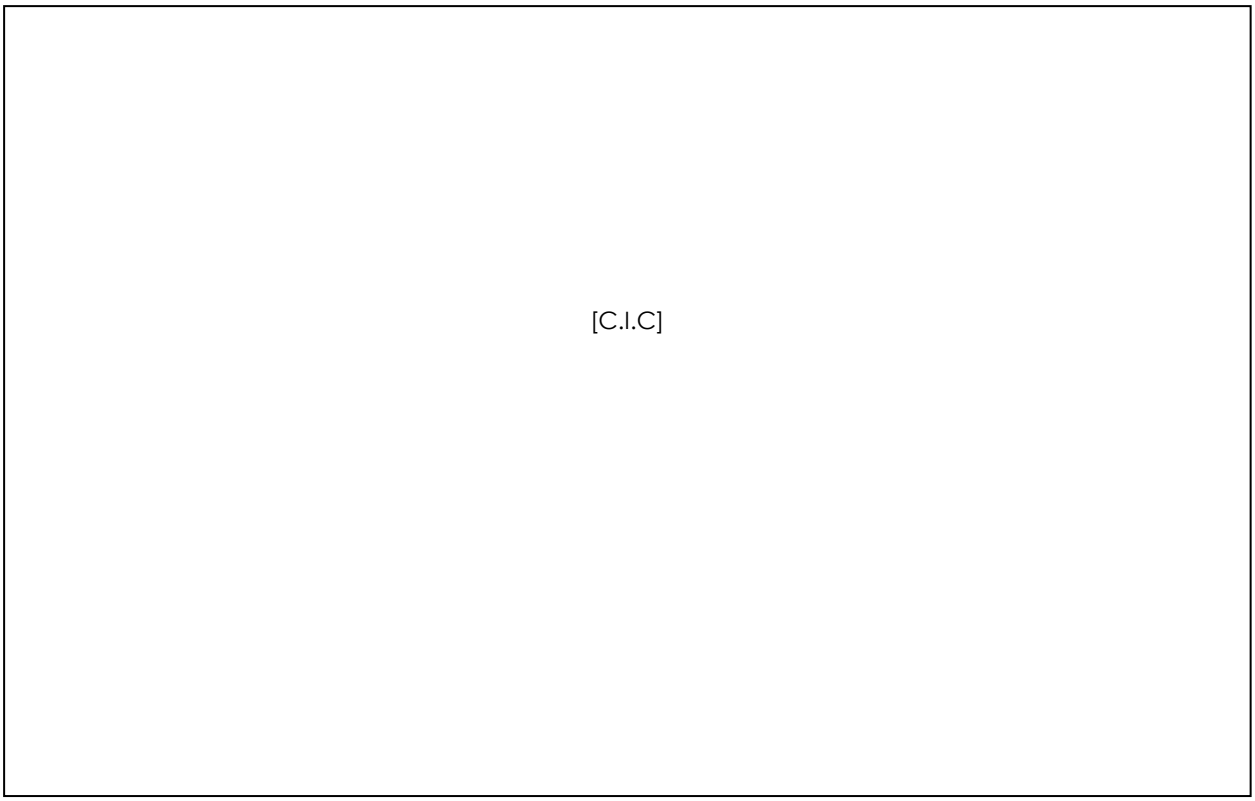

Figure 23: Breakdown Maintenance by Model Type 2014 – 2020

4.9.3. Data Loggers and Flow Correctors Replacement Program

There are currently 379 interval customers within AusNet Services gas business portfolio. A small error in usage measurement could lead to significant amount of gas being not billed and leading to a significant penalty to AusNet Services through the UAFG settlement process. In this regard, AusNet Services is heavily reliant on the accurate performance and reliability of its data logger and flow corrector fleets.

Over a period of last few years many anomalies in usage patterns have been identified leading to usage errors (UAFG) and disputes (billing). Factors contributing to the errors include frequent equipment breakdown and equipment accuracy (i.e., misalignment with the readings of physical meters).

To address the financial risk and to enhance operational excellence, a target replacement for the data logger and flow corrector sites as shown in Table are planned in the regulatory period.

Table 29: Data Logger / Flow Corrector Replacement

MODEL	QUANTITY
[C.I.C]	

4.9.4. Capital Expenditure of Data Logger and Flow Corrector Replacement

Capital expenditure for the data logger and flow corrector replacement program is summarised in Table 3.

Table 30: Capital Expenditure – Data Logger and Flow Corrector Replacement Program

PROGRAM	2023-24	2024-25	2025-26	2026-27	2027-28	2024-28 TOTAL
		[C.I.C]				

4.10. Reactive Data Loggers and Flow Correctors Replacement

Provision of the forecast volume of reactive data loggers and flow correctors replacement for 2023-2028 is based on historical performance of this asset type. Along with the proactive replacement program as described in 4.9.3, it is anticipated that the data loggers or flow correctors being removed from the field due to failure would reduce over the regulatory period. A forecast of 20% reduction in each consequent regulatory year is assumed.

In view of the historical performance of this asset type, analysis indicates that the rate of reactive replacement in the customer sites is averaged to one (1) unit of data logger or flow corrector per month. In most cases, the main reasons of triggering the replacements of this type of equipment were their aged models, out of alignments and flat measurements resulting in frequent breakdown calls, obsolete spare parts making them unrepairable and the degrade of the electronic components as physically exposed outdoor over time.

The forecast volume and expenditure of data logger and flow corrector reactive replacement program are provided in Table .

Table 31: Capital Expenditure – Reactive Data Logger / Flow Corrector Replacement Program

PROGRAM	2023-24	2024-25	2025-26	2026-27	2027-28	2024-28 TOTAL
		[C.I.C]				

4.11. Digital Metering Trial Program

With the potential risk of the metering market shifting exclusively to digital metering, AusNet Services has identified the need to investigate the potential implications and benefits of digital metering.

In order to optimize performance and understand the full implications of introducing a digital metering fleet, an investigation is proposed to test the capability of new metering technology.

4.11.1. Program Scope

The trial will involve the installation of approximately 1,000 digital meters with the objective to digitising the meter data collection process, enabling the collection of more accurate and frequent consumption data, and using this information to improve billing, regulatory and internal reporting, network configuration, and network planning.

- **Small scale trial (approximately 1,000 domestic sites)**
- **Targeted domestic customers sites:**
  - No access requiring estimated billings, vulnerable customers and concessional customers.
- **Type of digital meters:**
  - Retrofittable to the existing domestic diaphragm meters; and
  - Advanced (digital) meters solutions.
- **Functional requirements, e.g.,**
  - Battery life, temperature and pressure measurement, data collection interval, gas leak detection, remote supply cut off valve, tampering sensor and alert, reverse flow warnings, future proving (100% hydrogen ready) and durability, etc.
- **Communication infrastructures and solutions, e.g.,**
  - 4G, 5G and NB IoT etc.
- **Data management, e.g.,**
  - Integrate with AusNet electricity data management system and architect.

4.11.2. Potential Benefits

- Provide accurate and fast billings.
- Reduce estimated billings (No access sites).
- Enhance energy management from customers by giving them information about their energy consumption (subject to battery life and frequency/interval of data polling).
- Better manage vulnerable and concessional customers.
- Remote connection and disconnection.
- Reduce the safety risk of meter reader through manual reading on site (e.g., aggressive customers or dogs, etc).
- Align with the development of "The future of gas" strategy and future proofing (100% hydrogen ready, phasing out traditional diaphragm meters).
- Manage and monitor tempering, theft, faulty or damage meters promptly, hence improve public safety.
- Provide additional data for UAFG review and reconciliation (e.g., current billing method is based on PCF and bi-monthly cyclic readings).
- Understand gas usage and improve the capability of network modelling, planning and forecasting.

4.11.3. Digital Metering Trial Program

In order to understand the benefits and implications of the technology, a digital metering trial program will involve the installation of approximately 1,000 digital meters from 2024 to 2026 in the regulatory period.

The findings from the trial will inform AusNet Services of the best direction to support the shift in market and enable a smooth transition for its customers.

4.11.4. Capital Expenditure of Digital Metering Trial Program

Capital expenditure for the digital metering trial program is summarised in Table.

Table 32: Capital Expenditure – Digital Metering Trial Program

PROGRAM	2023-24	2024-25	2025-26	2026-27	2027-28	2024-28 TOTAL
		[C.I.C]				

5. Alignment with Network Objectives

Each program described under this strategy is aligned to at least one of the AusNet Services' gas network objectives.

Table 33: Alignment of Metering Strategies with Gas Network Objectives

PROGRAMS	GAS NETWORK OBJECTIVE			
	Maintain Network Safety	Maintain Operating Efficiency	Undertake Prudent & Sustainable investment	Deliver Valued Services to Customers
In-Service Compliance Testing	X	X	X	X
Domestic Time Expired Replacement	X	X	X	X
I&C Time Expired Replacement	X	X	X	X
'No Access' Meter Replacement	X			X
I&C Turbine Meters Replacement	X	X		X
Faulty Meter Replacement	X	X		X
Data Logger / Flow Corrector Replacement		X		X
Faulty Data Loggers and Flow Correctors Replacement		X		X
Digital Metering Trial Program		X		X

The following sections provide further detail around the program alignment to each of the gas network objectives.

Maintain Network Safety in accordance with the Gas Safety Case

Clause 32 of the *Gas Safety Act 1997* requires a gas company to ensure facilities are maintained and operated to minimise hazards and risks to the public. Each of the meter management programs has the aim of maintaining integrity of metering installations through the removal of defective meters from the field. This minimises the likelihood of gas meter leaks, resulting in reduced hazards and risks to the public.

Maintain top quartile operating efficiency

Under the GDSC, AusNet Services is required to provide a compliant metering installation at each supply point off the distribution network, test meter installations and replace meters as required. The meter management programs have been designed to maintain operating efficiency whilst ensuring compliance with sections 5 to 8 of the GDSC.

Field life extensions granted under the FLE program avoid unnecessary meter replacement costs. The size of annual programs, and smoothing of the domestic (high volume) meter replacement program, allows for unit rates to be competitively negotiated with meter manufacturers and labour contractors.

Furthermore, proactive meter replacement and planning ensures meter stock can be procured in anticipation of meter failures and replacements, enabling more efficient replacement programs and avoiding material lead time.

Undertake prudent and sustainable network investment

The proactive programs described under this strategy ensure compliance with the GDSC but also reduce the volume of unplanned interruptions in the future. The programs identify meter families that are defective and remove these from the field, avoiding more costly reactive replacement costs in future years.

The strategy also considers whole of life costs of refurbished and brand new meters purchased from meter suppliers. Refurbished meters are not installed at domestic sites, due to the increase in whole of life costs associated with these units. This is considered prudent and sustainable investment as it considers the cost impacts to the customers beyond a 5 year period.

Delivery of valued services to our customers

Each meter management program has the aim to deliver a safe and reliable service to customers. Defective meters are replaced with accurate, correctly functioning units. This maintains integrity of the billing system, ensuring consumers are charged correctly for their gas usage.

Proactive testing and replacement also avoids unplanned outages and disruptions to customers due to meter failures.

6. Summary of Capital Expenditures

6.1. Phasing and Financial Disclosure

All programs are defined in Australian financial years, aligning to regulatory years from July until June of the ensuing year.

All financial figures quoted within this document, including all historic and forecasted expenditure - unless otherwise specifically stated – have the following characteristics:

- Real Expenditure / Cost (reference year = 2022);
- Direct Expenditure only (i.e. excludes overheads and corporate finance costs); and
- In units of $1,000 (i.e. '000).

Table summarises the proposed capital works programs and expenditure in 2024 to 2028. These forecasts are based on detailed analyses of historic asset performance and predicted failure rates as well as the prediction of annual replacement volumes for each meter testing and time expired replacements.

Table 34: Proposed Capital Works and Expenditure Forecasts

PROGRAM		2023-24	2024-25	2025-26	2026-27	2027-28	2024-28 TOTAL
		[C.I.C]					

Figure displays the proposed capital works programs and expenditure forecasts in 2024 to 2028.

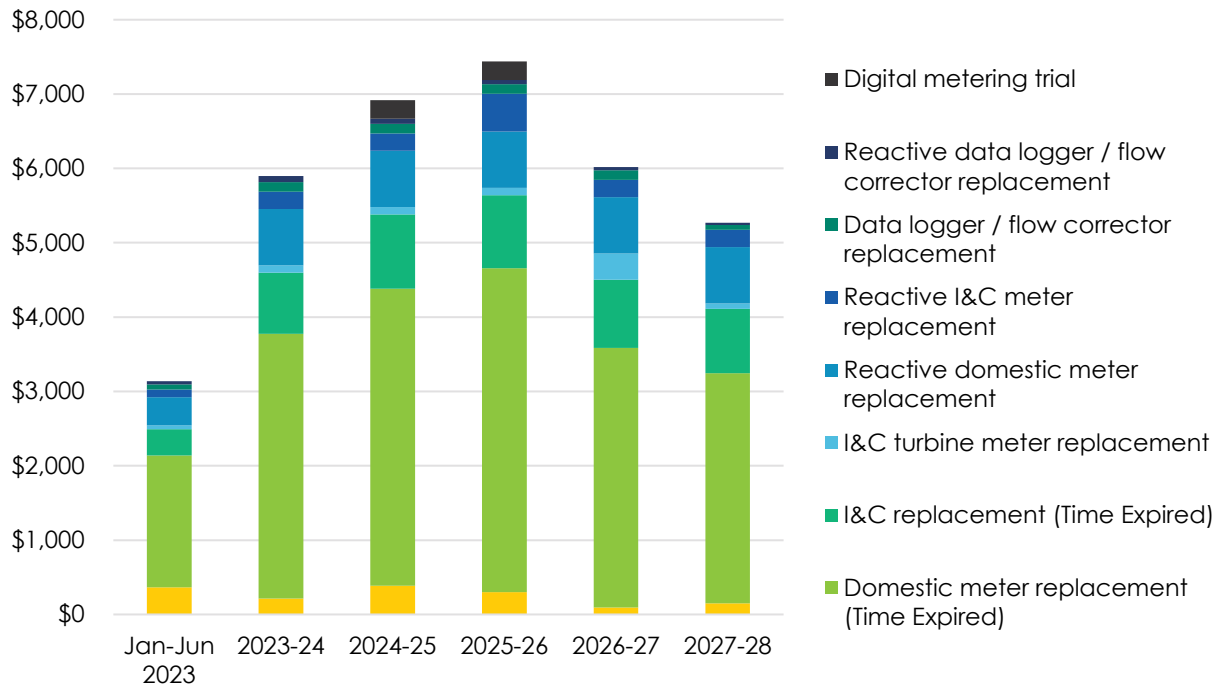

Figure24: Gas Metering Assets Expenditure Forecasts

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