Attachment 8.4

Meter Replacement Plan – South Australia

SA Final Plan July 2021 – June 2026

July 2020

Australian Gas Networks

apa

Name	Position
Prepared	
Steve Polglase	Asset Systems Manager
Reviewed	
Robin Gray	State Operations Manager
Keith Lenghaus	Acting Manager Asset Strategy and Planning
Rob Davis	Acting General Manager Operations
Approved	
Edwin DePrinse	APA – General Manager Networks
Mark Beech	AGN – General Manager Network Operations

Revision	Date	Reason / Changes made
0.1	22 July 2019	Issued for R Gray Review
0.2	23 September 2019	Issued for AGN review
0.3	1 July 2020	Finalise for SA Final Plan

Contents

Executive summary

The Meter Replacement Plan – South Australia (the Plan) outlines the program of work we will undertake to manage the accuracy and integrity of our customers' gas meters on a rolling five-year basis.

Our meter replacement work program for the next access arrangement (AA) period (1 July 2021 to 30 June 2026) will see more than 93,000 meters replaced at cost of $18 million. The program includes:

- replacing more than 81,500 end-of-life meters;
- conducting over 400 initial in-service compliance testing of new meter families;
- continuing our focus on extending the life of meters by conducting field-life extension (FLE) testing on more asset families. We estimate ~1,500 meters will be removed from the field and subject to FLE testing over the next five years; and
- replacing approximately 10,000 defective meters.

The following table provides a summary of the periodic meter change (PMC) activity over the next AA period.

South Australian Network: Meter replacement volumes cost estimate ($'000 2019/20, direct unescalated costs)

	2021/22	2022/23	2023/24	2024/25	2025/26	Total
Domestic meters						
Number of PMCs	15,365	14,582	21,985	17,444	21,098	90,474
Unit rate ($/meter)			[redacted]			
Forecast cost	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
I&C meters						
Number of PMCs	501	617	516	741	620	2,995
Unit rate ($/meter)			[redacted]			
Forecast cost	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total PMCs (volume)	**15,866**	**15,199**	**22,501**	**18,185**	**21,718**	**93,469**
Total all meters ($'000)	**3,079.6**	**2,989.4**	**4,311.7**	**3,577.5**	**4,196.6**	**18,154.9**

Note: Some totals may not add due to rounding.

Our meter replacement program for the next AA period follows on from the works program being delivered in the current AA period (1 July 2016 to 30 June 2021). By the end of the current AA period we will have replaced more than 140,000 meters at a total forecast cost of $22 million.

The decrease in meter replacement volumes over the next AA period is due to improvements in our in-field service testing and asset life extension strategies. For example, over the last ten years we have moved to installing domestic meters that have an 18-year life. This means we are approaching a trough in the meter replacement cycle, as these longer life meters are yet to reach their replacement dates.

We have also changed our FLE strategies so that we are undertaking more FLE tests and extending the life of more meters. Historically, we have tended not to conduct FLE on smaller meter families due to the high cost of testing. If the population of that meter family is small (for example 200 to 300) it was considered more economical to simply replace the meters rather than conduct testing to extend the asset life.

We have reviewed this position and tested whether changes in testing costs and improvements in data quality mean it may now be more economical to conduct FLE on smaller meter families. Net present cost (NPC) analysis indicates it is now economical to test and replace families containing as few as 100 meters.[1] As a result, more meters are having their field lives extended and the volume of replacements has fallen.

The work program for the next AA period has a higher proportion of industrial and commercial (I&C) customer meters, which are larger and more costly to replace than domestic meters. As a result the overall average replacement unit rate over the next AA period is higher.

We have also implemented a change in work practices when our contractors conduct PMCs. The technician is required to conduct more ancillary and associated works when attending each meter, with the aim of reducing the frequency of visits and extending the life of the assets where practicable. This change also contributes to higher meter replacement unit rates going forward.

For details on changes in the meter replacement unit rates, please refer to Attachment 8.9 Unit Rates Report.

Our meter replacement work program is guided by strict standards for metering installations relating to accuracy, safety and testing. We are obligated to replace meters when:

- they have reached the end of their field life (where this cannot be extended);
- when they have failed; or
- if testing shows their accuracy falls outside of the Metering Code requirements (± 2%).

This means the volume of meter replacement work in each AA period is directly influenced by the age and condition of the current stock of domestic and commercial meters in our network at that time. As such, volumes can vary between AA periods.

This Plan sets out our metering related regulatory obligations, the current stock and performance of domestic and commercial meters in our network, our meter replacement policy, our performance in the current AA period and our forecast meter replacement program for the next AA period (including our approach to developing this forecast).

[1] Meter families of less than 100 are still replaced rather than having a field life extension.

1. Introduction

1.1. Purpose

Australian Gas Networks Limited (AGN) reticulates gas to over 450,000 customers in the South Australian natural gas distribution networks (the networks). The volume of gas delivered to a customer is measured through a meter, with meter measurements being a key input into customer bills.

Under the *National Measurement Act 1960* (Commonwealth) (National Measurement Act) and the South Australian Gas Metering Code, we have a regulatory obligation to manage the integrity of these meters and ensure they operate within a prescribed tolerance band for metering accuracy (i.e. +2% to -2% of the volume of gas delivered at the site). Periodic meter changes (PMCs) must therefore be carried out to:

- test the accuracy of meters; and
- replace meters when the accuracy of their measurements falls outside the prescribed band.

Failure to maintain the accuracy of meters to the required standards increases the likelihood of customers being charged the incorrect amount for gas usage. For meters servicing larger customers, meter inaccuracy can have a significant effect on the level of unaccounted for gas. It can also result in a breach of our licence obligations, penalties, and other compliance actions.

This Plan provides an overview of the current stock of domestic and commercial meters in our networks, the standards for metering installations and the obligations we have to test and replace these meters. The Plan also outlines the ongoing processes and continuous improvements we apply to ensure we deliver value to our customers and comply with our regulatory obligations in relation to these meters. The Plan sets out the forecast capital expenditure (capex) on PMCs for domestic and commercial meters over this period.[2]

In developing this Plan, we have had regard to:

- the metering standards and other regulatory obligations set out in the National Measurement Act, the South Australian Gas Metering Code, Australian Standard (AS) 4944 (Gas Meters – In-Service Compliance Testing); and
- Rule 79 of the National Gas Rules (NGR), which requires capex to be:
  - such as would be incurred by a prudent service provider, acting efficiently, in accordance with accepted good industry practice to achieve the lowest sustainable cost of providing this service; and
  - justifiable on one of the grounds set out in rule 79(2), and particularly in the case of periodic meter replacement activities, to comply with a regulatory obligation or requirement.

This Plan has been developed and reviewed as part of our asset management planning processes and is an input into the Strategic Asset Management Plan (SAMP), which is provided as Attachment 8.2 to our Final Plan.

[2] Note that this Plan does not include Tariff D interval meters because their installation and replacement is specific to the customer and determined on an individual basis according to the design of the meter set. Also, the cost of these meters is recovered directly from the Tariff D customers.

1.2. Stakeholder engagement

We are committed to operating our networks in a manner consistent with the long-term interests of our customers. To facilitate this, we conduct regular stakeholder engagement to understand and respond to the priorities of our customers and stakeholders. Feedback from stakeholders is built into our asset management considerations, and is an important input when developing and reviewing our expenditure programs.

Our customers have told us their top three priorities are price/affordability, reliability of supply, and maintaining public safety.[3] They also told us they expect us to deliver a high level of public safety and are satisfied that this is current practice. Customers are also sensitive to price increases and would prefer their billing to be as accurate as possible to help minimise price shock.

This Plan, and the proposed meter testing and replacement activities outlined in it, are designed to ensure meters remain consistent with technical specifications, safety standards and compliance requirements, thereby helping maintain a safe and reliable service to customers. These activities are consistent with stakeholder expectations of our network and the levels of service our customers' value.

We aim to deliver the meter testing and replacement programs outlined by this plan for the lowest sustainable cost, thereby minimising impact on distribution network tariffs.

Further information on our customer and stakeholder engagement program is available in Chapter 5 of our Final Plan.

1.3. Document scope and structure

1.3.1. Scope

This Plan applies to meters used by domestic, and industrial and commercial (I&C) customers only. It does not apply to meters used at Tariff D customer sites (i.e. customers consuming more than 10 TJ per annum). Those meters are managed on a site-by-basis as determined by the design of the meter set. Costs associated with domestic and I&C meters are recovered from the regulated gas distribution network tariffs. The cost of replacing Tariff D meters are recovered directly from Tariff D customers.

This Plan applies to meters only. It does not cover the replacement and/or refurbishment of associated metering facility assets.

1.3.2. Structure

This document is structured as follows:

- Metering related regulatory obligations – this section outlines AGN's metering related obligations under the National Measurement Act, the South Australian Gas Metering Code, and Australian Standard AS 4944;
- Meters in the South Australian networks – this section sets out the types of meters currently in operation in our networks that are subject to the National Gas Law (NGL) and National Gas Rules (NGR)[4];

3 See feedback at: https://gasmatters.agig.com.au/SA

4 These meters are located in the Adelaide Metropolitan Area and regional towns serviced by the Moomba to Adelaide Pipeline System (MAPS) – Whyalla, Pt Pirie, Peterborough, Barossa Valley towns, Riverland towns, and small townships just north of Adelaide, as well as Mt Gambier in the south-east of the state.

- Meter replacement policy – this section outlines the meter replacement policy, which governs our approach to meter replacement;
- Current performance – this section summarises meter replacement volumes and expenditure during the current AA period;
- Forecast meter replacement program – this section describes the forecasting methodology we use to determine the amount we expect to spend on PMCs subject to the NGL and NGR in the next AA period, as well as the results of this forecasting methodology.

2. Metering related regulatory obligations

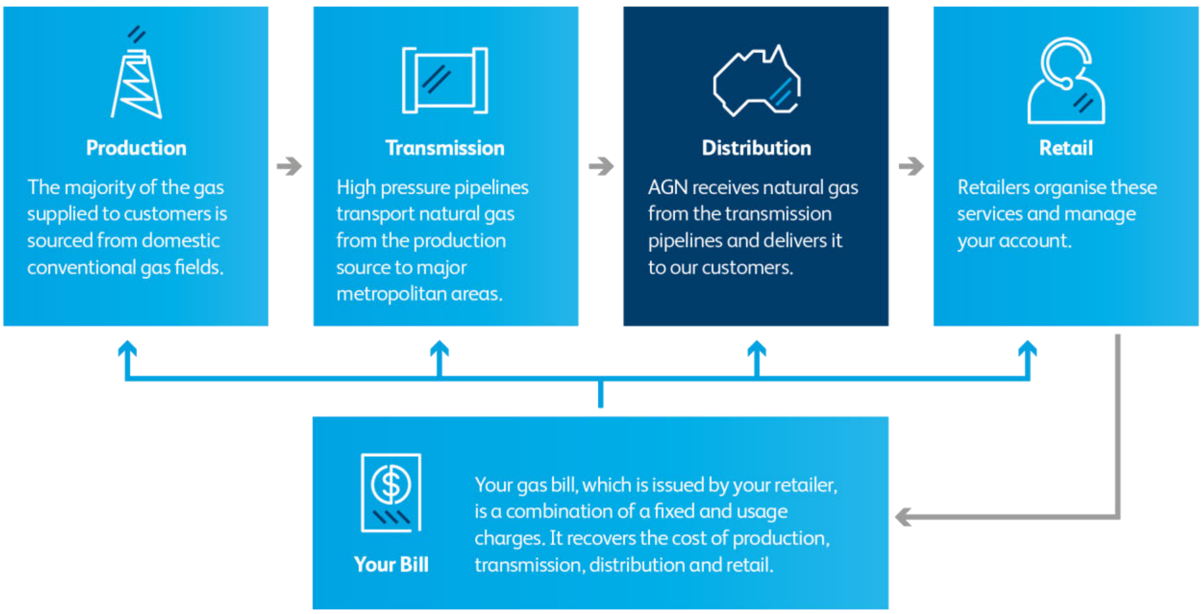
2.1. Role of AGN in customer metering

Our role in supplying natural gas to customers is illustrated in Figure 2.1. We own the distribution networks that transport gas directly to the customer. We also own, maintain and read the meters at each customer site.

The majority[5] of customers connected to our distribution networks have their gas transported to them by retailers. Retailers are responsible for purchasing natural gas from producers, transporting the gas through the transmission and distribution networks, and billing customers for all of the services required to supply natural gas to their site. This includes billing for use of the distribution network. Therefore, the metering information we collect is a key input into a retailer's billing process, as well as AGN's billing process to retailers.

The costs of using the distribution network are recovered from customers through a network tariff that comprises a fixed supply charge and a volumetric (consumption) charge. The volumetric charge is directly related to the amount of gas supplied to each customer site, which is measured by our meters.

Figure 2.1: Our role in the South Australian gas supply chain



AGN is the asset owner, and is ultimately responsible for investment decisions in the network. However, the day-to-day operation, maintenance and construction in our network is undertaken by our operational and management service provider, APA Asset Management (APA).[6] APA is

5 While there are a small number of large industrial customers that enter into their own gas supply and transportation arrangements, the majority of customers rely on a retailer for that service.

6 As outlined in Chapter 2 of our Final Plan, APA manages and operates AGN's natural gas distribution networks.

responsible for installing meters in our networks[7]. APA is also responsible for managing the PMCs. PMC activities include:

- testing the accuracy of the meters; and
- replacing meters when their accuracy falls outside the prescribed tolerance band.

Meter testing is conducted by a National Association of Testing Authorities (NATA) accredited facility, while the meter replacement activities are carried out by a combination of APA staff and contractors.

2.2. Meter concepts

2.2.1. Meter types

There are three main types of meter design used in the South Australian networks:

- diaphragm meters;
- rotary meters; and
- turbine meters.

These meters are grouped according to their service category. The groups are:

- *domestic meters* – typically diaphragm meters with a capacity up to 8m^3 per hour that are used to supply both residential and some small commercial customers;
- *industrial and commercial (I&C) meters* – these can be any of the above type of meters, with a capacity greater than 8m^3 per hour and used to supply medium-to-large scale commercial facilities and small-to-large size industrial customers.

Larger capacity I&C meters are used at Tariff D customer sites, however Tariff D meters are outside the scope of this Plan. Any reference made in the Plan to meters of size >25m^3 per hour is referring to medium to large I&C meters (i.e. non-Tariff D customers).

Meters are also usually grouped into families, with the term *family* being used to refer to *a quantity of meters that is considered uniform*. Consistent with AS 4944 and with the National Measurement Institute's document NITP 14, a meter family (also known as meter population) has the following details in common:

- manufacturer;
- country of manufacture;
- type or model of the meter;
- year of manufacture (within the same 12-month period);
- year of initial verification in the country of manufacture (within the same 12-month period);
- accuracy class; and
- certificate of approval.

7 APA is required to install the meters in a position that allows unimpeded access to any person that is required to test, adjust, maintain, repair or replace the metering installation or collect metering data. Once the meters are installed, customers are responsible for ensuring their meter remains accessible to operations personnel.

For example, the Email 602 meter type, which was installed each year between 2000 and 2019, consists of 20 meter families (populations).

2.3. Meter testing and replacement obligations

2.3.1. Regulatory requirements

This Plan relates to domestic and I&C customer meters installed in our South Australian networks, which are subject to the following regulatory obligations:

- *National Measurement Act 1960 (Commonwealth)* – gas measurement laws are governed through the National Measurement Institute by the Chief Metrologist, who is empowered to oversee and administer the National Measurement Act. This Act sets out the requirements that apply to utility meters used for trade, their verification and the penalties for failure to comply with certain provisions in the Act.[8]
- *South Australian Network* – as a condition of our South Australian Gas Distribution Licence, we are required to comply with the metering related provisions set out in the South Australian Gas Metering Code. Amongst other things, this Code:[9]
  - requires us to provide metering installations and sets out our obligations in relation to the standard of those installations, meter testing and replacements, and the collection and provision of metering data to retailers;[10] and
  - requires us to comply with AS 4944 when determining the initial and ongoing life of a meter family defined in this standard and when testing these meters.[11]

Failure to maintain the accuracy of meters to the required standards increases the likelihood of customers being charged the incorrect amount for gas usage and, on larger meters, can have a significant effect on the level of unaccounted for gas. Failure to comply with the obligations outlined above can also result in:

- a breach of our licence conditions and authorisation in South Australia;
- enforcement actions as set out in the *Gas Act*;[12] and
- penalties being applied under the *National Measurement Act*.

8 Under this Act, a person may be required to pay a penalty if they supply a utility meter for trade that gives an inaccurate measurement. The maximum penalty for such an offence is 200 penalty units, with each penalty unit worth $180. The maximum penalty that could be payable if a single meter was found to give an inaccurate measurement (i.e. running fast) is therefore $36,000.

9 The South Australian Gas Metering Code can be accessed online here: https://www.escosa.sa.gov.au/ArticleDocuments/619/130131-GasMeteringCode-GMC04.pdf.aspx?Embed=Y. This Code has been developed by the Essential Services Commission of South Australia (ESCOSA) and applies to all distributors that hold a gas distribution licence. The Code sets out the minimum standards for metering installations. Clause 4 of AGN's Gas Distribution Licence requires compliance with this Code.

10 These provisions can be found in sections 2-4 of the South Australian Gas Metering Code.

11 This provision can be found in section 3.4 of the South Australian Gas Metering Code.

12 Gas Act Section 27

2.3.2. Meter capacities

AS 4944 (Gas meters – In-Service Compliance Testing) applies to diaphragm meter families with a capacity of 25m^3 per hour or less.[13] A distinction can therefore be drawn between meter families with a capacity:

- *up to and including 25m^3 per hour* (i.e. domestic and smaller/medium I&C meters), which are subject to AS 4944, the South Australian Gas Metering Code and the National Measurement Act; and
- *greater than 25m^{3}per hour* (i.e. medium to large I&C meters), which are subject to the South Australian Gas Metering Code and the National Measurement Act.

Our meter testing and replacement obligations under AS 4944 and the South Australian Gas Metering Code are outlined in sections 2.3.3 and 2.3.4 respectively.

2.3.3. Meter testing

2.3.3.1. Meters ≤10 m^3/hr

We are required by the South Australian Gas Metering Code to carry out, or cause to be carried out the following tests on meters:

- acceptance tests before a new meter is placed into service, before a meter that has been removed from service is placed back into service and after any repairs, maintenance or recalibration is performed on a meter;[14]
- initial in-service compliance testing, which must be carried out in accordance with the requirements set out in AS 4944;[15] and
- field life extension (FLE) testing (also referred to as ongoing in-service compliance testing), which must be carried out in accordance with the requirements set out in AS 4944. [16]

We are also required to carry out testing if a customer requests such a test.[17]

The criteria for these tests are set out in Clauses 2.6, 3.4 and 3.7.2 of the South Australian Gas Metering Code and summarised below:

> 2.6.1 The ***minimum standards*** of accuracy for ***metering installations*** are within a margin of accuracy of plus or minus 2% of the net volume of ***gas*** delivered to that ***delivery point***.
>
> 3.2.2 The ***distributor*** must only adopt a new type of ***metering installation*** if that ***metering installation*** has been ***type tested***.

[13] AS 4944:2006 section 1 Scope and section 4.1.2 Maximum flow rate.

[14] South Australian Gas Metering Code, section 3.2.1.

[15] South Australian Gas Metering Code, section 3.4.

[16] South Australian Gas Metering Code, section 3.4.

[17] South Australian Gas Metering Code, section 3.3. This section of the Code requires AGN to:

- give a retailer at least five business days' notice (or agree such other mutually convenient time) of when the requested test is proposed to be performed; and
- test a metering installation within 15 business days of a request from retailer to ascertain whether or not the installation is defective.

This section also allows AGN to seek payment from the affected party of the costs of testing the metering installation and associated costs if the installation is not defective and meets the accuracy standards set out in the Code.

3.4.1 The ***distributor*** must conduct, or cause to be conducted, ***acceptance tests*** on ***meters***, ***correctors*** and ***data loggers*** that are components of ***metering installations*** in the following circumstances:

(a) before a new ***meter***, ***corrector*** or ***data logger*** is placed in service;

(b) before a ***meter***, ***corrector*** or ***data logger*** that has been removed from service is placed back into service; and

(c) after any repairs, maintenance or recalibration performed on a ***meter***, ***corrector*** or ***data logger*** have been completed.

3.4.3 The testing and sampling plan must provide that ***meters*** be tested at both 20% and 100% of the badge capacity of the ***meters***.

3.4.6 If the test results do not satisfy:

(a) the maximum allowable error limits for badge capacity of the ***meter***s at 20% and at 100% as set out in clause 2.6, with an ***uncertainty limit*** of no more than 1%; and

(b) such other requirements of the testing and sampling plan approved by the ***Commission***, then the ***distributor*** must replace or recalibrate all ***metering installations*** in that ***meter class***.

3.7.2 A ***distributor*** can only make an adjustment for ***meter*** error using a ***corrector*** or a ***correction factor*** when:

(a) the ***corrector*** and ***meter*** for the specified correction is uniquely identified;

(b) the accuracy of the ***meter*** and/or ***corrector*** is within the ***minimum standards***;

(c) the method of adjustment by the ***corrector*** can be varied; and ……..

Our meter testing program is therefore carried out to ensure:

- the net volume of gas delivered to each delivery point falls within the prescribed tolerance band of metering accuracy;
- metering installations do not show any systematic bias within the allowable margin of accuracy and meters are not tampered with, or calibrated with the intent of causing bias in the meter; and
- the tolerances of the individual components (meters, correcting instruments, pressure and temperature transmitters) used to measure gas supplied to a customer are such that the gas measured is within a margin of accuracy of ±1% of the net volume of gas supplied for new meters leaving the manufacturer.

The remainder of this section provides further detail on the acceptance testing, initial in-service compliance testing and FLE testing requirements.

Acceptance testing

We are required to carry out, or cause to be carried out, acceptance tests on new and refurbished meters and meters to be placed back into service. The term *acceptance testing* is defined in the South Australian Gas Metering Code as the *testing and setting by a manufacturer or installer on a meter, corrector or metering installation to establish the initial calibration of the meter, corrector or metering installation.*

To comply with this obligation, we require domestic meters (up to 8 m^3/hr capacity) and small I&C meters (up to 10 m^3/hr capacity) to be tested prior to delivery by the manufacturer or refurbisher in accordance with AS 4647-2005 to an accuracy of at least ±1%.[18]

Meters received from manufacturers with accredited testing facilities are sealed prior to delivery and accepted without further testing. These meters are inspected on delivery to ensure the seals are intact and no damage has occurred during transit. If the inspection is satisfactory, these meters are accepted without further testing, prior to installation. If the inspection is not satisfactory, then the meters will be subject to further testing.

Initial in-service compliance testing

Once a meter family is placed into the field then it may, depending on when it was installed, be subject to an initial in-service compliance test to determine the initial meter life. This is referred to in AS 4944 as the compliance period, which is the interval before FLE testing is required to demonstrate that the meter family is maintaining its accuracy within an acceptable range.

In keeping with AS 4944, meter families installed:

- *up to and including 2005* are deemed to have an initial field life of 15 years, from the date of their original installation[19]. In May 2019 there were 15,969 of these meters installed in the networks; and
- *from 2006 onwards* are required to undergo an initial in-service compliance test after a period of three to five years of field service to determine the initial meter life[20]. In May 2019 there were 437,471 of these meters installed in the networks.

For those meters installed from 2006 onwards, the initial in-service compliance testing is usually carried out between the third and fifth year of service and, in keeping with AS 4944, is conducted by:

- removing a random sample of meters from the meter family (population) from the field that is sufficiently large to enable the testing to meet the sample requirements set out in Table 2 of AS 4944[21]; and
- testing whether the accuracy of this sample of meters falls within a ±1.5% band, or a ±2% band, which is then used to determine the initial meter life (compliance period) as set out in Table 2.1[22].

Table 2.1: Meters in-service compliance period as derived from initial in-service test

	Accuracy from initial service test	
	Within ±1.5%	Within ±2.0%
Compliance period	18 years	15 years

Source: AS 4944, Table 4.

18 Manufacturers are required to supply on this basis under the terms of their supply contracts.
19 AS 4944, clause 6.2.1.
20 AS 4944, clause 6.2.2.
21 Given the potential for meters to be damaged when they are removed or transported to the testing site, or for other factors to prevent testing, we usually take an additional 15% of meters from the field to ensure that the sample size that is tested meets the requirements in Table 2 of AS 4944.
22 Note that there is some flexibility that meter populations can be grouped according to year of installation rather than manufacturer.

Field life extension (ongoing in-service compliance) testing

Under AS 4944, meter families with a capacity of up to 25m^3 per hour must be tested to determine whether or not a meter family's field life can be extended beyond its designated initial meter life. This is referred to as FLE testing, or ongoing in-service compliance testing.

FLE testing generally occurs early in the final year of a meter family's approved initial meter life (for example, a meter family with a 15-year initial life will be tested early in year 15). In keeping with AS 4944, the test is conducted by:

- removing a random sample of meters from the relevant meter family (population) from the field, with the size of the sample based on the requirements set out in Table 2 of AS 4944; and
- testing whether the accuracy of this sample of meters:
  - falls within a ±2% band, in which case the field life can be extended by five years[23]; or
  - falls outside the ±2% band, in which case the meter family will be failed and replaced.

2.3.3.2. Meters >10 m^3/hr

Initial field life

AS 4944 covers the testing requirements of small to medium I&C meters between 10 m^3/hr and 25 m^3/hr, but does not cover larger I&C meters (i.e. meter families with a capacity greater than 25m^3 per hour). The testing requirements for these larger meter types are instead set out in the South Australian Gas Metering Code.

For meters >10 m^3/hr, the metering provisions in the South Australian Gas Metering Code requires AGN to carry out, or cause to be carried out the tests nominated in Section 2.3.3.1.

These meter families do not undergo initial in-service compliance testing, rather they are deemed to have an initial field life of ten years[24].

FLE testing

Meter families >10 m^3/hr typically do not undergo FLE testing. Their lives are not usually extended beyond ten years because even small metering inaccuracies at these sites can have a significant effect on unaccounted for gas volumes given the larger volumes of gas supplied to these sites. Also, because there are relatively few of each meter family installed, it makes it uneconomic to extend their lives as the cost of carrying out the testing is quite high.

However, in some selected cases, a meter family with a capacity >10 m^3/hr but <25 m^3/hr will be subject to FLE testing. This only occurs where the size of the family makes it more economic to extend the family's life than replace it. In these cases, the life extension criteria for domestic meters apply.

Acceptance testing for meters >10 m^3/hr

Like domestic meters, new I&C meters >10 m^3/hr are generally supplied by accredited manufacturers and tested by the manufacturer to an accuracy of at least ±1% prior to delivery.

Meters received from these manufacturers are sealed prior to delivery and accepted without further testing. These meters are inspected on delivery to ensure the seals are intact and no damage has occurred during transit. If the inspection is satisfactory, the meters are accepted without further testing, prior to installation.

[23] AS 4944, Table 5

[24] South Australian Gas Metering Code, section 3.4.1

If meters are received from a non-accredited manufacturer, they will be tested before being placed into the field using the same criteria applying to domestic meters:

- all diaphragm meters are tested at both 20% and 100% flow rate and must be accurate to ±1%; and
- rotary meters are tested at 10%, 40%, 70% and 100% capacity and must be accurate to ±1%;
- turbine meters are tested at 10%, 25%, 50%, 75% and 100% capacity and must be accurate to ±1%.

2.3.4. Meter replacement

We are required by the South Australian Gas Metering Code to replace meters if the test results fall outside the accuracy range specified in the Code:

- *meters sized ≤25m^3 per hour* – these meter families must be replaced if the test results (usually FLE testing) fall outside the accuracy range specified in the South Australian Gas Metering Code; and
- *meters sized >25m^3 per hour* – these meter families are replaced once the meter family reaches 10 years of age, unless the meter family has passed an FLE test.

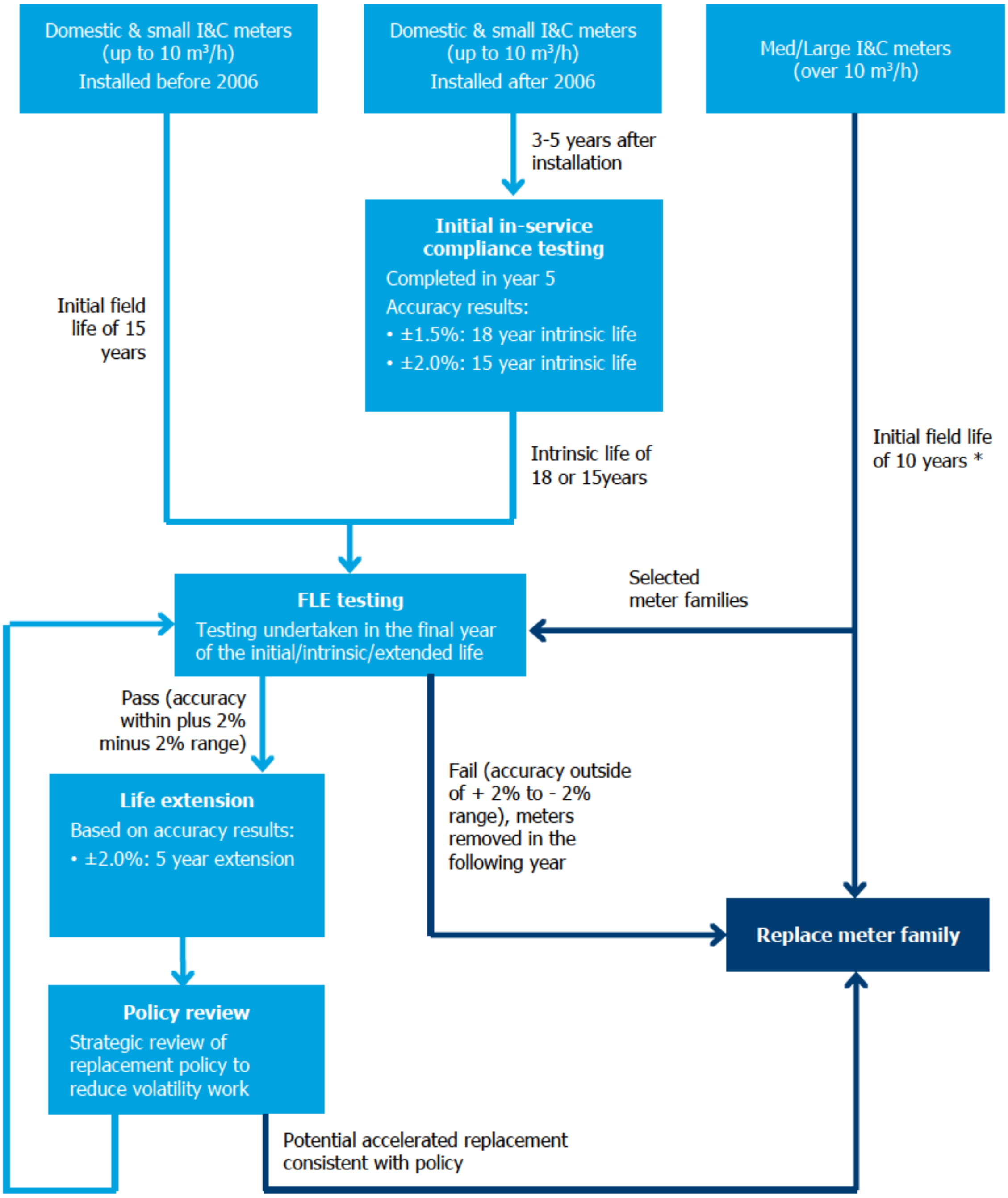
Where feasible, we will use refurbished meters when carrying out the PMCs. While refurbished meters have a shorter average life, they can be a lower cost option than new meters (see Section 4.3 for more detail). There are, however, limits on the availability of refurbished meters (i.e. because there are only a certain number of meters that are removed from the field each year that are economically viable to repair). Currently up to 18,000 domestic meters are refurbished per annum, but this number is dependent on the total number of meters removed from the field.

Figure 2.2 illustrates our approach to identifying the number of meters required to be replaced. We may bring forward the replacement of meter populations to manage deliverability risk, minimise the cost of the replacement and ensure compliance with regulatory obligations.

It is noted that meters removed from service as part of the meter testing or replacement process may be either:

- repaired, tested and returned to service where it is economic to do so; or
- disposed of if it is uneconomic to repair the meters or parts are no longer available.

Figure 2.2: Meter replacement identification process



* Meters >10 m³/hr are typically replaced at the end of their initial field life, but in a small number of cases the field life may be extended the after the meters are subject to successful FLE testing.

2.3.5. Asset management optimisation

Consistent with good asset management practice, and in line with the tests under NGR 79, we continually seek ways of delivering works programs for the lowest sustainable cost. For example, we have changed our FLE strategies so that we are undertaking more FLE tests and extending the life of more meters. Historically, we have tended not to conduct FLE on smaller meter families due to the high cost of testing. If the population of that meter family is small (for example 200 to 300) it was considered more economical to simply replace the meters rather than conduct testing to extend the asset life.

We have reviewed this position and tested whether changes in testing costs and improvements in data quality mean it may now be more economical to conduct FLE on smaller meter families. Net present cost (NPC) analysis indicates it is now economical to test and replace families containing as few as 100 meters.[25] As a result, more meters are likely to have their field lives extended and the forecast volume of replacements has fallen.

We will continue to review and revise our asset management practices during the delivery of the meter replacement program and seek opportunities to improve efficiency/productivity where practicable.

[25] Meter families of less than 100 are still replaced rather than having a field life extension.

3. Meters in the South Australian networks

This section sets out:

- the numbers and types of meters currently installed in the South Australian networks; and
- the results of the testing that has recently been carried out in these networks.

3.1. Meter types

We currently reticulate gas to over 450,000 customers in our networks. Each customer has a meter installed at their premises. Table 3.1 provides a breakdown of the number of meter types, meter families and meters installed in the networks.

Table 3.1: Split of meters installed in South Australian Networks (as at May 2019)

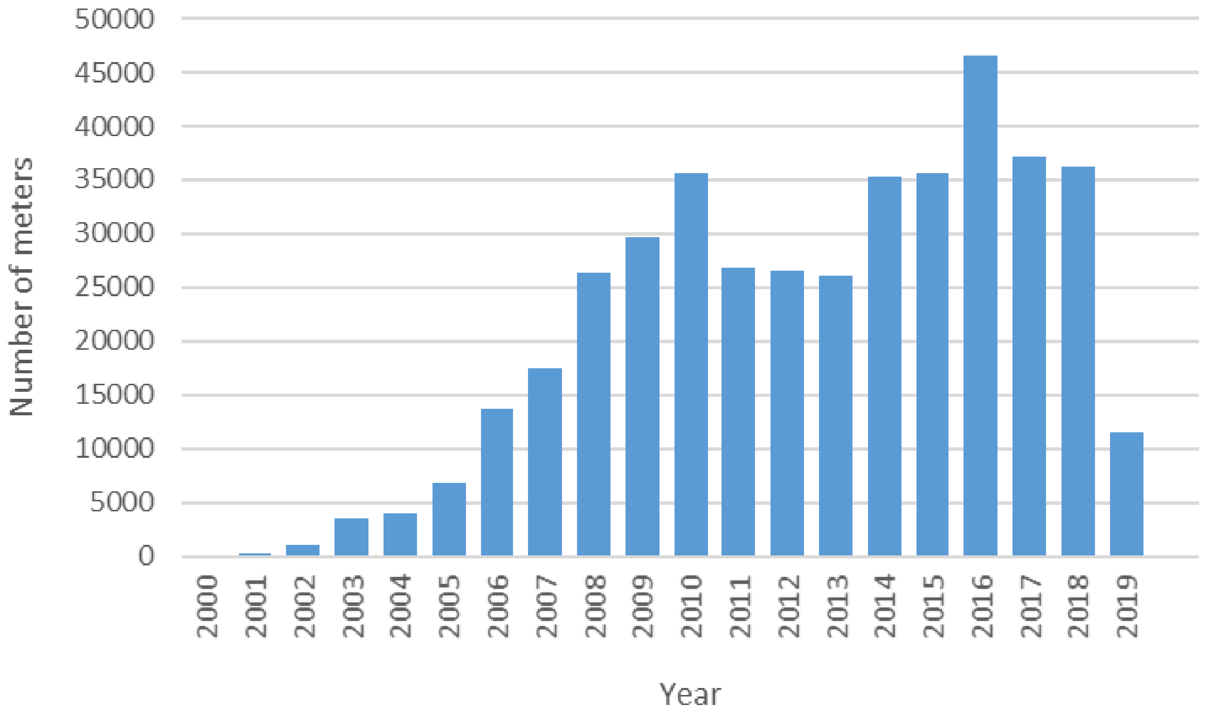
	Domestic (Capacity ≤8m³ /h)	I&C (Capacity >8m³ /h)	Total
Number of meter types	23	79	**102**
Number of meters	420,410	33,030	**453,440**

The age profile of the domestic and I&C meters that were installed as at May 2019 is set out in Table 3.2, while Figure 3.1 and Figure 3.2 provide further detail on the year these meters were installed.

Table 3.2: Age profile of meters (as at May 2019)

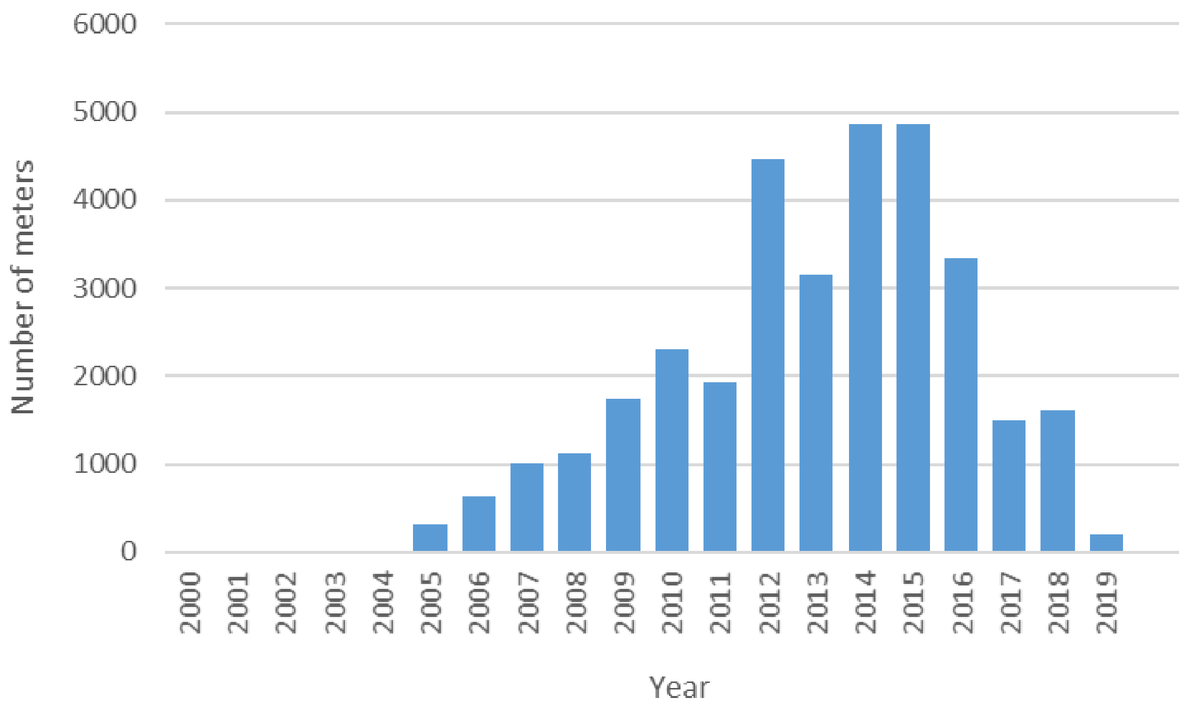
Age	Domestic	I&C
0-5 years	202,505	16,346
6-7 years	52,577	7,614
8-9 years	62,464	4,243
10-11 years	56,033	2,863
12-13 years	31,140	1,646
14-15 years	10,850	318
16-19 years	4,841	0
Total	**420,410**	**33,030**
Average age	**6.3 years**	**6.0 years**

Figure 3.1: Year of installation – domestic meters as at May 2019



Note: Average age of meters as at May 2019: 6.3 years

Figure 3.2: Year of installation – I&C meters as at May 2019



Note: Average age of meters as at May 2019: 6.0 years

As Figure 3.1 highlights, there was a significant increase in the number of domestic meters installed in 2016. This was the result of a carry-over from previous years and removing a backlog of scheduled PMCs.

Both graphs also highlight that the total meter population is relatively young, with average ages of 6.3 years for domestic, and 6.0 years for I&C meters.

3.2. Meter testing results

3.2.1. Test results for domestic and small I&C meters

The South Australian Gas Metering Code requires meters to be sampled and tested for accuracy, with the results of those tests being used to determine the life and forecast replacement date for the wider meter family.

In keeping with the testing requirements in AS 4944 and the South Australian Gas Metering Code, we have an obligation to test (or cause to be tested) the performance of these meters in the following ways[26]:

- new meters must be subject to acceptance testing before they are placed into service;
- initial in-service compliance testing must be conducted on each meter family (population) installed from 2006 onwards within three to five years of the meter family being installed in the field; and
- FLE testing must be conducted to determine whether or not a meter family's field life can be extended beyond the initial meter life, which for domestic meters is typically 15 or 18 years.[27]

The remainder of this chapter provides an overview of the results of the acceptance testing, initial in-service compliance testing and the FLE testing that has been conducted.

3.2.1.1. Acceptance testing

Manufacturers with accredited testing facilities are required to test the accuracy of new meters to a standard of ±1% prior to delivery. The new meters supplied by manufacturers over the last five years have fallen well within the ±1% accuracy range.

3.2.1.2. Initial in-service compliance testing

To carry out the initial in-service compliance testing, a random sample of meters from the relevant meter family must be removed from the field and tested to determine the initial meter life. This testing is usually carried out in the third to fifth year of the service life.

The results of testing carried out since 2012 are set out in Table 3.3.

[26] Testing must also be carried out if requested by a customer.

[27] South Australian Gas Metering Code, section 3.4.2

Table 3.3: In-service compliance meter family testing results 2012 to 2017

		2012	2015	2017
No. of meter families tested		2	2	1
Meters passing:	18-year initial life	2	2	1
	15-year initial life	0	0	0
	10-year initial life	0	0	0

Five meter families have been tested in the period 2012 to 2017, with all being accorded an initial meter life of 18 years.

3.2.1.3. FLE testing

In a similar manner to the initial in-service compliance testing, FLE testing requires a random sample of meters from the relevant meter family to be removed from the field and tested to determine whether the life of the meter family can be extended beyond the meter family's initial service life. The FLE test is usually carried out early in the final year of the meter family's designated service life.

If a meter sample passes FLE testing, then the life of that entire meter family would be extended (typically by five years). If the sample fails, then the entire meter family would be removed from the field.

3.2.2. Test results for larger I&C meters

The only testing medium-to-large I&C meters (>10 m^3/hr) must undergo [28] is assurance testing. Assurance testing must be carried out on new meters before they are placed into service.

Like the manufacturers of smaller meters, manufacturers of larger meters with accredited testing facilities are required to test the accuracy of the larger meters to a standard of ±1% prior to delivery. Over the last five years the new meters provided by our manufacturers have performed well within the ±1% accuracy range.

[28] Testing must also be carried out if requested by a customer. FLE testing is undertaken in limited circumstances, however meters >10m3/hr are typically replaced at the end of their field life of ten years.

4. Meter replacement policy

4.1. Meter replacement policy

The overarching objectives of our meter replacement policy are to ensure compliance with regulatory obligations and carry out the meter replacement program in the most prudent and efficient manner by:

- optimising the level of inter-year variability in program size and, in so doing, minimising the unit rates and program delivery risks;
- optimising the use of refurbished meters, which can be more cost effective to install than new meters; and
- using testing facilities and contractors that have been selected through a competitive tender process (for more information relating to our forecast unit rates and contracts we have in place, please refer to Attachment 8.9 Unit Rates Report).

Information on the processes we have in place to minimise the costs and risks associated with the meter replacement program are set out below.

4.2. Inter-year variations in program size

The age profile of the current stock of meters as highlighted in Figure 3.1 and Figure 3.2 (above), will give rise to a degree of inter-year variability in the number of meters that need to be tested and replaced. For example, during the next five years, compliance with the testing and meter replacement obligations is expected to result in the annual number of meter replacements for:

- domestic meters fluctuating between 14,582 and 21,985 meters; and
- I&C meters fluctuating between 501 and 741 meters.

The degree of inter-year variation can be seen more clearly in Figure 4.1 and Figure 4.2 (note the process by which the forecasts presented in these figures were developed is described in detail in Section 6).

Figure 4.1: Domestic meters forecast to be replaced

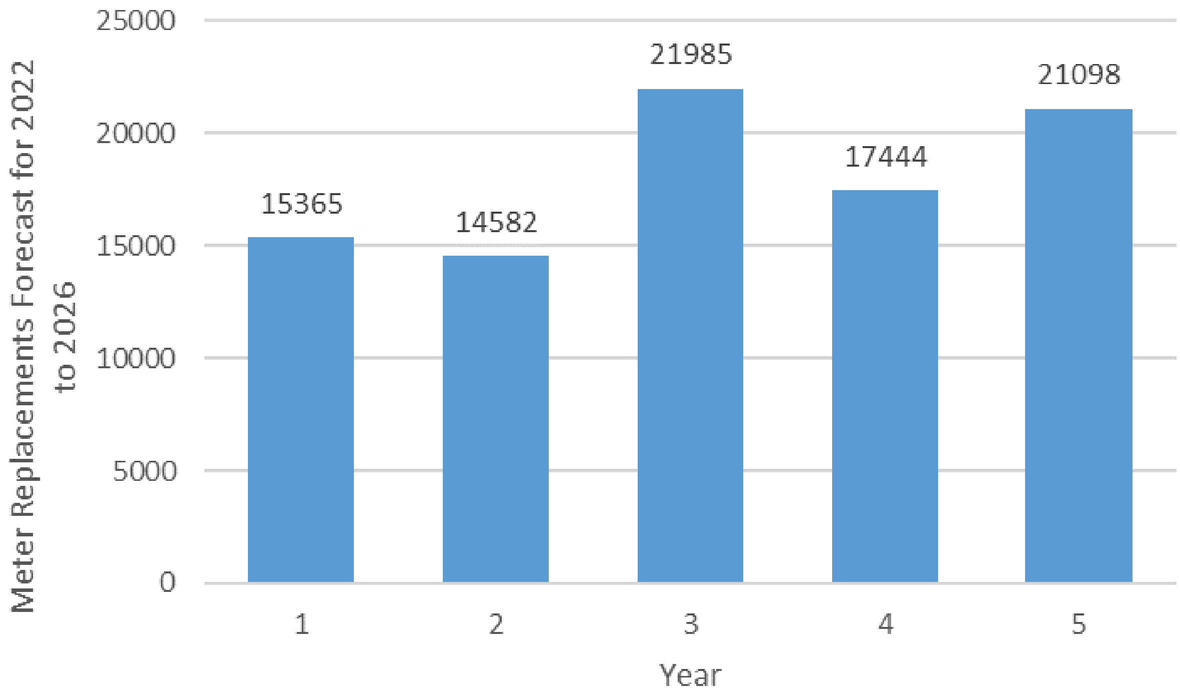
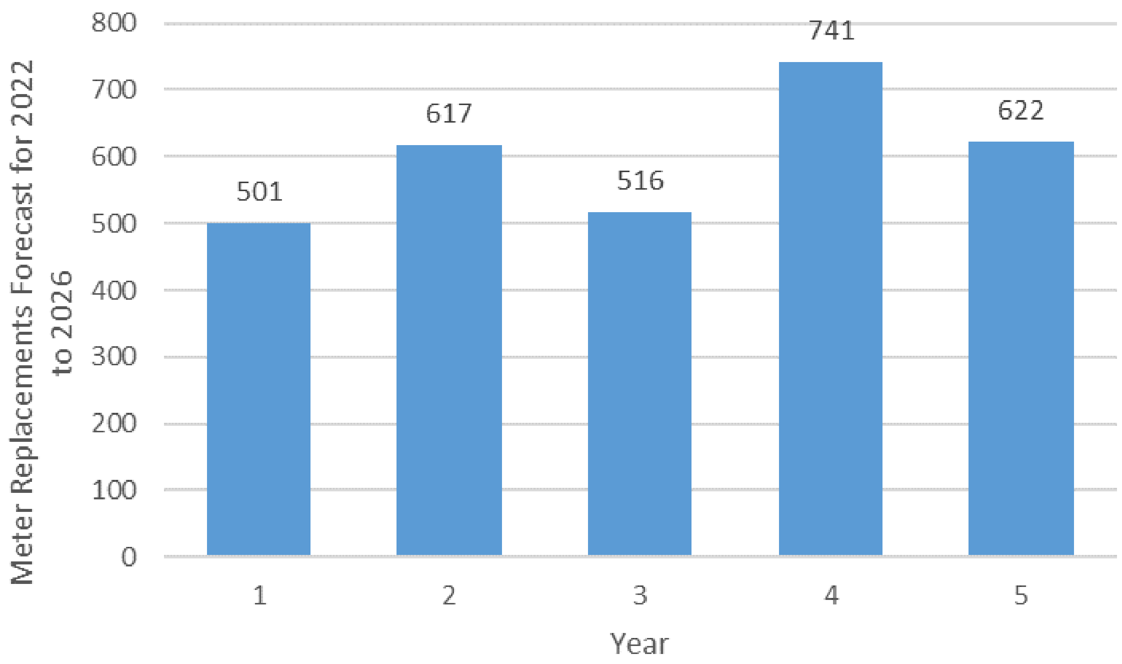


Figure 4.2: I&C meters forecast to be replaced



As these figures show, there is inter-year variability. We manage this variability by scheduling replacements to smooth the works program (to the extent we can) to optimise efficiency and avoid placing upward pressure on the internal and external costs of carrying out the program.

When developing the meter replacement program, we give careful consideration to the costs of mobilising and demobilising resources on a year-to-year basis as well as the availability of refurbished meters. We develop our replacement program within the following constraints:

- *refurbished and new meters* – to minimise the cost of the meter replacement program, a large proportion of the replacement meters in our networks are refurbished and reused. Historically, we have been sourcing around 18,000 refurbished meters per annum from the supplier, on the basis of a broad average of 30,000 meter replacements per year[29]. If the volume of meters that need to be replaced in a year exceeds this number, new meters will need to be purchased and installed, which are approximately 14% more expensive than refurbished meters. If, on a national basis, the number of new meters to be installed in a particular year is too high, we may also experience constraints trying to procure new meters, which could drive up their price.
- *internal labour* – internal resources are used to plan, schedule and co-ordinate the meter replacement program, so if the number of meters to be replaced in a particular year substantially exceeds the average, then additional resources will need to be dedicated to this task. In peak years contractors may need to be engaged to supplement the internal work force, which will give rise to additional costs (e.g. to train the staff and to potentially work overtime to complete the program).

During the next AA period, the maximum number of meters we propose to replace in any one year is 22,501 (in 2024). This is significantly less than the maximum number of meters replaced in previous years using a similar level of resources (circa 30,000). We are therefore confident the meter replacement program for the next AA period can be delivered without a negative impact on unit cost rates, or upwards pressures on management costs, and therefore the forecast remains prudent and efficient.

The benefits of smoothing – bringing forward replacements into earlier years, or to increase resources in the later years – outweighs any additional cost arising from year-on-year volume adjustments.

4.3. Minimising costs through use of refurbished meters

We replace meters with a combination of new and refurbished meters. A cost comparison between a new domestic meter and a refurbished one shows there is a per meter saving of approximately 34% when refurbished meters are used. The reduction in anticipated service life between a new and a refurbished meter is 22% (18 years versus 23 years), which means that the overall cost saving of using a refurbished meter is around 14% over the anticipated asset life.

The ability to maximise the use of refurbished meters depends on the number of meters available from refurbishers, and is the net result of:

- total meters removed from the field; less
- number of meters unsuitable for refurbishing; less
- number of meters unable to be refurbished in the workshop; less
- number of meters failing testing following refurbishment.

Within any one year it is estimated that the number of meters removed from the field, sent to refurbishers and returned available for reinstallation is approximately 60% of the number initially

[29] Refer Section 4.3 for further detail on availability of refurbished meters.

removed. Thus approximately 40% of meters required for field installation (in any one year) will be new meters.

It is worth noting that following the next AA period, a considerable number of older meters will reach the end of their service lives and will not be able to be refurbished. For example, there are ~35,000 Email 602 meters that have already been refurbished and reinstalled before. These meters would be approximately 40 years old and at the end of their useful life, therefore it will not be possible to refurbish and re-use them again.

This prevalence of previously refurbished meters means there is likely to be a greater percentage of new meters required in the following AA period (July 2026 to June 2031).

4.4. Further project cost optimisation

4.4.1. Contractor/services cost optimisation

To help ensure testing and meter replacements are carried out in the most efficient manner, we have contracts with a range of services providers. Service providers are selected via a competitive tender process, which helps promote efficient costs and optimum outcomes for customers.

Further detail on these contracts can be found in the Attachment 8.9 Unit Rates Report.

4.4.2. Project optimisation

Meter replacement contracts are optimised geographically, and meter replacement work packages allocated by postcode to ensure travel times remain minimal between meter replacement sites.

While contractors are used for reactive domestic and I&C meter replacements, internal work resources are used for larger I&C and demand customer reactive meter replacements. For these internal resources, reactive meter replacement duties are combined with other operational activities, to ensure efficient utilisation of the workforce.

5. Current performance

This section provides an overview of historical meter replacement activities and expenditure for the networks.

The unit rates we incur when replacing meters differs depending on the type of meter being replaced (industrial and commercial or domestic application) and whether new or refurbished meters are being used. Further detail on these metering unit rates can be found in the Attachment 8.9 Unit Rates Report.

5.1. Meter replacement – Meters < 25m^3 (Domestic)

5.1.1. Nature of works and costs

Replacing domestic gas meters involves:

- procuring any new or refurbished meters required, including quality control;
- planning and scheduling of meters to be changed over;
- organising resources (combination of direct and contractor) to carry out the meter change, which includes testing of outlet service and relighting appliances, and if required, re-attending premises after hours if the customer requires assistance;
- testing meters brought in from the field;
- life extension; and
- refurbishing meters as required.

Replacement of domestic meters are calibrated and fit for purpose by accurately measuring gas usage within ±2%, as required by Australian Standard AS 4944 and the South Australian Gas Metering Code.

5.1.2. Historical and forecast installation volumes

Table 5.1 shows the number of meters replaced during the current AA period, compared to the approved forecast in the AER's Final Decision for the current AA period. It also shows how we are tracking in terms of capex incurred versus the AER Final Decision.

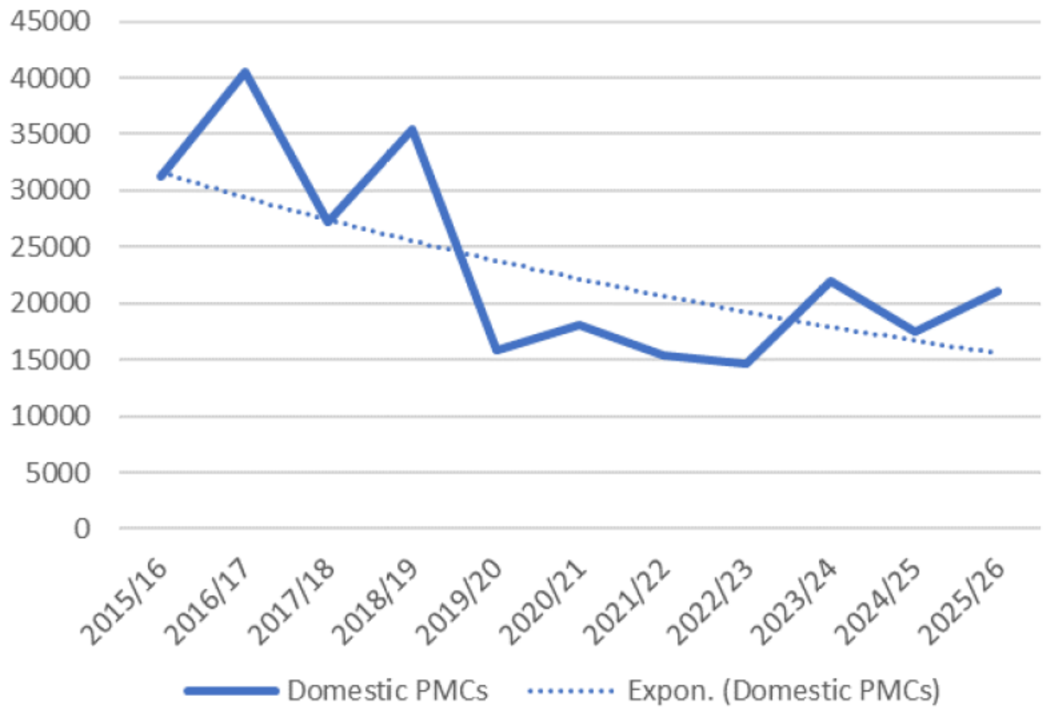
Table 5.1: Domestic meter replacement volumes and expenditure ($2019/20 direct capex)

Domestic meters	Year	2016/17	2017/18	2018/19	2019/20*	2020/21*	Total
Actual	Volumes (no. of meters)	40,560	27,189	35,485	15,995	15,831	**135,060**
	Capex ($'000)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
AER Final Decision	Volumes (no. of meters)	37,347	35,064	31,101	24,077	16,656	**144,245**
	Capex ($'000)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Variance	Volumes (no. of meters)	(3,213)	7,875	(4,384)	8,082	825	**9,185**
	Capex ($'000)	(1,152.1)	(546.7)	(1,873.7)	(205.1)	(1,015.5)	**(4,793.0)**

*Forecast

The replacement volumes are broadly in line with the forecast after the first three years of the current period, but with some inter-year variability. The overarching profile of meter replacement can vary with time depending on the age of the assets, and predominantly aligns to historical peaks and troughs in residential property construction. Figure 5.1. shows historical and forecast domestic meter replacement volumes.

Figure 5.1: Historical and forecast domestic meter replacement volumes



The downward trend in meter replacement volumes from 2019/20 onwards is due to improvements in our in-field service testing and asset life extension strategies. For example, over the last ten years we have moved to installing domestic meters that have an 18-year life. This means we are approaching a trough in the meter replacement cycle, as these longer life meters are yet to reach their replacement dates.

We have also changed our FLE strategies so that we are undertaking more FLE tests and extending the life of more assets. Historically, we have tended not to conduct FLE on smaller asset families due to the high cost of testing. If the population of that meter family is small (for example 200 to 300) it was often at the time more economical to simply replace the meters rather than conduct testing to extend the meter life.

We have reviewed this position and tested whether changes in testing costs and improvements in data quality mean it may be more economical to conduct FLE on smaller meter families. Net present cost (NPC) analysis indicates it is now economical to replace families containing 100 or more meters.[30] As a result, more meters are having their field lives extended and the volume of replacements has fallen.

However, as shown in Table 5.1, despite the lower replacement volumes we have incurred higher than benchmark costs and are forecasting to incur even higher costs per meter change during 2019/20 and 2020/21. This is because the availability of refurbished meters has declined, meaning we are needing to install a greater proportion of new meters. New domestic meters cost more than refurbished meters, therefore the unit rate we expect to achieve in 2019/20 and 2020/21 is higher than that achieved earlier in the period.

The unit rates actually incurred have also been impacted by an increase in the scope of works included during a meter change to capture other maintenance activities on regulators and meter boxes. This additional work aims to reduce the number of repeat visits and extend the life of these associated assets.

For information on how the domestic meter replacement unit rates have changed over the current AA period, refer to the Unit Rates Report provided in the SA Final Plan Attachment 8.9.

5.2. Meter replacement – Meters > 25m^3 (Commercial)

5.2.1. Nature of works and costs

Replacing commercial gas meters involves:

- procuring any new or refurbished meters required, including quality control;
- fabrication of site-specific fittings and pipework;
- planning and scheduling of meters to be changed over;
- organising resources to carry out the meter change in conjunction with customer requirements/restrictions;
- testing meters brought in from the field; and
- refurbishing meters, as required.

This work is low volume and subject to a significant degree of volatility because the scope of work can differ depending on the mix of sizes of the non-domestic meters that need to be replaced.

[30] Meter families of less than 100 are still replaced rather than having a field life extension.

5.2.2. Historical and forecast installation volumes

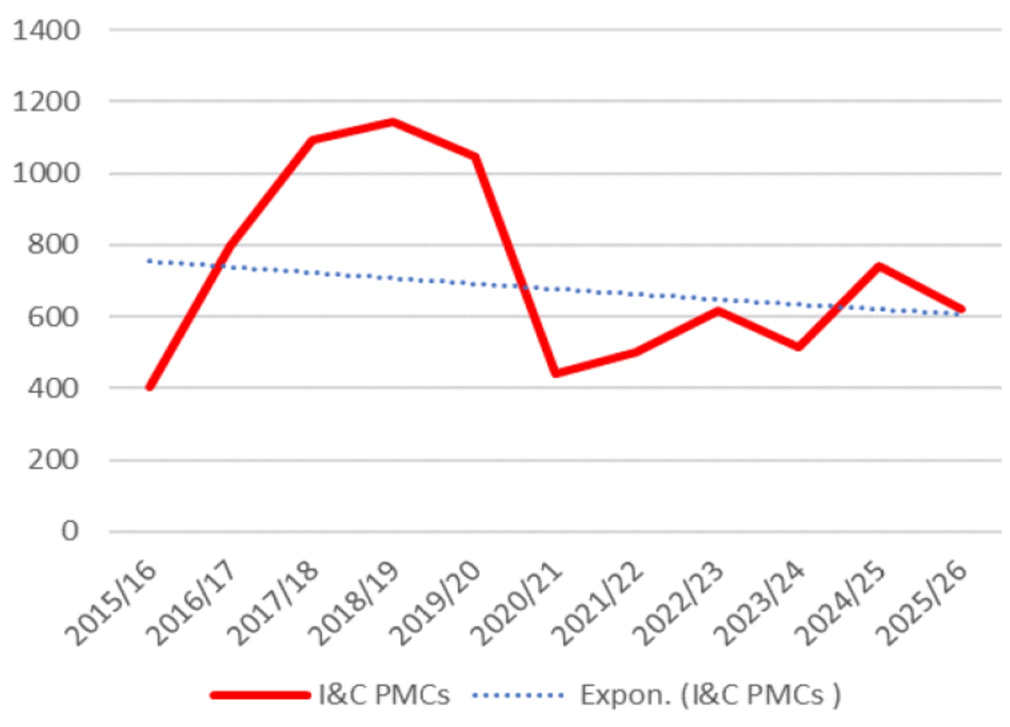
Table 5.2 shows the number of I&C meters replaced during the current AA period, compared with the amount forecast in the AER's determination for the current AA period. It also shows how we are tracking in terms of capex incurred vs the AER determination.

Table 5.2: I&C meter replacement volumes and expenditure

I&C meters	Year	2016/17	2017/18	2018/19	2019/20*	2020/21*	Total
Actual	Volumes (no. of meters)	814	1,078	1,146	966	619	**4,623**
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
AER Final Decision	Volumes (no. of meters)	860	955	1,059	1,013	1,316	**5,203**
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Variance	Volumes (no. of meters)	62	(140)	(87)	(72)	579	**342**
	Capex ($'000)	100.4	279.5	300.3	(32.5)	287.5	**935.1**

As with domestic meters, the replacement volumes for I&C meters started the period broadly in line with forecast, with some inter-year variability, and is expected to decrease in the final year of the period as FLE testing increases. Figure 5.2 shows historical and forecast I&C meter replacement volumes.

Figure 5.2: Historical and forecast I&C replacement volumes



The profile of meter replacement can vary with time depending on the age of the assets, and predominantly aligns to historical peaks and troughs in commercial property construction and economic growth. As with domestic meters, the downward trend in I&C meter replacement from 2019 onwards is also due to improvements in our in-field service testing and asset life extension strategies, which are outlined in section 5.1.2 above.

Expenditure on I&C meters was lower than the allowance in the first three years, peaking in 2019/20 and then dropping again with lower volumes of replacements forecast in 2020/21.There has also been year to year fluctuation in the average unit rate incurred. This is expected with I&C meters as costs can vary significantly depending on the size and complexity of the installation and specific customer requirements.

For information on how the I&C meter replacement unit rates have changed over the current AA period, refer to Attachment 8.9 Unit Rates Report.

6. Forecast meter replacement program

This chapter sets out our forecast costs for domestic and I&C PMCs in the South Australian networks over the next AA period.

In developing these forecasts, we have had regard to the regulatory obligations set out in the South Australian Gas Metering Code, AS 4944 and the National Measurement Act. We have also had regard to Rule 79 of the NGR, which requires the capex to be:

- such as would be incurred by a prudent service provider acting efficiently in accordance with accepted good industry practice to achieve the lowest sustainable cost of providing this service; and
- justifiable on a ground set out in Rule 79(2).

The grounds for conforming capex set out in Rule 79(2) are as follows:

a *the overall economic value of the expenditure is positive; or*

b *the present value of the expected incremental revenue to be generated as a result of the expenditure exceeds the present value of the capital expenditure; or*

c *the capital expenditure is necessary:*

i *to maintain and improve the safety of services; or*

ii *to maintain the integrity of services; or*

iii *to comply with a regulatory obligation or requirement; or*

iv *to maintain the service provider's capacity to meet levels of demand for services existing at the time the capital expenditure is incurred (as distinct from projected demand that is dependent on an expansion of pipeline capacity); or*

d *the capital expenditure is an aggregate amount divisible into 2 parts, one referable to incremental services and the other referable to a purpose referred to in paragraph (c), and the former is justifiable under paragraph (b) and the latter under paragraph (c).*

With regard to metering testing and replacements, capex is generally required to comply with the regulatory obligations under the South Australian Gas Metering Code and AS 4944, therefore capex is typically conforming under Rule 79(2)(c)iii. However, as a prudent asset manager, we give careful consideration to the ongoing safety and network integrity risks and consider whether capex is conforming from a number of perspectives before committing to capital investment.

We also give regard to Rule 74 of the NGR, which states that any forecast or estimate must be arrived at on a reasonable basis and represent the best forecast or estimate possible in the circumstances.

6.1. Forecasting approach

To develop the five-year forecasts, we have taken the following steps:

Step 1. **Forecast the number of PMCs for meters with low installed volumes to occur in the next AA period**

Where there is a very small volume[31] of a certain meter family installed, it is uneconomical to conduct in-service or FLE testing. These low volume meter types (as at May 2019) will be replaced with new meters at the end of their field life. Note that we plan to increase standardisation of meter type, which will mean more meter families can be subject to FLE in the future, increasing the asset life and allowing more efficient asset management strategies.

Step 2. **Forecast the number of PMCs for domestic meters to occur in the next AA period**

Based on the age of domestic meters installed as at May 2019, we have developed a five-year forecast of:

- the number of domestic meters at the end of their lives and will be required to be removed;
- the number of initial in-service compliance tests that will be required;
- the number of FLE tests that will be required and forecast the extensions that will flow from this testing;
- the number of domestic meters that will fail the FLE testing and require replacement; and
- the number of defective[32] meters that will need to be replaced on a reactive basis.

Step 3. **Forecast the number of PMCs for I&C meters**

Based on the age of I&C meters installed as at May 2019, we have developed a five-year forecast of:

- the number of I&C meters at the end of their lives and will required to be removed;
- the number of initial in-service compliance tests that will be required;
- the number of FLE tests that will be required and the extensions that will flow from this testing.

(The number of meters that will fail the FLE testing and require replacement is not part of the forecast process for I&C meters, because all I&C meters selected for FLE testing are projected to pass).

Step 4. **Calculate the forecast cost of the PMC program in the next AA period**

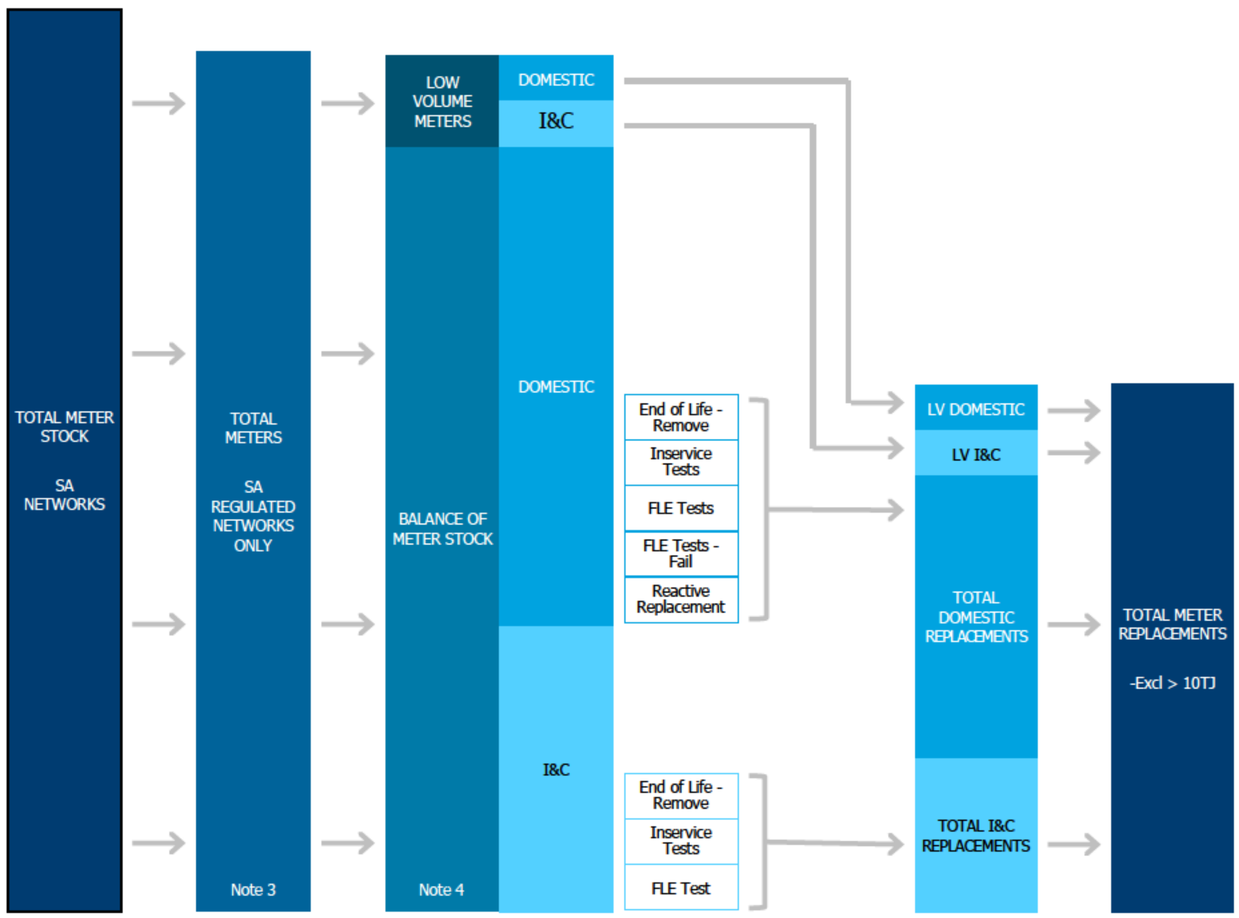
Using the meter replacement profiles derived in Steps 1 to 3 and the unit rates set out in Attachment 8.9 Unit Rates Report, we have calculated the forecast cost of the PMC program.

This process is shown diagrammatically in Figure 6.1.

31 Low volume is defined as fewer than 100 meters of a particular meter type/family reaching the end of their service period in any one year.

32 These replacements are usually the result of meter failures, including leakage. The term defective is used in this context to distinguish these meters from those that are replaced because the meter family is no longer providing an accurate measure of the volume of gas consumed.

Figure 6.1: PMC forecasting methodology



Notes:

1. Vertical bars are for illustration only – they **do not** represent numbers
2. Meter Replacement Plan numbers exclude > 10 TJ customers
3. SA regulated networks meters = approx 98% of total SA meter numbers
4. Low volume meters to be removed = approx 0.7% of total SA regulated network meters, but 64% of total installed meter types

Each of the steps illustrated in Figure 6.1 are discussed in further detail in the sections that follow.

6.2. Step 1: Forecast PMCs for meters with low installed volumes

As at May 2019, there are a 64 meter types out of a total 101 that have a small population, and which will be required to be replaced in the next five years.

For these low volumes of meter types, it is not economical to undertake FLE testing. We therefore replace these meter types when their field life expires. Table 6.1 shows the number of PMCs required for this category.

Table 6.1: South Australian networks - Low volume meter types replacements

	2021/22	2022/23	2023/24	2024/25	2025/26	Total
Domestic meters to be changed	37	66	49	131	975	1,258
I&C meters to be changed	174	181	207	300	360	1,222
Total meters to be changed	**211**	**247**	**256**	**431**	**1,335**	**2,480**

6.3. Step 2: Forecast PMCs for domestic meters

6.3.1. End-of-life domestic meters

As at May 2019, there are 46,685 domestic meter types that have reached/will reach the end of their field life during the next five years. FLE tests will not be carried out due mainly to the fact that these meters have been refurbished several times and are at the end of their useful life. We propose to replace these meter types when their field life expires with new, more reliable, longer life (18 years) meters. Table 6.2 shows the number of PMCs required for this category.

Table 6.2: South Australian networks - Domestic end-of-life replacements

	2021/22	2022/23	2023/24	2024/25	2025/26	Total
Number of meters to be changed	6,911	7,379	9,979	9,709	12,707	46,685

6.3.2. Initial in-service compliance testing

To forecast the number of initial in-service compliance tests required over the next five years, we have assumed:

- the testing is carried out in the third to fifth year the meter family came into service;
- in accordance with AS 4944, once a meter family has successfully passed the testing and is assigned an initial in-service life, the total population that can be installed is five times the population initially tested before any further in-service testing is required[33] [34].
- further in-service compliance testing is carried out in the year prior to when the approved number is forecast to be exceeded.

Using these assumptions, as well as information on the age of the meters and the sample size requirements set out in Table 2 of AS 4944[35], we estimate 258 meters will need to be removed from the field during the next five years and be subject to initial in-service compliance testing (see Table 6.3).

33 AS 4944 Cl 6.2.2 For example, if an initial population that is tested is 1,000 meters, up to 5,000 of the same meter type can be installed before a further in-service test is required.

34 As an example, there were a total of 102,365 AMPY 750 meters installed in 2015. An Initial In-Service life test of 86 of this meter type was undertaken in 2015, taking the total approved number to 112,000 meters. Based on the numbers installed between 2015 and 2019, a further Initial In-Service Test will be required in 2019, which will take the approved number for this meter type to 207,000 if, as expected, they pass the test. Forecasts show that a further test will not be required until 2023.

35 Given the potential for meters to be damaged when they are removed or transported to the testing site, or for other factors to prevent testing, we have assumed that an additional 15% of meters from each family will need to be removed from the field for testing.

Table 6.3: South Australian networks - Initial in-service compliance testing (Domestic)

	2021/22	2022/23	2023/24	2024/25	2025/26	Total
Number of meters to be tested	-	172	86	-	-	258

6.3.3. FLE testing

In contrast to initial in-service compliance testing, FLE testing is harder to predict because meters do not deteriorate (fail meter testing) in a standardised and predictable manner. Some assumptions must therefore be made about when the FLE tests will be required.

For meters that have not previously been subject to any form of in-service testing (i.e. initial in-service compliance or FLE testing), we assume the following:

- the initial service life of newly manufactured meters is 18 years[36] and meter accuracy is maintained as follows:
  - an FLE test is conducted at the commencement of year 18 and result in a five-year extension with the meter family being removed at the end of year 23; and
- the initial service life of refurbished meters is assumed to be 15 years and meter accuracy is maintained as follows:
  - an FLE test is conducted in at the commencement of year 15 and result in a three-year extension with the meter family being removed at the end of year 18.

We use these assumptions, as well as information on:

- the age of the assets that are stock as at May 2019;
- the results of previous Initial In-Service Compliance and FLE testing; and
- the sample size requirements set out in Table 2 of AS 4944.

We estimate 1,272 meters from these meter families will need to be removed from the field and subject to FLE testing in the next five years (see Table 6.4).

Table 6.4: South Australian networks: Domestic FLE testing

	2021/22	2022/23	2023/24	2024/25	2025/26	Total
Number of meters to be tested	139	316	277	270	270	1,272
Number of families	2	6	5	4	2	19

6.3.4. Meters forecast to fail the FLE test

The number of meters that will need to be replaced in a particular year because the meter family's accuracy no longer falls within the prescribed tolerance band, will depend on the results of the previous year's FLE testing. Meters that fail this testing will be removed from service in the following year.

[36] The only new meters that have been purchased for a number of years now are AMPY 750 and Atlas U8 meters. Early in-service compliance testing has confirmed a consistent 18 year initial life for these meter types, so this is the assumption used in the forecasts

To estimate the number of meters that will fail the FLE in the next five years, we make an assumption based on whether the meter family has previously been subject to an FLE test, and previous history with other meter families of the same meter type[37]. For meters that have not previously been subject to any form of in-service testing, we assumed that:

- newly manufactured meters have a 23-year life (i.e. an initial service life of 18 years plus one FLE extension totalling five years); and
- refurbished meters have an 18-year life (i.e. an initial service life of 15 years plus one FLE extension totalling three years).

For meters previously subject to initial in-service compliance and/or FLE testing, the life of the meters will be informed by the results of the last tests that were conducted.

Using these assumptions, as well as information on the age of the assets in stock as at May 2019 and prior test results, we estimate 31,001 meters will need to be removed from the field during the next five years because they fail the FLE testing (see Table 6.5).

Table 6.5: South Australian networks - Domestic meters replaced due to failure of FLE testing

	2021/22	2022/23	2023/24	2024/25	2025/26	Total
Meters to be replaced	5,778	4,399	9,594	5,584	5,646	31,001

6.3.5. Reactive replacements of defective meters

In addition to having to replace meter families that no longer satisfy the prescribed tolerance band for metering accuracy, there are occasions where individual meters become defective and require replacement. This is referred to as reactive replacement.

Historically, around 1,500 meters per annum have had to be replaced on this basis, but in the last three years an average of 2,500 meters has been replaced. This is because a large variety of legacy meter types (mostly refurbished) have reached/are approaching the end of their lives, and are due for replacement. However, once we have replaced this spike in refurbished meters, we expect a steady decline in reactive replacements back down to the historical average of 1,500 per year.

Table 6.6: South Australian networks - Reactive replacements

	2022	2023	2024	2025	2026	Total
Meters to be replaced	2,500	2,250	2,000	1,750	1,500	10,000

6.3.6. Summary of forecast PMCs for domestic meters

The total number of PMCs for domestic meters that are forecast to be required in the next five years in the South Australian networks are set out in Table 6.7.

37 For example, 5,847 Email 610 meters were installed in 2012, and will be FLE tested in 2023. They are expected to fail this test, and thus will need to be removed in 2024.

Table 6.7: South Australian Networks - PMC forecast for domestic meters

	2021/22	2022/23	2023/24	2024/25	2025/26	Total
End-of-life meters	6,911	7,379	9,979	9,709	12,707	46,685
Initial in-service testing	-	172	86	-	-	258
FLE testing	139	316	277	270	270	1,272
Meters requiring replacement after failing FLE testing	5,778	4,399	9,594	5,584	5,646	31,001
Reactive replacements of defective meters	2,500	2,250	2,000	1,750	1,500	10,000
Total	**15,328**	**14,516**	**21,936**	**17,313**	**20,123**	**89,216**

6.3.6.1. Continuous improvement

The number of domestic PMCs forecast to occur over the next five years is approximately 33% lower than the number we expect to complete in the current AA period. This reduction can be attributed to the following:

- the use of 18-year life domestic meters over the last decade, resulting in a trough in the meter replacement cycle as the shorter life meters are replaced and longer life meters have yet to come up to their replacement dates;
- analysis undertaken on the FLE process to verify the historical practice of selecting meters for FLE testing based on an anecdotal lower limit of meter family size. This has resulted in a smaller meter family size being economical to FLE test (<100), and thus a greater number of meter families being planned for FLE testing than previously. Historical practice was to replace the family rather than FLE test. Our revised approach therefore significantly reduces the number of changeovers required; and
- a generally younger age of the whole meter population, with the average age of domestic meters being 6.3 years and I&C meters being 6 years.

The volume of replacements is forecast to rise again in after the next AA period due to large numbers of meters with 10-year lives reaching their replacement date, and which will not undergo FLE tests. These will be replaced with 18-year life meters (the same meter types as in Section 6.3.1).

6.4. Step 3: Forecast PMCs for I&C meters

To forecast the number of PMCs that will be required in the next five years for I&C meters consideration must be given to:

- the number of meters which are at the end of their lives and will required to be removed;
- the number of initial in-service compliance tests;
- the number of FLE tests and the resulting field life extensions; and
- the number of meters in families that, while of the type that would normally be FLE tested, are not present in great enough number to justify FLE testing.

6.4.1. End-of life I&C meters

As at May 2019 there are 1,362 I&C meter types that have reached/will reach the end of their field life during the next five years. FLE tests will not be carried out due mainly to the fact that these meters have been refurbished several times and are now at the end of their useful life. We therefore propose to replace these meter types when their field life expires with new, more reliable, longer life (15 or 18 years) meters. Table 6.8 shows the number of PMCs required for this category.

Table 6.8: South Australian networks: I&C end-of-life replacements

	2021/22	2022/23	2023/24	2024/25	2025/26	Total
Number of meters to be changed	221	353	249	360	179	1,362

6.4.2. Initial in-service compliance testing

To forecast the number of initial in-service compliance tests required over the next five years, we have assumed:

- the testing is carried out in the third to fifth year the meter population came into service; and
- in accordance with AS 4944, once a population has successfully passed the testing and is assigned an initial in-service life, the total population that can be installed is five times the population initially tested before any further in-service testing is required[38].

Using these assumptions, as well as information on the age of the meters and the sample size requirements set out in Table 2 of AS 4944[39], we have calculated that 145 meters will need to be removed from the field during the next five years and subject to initial in-service compliance testing (see Table 6.9). The front-end phasing over the next five years is a direct reflection of the calculated rates and timings.

Table 6.9: South Australian networks: Initial in-service compliance testing – I&C meters

	2021/22	2022/23	2023/24	2024/25	2025/26	Total
Number of meters to be tested	89	48	8	0	0	145

6.4.3. FLE testing

I&C meters less than 10m^3/hr typically undergo FLE testing, but those above this capacity do not[40]. Similar to domestic meter FLE testing, some assumptions must be made about when the FLE tests will be required. For those meters that have not previously been subject to any form of in-service testing (i.e. Initial In-Service Compliance or FLE testing), we assume the following:

- the initial service life of newly manufactured meters is either ten years or 18 years and meter accuracy is maintained as follows:

[38] AS 4944 Cl 6.2.2 Refer Footnotes 27 ad 28 of this Plan for an explanation.

[39] Given the potential for meters to be damaged when they are removed or transported to the testing site, or given other factors that prevent testing, we have assumed that an additional 15% of meters from each family will need to be removed from the field for testing.

[40] Except in some selected circumstances where it is reasonable to do so

  - an FLE test is conducted at the commencement of year ten or 18 and result in a five year extension with the meter family being removed at the end of year 15 or 23; and
- the initial service life of refurbished meters is assumed to be ten years and meter accuracy is maintained as follows:
  - an FLE test is conducted in at the commencement of year ten and result in a three-year extension with the meter family being removed at the end of year 13.

Using these assumptions, as well as information on the age of the assets as at May 2019, the results of previous initial in-service compliance and FLE testing and the sample size requirements set out in Table 2 of AS 4944, we estimate 266 meters will need to be removed from the field and subject to FLE testing in the next five years (see Table 6.10).

Table 6.10: South Australian Networks: I&C meter FLE testing

	2021/22	2022/23	2023/24	2024/25	2025/26	Total
Number of meters to be tested	17	35	52	81	81	266
Number of families	1	2	3	3	3	12

6.4.4. Summary of forecast PMCs for I&C meters

The total number of PMCs for I&C meters that are forecast to be required in the next five years in the South Australian networks are set out in Table 6.11.

Table 6.11: South Australian Networks: PMC forecast for I&C meters

	2021/22	2022/23	2023/24	2024/25	2025/26	Total
End of life meters	221	353	249	360	179	1,362
Initial in-service testing	89	48	8	0	0	145
FLE testing	17	35	52	81	81	266
Total	**327**	**436**	**309**	**441**	**260**	**1,773**

6.5. Summary PMC forecast

Table 6.12 provides a summary of the total PMC profile (domestic and commercial) we intend to deliver over next AA period.

Table 6.12: South Australian networks – PMC forecast volumes

	2021/22	2022/23	2023/24	2024/25	2025/26	Total
Number of low volume end-of-life PMCs - Domestic	37	66	49	131	975	1,258
Number of low volume end-of-life PMCs – I&C	174	181	207	300	360	1,222
Predicted number of domestic PMCs	15,328	14,516	21,936	17,313	20,123	89,216

	2021/22	2022/23	2023/24	2024/25	2025/26	Total
Predicted number of I&C PMCs	327	436	309	441	260	1,773
Total number of PMCs	**15,866**	**15,199**	**22,501**	**18,185**	**21,718**	**93,469**

6.6. Step 4: Calculate the forecast cost of the PMC program

The forecast cost of the PMC program has been calculated by multiplying the forecast number of PMCs by the unit rates set out in Attachment 8.9 Unit Rates Report. In the Unit Rates Report, separate unit rates have been calculated for:

- domestic meters – the unit rate in this case is [redacted] ($2019/20) per meter; and
- I&C meters – the unit rate in this case is [redacted] ($2019/20) per meter.

The unit rates in both cases reflects the costs of:

- procuring new and refurbished meters;
- planning and scheduling the meters to be changed over and organising the resources (combination of direct and contractor) to carry out the meter change;
- installing the meters; and
- carrying out the testing required by AS 4944 and the South Australian Gas Metering Code.

Further detail on these unit rates can be found in the Unit Rates Report.

Table 6.13 sets out the forecast cost of the PMC program in the networks.

Table 6.13: South Australian networks – Forecast PMCs in the next AA period

	2021/22	2022/23	2023/24	2024/25	2025/26	Total
Low volume meters						
Number of PMCs - Domestic	37	66	49	131	975	1,258
Unit rate ($/meter)			[redacted]			
Forecast cost ($'000)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Number of PMCs – I&C	174	181	207	300	360	1,222
Unit rate ($/meter)			[redacted]			
Forecast cost ($'000)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Domestic meters						
Number of PMCs	15,328	14,516	21,936	17,313	20,123	89,216
Unit rate ($/meter)			[redacted]			
Forecast cost ($'000)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
I&C meters						
Number of PMCs	327	436	309	441	260	1,773
Unit rate ($/meter)			[redacted]			
Forecast cost ($'000)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total program						
Total PMCs (volume)	15,866	15,199	22,501	18,185	21,718	93,469
Total all meters ($'000)	**3,079.6**	**2,989.4**	**4,311.7**	**3,577.5**	**4,196.6**	**18,154.9**

Note: Some totals may not add due to rounding

6.7. Consistency of Forecast with the National Gas Rules

Consistent with the requirements of rule 79(1)(a) of the NGR, AGN considers the forecast capex for this project to be:

- *Prudent* – The expenditure is necessary to maintain the accuracy of meters and the integrity of metering services, and is of a nature that a prudent service provider that is subject to the regulatory obligations set out in the South Australian Gas Metering Code, the National Measurement Act and AS 4944, would incur.
- *Efficient* – The manner in which we intend to carry out the replacement program can also be considered efficient, because it will be carried out:
  - by meter testers, manufacturers and gas fitters that have all been selected through competitive tender processes; and
  - on a continuous basis over the five-year period, which will enable us to:
    - reduce the field risks to as low as reasonably practicable, because it will allow retention of, and investment in, trained contractors; and

   - minimise the non-compliance risks.

- *Consistent with accepted good industry practice* – complying with the regulatory obligations set out in the South Australian Gas Metering Code, the National Measurement Act and AS 4944 is consistent with accepted good industry practice. Assumptions used as part of the analysis regarding volumes of replacements are in line with good industry practice.
- *Achieves the lowest sustainable cost of delivering pipeline services* – carrying out the replacement program by optimising the use of refurbished meters, and carrying out FLE testing on all meter family sizes above the minimum economic size, represents the most cost effective option. This action will contribute to the attainment of the lowest sustainable cost of delivering pipeline services over the next five years. It should be noted that the recent decrease in the minimum threshold for conducting FLE testing on meter families means a larger number of meters will be subject to FLE testing during the next AA period. We expect this will lead to a reduction in replacement volumes, thereby driving a lower overall cost of meter replacement over the next five year.
- *Is consistent with feedback received from customers and stakeholders* – Customers consider the safe operation of our networks to be of highest importance and value a reliable natural gas supply and accurate billing

The capex can therefore be viewed as being consistent with rule 79(1)(a) of the NGR.

The proposed capex is also consistent with rule 79(1)(b), because it is necessary to:

- *maintain the integrity of services (rule 79(2)(c)(ii))* – carrying out the testing and meter replacements proposed in this Plan will enable us to maintain the integrity of the metering services, which is, as noted above, critical to:
  - ensuring the accuracy of the measurement of our customers' gas usage falls within the prescribed tolerance band of +2% to -2%;
  - minimising the volume of unaccounted for gas at larger consuming sites; and
  - ensure customer bills accurately reflect their usage.
- *comply with a regulatory obligation (rule 79(2)(c)(iii))* – carrying out the testing and meter replacements proposed in this Plan will ensure that we comply with the regulatory obligations prescribed in:
  - the National Measurement Act 1960;
  - the South Australian Gas Metering Code; and
  - AS 4944.

As noted above, if we fail to comply with the obligations set out in these instruments it can constitute a breach of our license, result in penalties and a range of other compliance related actions.

Consistent with the requirements of Rule 74 of the NGR, We consider the forecasts and estimates have been arrived at on a reasonable basis by following realistic assumptions of volumes that are in line with good asset management practices and industry standards, along with market tested rates and project optimisations, which have been outlined in the Plan. The program outlined in the Meter Replacement Plan therefore represents the best forecast or estimate possible in the circumstances.

Appendix A – Domestic PMC Forecast

The tables below provides more detail on how the forecasts for Initial In-Service Compliance testing, FLE testing and meter replacements have been developed.

Table A.1: Domestic low volume removal and end of life meters

			METERS REACHING END OF THEIR SERVICE LIFE					
					NEXT AAP 2022-2026			
Size	Type	Category	2022	202	202	202	2026	Total for AAP
Dom	055M	LOW VOL REMOVE	1	2	1	4	2	10
Dom	055R	EOL Remove	3018	1627	1412	3002	5039	14098
Dom	08M	LOW VOL REMOVE	1	40	0	78	918	1037
Dom	162M	LOW VOL REMOVE			1			1
Dom	16M	LOW VOL REMOVE			12	0		12
Dom	1M	EOL Remove	772	2881	1700	2852	2732	10937
Dom	251M	LOW VOL REMOVE	23	24	13	24	17	101
Dom	25M	LOW VOL REMOVE	12		22	25	38	431
Dom	30M	EOL Remove	112	121	500	2	8	743
Dom	30R	EOL Remove	3009	2750	6367	3853	4928	20907
		Total LV Remove - Dom	37	66	49	131	975	1258
		Total EOL Remove - Dom	6911	7379	9979	9709	12707	46685

Table A.2: Domestic In-service Meter Tests

		IN-SERVICE COMPLIANCE TESTING 2022-2026																							
Model	Dom/I&C								<1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Yr of Installtn		2026	2025	2024	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	
AMPY 750 (257M)	D	9800	9800	9800	9800	9800	9800	9800	6383	14686	13607	19573	11389	12733	9104	8936	9218	10039	9492	12084	8690	8299	1281	1100	156614
Cum no		225214	215414	205614	195814	186014	176214	166414	156614	150231	135545	121938	102365	90976	78243	69139	60203	50985	40946	31454	19370	10680	2381		
Family size					9800				19000				9,900					11,000		1500					
Inservce Test - sample size					86				115				86					115		58					
Approved No					49000				95000				49500					55000		7500					
Appvd No - Cum					256000				207000				112000					62500		7500					
ATLAS U8 (12M)	D	2300	2300	2300	2300	2300	2300	2300	1742	1384	3272	5308	3057	3392	965	583	949								20652
Cum no		36752	34452	32152	29852	27552	25252	22952	20652	18910	17526	14254	8946	5889	2497	1532	949								
Family size				2300	2300		1700		3400				1200												
Inservce Test - sample size				86	86		86		86				40												
Approved No				8500	8500		8500		8710				6000												
Appvd No - Cum				40210	31710		23210		14710				6000												
TOTAL Dom		0	0	86	172	0			11585	36166	37249	46637	35602	35266	26012	26565	26818	35646	29703	26330	17506	13634	6878	3972	3509
		TOTAL DOMESTIC IN-SERVICE COMPLIANCE TESTS																							

Table A.3: Domestic FLE Meter Tests

		NEXT AA PERIOD 2022-2026				
Size	Type	2022	2023	2024	2025	2026
Dom-10Y	15M - E602 Intest	444	302	227	0	1
	Sample size	20	20	15		
	FLE Test	23	23	17		
Dom-10Y	251R - E610	2303	5847	1966	1622	2569
	Sample size	50	75	50	50	50
	FLE Test	58	86	58	58	58
Dom-18Y	257M - AMPY 750	1	1100	1281	8298	8690
	Sample size		35	50	75	75
	FLE Test		40	58	86	86
Dom-15Y	25M - E602	12	334	22	25	38
	Sample size		20			
	FLE Test		23			
Dom-15Y	25R - E602	1652	3445	3391	4024	5665
	Sample size	50	75	75	75	75
	FLE Test	58	86	86	86	86
DOM-15Y	11M - Atlas U8		1663	2072	795	1149
	Sample size		50	50	35	35
	FLE Test		58	58	40	40
Domestic FLE Tests		139	316	277	270	270

Table A.4: Domestic Meters Failing FLE Tests

				METERS REACHING END OF THEIR SERVICE LIFE					
						NEXT AAP 2022-2026			
Size	Type	Category	20	2022	202	202	202	2026	Total for AAP
Dom	15M	FLE-Fail	3707	444	302	227	0	1	974
Dom	251R	FLE-Fail	2071	2303	5847	1966	1622	2569	14307
Dom	25R	FLE-Fail	107	1652	3445	3391	4024	5665	18177
		FLE-Fail - Domestic		5778	4399	9594	5584	5646	31001

Note: Meters are removed in the year after a failed FLE test is carried out – ie 3707 15M meters, and 2071 251R meters are removed in 2022