Appendix 3.5

Connection and metering forecast methodology

Access arrangement information

ACT and Queanbeyan-Palerang gas network 2021–26

Submission to the Australian Energy Regulator

June 2020

evoenergy

Evoenergy

2021-26 Access Arrangement Proposal

Appendix 3.5

Connection and metering forecast methodology

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Glossary

4-year average unit rates	The 4 year average of our average unit rates.
Average unit rates	The average cost per meter of main, service or meter. This captures all costs we incur.
Capex	Capital expenditure
Commercial	The market segment that captures the cost of non-residential and non-contract customers.
Connections forecast	The connection forecast prepared by CIE for the 2021-26 period.
Contract unit rates	The unit rates specified in our contracts with our contractors. These contract unit rates are distinct from our average unit rates which capture all of our costs (of which contractor costs are only one part).
CIE	The Centre for International Economics
CMF	Construction Management Fee
Electricity to gas	The market segment that captures the cost of connecting existing homes.
I&C	Industrial and Commercial
Market segment	We group our connections into the following categories: new homes, medium density / high-rise, commercial, electricity to gas and I&C contract.
MDL	Meter Data Logger
Medium density / high-rise	The market segment that captures the costs of dwellings with more than two dwellings per site (townhouse, high-rise buildings etc).
New homes	The market segment that captures the costs of connecting new homes.
Opex	Operating expenditure
RIN	Regulatory Information Notice
Unit rates	The cost per metre of main, per service and per meter.
Volume forecast	The forecast number of mains, services and meters we will connect.
Volume mix	The average number of mains, service and meters installed per connection.

Overview

The purpose of this document is to provide additional information on our approach to forecasting connections and meter replacement capital expenditure (**capex)**.

This document is structured as follows:

- Section 1 provides a summary of our connections performance over recent years. We also provide further detail on costs movements at a **market segment** level.
- Section 2 provides a detailed description of our connections forecasting method with the aim of supporting the connections forecast model by explaining the approach taken and the calculations made.
- Section 3 provides an overview of our metering replacement forecast method.

All actual (historical) financial numbers are presented in direct real 2020 dollars data to align with data presented in the Regulatory Information Notice (**RIN**).

Forecast numbers are presented in direct *un-escalated* real 2020 dollars to align the numbers in this document with those in the meter replacement and market expansion capex forecast models (as we apply forecast escalation in our capex forecast model).[1]

[1] These meter replacement and market expansion forecast models are included as part of our proposal. See Appendix 3.2 Market Expansion Model and Appendix 3.3 Meter Replacement Model. The capex model also is included as Appendix 3.1 of the AA proposal.

1. Historical connections capex

In recent years we have continue to connect new customers and each of these new customers are now contributing towards the largely fixed costs of operating the network. In part, it is these connections which have allowed us to propose slight price reductions in our 2021-26 Proposal.

We connected these customers while working against an increasingly challenging cost environment, which included:

- **Increased resource requirements** – to flex up and ensure we can connect the larger number of customers.
- **Low customer densities** – connecting customers in new estates areas requires longer lengths of mains per connection.
- **Introduction of new climate policies** – the escalation and incentivisation of government policies against national gas in new estate developments.

Another component of our success has been our efforts to limit cost increases. We have been able to mitigate the cost impacts from the challenges we have faced through:

- Our outsourcing strategy which allowed us to flex up resources and shift costs risks (from rising labour and traffic costs) to our contractors.
- Working with other stakeholders to lower costs in new estates and medium density / high rise.

Figure 1-1 Average connection costs[2] by market segment ($2020, direct)[3]

[redacted]

Note : Negative unit rates for the year are due to accruals which get trued-up to actuals, hence, smoothing out the fluctuations through a 4 year average.

2 Costs are reconciled to the RIN data, inclusive of the Construction Management Fee (CMF).

3 As connecting industrial and commercial customers is higher than residential customers we have graphed these costs on the secondary right hand side (RHS) axis.

New homes

New homes[4] makes up more than a third of our connections capex. We are currently connecting more than 1,500 new homes per year (3,000 in 2016-17) but expect this to fall to about 700 per year over the 2021-26 period with most of these forecast connections in NSW as the full implications of the ACT Government policies become realised.

The bulk of new home connections occur in new estates where we need to reticulate whole suburbs at a time. While we install more metres of main per connection in these areas (relative to other market segments) the costs per metre of main is relatively lower. This is due to lower traffic management requirements (compared to other market segments) and the opportunity to coordinate work with other stakeholders to reduce restoration costs, for instance through common trenching.

Medium density / high-rise

Our **medium density / high-rise** market segment covers all multiple dwelling connections, including town houses, small walk-up unit blocks and large high-rise apartments. This market segment accounts for approximately half of the number of dwellings we connect each year (on average 2,000 dwellings per year) and has continued to increase proportionally to the total number of connections. For the 2021-26 period we expect the connections in this market segment to fall to just under 1,200 dwellings per year but account for almost 90% of total forecast connections.

The majority of these new high-rise apartments have been built along the main road corridors and city areas. While medium density townhouses generally replace larger single dwellings in established areas, these areas are more expensive to install new mains and services. The larger numbers of high-rise dwellings also increase our mains and services costs on a per site basis as these connections require higher capacity mains and services.

Despite these factors we have been able to constrain our overall medium density / high-rise connection costs partly through the introduction of our volume boundary product. This allowed us to install a single meter at the boundary of high-rise developments rather than installing individual hot water meters for each dwelling.

Industrial and Commercial tariff

Our **industrial and commercial tariff**[5] market segment captures all non-residential volume market connections. These customers can range from local restaurants up to large users, such as manufacturers or food processors.

As the customer mix varies from year to year, so too does the average cost to connect. Although smaller commercial customers can be connected at close to the cost of a residential customer, higher capacity connections cost significantly more. Costs can be an order of magnitude higher if a steel service or a larger meter set is required. A few higher capacity connections in a given year can distort the average connection costs given the relatively low volumes (about 90 per year).

While it can cost more to connect larger customers, these customers also bring in more revenue leading to greater bill reductions for existing customers. We test each connection to ensure that we do not make any connections where the cost is higher than the revenue it will bring in.

Similar to medium density / high-rise connections, industrial and commercial tariff customers tend to be located in areas in high density community use areas (such as hotels, office buildings and shopping centres) or those located in industrial parks (where roads are more expensive to repair as they are built to withstand wear from heavier vehicles). These costs have increased in recent years affecting the cost to lay mains and services to connect commercial customers.

4 We sometimes refer to this market segment as 'new estates'.

5 Also referred to as tariff I&C, tariff volume, I&C volume and small business. This market segment does not cover connecting our larger contract customers consuming greater than 10TJ per annum included in the I&C contract market segment.

Electricity to gas

The **electricity to gas** market segment captures the cost of connecting existing homes which do not currently have a gas connection and tend to occur in established areas. Compared to the other residential market segments, we connect a smaller number of customers each year. We only made about 99 connections in 2018-19 (down from about 500 in 2014-15) and expect this decline to continue across the 2021-26 period.

Electricity to gas connection costs vary depending on how close the customer is to the nearest main. If a main passes by the home to be connected then we just need to install a service and meter. On average we only install about 2 metres of main per connection as we typically only install a small mains connection, much less than the average 21 metres of mains we install for each new home.

If connection costs exceed the revenue from the connection we will not proceed, unless the customer makes a capital contribution or if enough customers in a particular area all agree to connect.

Figure 1-2 Cost per metre of main by market segment ($2020, direct)

[redacted]

Note : Negative unit rates for the year are due to accruals which get trued-up to actuals which is also due to the volatility year-on-year, hence smoothing out the fluctuations through a historical year average provides more practicable forecasting.

Figure 1-3 Cost per service by market segment ($2020, direct)

[redacted]

Figure 1-4 Cost per gas meter by market segment ($2020, direct)

[redacted]

Note: Medium density / high-rise metering costs includes the cost of boundary meters and hot water meters but is shown in the graph above on a per gas meter basis. This results in a distorted line for two reasons. The first is due to the combination of small gas meters (sized for a single dwelling) and larger meters (sized for a whole site).

2. Connections capex forecast

This section provides a detailed description of our connections forecasting methods. It aims to support the connections capex forecast model[6] by explaining the approach taken and the calculations made.

Our forecast based on our revealed historical costs, is simple, transparent and relies on consistent data.

Revealed historical costs

The foundation of the Australian regulatory regime is to provide network businesses with incentives to only incur efficient costs.[7] Incentives work by introducing financial repercussions for cost increases and rewards for finding ways to lower costs. The rewards from cost savings finance the investment (in terms of money and risk) required to trial new ways of working and find continuous improvement.

To provide customers and the AER with confidence in our forecast, we have built our forecast on our actual revealed historical costs (incurred with the incentive to reduce and constrain costs). This approach ensures the efficiencies we have achieved in the past flow through into our forecast costs.

Simple and transparent

We sought to adopt a simple and transparent approach to ensure that the forecast can be easily reviewed and verified. To do this we have based our forecasting approach on a top-down method for the 2021-26 period as much as possible.

Consistent data

To address the AER's past concerns about combining different data sets we have sought to rely on consistent data. We primarily rely on data submitted as part of our RIN response. This data is presented in AER prepared templates and has been audited, in line with the quality assurance requirements set out in the RIN.

Where additional data was required we sought to use the most consistent data possible from our new SAP financial information system to avoid using data from different information sources.

2.1 Forecasting methods

For the following market segments, we forecast costs using a historical average cost per connection method.

Electricity to gas, new homes, medium density / high rise, industrial and commercial tariff

6 Appendix 3.2 Market Expansion model

7 Depending on the market forces and cost pressures this could either lead to cost reductions or constrained cost increases.

At a high level this approach can be summarised as:

Forecast capex = **average unit rates** X **volume forecast**

Where:

- **Average unit rates** (cost per metre of main, per service and per meter) is the historical unit rates reconciled with the RIN data.
- A **volume forecast** which is the total number of mains, services and meters we expect to install. We calculate this by combining the historical average **volume mix** (the number of mains, services and meters per connection) with the connection forecast (developed by the Centre for International Economics (The**CIE**)[8]).

As we use the average historical number of mains, services and meters per connection (along with average historical unit rates), this results in a forecasting approach based on the average cost per connection.

In the sections below we provide more detail on each step.

Industrial and commercial contract

We apply a simple average of historical costs.

2.1.1 Average unit rates

The data presented in our response to the AER's RIN provides **unit rate** data[9] – annual costs for mains (per metre), services (per service) and meters (per meter) by **market segment**.

These **unit rates** capture all direct costs including contractor costs, restorations, internal labour and materials, which are different to the **contract unit rates** which we pay our contractors.

Unit rates vary from year to year due to:

- Accruals that occur from year to year due to the timing of invoices for work completed between the service provider Jemena and Evoenergy which is trued-up to actuals.
- Timing differences of non-routine costs like restoration work can often be paid several months after the work is completed.
- Natural variation in the type of jobs that are performed – for example costs are higher when we connect more customers in higher density areas due to the greater traffic management requirements.

To account for this natural variation we take the last four year average of costs to smooth these fluctuations.[10] While we do adjust for inflation we do not take into account movements in real cost escalation. This results in **4-year average unit rates** per metre of main, per service and per meter installed for each **market segment.**

8 Appendix 7.1 of our 2021-26 Proposal.

9 Presented in RIN Workbook 2 – historical attachment, template E5.

10 While taking a longer sample provides greater smoothing out of cost fluctuations, it has the disadvantage of using older information which no longer reflects the costs of delivering services.

Table 2–1: Electricity to gas average unit rates ($2020, direct)

	2015-16	2016-17	2017-18	2018-19	4 year average
Mains (per metre)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Services (per service)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Meters (per meter)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 2–2: New homes average unit rates ($2020, direct)

	2015-16	2016-17	2017-18	2018-19	4 year average
Mains (per metre)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Services (per service)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Meters (per meter)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 2–3: Medium density / high rise average unit rates ($2020, direct)

	2015-16	2016-17	2017-18	2018-19	4 year average
Mains (per metre)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Services (per service)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Meters (per meter)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 2–4: Industrial & Commercial tariff average unit rates ($2020, direct)

	2015-16	2016-17	2017-18	2018-19	4 year average
Mains (per metre)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Services (per service)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Meters (per meter)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

2.1.2 The volume forecast

The next step is to forecast the volumes of mains, services and meters we will need to install.

The first part is to identify the metres of mains and the number of services and meters required per connection – the **volume mix**. Using the **volume mix** means that this method is effectively an average cost per connection approach[13]. The **volume mix** is obtained via the sum of historical connections over the sum of historical volumes (for mains, service and meters) for each market segment.

Table 2–5: Historical connections 2015-2019

	2015-16	2016-17	2017-18	2018-19	Total Connections
Electricity to gas	221	227	168	99	**715**
New Homes	928	3,070	1,729	1,593	**7,320**
Medium density / high rise	2,221	2,073	3,982	1,386	**9,662**
Industrial & Commercial tariff	98	132	11	51	**292**

11 Negative unit rates for the year are due to accruals which get trued-up to actuals, hence, smoothing out the fluctuations through a 4 year average.

12 Negative unit rates for the year are due to accruals which get trued-up to actuals, hence, smoothing out the fluctuations through a 4 year average.

13 The average cost per connection can be seen by applying the average unit rates directly to the volume mix. This average unit rate can be applied to the connection forecast to obtain the capex forecast.

Table 2–6: Electricity to gas volume mix

	2015-16	2016-17	2017-18	2018-19	Volume mix for all historical years
Mains (metres per connection)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Services (per connection)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Meters (per connection)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 2–7: New homes volume mix

	2015-16	2016-17	2017-18	2018-19	Volume mix for all historical years
Mains (metres per connection)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Services (per connection)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Meters (per connection)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 2–8: Medium density / high rise volume mix

	2015-16	2016-17	2017-18	2018-19	Volume mix for all historical years
Mains (metres per connection)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Services (per connection)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Meters (per connection)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 2–9: Industrial & Commercial tariff volume mix

	2015-16	2016-17	2017-18	2018-19	Volume mix for all historical years
Mains (metres per connection)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Services (per connection)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Meters (per connection)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

We then use the **connections forecast** for each market segment prepared by The**CIE**[14]**.**

Table 2–10: 2021-26 connections forecast

	2021-22	2022-23	2023-24	2024-25	2025-26
Electricity to gas	47	34	25	19	15
New Homes	680	676	675	702	716
Medium density / high rise	1,141	1,201	1,133	1,179	1,244
Industrial & Commercial tariff	65	66	66	66	67

Multiplying the **volume mix** (for all historical years) with the **connections forecast** for each **market segment** provides the **forecast volumes** for the 2021-26 period.

14 Appendix 7.1 of our 2021-26 Proposal.

Table 2–11: Electricity to gas forecast volumes

	2021-22	2022-23	2023-24	2024-25	2025-26
Mains	87	62	46	35	28
Services	57	41	30	23	19
Meters	56	40	30	23	18

Table 2–12: New homes forecast volumes

	2021-22	2022-23	2023-24	2024-25	2025-26
Mains	14,523	14,433	14,404	14,978	15,282
Services	633	629	628	653	666
Meters	585	581	580	603	615

Table 2–13: Medium density / high rise forecast volumes

	2021-22	2022-23	2023-24	2024-25	2025-26
Mains	2,467	2,597	2,450	2,550	2,689
Services	407	428	404	420	443
Meters	460	484	457	475	501

Table 2–14: Industrial & Commercial tariff forecast volumes

	2021-22	2022-23	2023-24	2024-25	2025-26
Mains	2,464	2,478	2,491	2,505	2,518
Services	58	59	59	59	60
Meters	62	62	62	63	63

2.1.3 Capex forecast

The last step is to combine the **average unit rates** and the **volume forecast**. These connection costs flow through from our market expansion model (Appendix 3.2) to our capex forecast model (Appendix 3.1)

Table 2–15: Electricity to gas capex forecast ($2020, direct, unescalated)

	2021-22	2022-23	2023-24	2024-25	2025-26
Mains	18,878	13,532	10,007	7,683	6,150
Services	78,223	56,069	41,463	31,833	25,484
Meters	7,657	5,488	4,059	3,116	2,495
Total	**104,759**	**75,089**	**55,528**	**42,632**	**34,129**

Table 2–16: New homes capex forecast ($2020, direct, unescalated)

	2021-22	2022-23	2023-24	2024-25	2025-26
Mains	298,554	296,699	296,106	307,896	314,152
Services	502,775	499,652	498,652	518,507	529,042
Meters	116,299	115,577	115,346	119,938	122,375
Total	**917,628**	**911,928**	**910,104**	**946,341**	**965,568**

Table 2–17: Medium density / high rise capex forecast ($2020, direct, unescalated)

	2021-22	2022-23	2023-24	2024-25	2025-26
Mains	59,385	62,508	58,985	61,384	64,730
Services	274,167	288,586	272,321	283,398	298,842
Meters	276,388	290,924	274,527	285,693	301,262
Total	**609,941**	**642,018**	**605,834**	**630,475**	**664,834**

Table 2–18: Industrial & Commercial tariff capex forecast ($2020, direct, unescalated)

	2021-22	2022-23	2023-24	2024-25	2025-26
Mains	176,575	179,074	181,572	184,070	186,568
Services	294,614	297,161	299,708	302,256	304,803
Meters	267,878	269,567	271,256	272,945	274,634
Total	**739,067**	**745,801**	**752,536**	**759,270**	**766,005**

2.2 Industrial and Commercial Contract

Due to the volatility of industrial and commercial contract connections and the variability in connection costs mainly due to required high capacity steel / plastic mains and / or large industrial meters, we are forecasting the costs of connecting these customers by applying a 4-year average of historical connection costs.

Table 2–19: Industrial & Commercial contract historical costs ($2020, direct)

	2015-16	2016-17	2017-18	2018-19	4 year average for all historical years
Mains	307,982	48,880	299,292	468,733	**281,221**
Services	73,064	334,119	-88,196[15]	369,945	**172,233**
Meters	64,862	32,565	38,032	31,092	**41,638**
Total	**445,908**	**415,563**	**249,129**	**869,770**	**495,092**

[15] Negative historical cost for the year is due to accruals which get trued-up to actuals, hence, smoothing out the fluctuations through a 4 year average.

Table 2–20: Industrial & Commercial contract capex forecast ($2020, direct, unescalated)

	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26
Mains	281,222	281,222	281,222	281,222	281,222	281,222	281,222
Services	172,233	172,233	172,233	172,233	172,233	172,233	172,233
Meters	41,638	41,638	41,638	41,638	41,638	41,638	41,638
Total	**495,092**	**495,092**	**495,092**	**495,092**	**495,092**	**495,092**	**495,092**

3. Metering capex forecast

This section provides further detail on our metering capex forecast including:

- The forecasting methods applied in our meter replacement capex forecast model[16] (Section 3.1).
- How we selected the forecast method for each program and why (Section 3.2).
- Detail on how the meter replacement volume forecast model[17] works (Section 3.3).

3.1 Our forecasting methods

We forecast the capex required for each of our metering programs using one of the following methods:

A. Historical unit rates – Consistent with our connections forecasting approach, we calculate average unit rates based on historical data. These unit rates are then applied to a separately derived volume forecast.

As with our connections forecasting method (discussed in section 2), this approach ensures that the efficiencies we have made in the past flow into our forecast.

The per unit nature of this method is best for areas of our program where the volumes of work varies year-to-year but the scope of work remains relatively constant.

B. Project Cost Estimate – where we apply a high level project cost estimation by a subject matter expert. This approach produces a whole project cost, or a unit rate which is then applied to a volume forecast.

We use this method where historical unit rates will not provide the best forecast, typically when we do not have historical data or the scope of work changes over time.

C. Historical yearly spend – a simple average of historical annual costs.

This approach is applied where volumes are not expected to significantly change. As with the historical unit rate approach, this method relies on revealed costs producing a forecast that ensures that the efficiencies we have made flow into our forecast.

3.1.1 Residential gas and hot water meters

- **Planned and statistical –** Our meter replacement and statistical sampling programs are characterised by steady unit costs and varying volumes. In these programs the volumes change each year depending on the age profile and performance of our meter fleet.

  Accordingly, the capex forecast is based on two components:

  - Unit rates based on historical unit rates, calculated by summing direct costs over the last four years[18] and dividing by total volumes[19].
  - Applying the historical unit rates to expected volumes, from our meter replacement volume forecast model, described in section 3.2.

- **Defective gas meters and regulators –** Our defective meter and regulator programs (like all of our defective programs) are forecast using the historical yearly cost approach.

[16] Appendix 3.3 Meter replacement capex forecast model

[17] Appendix 3.12 Meter replacement volume forecast model

[18] Similar to our approach for connections, see section Average unit rates 2.1.1

[19] We do not use RIN data as the required level of granularity is not available. Instead we use the next layer down which is consistent with the RIN data and provides a split of costs by program.

To forecast costs we use the average of annual costs incurred over the last four years. This approach captures the historical failure rate and the historical average unit costs. We consider that this represents a conservative forecast as it does not take into account the expected rise in failure rates as our meters age and wear.

- **Internal gas meter upgrades –** We apply a project cost estimate approach for these internal gas meter upgrades with potential safety compliance as per findings from inspections.

Table 3–1: Residential gas meter forecasting approach

	Forecasting approach
Planned	Historical 4 year average rate
Statistical	Historical 4 year average rate
Defective gas meters	Average 4 year historical spend
Defective regulators	Average 4 year historical spend
Internal gas meter upgrades	Project cost estimate

Table 3–2: Residential hot water meter forecasting approach

	Forecasting approach
Planned	Historical 4 year average rate
Defective	Average 4 year historical spend

3.1.2 Meter data loggers (MDL)

- **Planned** - The nature of our MDL planned replacement program has changed over time. Over the current period we replaced parts, batteries and communication equipment. Over the forecast period we only expect to replace batteries.

  Applying the historical unit cost approach would result in an overestimate of costs, hence we instead apply a project cost estimate approach to reflect the reduced scope of work we will undertake.

- **NBN rollout** – We apply a project cost estimate rate as sufficient historical data is unavailable.

Table 3–3: Meter data logger forecasting approach

	Forecasting approach
Planned	Project cost estimate
NBN rollout	Project cost estimate

3.1.3 Industrial and commercial gas meters

- **Planned** – Unlike residential meters, there is a high degree of variability in the size and type of our industrial and commercial meters[20] we replace or refurbish. Our planned replacement program costs change over time depending on the mix of meters in our program, hence we have applied a historical average unit rate to smooth these fluctuations.
- **Statistical sampling** – We apply the historical average unit rate approach for our statistical sampling program as these costs are steady over time, as only a subset of our I&C diaphragm meters form part of this program.
- **Defective** – We apply the average historical spend approach to our defective programs which include turbine, diaphragm and rotary gas meters.
- **Meter upgrades (non-residential)** – For our meter upgrade program, our costs vary year-to-year based on customer requirements. However, as we do not know what customers' requirements will be whether it be an increase or decrease in gas load, the best forecast of future costs is what has incurred in the past. For this reason we have applied an average historical spend approach.
- **Meter Set upgrades** – We apply a project cost estimate approach for these I&C meter sets with a non-fit for purpose installation as per findings from inspections.

Table 3–4: Industrial and commercial gas meter forecasting approach

	Forecasting approach
Planned - diaphragm	Historical 4 year average rate
Planned - rotary	Historical 4 year average rate
Planned - turbine	Historical 4 year average rate
Statistical sampling	Historical 4 year average rate
Defective – diaphragm	Average 4 year historical spend
Defective – rotary	Average 4 year historical spend
Defective – turbine	Average 4 year historical spend
Meter upgrades (non-residential)	Average 4 year historical spend
Meter Set upgrades	Project cost estimate

3.1.4 Metreteks

- **NBN rollout program** – We have used the project cost estimation approach as there is a certain number of metreteks remaining to be replaced to complete the rollout.

Table 3–5: Metretek forecasting approach

	Forecasting approach
NBN rollout	Project cost estimate

[20] Diaphragm, turbine and rotary.

3.1.5 Testing

- **Quality assurance testing program** – To forecast these costs we use a project cost estimate approach as volumes are not captured by our SAP system which include new gas meters, water meters and regulators.

Table 3–6: Meter testing program forecasting approach

	Forecasting approach
Quality assurance testing	Project cost estimate

3.1.6 Other metering costs

- **Wireless Radio Frequency (RF) gas meters (residential)** – As this program is new and will take a phased ramp up approach, we apply a project cost estimate approach.
- **ACT / NSW flow boundary meters** – This is a one off metering project to upgrade 3 gas meters measuring flow from the ACT to NSW with metretek devices attached, hence we have applied a project cost estimate approach.

Table 3–7: Other metering costs forecasting approach

	Forecasting approach
Wireless RF gas meters (residential)	Project cost estimate
ACT / NSW flow boundary meters	Project cost estimate

3.2 Forecast meter volumes model

To forecast the volume of meters to be replaced we have developed a meter replacement volume forecast model[21]. We use this model for the following programs:

- Residential gas meters replacement and statistical sampling programs.
- Residential hot water meters replacement program.
- Industrial and commercial meters (diaphragm, turbine and rotary) replacement and the diaphragm statistical sampling programs.

We monitor the performance of our meters by 'lots' – a group of meters manufactured under the same set of conditions.

The meter replacement volume forecast model takes the age profile of our meters (by lot) and projects forward an age profile. Each year the model adjusts the meter population for the expected number of defective meters, meters removed for statistical sampling and meters replaced by our planned replacement program.

3.2.1 Residential gas meters and statistical sampling programs

We test residential gas meters in accordance with Australian Standards[22] to identify the accuracy and leak tightness of meters installed in the network.

[21] Appendix 3.12 Meter replacement volume forecast model

[22] AS/NZS 4944:2006 Gas Meters – In-service compliance testing

We first test meters at the age of 13 years so that we can make a decision on whether to extend or replace the specific lot of meters by the time they reach 15 years of age. If the meter readings are accurate to ± 2%, we extend their life by 5 years.

We then subsequently test these meters again two years prior to the end of their life extension.

The meter replacement volume model takes into account the statistical sampling test results (at 13, 18 and 23 years) of each lot of meters. If the meters:

- Fail – they are scheduled for replacement two years out from when replacement is due.
- Pass – another statistical test is scheduled in five years[23] and the meters to be tested are removed from the meter population to ensure they are not double counted.

Where we don't have testing results, based on the latest meter performance results we assume that all untested residential gas meters will pass their 15 and 20 year life extensions and will be replaced at 25 years. We do not account for the proportion of meters which will fail these tests, leading to a conservative (lower) volume forecast.

3.2.2 Residential hot water meters

Hot water meter replacement volumes are based on field failure information and initial purchase specifications including Original Equipment Manufacturer (**OEM**) recommendations. Our approach is to replace:

- Mechanical hot water meters at 25 years. This reflects the historical field failure data.
- Hot water meters with a Cyble head[24] at 10 years, reflecting the battery life of 10 years, field performance and as indicated by the OEM.
- All other hot water meters with a battery at 15 years. This reflects the battery life of 15 years as indicated by the OEM.

Unlike gas meters, we are unable to extend the lives of hot water meters using statistical sampling. This is due to the communication components of the hot water meters (which send signals to a central MDL) requiring a battery.

3.2.3 Industrial and commercial gas meters

The testing approach is very similar[25] to residential meters. We test I&C diaphragm gas meters at the age of 13 meters (before they reach 15 years of age). If the meter readings are accurate to ± 2%, we extend their life by five years. We then subsequently test them again two years prior to the end of their life extension.

If we don't have test results, we take the following approach based on historical statistical sampling data (as with our residential gas meter program) for meter models:

1. AL425 and AL1000 - we assume they pass the 15 year test and then replaced at 20 years.
2. AL1400, AL2300 and AL5000 - we assume they will need to be replaced at 15 years. Volumes of these meters are small and we do not have testing evidence which supports extending their life further.

We do not statistically test our rotary or turbine meters given the volume of gas that is measured by these meters. Instead, we periodically take these meters out of service and test their performance. We generally refurbish the

23 The number of meters we test is determined by the lot size and is set out in the meter replacement volume forecast model.

24 The Cyble is a device attached to a hot water meter. It sends pulses to a Meter Data Logger (MDL) to communicate how much hot water has been used.

25 We test our larger meters using the 'attribute method' which consists of counting the number of non-conformities found in a random sample consistent with AS/NZS 4944:2006. This differs to the 'variable method' used with residential gas meters where a pass or fail depends on the average and variability of the measurements obtained.

meters and reuse the meter. We replace rotary and turbine meters at 10 and five years in line with OEM recommendations.

3.2.4 Metering program names

Table 3–8: Names of our metering programs in our models[26]

Category	Program	Name in models
Residential gas meters	Planned	Planned replacement of Residential aged gas meters
	Statistical	Planned statistical sampling of Residential aged gas meters
	Defective gas meters	Defective replacement of Residential gas meters
	Defective regulators	Defective replacement of Residential regulators
	Internal gas meter upgrades	Internal Residential gas meter upgrade
Residential hot water meters	Planned	Planned replacement of Residential hot water meters
	Defective	Defective replacement of Residential hot water meters
Meter data loggers	Planned	Planned replacement of MDL batteries (52H)
	NBN rollout	Planned replacement of MDL modems – 3G/CSD network shutdown
Industrial and commercial gas meters	Planned - diaphragm	Planned replacement of I&C Diaphragm gas meters & regulators
	Planned - rotary	Planned replacement of I&C Rotary gas meters & regulators
	Planned - turbine	Planned replacement of I&C Turbine gas meters
	Statistical sampling	Planned statistical sampling of I&C Diaphragm meters
	Defective - diaphragm	Defective replacement of I&C Diaphragm gas meters
	Defective – rotary	Defective replacement of I&C Rotary gas meters
	Defective - turbine	Defective replacement of I&C Turbine gas meters
	Meter capacity (non-residential)	Meter Upgrades Non-Residential
	Meter Set upgrades	I&C meter set upgrade
Metreteks	NBN rollout	Planned replacement of Metreteks - NBN rollout
Testing	Quality assurance testing	Planned quality assurance testing of new gas & water meters & regulators
Other metering costs	Wireless RF gas meters (residential)	Installation of RF residential gas meters
	ACT / NSW flow boundary meters	ACT / NSW flow boundary meters

26 Refer Appendix 3.1 Capex Forecast Model, Appendix 3.2 Market Expansion Capex Model and Appendix 3.3 Meter Replacement Capex Model.