# Jemena Asset Management Pty Limited

## UAG in the ActewAGL Distribution gas network

Proposed UAG level substantiation

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# OVERVIEW

As part of its Access Arrangement proposal ActewAGL Distribution (AAD) is required to provide a forecast of its operating expenditure (opex). One of the elements of AAD's opex is the cost of Unaccounted for Gas (UAG). UAG is defined as the difference between the quantity of gas that is measured entering the network at custody transfer stations (receipts) and the quantity of gas that is measured leaving the network (deliveries). This difference is effectively "lost" or unaccounted for. AAD is required to replace UAG under the terms of its Access Arrangement – effectively replacing gas that belonged to the Users of the Network that has not been delivered to their customers.

Jemena manages UAG as part of the services provide to AAD under the Distribution Asset Management (DAMS) agreement. Jemena has prepared this report for AAD to include as part of its Access Arrangement proposal.

AAD's UAG level has increased from the prior Access Arrangement period from around 1.7% to a four year average of 1.96 per cent. Analysis of UAG data demonstrates clearly that AAD's UAG is largely attributable to measurement related issues rather than leakage. This is supported by the effect of the balance of supply into the network between its two receipt points on the level of UAG.

Jemena applies recognised good industry practice to actively manage UAG. This includes sound practices to ensure accurate metering, both into and out of the network. However, the causes of UAG by nature are subject to considerable uncertainty, because they cannot be directly measured, and inferences about any particular source of UAG are difficult to make despite best efforts to do so.

AAD's UAG level is the lowest of any Australian gas network, if the one anomalous gas network is excluded. Accordingly, AAD is proposing that the approved level of UAG be based on the same reasoning and approach as applied in the 2012/13 review of UAG for the Victorian gas network businesses by the Victorian Essential Service Commission. That is, that the approved UAG benchmark apply the revealed cost approach to incentive regulation.

Accordingly, the four year historical average of 1.96 per cent of gas receipts has been applied as the forecast for UAG for the 2016-2021 Access Arrangement Period. This approach is consistent with the requirements of Rule 91 of the NGR that opex "*must 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 delivering pipeline services."* In the case of UAG AAD may only include the cost of UAG that is prudent and efficient and will deliver the lowest sustainable cost.

# 1. INTRODUCTION

As part of its Access Arrangement proposal ActewAGL Distribution (AAD) is required to provide a forecast of its operating expenditure (opex). One of the elements of AAD's opex is the cost of Unaccounted for Gas (UAG). UAG is defined as the difference between the quantity of gas that is measured entering the network at custody transfer stations (receipts) and the quantity of gas measured leaving the network (deliveries). It is effectively "lost" or unaccounted for. AAD is required to replace UAG under the terms of its Access Arrangement – effectively replacing gas that belonged to the Users of the Network that has not been delivered to customers.

Rule 91 of the NGR requires that opex "*must 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 delivering pipeline services."* In the case of UAG AAD may only include the cost of UAG that is prudent and efficient and will deliver the lowest sustainable cost.

Jemena manages UAG as part of the services provide to AAD under the Distribution Asset Management (DAMS) agreement.

This report explains why the proposed level of UAG meets the requirements of Rule 91.

# 2. BACKGROUND ON UAG

In its Access Arrangement proposal for the 2010 – 2015 period AAD provided an in-depth and a detailed explanation of UAG and the history of UAG for the ACT/Queanbeyan/Palerang gas network. The general content of that report has not changed and therefore this report does not repeat that explanation, but provides a summary of what UAG is and the various contributors to it.

UAG arises due to a number of factors. The efficiency of the AAD's UAG is best understood by considering the contributors to UAG. The key contributors are:

- Receipt point uncertainty[1]
- Delivery point uncertainty
- Delivery point meter degradation
- Fixed factor uncertainty
- Heating value allocation uncertainty
- Leakage
- Unmetered gas for operational purposes
- Theft

*Receipt point uncertainty* – Meter stations, at receipt points use high standards of measurement equipment. The measurement of standard volumes (i.e. converted from measured conditions to standard conditions (room temperature and pressure)) requires a number of associated measurements. The measurements include the primary measurement element (such as an orifice plate, turbine meter, ultrasonic meter, coriolis), temperature, pressure and composition measurement. The combination of the errors in each of the contributing measurements allows a receipt point meter to be accurate to within, at best, +/- 1.00 per cent of the true quantity being measured.

*Delivery points* – These are the meters supplying customers. These typically have an accuracy of +/- 2 per cent.

*Delivery point meter degradation* – Customer meters are installed for long terms: turbine and rotary meters for five and ten years respectively; diaphragm meters for 15 to 25 years. While they generally remain within the accuracy requirements set within technical regulations[2] aging will cause meter degradation. Turbine and rotary meters used for large demand customers will read slow as they age. These meters are replaced every five or ten years to ensure they remain within a sufficient metering accuracy. Diaphragm meters also degrade and may either read "fast" or "slow" as a result of age. However, another common phenomenon is non-registering of meters as they age with the result that 100% of usage is not measured. A significant proportion of non-registering meters will be identified and replaced after one or more billing cycles, although some may not be identified for some time. Another factor is that the regulated accuracy requirement for gas meters is +2/-3 per cent. As meters age, this results in an inherent bias to meters reading slow. The result of all of these is an increase in UAG.

[1] Metering uncertainty is often called metering error because it is the difference between the amount measured and the true measurement which cannot be known.

[2] ACT General Gas Metering Code is the regulation governing metering.

*Fixed Factor uncertainty* – All residential meters and small industrial and commercial meters have fixed factor metering. This comprises the use of a pressure regulator to hold the metering pressure constant. Correction factors are also applied to convert gas volumes to standard volume measurements based on published long-term averages from the Bureau of Meteorology. While these corrections are essential for maximising the accuracy of gas measurement, they are imperfect representations of the conditions at each customer's meter, because actual monthly temperatures will vary from the historic average and the temperatures at a single location will be an imperfect proxy for the actual temperatures of gas passing through a customer's meter. The same is true of barometric pressure. As result there is an inherent additional uncertainty in the measurement of gas being delivered from the network.

*Heating value allocation uncertainty* – Heating value of gas in the network is measured at two locations to enable gas volumes to be converted to energy quantities. The application of a single heating value to delivery meters on major network sections is a practical approach to characterising the heating value of delivered gas, but it has inherent impact on the accuracy of measurement of gas deliveries.

*Leakage* – The AAD network commenced operation in 1982 so it is constructed with modern steel and plastic technology and so has relatively low levels of leakage. The majority of leakage from modern plastic systems is from small above ground leaks around meter sets, which are relatively easily detected and rectified.

*Gas used for operational purposes* – Gas escapes from the network when gas mains are being commissioned and during maintenance. It also escapes when there is third party damage to gas mains. While Jemena's and AAD's systems are designed to limit third party damage through participation in the "Dial before you dig" service and patrols of its high pressure networks third party impact does occur and contributes to UAG.

*Theft* – This is considered to be uncommon, due to the inherent hazards of unskilled work with gas. This element is particularly hard to both detect and estimate.

An important consideration when seeking to understand UAG and to manage it is the significant uncertainty around the estimates of the contributions to UAG from the causes identified above. This is generally accepted in the gas industry.

With respect to the measurement related causes, these uncertainties are unavoidable because of limitations associated with any measurement process. Even the most accurate metering systems cannot provide an accuracy of much better than +/- 1%. Typically the cost of improving the accuracy of any of these elements is far greater than any benefit. Industry practice, backed by regulations, has determined the efficient levels of accuracy for each of these elements over many years of gas industry operation.

Similarly, estimating gas losses from the network from leakage, operational use and theft suffers from high levels of uncertainty. While there is some scope to estimate gas lost from leakage, purging and filling mains and when there is a third party hit, estimates will be only order of magnitude level estimates. The cost of improving the estimates would significantly outweigh any benefit, which can be expected to be small.

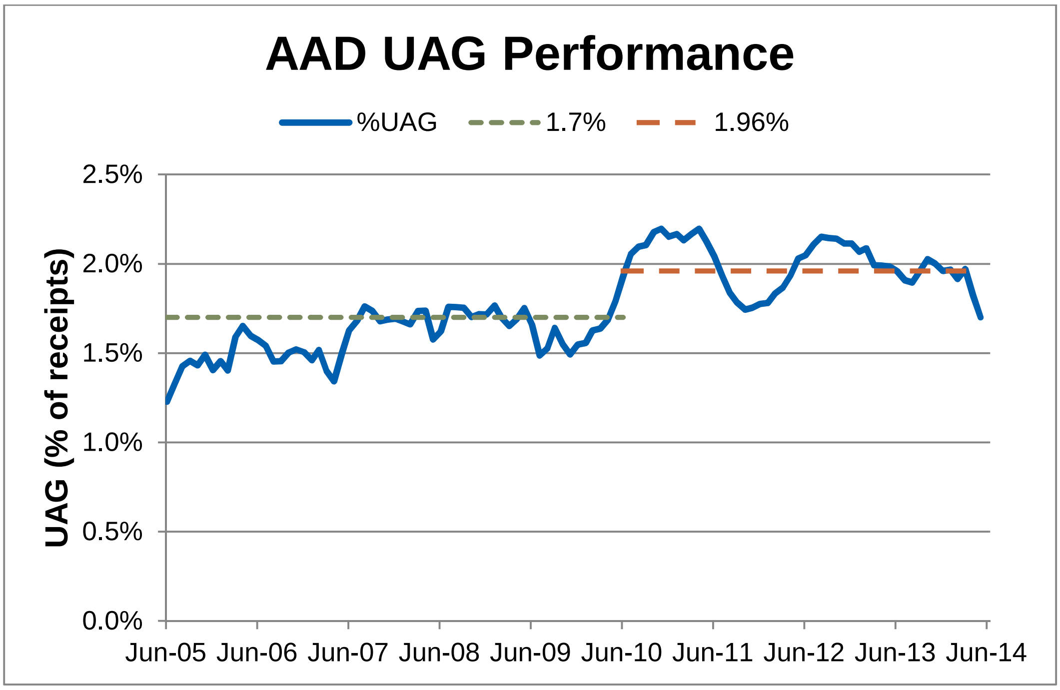
# 3. UAG PERFORMANCE

## 3.1 HISTORIC UAG LEVELS

AAD's UAG performance reflects the fact that it is a modern network with no cast iron or unprotected steel mains. Mains are constructed of cathodically protected welded steel mains for high pressures (ie 1,050kPa and above) and fused plastic pipe medium pressure (300kPa and below). The result is that leakage is a much smaller component of UAG than older networks that have cast iron and unprotected steel mains.

From July 2005 until June 2010 UAG was close to UAG of 1.7 per cent allowed by the AER for the 2010-2015 AA period. From July 2010 there has been some noticeable volatility and a modest increase in the level of UAG. The average for the four year period (2010 – 2014) is 1.96 per cent.

**Figure 1**



## 3.2 ANALYSIS OF AAD'S UAG

Jemena has undertaken a number of analyses of AAD's historic UAG to better understand the efficiency of the level of UAG by understanding some of the UAG drivers. The information that can be gleaned from analysis of the historic UAG data is limited as will be seen below.

### 3.2.1 AAD'S UAG IS LARGELY MEASURMENT DRIVEN

UAG is as a result of leakage, operational use or theft is unrelated to the level of network throughput. Therefore, any correlation between throughput and UAG is generally a product of uncertainty in measurement. The following graphs show the relationship between UAG quantities (i.e. in TJs not a percentage of receipts) and network receipts.

**Figure 2**

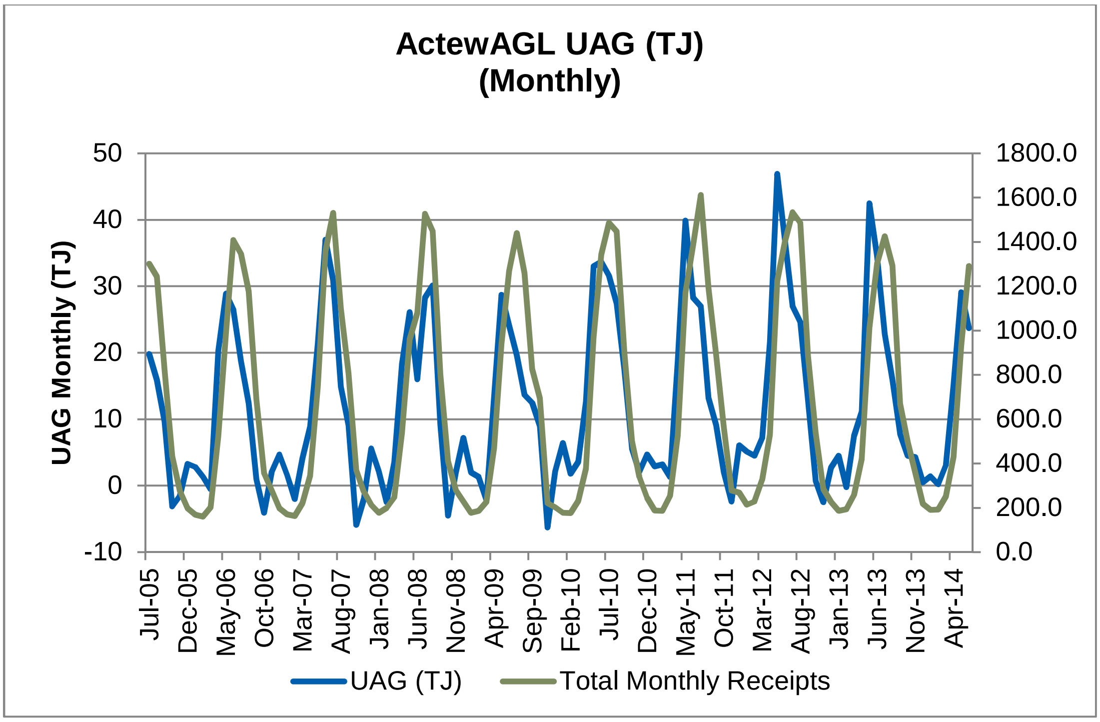
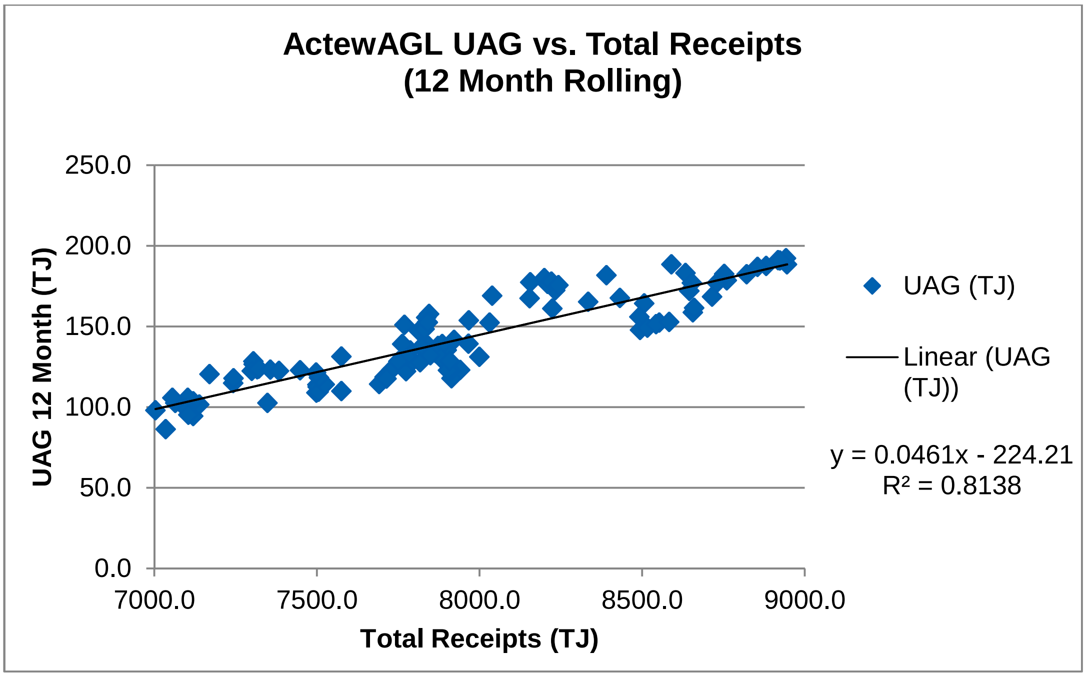


**Figure 3**



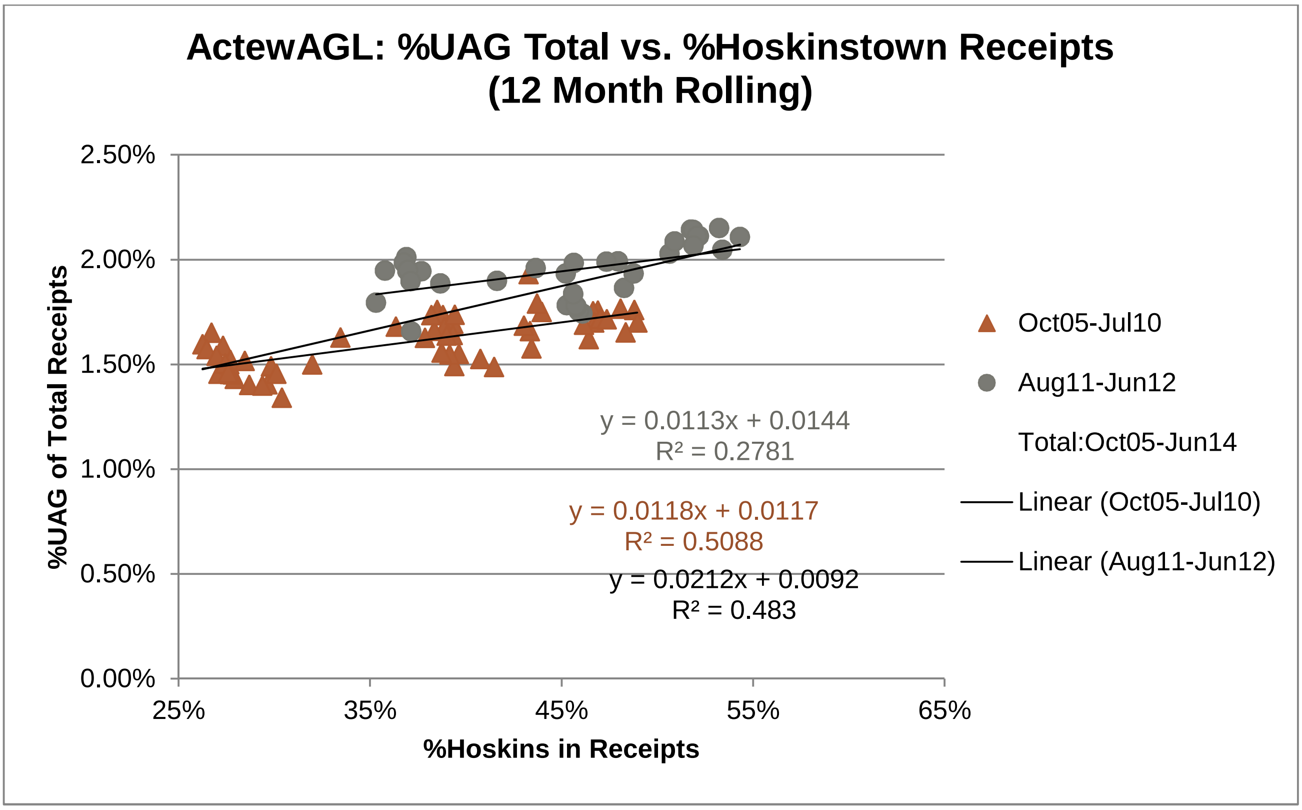

Clearly there is a very strong relationship between the quantity of UAG and network throughput with the quantity of UAG closely following the quantity of gas receipts. The correlation between 12 month rolling UAG and receipts is strong with an $R^2$ of 0.81 indicating the over 80% in the variation in UAG is related to the quantity of gas flowing through the AAD. However, the accuracy of the correlation parameters must be questioned as the intercept of the correlation equation suggests that UAG would be negative if there was no throughput. What is strongly indicated by this analysis is that the vast majority of UAG is related to measurement uncertainty rather than unmeasured losses from the network. This is consistent with the fact that AAD's network does not include any leak prone cast iron pipe materials and the results of its leakage surveys.

### 3.2.2 VARIATION IN UAG IS RELATED TO RECEIPT POINT DIFFERENCES

Another source of UAG variation that has been investigated using historic UAG data is the extent to which UAG varies as the balance of receipts varies between the two receipt points on AAD's network – Hoskinstown CTS and Watson CTS. The average proportion of gas being supplied by Hoskinstown for the 2005 – 2010 period was 36 per cent and the average for the period 2010 – 2014 was 45 per cent

The following graph in Figure 4 demonstrates that there is a relationship, but that it is not possible to quantify it with any degree of confidence.

**Figure 4**




Three correlations were performed on data from October 2005 to June 2014:

- One covering all the data for the whole period
- Two for two sub-periods where other effects on UAG were largely removed: from October 2005 – the July 2010 and August 2011 – Jun 2012

The quality of the correlations varies with $R^2$ between 0.28 and 0.51. The correlation equations vary with slopes between 0.0113 and 0.0212 and intercepts between 0.92% and 1.14%. With such a wide range of results and the uncertainty about representativeness of the data, it is not possible to deduce anything more than that the UAG percentage has increased as the percentage of receipts supplied through Hoskinstown has increased. This is not a surprising result as each of the meters can expect to be offset from the true value by up to 1.0%.

### 3.2.3 STATISTICAL MODEL REVISION

For AAD's 2010-2015 Access Arrangement review Jemena developed a model to identify the efficient range for AAD's network. The model indicated that UAG within the range 0.1 – 1.8% would be a reasonable expectation. In the light of AAD's UAG increasing above that range Jemena has reviewed the model and made some refinements.

The refinements were:

- A separation of billing system issues and fixed factor metering issues
- Developing a better basis for fixed factor metering uncertainty
- A more accurate weighting between rotary meter uncertainty and diaphragm meter uncertainty.

- A more realistic uncertainty range for leakage

The resulting changes to the model of a range for UAG of 0.9% to 2.1% reflect a greater and more realistic degree of uncertainty in some of the UAG contributors. Table 1 shows the output of the statistical UAG model.

**Table 1 - Revised Statistical Model for AAD's UAG**

| Contributing Factor | Mid point (%) | Range (+/-) (%) | Comment |
|---|---|---|---|
| Receipt points | 0.0 | 0.71 | Industry standard |
| Delivery Points | 0.0 | 0.03 | Industry standard |
| Billing system issues | 0.0 | 0.15 | Jemena estimate |
| Meter degradation | 0.6 | 0.26 | Jemena meter degradation model |
| Heating Value Allocation | 0.0 | 0.05 | Jemena estimate |
| Fixed factor metering | 0.0 | 0.77 | Jemena estimate |
| Leakage | 0.3 | 0.10 | Jemena estimate |
| Unmetered gas for operational purposes | 0.1 | 0.10 | Jemena estimate |
| Theft | 0.1 | 0.05 | Jemena estimate |
| **Total** | **1.00** | **1.10** | |
| **Expected Range: -0.09% to 2.10%** | | | |

# 4. LESSONS FROM RECENT VICTORIAN UAG REVIEW

Jemena has relied on the 2013 review of the Victorian gas distribution businesses by the Essential Services Commission of Victoria (ESC) to source UAG benchmarks, because its consideration of UAG is the most up-to-date including the UAG benchmarking results of the most recent Access Arrangement reviews by the AER.

In addition to including the most recent UAG benchmarks, the review by the ESC provided some useful insights to assist in assessing the efficient level of UAG for AAD.

### 4.1.1 INHERENT UNCERTAINTY IN DETERMINING THE CAUSE OF UAG

One of the findings of the ESC[3] was that there is inherent uncertainty in determining the causes of UAG, because by nature they are not measurable and in most cases estimating the size of each contributor involves high levels of uncertainty.

The ESC quoted consultant to the Victorian Gas Network businesses, AIA[4]:

> *Unaccounted for Gas (UAFG) is an easy concept (inputs minus outputs), however in practice many parts make up total UAFG and some of these factors are extremely hard to measure with certainty. Indeed there is an inherent uncertainty with measuring a compressible fluid whose measurement changes with pressure and temperature conditions, composition and flow rates together with the fact that physical unmetered losses from the network are by definition lacking in data.*

The ESC's consultant Zincara[5] confirmed that forecasts of UAG are inherently uncertain by saying "…it is not possible to quantify with any certainty the components of UAFG".

### 4.1.2 IMPORTANCE OF UAG MANAGEMENT PLANS

In assessing the efficient levels of UAG for the Victorian gas networks the ESC recognised the importance of each business' UAG management plans. Each of the gas network businesses provided an explanation of their programs to manage UAG. This assisted the ESC in understanding the drivers of UAG and provided it with confidence in applying historical levels of UAG as representing an efficient approach to forecasting UAG.

Appendix 1 provides a summary of Jemena's program for management of UAG and it's recent investigations to reduce UAG for AAD's network.

### 4.1.3 REVEALED COST APPROACH

In determining the UAG benchmarks for the Victorian gas networks the ESC considered the validity of using the "revealed cost approach". This approach is equivalent of applying the base-step-trend approach to the controllable cost component of opex to UAG. That is, in this approach it is accepted that the incentive to economically minimise UAG is sufficient to accept the recent historic level of UAG as efficient.

The ESC provides extensive reasoning around its choice to use the revealed cost approach stating that "*The alternatives to the revealed cost approach—a bottom-up approach or external comparisons—cannot be used to provide a reasonable basis for the forward benchmarks."*[6]. In rejecting the direct application of external

[3] Review of UAFG benchmarks – Final decision, ESCV, June 2013, page 36

[4] Review of UAFG benchmarks – Final decision, ESCV, June 2013, page 37

[5] Review of UAFG benchmarks – Final decision, ESCV, June 2013, page 38

[6] Review of UAFG benchmarks – Final decision, ESCV, June 2013, page 42

benchmarks it decided that *"…like-with-like comparisons cannot be made based on the available information. The use of external comparisons is therefore limited. This means 'internal information' provided by the GDBs must be relied on to make an assessment of the appropriate benchmarks."*[7]

Rather than apply a single base year the ESC concludes that a multi-year average removes potential distortions that could arise from a single year and also removes the impact in volatility in UAG from year to year. In particular, it determined that "A *multi-year average can strengthen incentives for the GDBs to seek out efficiencies. Assuming the GDBs' efforts can reduce UAFG levels over time, benchmarks based on a multi-year average would in principle be higher than using the most recent year as the base—all other things being equal. Under this scenario, a multi-year average allows the GDBs to essentially keep any cost savings achieved in the final few periods for longer."*[8]

Accordingly the ESC applied the three year average as the basis for its forecast.

### 4.1.4 AUSTRALIAN GAS NETWORK BENCHMARKS

The benchmarks for other Australian gas networks were compiled for the ESC by Zincara[9]. Table 2 shows updated information for Jemena Gas Networks shows the level of UAG (as a percentage of receipts) for a majority of Australian gas networks.

**Table 2 - Current UAG levels for Australian gas networks**

| Gas Distributor | UAG Benchmark (%) |
|---|---|
| APA Allgas Queensland | 4.0 |
| Envestra Queensland | 0.5* |
| Envestra SA | 8.3 |
| Jemena Gas Networks | 2.24 |
| Envestra Victoria | 2.86 |
| Multinet | 4.03 |
| SPAusnet | 3.53 |
| ATCO Gas WA | 2.67 |
| IGU Working Committee Oct 2009 | 2.7 |
| **ActewAGL Distribution** | **1.96** |

*Note: Zincara notes that "There are no explanations to why Envestra's Queensland UAG is unusually low."

If Envestra Queensland is disregarded as an anomaly (as suggested by Zincara) AAD's UAG level represents better performance than all of the Australian gas networks. However, it must be noted that all of these gas networks have some proportion of their mains constructed of aging cast iron from which leakage will be a contributor to the UAG levels. AAD's network does not include cast iron mains and leakage will play a less significant role in creating UAG.

[7] Review of UAFG benchmarks – Final decision, ESCV, June 2013, page 43

[8] Review of UAFG benchmarks – Final decision, ESCV, June 2013, page 43

[9] Review of Distribution Businesses Unaccounted for Gas, Prepared for the Essential Services Committee, Zincara Pty Ltd, 7 April 2013, page13

The ESC also considered UAG benchmarks for non-PST (non-Primary Transmission System) networks[10]. Two out of three of the non-PST networks (Envestra and Multinet) are more closely aligned to AAD's in that they have no cast iron mains with the associated leakage problems. For these two networks no historical UAG data was provided. Consequently the ESC continued the application of a benchmark of 2 per cent that has been operative for a number of years. These two networks are the best available comparators for the AAD network. AAD's historic UAG level is consistent with this benchmark.

[10] Gas Distribution Code, Review of Unaccounted for Benchmarks, Final Decision, June 2013 ,pp45-46

# 5. PROPOSED UAG LEVEL

In the light of the evidence about the drivers of AAD’s UAG and the lessons from the ESC’s review of UAG for the Victorian gas networks, the 4 year average for UAG for AAD of 1.96 per cent of gas receipts will be applied. This brings consistency with the treatment for the Victorian gas networks, will provide appropriate incentives by apply the “revealed cost approach” and ensure the allowance for UAG in AAD’s cost base reflect a realistic level.

# A1.1 APPENDIX 1 – JEMENA'S UAG MANAGEMENT SYSTEM AND UAG INVESTIGATIONS

## JEMENA'S UAG MANAGEMENT PROGRAM

Jemena, as part of the asset management and services it provides for AAD's ACT network, undertakes the following activities that are part of good industry practice in managing UAG.

### GENERAL

- Monthly monitoring and internal reporting of UAFG, with investigation of adverse outcomes as required.
- Jemena UAG committee reviews UAG performance and initiates investigations and reports to AAD periodically

### RECEIPT POINT UNCERTAINTY

- Witness testing of custody transfer station calibrations: Hoskinstown – 3 monthly, Watson – 6 monthly

### DELIVERY POINT UNCERTAINTY AND DEGRADATION

- Jemena undertakes type testing and batch testing of meter manufactures and meter repairs to ensure compliance with applicable accuracy standards.
- Aged meter replacement program – Meters are replaced once they reach an age when there is insufficient confidence of meter accuracy. This may be up to 25 years where statistical analysis demonstrates that meters remain accurate.
- Statistical meter testing, analysis of results. Samples of meters are removed for testing and applied to populations by age and meter type and manufacturer.
- Pressure and temperature corrections are individually applied to large consumers.
- Resizing of I&C meter sets when the flow rates through the meters are either greater or less than the accurate range.
- Planned maintenance on meter sets operating 15kPa and above, including calibration of T & P transducers.
- Meters that under-record consumption are detected in the billing system. In the first instance an estimate of consumption is applied and the meter is flagged for replacement.
- Ongoing review of large consumers – meter data analysed on an individual meter basis to identify changes in consumption patterns that could result in UAFG.
- Pressure correction factor reviews - Jemena undertakes reconciliations of pressure correction factors recorded in Jemena's asset management system and metering/billing system to ensure there have been no administrative errors in billing consumption details.
- All gas used within the AAD system (such as gas used for water bath heaters) is metered.
- Jemena applies meter sizing charts to ensure that the meter size is appropriately matched to loads.
- Replacement of I&C rotary and turbine meters is more frequent than under the standard to minimise metering error.

- Daily-metered customer data is monitored to detect any indications of plant breakdown or incidence of faulty equipment.
- Incorrect or missing data is substituted with estimated or recovered actual data, to ensure that the measurement of total UAFG is as accurate as possible.

LEAKAGE

- Prompt responses to all gas escapes and undertaking of repairs immediately where gas leaks are found.
- Replacements of customer meter regulators with minor leaks, venting (related to public reported leaks).
- Operational checks of District Regulators (focus on pressure control) – six monthly.
- 5 yearly leakage survey and resulting mains repair.
- Quality construction (joining of steel and plastic) to ensure joints are leak tight.

THEFT

- For residential and small commercial customers investigations of illegal connections, unmetered / unbilled gas consumption, and bypass of gas and hot water meters are undertaken when detected.
- For large customers there are a range of preventative actions in addition to daily monitoring of usage levels, including bypass locks, regular meter set services and training of meter readers to detect installation of meter bypasses.

## RECENT INVESTIGATIONS BY THE JEMENA UAG COMMITTEE TO REDUCE UAG ON THE AAD NETWORK

| Activity | Description |
|---|---|
| **Under registration of domestic meters** | Investigated if different rubber types swell when exposed to heavy hydrocarbons as 750 style meters (most susceptible) were introduced around increase in AA UAG. In Nov 2011, sample meters were tested found no impact on performance. |
| **Contract customers not registering** | Large contract customers not in billing system or wrong pressure were investigated. ANU was found to have four mismatched sites out of 100, however the mismatches were in the network favour. |
| **Equation of state (EOS)** | The ethane content can effect gas density and cause the densitometer to under read at 6,000kPa. This is now a known variable and reflected for Wilton and Hoskinstown. |
| **Leakage** | Broadly speaking, UAG moves up and down with consumption, suggesting a measurement rather than leakage. |
| **Improper adjustment of quarterly and monthly tariffs** | Analysts are aware of the issue and hence reporting shows a 3 month lag. Additionally, over a year cycle, there is no error, but potential variance over monthly based on spring and autumn. |
| **Use of gauge pressure not absolute in EOS at contract meters** | Investigated in 2009 |
| **Introduced statistical sampling for domestic meters** | Annual review of domestic meters to ensure they are fit for purpose. |

| Activity | Description |
|---|---|
| **Correct sizing of meters** | Annual review and correct sizing program of meters due for replacement |
| **Billing correlation** | Review of metering and billing details. |
| **Operate at lower pressure** | Bungendore is operating at lower pressure |
| **Hoskinstown meter throughput** | Correct sizing of meters is important to measure the range of volumes. Flow arrangements changed to ensure in the best range. Recommended meter is recalibrated, and potentially duplicated which can be used on duplicate run.<br>Proposal being considered. |
| **UAG Steering committee issues** | Review areas covering metering, receipt metering, calculation process, billing, network protection, maintenance, operations and Hot water |
| **Complaints by area** | Publicly reported complaints are tracked and reported monthly |
| **Five yearly leakage survey** | Each year 20% of the network is surveyed |
| **Watson Turbine meter** | Turbines meters typically under register as they age. Recommending regular calibration program be added to FY2015-20 Asset Management plan |