Jemena Gas Networks (NSW) Ltd

2025-30 Access Arrangement Proposal

Attachment 6.7

Unaccounted for gas

Overview

Unaccounted for Gas (**UAG**) refers to gas supplied into the gas network that is unaccounted for in deliveries from the network. It is calculated as the difference between the measured quantity of gas entering the network system (receipts) and metered gas deliveries (withdrawals). UAG is generally expressed as a percentage of receipts into the network. This allows UAG levels to be viewed in terms of efficiency and appropriately benchmarked between networks.

The underlying causes for UAG arise from gas measurement and calculation errors and physical losses. However, an important consideration when seeking to understand and manage UAG is the significant uncertainty around the estimates of the factors contributing to UAG. This uncertainty is accepted in the gas industry. UAG may be positive or negative where driven by measurement and calculation errors.

This document provides a summary of Jemena Gas Networks (NSW) Ltd's (**JGN's**) UAG performance and provides an overview of how we report and manage UAG across the network. It also sets out our UAG proposal for the 2025-30 period.

- Section 1 provides an overview of the UAG framework.
- Section 2 explains the sources of UAG and the uncertainty in the UAG calculation.
- Section 3 summarises JGN's historical UAG performance, and outlines how JGN manages UAG.
- Section 4 sets out our proposed UAG target rates for the 2025-30 period. We commissioned Frontier Economics (**Frontier**) to recalculate the UAG target rates for the 2025-30 period using a similar methodology to that which it applied when setting targets for the current and previous regulatory periods.
- Based on its analysis, the total UAG rate as a proportion of receipts over the five-year period from January 2018 to December 2022 was 3.035%. The UAG rate as a proportion of withdrawals over this period was 3.133%.
- The updated estimates of the UAG coefficients for the 2025-30 period are:
  - for forecasting UAG costs:
    - 1.647% of forecast withdrawals for the demand market
    - 4.952% of forecast withdrawals for the volume market
  - for annual true-ups:
    - 1.569% of withdrawals for the demand market
    - 4.718% of the tariff market residual (comprising volume market withdrawals and total UAG).

1. UAG framework

As part of our contractual arrangements with network users—under the Reference Service Agreement—we procure gas to replenish any gas unaccounted for whilst in JGN's custody.[1] The total cost of UAG is a product of the volume of UAG and the replacement cost of gas purchased by JGN to replace UAG. This gas is acquired by JGN through a competitive market tender process.

JGN's 2020-25 Access Arrangement (**AA**) includes an incentive to minimise the rate of UAG. JGN is provided a fixed allowance for a quantity of UAG based on target percentage rates of network receipts. In the **2020-25 AA period**, separate UAG targets are applied to the demand (daily metered) and volume market as follows:

- For forecasting UAG costs:
  - 0.705% of forecast withdrawals for demand market
  - 5.925% of forecast withdrawals for the volume market
- For annual true-ups:
  - 0.665%of withdrawals for the demand market
  - 5.593%of the balance of total market receipts for non-daily metered market

If the actual UAG rate is below (above) the target rate, JGN over (under) recovers its actual UAG costs.

Gas receipts and the replacement cost of gas are outside JGN's control. As a result the current AA includes an automatic adjustment to account for these factors. The current AA stipulates a two year lag for the automatic adjustment of the recoverable amount.[2] The UAG incentive is specified in section 2 of schedule 3 of the 2020- 25 AA.

1 See clauses 7.4, 7.5(d) and 7.5(e) of the Reference Service Agreement.

2 Since there is a delay between when the costs are incurred and when they are recovered through tariffs, a time value of money (WACC) adjustment is applied to account for the lag.

2. Sources of UAG and the uncertainty of its calculation

2.1 Sources of UAG

The efficiency of JGN's UAG is best understood by considering what contributes to UAG. The causes for UAG can be grouped into gas measurement and calculation errors and physical losses:

- Measurement and calculation errors:
  - metering uncertainty in receipt meters
  - metering uncertainty in delivery meters - both high and low capacity meters
  - degradation of meter accuracy
  - calculation uncertainty, due to heating value allocation
  - calculation uncertainty, due to the fixed factor(s) used for billing, including errors incurred due to atmospheric pressure and temperature changes
  - measurement period errors
  - billing estimations
- Physical losses:
  - leakage, due to:
    - integrity of materials
    - network damage
  - theft
  - unmeasured gas used for operational purposes.

Further explanation of each error or loss is provided below.

2.1.1 Measurement error

2.1.1.1 Receipt meter uncertainty

Receipt meters, also known as Custody Transfer Meters (**CTM**), are installed at sites where JGN accepts gas into the network. The size and complexity of these meters vary depending on the volume of gas being received into the network or network section. Typically, these meters operate within a range of +/- 0.5% volumetric error and are subject to 6 weekly or 3 monthly validation checks.

2.1.1.2 Delivery meter uncertainty

- Low capacity meters – These are the meters that supply our volume market customers, which include residential, commercial and small industrial customers. These meters typically have an accuracy range of +/- 1.5% to +/-2% (volumetric error).

- High capacity meters – These meters are used at large (demand market) customers. As these meters record larger volumes of gas, meters of a higher specifications are utilised providing more accuracy than the low capacity meters. Subject to their size and type, these meters generally operate in the range of +/- 0.5% to +/- 1% (volumetric error).

2.1.1.3 Degradation of meter accuracy

The typical in-service life of a customer meter ranges from 5 to 35 years. High capacity meters, such as turbine and rotary meters are used for large demand market customers, and are typically replaced after five (turbine meters) to 10 (rotary meters) years. While they generally remain within the accuracy requirements set by technical regulations, aging does cause meter degradation. These meters tend to read 'slow' as they age. Diaphragm meters are used for volume market customers and are replaced after 15 to 35 years. As they degrade they may either read 'fast' or 'slow', although they have an inherent bias to read slow.

2.1.1.4 Measurement uncertainty (metrology errors)

- **Heating value allocation uncertainty.** The heating value is one of the key factors (alongside pressure and temperature) used to convert volumetric quantities into energy quantities.[3]

  - Receipt measurement. The heating values allocated to the volume of gas entering the network has a level of uncertainty due to:

    - Inherent accuracy of the gas chromatograph equipment. At larger receipt points gas chromatograph equipment is installed to determine the heating value by analysing the gas composition. This equipment has some inherent error due to its mode of operation and computational processes. Though the level of error is very small, a large volume of gas passes through these sites, creating measurement uncertainty.

    - At smaller receipt metering sites, the heating value is inferred from nearby sites where equipment exists. The calculation of the 'inferred' heating value does lead to another layer of uncertainty – although this is generally of a negligible level.

  - Delivery measurement. To account for the different sources of gas that have differing heating values, the network is broken up into a series of major network sections, representing 'heating value district zones'. 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, as these zones are often interconnected and subject to the network characteristics, gas can pass from one section to another section.

- **High capacity meters** – high capacity meters incorporate temperature and pressure measurement equipment. The combination of the errors in each of the contributing measurements allows a high capacity meter to be accurate to within +/- 0.5% to +/- 1% of the true quantity being measured.

- **Low capacity meters** – to convert the volume measured to an energy quantity for low capacity meters, a fixed factor is used to adjust for temperature and pressure (both the pressure delivered to the customer gas system and the effect of barometric pressure).

  - The element of the fixed factor relating to the delivery pressure is based upon the pressure set by the regulator device on the meter.

  - The element of the fixed factor relating to temperature and barometric pressure is based on published long-term averages from the Bureau of Meteorology.

[3] Gas is measured on a volumetric basis (that is, m^3) but is converted to energy (that is, GJ) for billing purposes.

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 historical 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 a result there is an inherent additional uncertainty in the measurement of gas being delivered from the network.

2.1.1.5 Measurement period errors

Meters in the network are read at different intervals. For example, large network customers are read daily, while small domestic customers are read on a three-monthly cycle. To calculate UAG, these periods need to be aligned, and in the case of domestic customers, the readings need to be interpolated into smaller periods (i.e., months). This process involves a degree of estimation, which introduces errors into the calculation.

2.1.1.6 Billing estimation

- Where meters are unable to be read, or are known to be faulty, the flow through the meter may be estimated and the bill created accordingly. Any estimation of gas consumption introduces errors into the UAG calculation.
- The failure of meters can lead to them not registering, “non-registering meters”. A significant proportion of non-registering meters are identified and replaced after one or more billing cycles, although some may not be identified for some time.[4] Where a non-registering meter is identified an estimate is applied to the gas consumption.

2.1.1.7 Unread consumption

In a small number of instances meters may be installed but not correctly recorded and hence not be part of the reading/billing cycle.

2.1.2 Physical losses

2.1.2.1 Leakage[5]

- Integrity of materials. Leakage from distribution networks can be the result of:
  - Deterioration of materials over time – mains and services. Older areas of the network (some are over 100 years old), where the materials used were cast iron, unprotected steel or early generation plastics have higher levels of leakage due to the deterioration of the materials through corrosion or other means by which the materials break down over time.
  - Deterioration of materials – meters. Similarly, the fittings used on meter sets also deteriorate and leads to leaks from the unions and other fittings. Meter set leaks (from either deterioration of venting regulators –see below – are the highest proportion of leaks reported by the public.
  - Changes in operating conditions. The change to ground conditions, due to drought, road movements, etc can lead to stress being applied to the materials used in the gas network, leading to areas of leakage.
- Network damage. While JGN’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 is not an uncommon occurrence and contributes to UAG.

[4] For example, some customers only use gas for heating, so it is not unusual to have no consumption for these meters. This means that it may take longer to identify a non-registering meter.

[5] Many of the areas of leakage identified here are very small volumes and are generally not considered a safety risk. The use of odorant provides for most leaks to be detected well before a safety issue arises.

- Leakage from the high pressure pipelines is considered to be zero for practical purposes with the exception of some gas escape during maintenance. Small amounts of leakage may occur from above ground flanges and fittings, however, these are easily detected and rectified.

2.1.2.2 Theft

- Theft 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. Theft is typically the bypassing or partial bypassing of a gas meter.

2.1.2.3 Operational usage

- Meter regulator venting. Meter regulators incorporated in both network pressure control equipment and customer pressure control equipment can vent during some operational circumstances (such as pressure surges or temperature effects). The gas released from such venting is generally only small in quantity and is unmeasured.
- Operational usage, such as venting. A small amount of gas is lost from the systems during maintenance and operational activities.
- Activities involved in the commissioning of a new gas connection, such as gas purging.

System Use Gas (**SUG**) is used for operational purposes for water bath heaters. This is measured separately and is excluded from UAG.

2.2 Uncertainty of UAG calculation

An important consideration when seeking to understand and manage UAG is the significant uncertainty inherent in its calculation, as identified above. This uncertainty is widely accepted in the gas industry.

Regarding measurement-related causes, these uncertainties are unavoidable due to limitations associated with any measurement process. Even the most accurate metering systems cannot provide an accuracy much better than +/- 1%. Typically, the cost of improving the accuracy of any of these elements far outweighs any potential benefits. Industry practice has determined the most efficient levels of accuracy for each of these elements over many years of gas industry operation.

Similarly, estimating gas losses from the network due to leakage, operational use, and theft involves high levels of uncertainty. While there is some scope to estimate gas lost from leakage, purging, filling mains, and third-party hits, these estimates will only be at an order of magnitude level. The cost of improving these estimates would significantly outweigh any benefits, which are expected to be small.

3. UAG management and performance

3.1 Management of UAG

JGN actively monitors and manages UAG to ensure that it maintained at an economic level. The management of UAG is multi-faceted and targeted at each of its sources. Management of UAG is overseen by a senior cross-functional management committee.

3.1.1 UAG Management Oversight

JGN has a senior management committee whose scope is to review ongoing quantity and cost of UAG. The key objectives of the committee are to ensure that:

- the quantity of unaccounted for gas is minimised consistent with minimising total cost
- controls are in place to accurately capture, monitor and report UAG

The committee meets at least six times per year and its membership is comprised of senior managers from across the business.

Monitoring and reporting of UAG is undertaken on a monthly basis, with investigations conducted as required to ensure UAG performance is maintained within acceptable thresholds.

3.1.2 Activities to manage measurement errors

JGN undertakes a range of activities and programs to manage measurement error.

3.1.2.1 Metering uncertainty (volumetric errors) and degradation of metering accuracy

- Meter testing to confirm accuracy – JGN undertakes meter type and batch testing of meters and meter repairs to ensure compliance with applicable accuracy standards. JGN applies meter sizing charts to ensure that the meter size is appropriately matched to customer loads in the network. All turbine and rotary meters are tested at 5 and 10 years respectively to confirm accuracy prior to refurbishment.
- Validation programs – JGN conducts a comprehensive validation program for Custody Transfer Station (**CTS**) meters, temperature/pressure sensors and gas chromatograph equipment, while also witnessing the validation of third party CTS meters. The routine validation process ensures that all measurement devices operate within the acceptance criteria.
- Aged and planned meter replacement program:
    - Statistical meter testing program – samples of meters are removed from service for testing and results are analysed and are applied to populations by age, meter type and manufacturer.
    - Meters are replaced once they reach an age when there is insufficient confidence of meter accuracy. This threshold may extend meter life up to 35 years, during which statistical sampling test can still affirm their precision.
    - Resizing of industrial and commercial (**I&C**) meter sets when the flow rates through the meters are either greater or less than the accurate range.

  - Replacement of I&C rotary and turbine meters for recalibration is more frequent than for smaller meters to minimise metering error.

- Defective review and response – Defective meters are examined under the field failure program to identify any trends which would result in loss of accuracy or failure. Defective meter removal statistics are reviewed periodically to identify any failure or inaccuracy issues resulting from type failure.

3.1.2.2 Measurement uncertainty (metrology errors)

- Pressure and temperature corrections are applied to large consumers. JGN undertakes reconciliations of pressure correction factors recorded in the asset management system and metering/billing system to ensure there have been no administrative errors in billing consumption details.
- JGN undertakes planned maintenance on meter sets operating 15kPa and above, including calibration of temperature and pressure transducers.
- Gas heating value for the network is either measured or inferred at receipt points and a volume weighted value is applied in accordance with the heating value zones within the networks.
- Fixed factor billing is reviewed against Bureau of Meteorology data on a periodic basis.

3.1.2.3 Billing estimation and profiling

- 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 is analysed on an individual meter basis to identify changes in consumption patterns that could result in UAG.
- Daily metered customer data is monitored to detect any indications of plant breakdown or incidence of faulty equipment.
- Contractors carrying out calibration and maintenance of daily metered sites are subject to audit, to ensure that they perform in accordance with required standards.
- Incorrect or missing data is substituted with estimated or recovered actual data, to ensure that the measurement of total UAG is as accurate as possible.

3.1.3 Activities to minimise losses

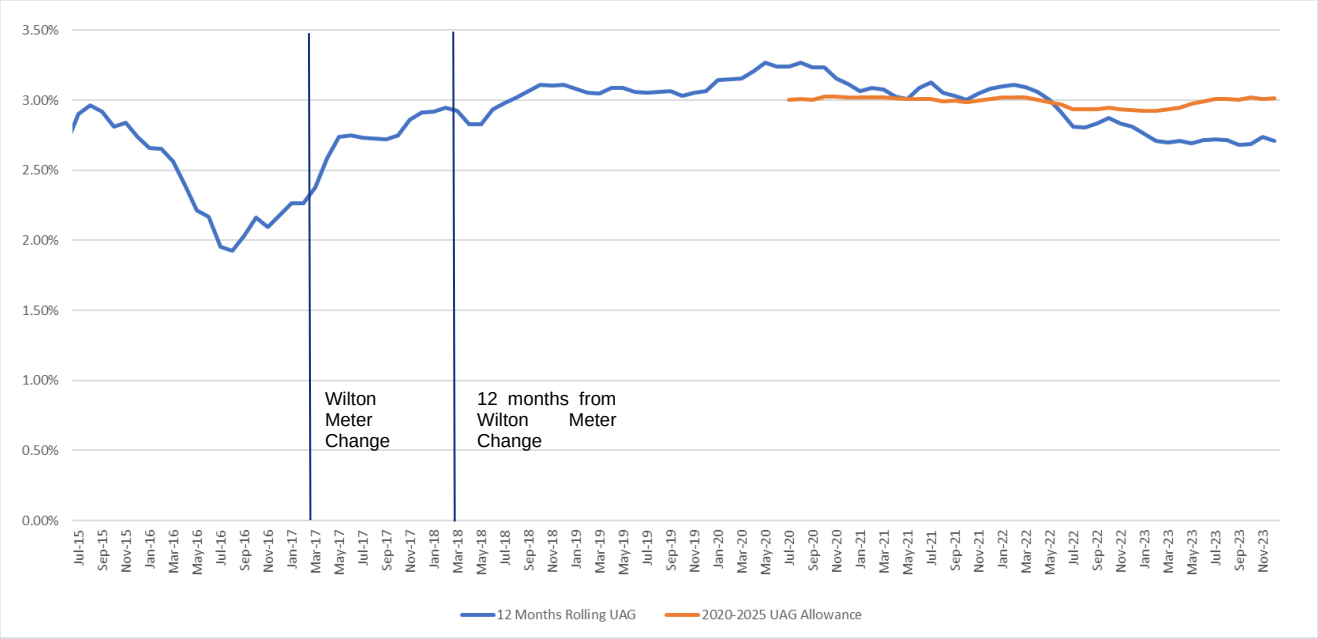
Key activities to minimises physical losses of natural gas from the network include:

- Prompt responses to all gas escapes and undertake repairs immediately where gas leaks are found.
- Five-yearly leakage surveys are conducted to inform mains repair decisions, with Picarro technology enabling annual leakage surveys for more frequent monitoring and assessment.
- Quality construction (joining of steel and plastic) to ensure joints are leak tight.
- Tracking of meters not yet installed to ensure all installed meters are read and billed.

3.2 Historical pattern of UAG

Figure 3–1 shows JGN's historical pattern of UAG.

Figure 3–1



This pattern reflects the varying levels of UAG during the period 2015 – 2020 which resulted from system changes, including the UAG calculation and changes to the Wilton meter which increased the metering accuracy at low flows. During the early part of the current regulatory period (2020-25), UAG was consistent with the recent historical levels and tracking above the UAG targets included in the 2020-25 Access Arrangement. By May 2022 the 12 months rolling UAG levels fell below the targets in May 2022 and has remained under since that time.

The reduction in UAG follows a number of initiatives undertaken with JGN to manage UAG including the lowering of pressure in particular networks areas to reduce the levels of leakage. The following areas have had pressure reduced Dubbo (February 2022), Wellington (October 2022), Lugano/Illawong (February 2023) and Faulconbridge (May 2023).

4. UAG proposal for 2020-25 period

4.1 Target rate proposal

JGN proposes that:

- The current UAG incentive continues to apply based on efficient annual target rates of UAG.
- JGN is compensated for variation in total market volumes and costs of purchasing UAG (which remain outside JGN's control) through an automatic annual adjustment.
- Consistent with the current approach, the efficient level of UAG be represented as two different UAG target rates – one applied to daily metered customer withdrawals and the other to gas received to supply non-daily metered customers.
- A two year lag continue to be applied to cost recovery.

In section 10.2 of *JGN - Att 6.1 – Operating expenditure - 20240628*, we have set out our approach to forecasting UAG costs for the 2025-30 period. Increases or decreases in the cost of UAG and variations in total market volumes will be fully taken into account through the automatic annual adjustment in the reference tariff variation mechanism.

4.2 Two different target UAG rates

A significant majority of the contributors to UAG (identified in Section 2.12) apply to the medium and low pressure parts of the network supplying our volume market customers. These are:

- metering uncertainty
- degradation of meter accuracy
- measurement uncertainty, including uncertainty introduced through fixed factor billing and heating value allocation
- measurement period errors
- billing estimation
- leakage
- theft
- unmeasured gas used for operational purposes.

Leakage is associated with low pressure cast iron mains and older plastic pipe technology operating at medium pressure. All operational gas used for commissioning gas mains arises on the medium and low pressure systems. Fixed factor metering uncertainty is also of much greater significance to volume customer metering. All non-daily metered customers are supplied from the medium and low pressure networks.

In contrast, almost all demand customers are supplied from JGN's high pressure network, which has negligible leakage and operational gas use. In addition, metering for demand customers is not affected by the same level of meter and metering system uncertainty as the volume market, because the majority of these meters are temperature and pressure compensated rather than fixed factor.

This strongly supports the continued approach to setting two different UAG rates for each market type, with an allocation of a higher UAG percentage allocation to volume customers and lower UAG percentage allocation to demand customers.

4.3 Derivation of UAG target rates

JGN engaged Frontier Economics (**Frontier**) to derive the UAG target rates for the 2025-30 period. Specifically, we engaged Frontier to:

- Update its 2019 analysis on the strength of the statistical correlation between UAG and withdrawals for the two separate markets with the most recent data up to December 2022.
- Determine the corresponding UAG rates/coefficients for the two markets.
- Calculate those rates and statistical relationship for the purposes of inclusion in JGN's 2025-30 AA proposal.

Frontier relied on the approach used to forecast JGN's UAG rates that it adopted in the 2015-20 and 2020-25 periods —which were accepted by the AER. Frontier included the most recent UAG data[6] and undertook a sensitivity analysis to check the validity of its results. Frontier's report is provided *JGN - Frontier Economics – Att 6.8 - UAG report* and the relevant spreadsheet is provided as *JGN - Frontier Economics - Att 6.9M - Estimated UAG rates* reporting model.

Frontier developed three models to estimate the UAG rates for each market and analysed each before selecting the best fitting model. The updated estimates of the UAG coefficients are:

- for forecasting UAG costs:
  - 1.647% of forecast withdrawals for the demand market
  - 4.952% of forecast withdrawals for the volume market
- for annual true-ups:
  - 1.569% of withdrawals for the demand market
  - 4.718% of the tariff market residual (comprising volume market withdrawals and total UAG).

4.4 Timing of recovery

JGN proposes that UAG costs continue to be recovered with a two year lag to allow the annual Tariff Variation Notice (**TVN**) to be submitted by 15 March. Applying a two year lag makes it easier for customers and stakeholders to review JGN's annual TVN, and allows the true-up to be made on a full year of actual demand data (see section 8.2.2 *JGN - Att 10.1 - Pricing* for more details).

A weighted average cost of capital (**WACC**) adjustment applies to the two year lag to take into account the time value of money.

[6] Frontier's analysis relies on monthly observations over the period July 2002 to December 2022.